

Using Simulation for Anesthesia Crisis Management in The Undergraduate Curriculum: Systematic Literature Review

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Abstracts: This literature review aims to shed light on the present status of simulation-based training for anesthesia crisis management in undergraduate medical education and suggest prospective areas for further study and improvement. This research study will implement a PICO formula to facilitate the search strategy's organized documentation. The study selection was performed using the EBSCOhost, and ScienceDirect to find studies that investigated the use of simulation in anesthesiology. The search strategy involved combining the keywords using the Boolean operator "AND" to refine the search and ensure the retrieval of relevant articles. After the inclusion and exclusion criteria, 15 studies were included. In this systematic review. The search was limited from 2018 to 2023 in both databases. Finally, Using simulation for anesthesia crisis management in undergraduate curricula effectively improves the performance of non-technical skills, such as situational awareness, decision-making, communication, and teamwork. The long-term effects of simulation-based training on clinical results and patient safety also need further investigation.

Keywords: Anesthesia, Crisis Management, Undergraduate Curriculum.

1. INTRODUCTION

Anesthesia is a critical aspect of medical care, and it requires a high level of knowledge, skill, and attention to detail to administer safely [1]. Because of the high stakes, a timely and effective response is essential in anesthesia crises. Teaching anesthesia crisis management to undergraduate medical students is crucial because it gives them the tools to respond appropriately in an emergency. Simulation-based training to teach clinical skills and crisis management in various medical fields has grown in favor in recent years. Students may learn and improve their abilities in a realistic atmosphere without endangering actual patients through simulation technology. The quality of education and patient safety results may benefit from simulation-based training in undergraduate medical education for anesthesia crisis management. This systematic literature review explores the current literature on using simulation-based training for anesthesia crisis management in the undergraduate curriculum. This evaluation aims to assess the value of simulation-based training in enhancing students' ability to handle anesthesia situations. Customarily, the institution of medical education stressed basic science knowledge and left majority of the clinical practice to an apprenticeship model [2]. However, Simulation-based training based on crisis resources management is anticipated to be the routine of training in the majority of healthcare settings [3]. and then G.R. Lorello et al. conclude their systematic review by the importance of the simulation in anesthesiology more than no intervention and non-inferior to non-simulation instruction [4].

The evaluation will also look at the hurdles and problems encountered in adopting simulation-based training programs in undergraduate medical education and the various simulation approaches used in training. This literature review aims to shed light on the present status of simulation-based training for anesthesia crisis management in undergraduate medical education and suggest prospective areas for further study and improvement.

2. REVIEW

2.1. Methods

After a systematic search of the literature in tow databases, we used a narrative synthesis approach enabling inquiry at several levels: supporting evidence, components of practice, and implementation strategies. We included

diverse types of studies with a range of research designs to produce different forms of evidence. PICO formula used to facilitate the search strategy. The PICO formula it uses acronyms to stimulate the researcher and serve as guide to the elements of focused and brief research topic; Population are undergraduate students studying anesthesia, Intervention is Simulation-based training for anesthesia crisis management, Comparison is the traditional lecture-based teaching, and the outcome: Competence in anesthesia crisis management. The Key terms used were simulation training, anesthesia management, crisis training, and undergraduate curriculum (Table 1).

Table 1: Search strategy

Step	Query
Search 1 – EBSCOhost	
1	Search (simulation training) AND
2	Search (anesthesia management) AND
3	Search (crisis training) AND
4	Search (undergraduate curriculum)
Search 2 – ScienceDirect	
1	Search (simulation) AND
2	Search (anesthesia crisis management) AND
3	Search (undergraduate curriculum))

General limitations to the search were set in the English language, published between 2018 and 2023 (Table 2).

Table 2: Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Simulation Focused Articles	Simulation non-Focused Articles
systematic review	research focusing on other areas of medical education
2018-2023	Studies conducted Before 2018
Researches focusing on Anesthesia crisis management in the context of undergraduate medical education	Research focusing on other areas of medical education

Data sources:

Search 1 - EBSCOhost

A comprehensive search for articles related to the use of simulation for anesthesia crisis management in undergraduate medical education was conducted using EBSCOhost. The search strategy will involve combining the keywords using the Boolean operator "AND" to refine the search and ensure the retrieval of relevant articles. The search terms "simulation training," "anesthesia management," "crisis training," and "undergraduate curriculum" were conducted by typing in the first box to generate the initial results, and the search yielded 50 hits. The search was limited from 2018 to 2023 and yielded 13 hits. The inclusion and exclusion criteria were applied by ensuring that the articles were peer-reviewed scholarly, and 4 articles were selected for appraisal in the next section (Fig. 1) (Table 1).

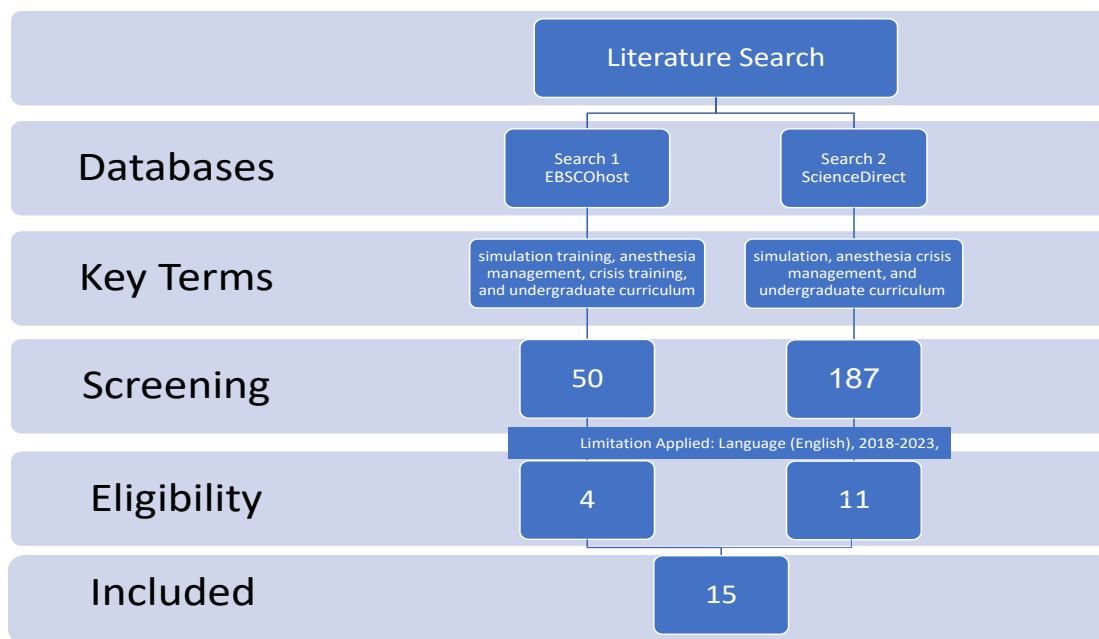


Figure 1: Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram summarizing literature search.

Search 2 - ScienceDirect

ScienceDirect is a special database that will be utilized for the second database search. The keywords "simulation," "anesthesia crisis management," and "undergraduate curriculum" were typed into the first box in ScienceDirect publications. The search strategy will combine the keywords using the Boolean operator "AND" to obtain the relevant articles. This yielded 187 hits. The search was further refined from 2018 to 2023, resulting in 60 hits. A manual search was applied, reducing the hits to eleven, which will be examined in this paper (Fig. 1) (Table 1).

Review

From the initial 237 records, 73 studies underwent full abstract review by the author who agreed on a final subset of 15 studies for inclusion (Table 3).

Table 3: The findings summary based on the reported articles

L'Her et al. [5].	discuss the importance of simulation-based teaching in critical care, anesthesia, and emergency medicine	The improved knowledge, abilities, attitudes, and increased patient safety are just some advantages of simulation-based training.
Sneyd et al. [6]	Discussed The effects of the COVID-19 epidemic on anesthesia residency programs	the postponement of elective surgeries and a decrease in clinical exposure are the most common difficulties to trainees that had effects on the crisis management curriculum for anesthesia students
Sheehan et al. [7].	Discussed the Human factors and patient safety in undergraduate healthcare education	the need for human aspects and patient safety to be included in undergraduate healthcare curricula make the medical practitioners better equipped to handle difficult clinical situations, such as crises
Mai, Szyld, & Cooper [1]	discusses using simulation in training trainees to address crisis circumstances in pediatric anesthesia	The authors stress the need for continuous education based on simulation to keep healthcare practitioners' abilities updated
Maneval et al. [8]	Discussed Clinical electives to improve the undergraduate nursing curriculum.	their courses provide students real-world opportunities to learn and practice critical clinical skills like crisis management. The clinical elective courses are improved knowledge, abilities, attitudes, and confidence in clinical practice. They stress the need for constant monitoring and

		analysis to guarantee the courses' success
Hofmann, Curran, and Dickens [9].	conducted an integrated scoping review of 42 papers about research and analyzed curricular learning objectives to explore models and measures of learning outcomes for non-technical skills in simulation-based medical education	They found that educators should place a high priority on the incorporation of non-technical skills into simulation-based medical education. They should also concentrate on the development of standardized metrics to evaluate the results of student learning
Toale, Morris, and Kavanagh [10].	carried out a scoping analysis from 28 suitable papers of the existing research on simulation-based evaluations of technical abilities in surgical procedures	They determined that simulation-based assessment of technical competence is generally favorably regarded among surgical trainees and trainers including providing a secure and controlled environment for trainees to practice their technical abilities and giving learners objective feedback on their performance
Raymond-Dufresne [11].	discusses the use of simulation in the field of critical care. The article presents an overview of the use of simulation for education and training in critical care	The simulation for critical care training give the ability to provide a safe and controlled environment for learners to practice critical care skills, the opportunity for learners to receive immediate feedback, and the capability of training learners for high-risk situations that are difficult to reproduce in real life
Chiniara and Rivière [12].	focus on adult education and simulation-based training and explores the role of debriefing in simulation-based education	the usage of simulation-based education in continuing professional development (CPD), and how adult learning theories might be applied for providing realistic and engaging learning experiences, allowing learners to practice new skills in a safe and controlled environment, and evaluating the effectiveness of continuing professional development programs
Chen et al. [13].	investigate if there was a connection between education and stress levels, as measured by publicly accessible keyword data and in-training test results	the residents who got an education based on publicly accessible keyword data reported lower stress levels and higher performance on in-training exams than those who did not. The authors believe that increasing anesthesia trainees' education with the help of instruction based on keyword data accessible to the public might be a valuable tool
Tallach and Brohi [14].	the significance of accepting uncertainty in the context of mass casualty catastrophes	The authors hypothesize that training that is based on simulation may assist medical professionals in developing the competencies and mentality that are necessary to deal with the unpredictability and complexity of MCIs
Schulte-Uentrop et al [15].	investigate the relationship between situational motivation and non-technical skills performance in medical students during simulation-based emergency training	The authors recommend considering situational motivation while creating simulation-based crisis management training
Van Gessel et al. [16].	Described an interprofessional training program for healthcare undergraduates. Students from various healthcare specialties collaborate to resolve simulated medical crises during the program's simulation-based training	Faculty and students have expressed appreciation for the program, and the authors conclude that it has the potential to foster cooperation and collaboration among healthcare professionals
Tremblay [17]	The author contends that pharmacy students need to learn how to think and act in a crisis to provide their patients with the best possible treatment.	They found that the requirement for healthcare practitioners to perform appropriately in times of crisis and the complexity of today's healthcare systems. The authors stress the need to learn crisis management skills such as communication, collaboration, leadership, and situational awareness
Arab et al. [18].	Studied the current practice in Saudi Arabian anesthesia training schools is to include simulation within the curriculum	They stated that anesthesiologists' performance in clinical settings may be improved by simulation-based training, leading to higher-quality anesthetic care for patients. Improved patient outcomes, less medical mistakes, and heightened patient safety are all possible results of this training

L'Her et al. discuss the importance of simulation-based teaching in critical care, anesthesia, and emergency medicine. Trainees may safely practice and improve their crisis management and other complicated clinical scenario-handling abilities in a simulation-based educational setting [5]. The authors emphasise that improved knowledge, abilities, attitudes, and increased patient safety are just some advantages of simulation-based training. High-fidelity dummies and virtual reality are examples of the simulation modalities they use to train future crisis

managers. This article highlights the importance of simulation-based education in preparing healthcare personnel for actual circumstances [5].

The effects of the COVID-19 epidemic on anesthesia residency programs are discussed by Sneyd et al. The authors highlight the difficulties that trainees have encountered during the pandemic. These difficulties include the postponement of elective surgeries and a decrease in clinical exposure. In particular, they claim that these difficulties have had an enormous effect on the crisis management curriculum for anesthesia students [6]. The authors suggest that training in a simulated environment might effectively counteract the decline in actual clinical practice. They also stress the need for continuous guidance and mentoring for trainees throughout the process [6].

Human factors and patient safety in undergraduate healthcare education are the subjects of a comprehensive review by Sheehan et al. [7]. The authors provide an overview of the relevant research and stress the need for human aspects and patient safety to be included in undergraduate healthcare curricula. They claim that if this is done, medical practitioners would be better equipped to handle difficult clinical situations, such as crises. The authors also note the need for further study on the best methods for teaching human aspects and patient safety [7].

Mai, Szyld, & Cooper discusses using simulation in pediatric anesthesia. Due to the complexity and diversity of pediatric patients, the authors stress the relevance of simulation in training trainees to address crisis circumstances in pediatric anesthesia. Also included is incorporating several simulation modalities, such as immersive simulation and team training, into the pediatric anesthetic crisis management curriculum [1]. The authors stress the need for continuous education based on simulation to keep healthcare practitioners' abilities updated [1].

Clinical electives are discussed by Maneval et al. as a means to improve the undergraduate nursing curriculum. The authors state that their courses provide students real-world opportunities to learn and practice critical clinical skills like crisis management [8]. The authors note that the advantages of clinical elective courses are improved knowledge, abilities, attitudes, and confidence in clinical practice. They stress the need for constant monitoring and analysis to guarantee the courses' success [8].

Hofmann, Curran, and Dickens conducted an integrated scoping review of research and analyzed curricular learning objectives to explore models and measures of learning outcomes for non-technical skills in simulation-based medical education [9]. The research concluded that standardized measurements and frameworks are scarce for measuring non-technical abilities in simulation-based medical education [9]. The research identified 42 papers suitable for inclusion in the study [9]. According to the authors' recommendations, educators should place a high priority on the incorporation of non-technical skills into simulation-based medical education. They should also concentrate on the development of standardized metrics to evaluate the results of student learning [9].

Toale, Morris, and Kavanagh carried out a scoping analysis of the existing research on simulation-based evaluations of technical abilities in surgical procedures [10]. This research aimed to investigate the thoughts and feelings that surgical trainees and trainers have toward the use of simulation-based evaluation methods [10]. Based on the evaluation's findings, which included the identification of 28 suitable papers, it was determined that simulation-based assessment of technical competence is generally favorably regarded among surgical trainees and trainers [10]. The papers emphasized the advantages of simulation-based assessment, including providing a secure and controlled environment for trainees to practice their technical abilities and giving learners objective feedback on their performance [10]. However, the analysis also demonstrated the need for more studies to investigate the validity and reliability of simulation-based evaluation tools in surgery. The study's authors emphasized the need to create standardized assessment tools and set clear standards for using simulation-based evaluations in surgical training. The scoping review provides valuable insights into surgical trainees' and trainers' perceptions and experiences regarding the simulation-based assessment of technical skills. Additionally, the review highlights the need for further research to improve the efficiency and reliability of these assessments in surgical training [10].

Raymond-Dufresne discusses the use of simulation in the field of critical care. The article presents an overview of the use of simulation for education and training in critical care [11]. Topics covered in this overview include the advantages and disadvantages of simulation, the many kinds of simulations, and the future of simulation in critical

care [11]. The author highlights the benefits of using simulation for critical care training, some of which include the ability to provide a safe and controlled environment for learners to practice critical care skills, the opportunity for learners to receive immediate feedback, and the capability of training learners for high-risk situations that are difficult to reproduce in real life [11]. The difficulties of employing simulation for critical care training, including the high expense of simulation equipment, the need for expert trainers, and the possibility of simulation oversimplifying complicated clinical circumstances, are also discussed in the article. The author also offers an overview of several simulations, such as those with standardized patients and computer-based simulations. Airway management, resuscitation, and other critical care treatments are just some areas the article focuses on [11].

New technologies, such as virtual and augmented reality, are discussed concerning the future of simulation in critical care. The author underlines the potential for simulation to become more immersive and engaging [11]. To guarantee that simulation-based training in critical care continues to be a successful and beneficial tool for students, the article further highlights the significance of continuous research and assessment. Both the advantages and disadvantages of employing simulation in critical care education and training are discussed in this chapter [11]. Furthermore, Chiniara and Rivière focus on adult education and simulation-based training. This article explores the role of debriefing in simulation-based education, the usage of simulation-based education in CPD, and how adult learning theories might be applied [12].

The authors first address adult learning theories, such as self-directed learning, relating to using simulations in teaching. They stress the value of simulating real-world situations for adult students, among other active and experiential learning methods, in boosting students' interest and material retention [12]. The article then explains why debriefing is essential in a simulation-based learning environment. The authors stress the value of organized debriefing strategies for encouraging reflective learning and assisting students in pinpointing areas for development. They talk about how debriefing may be a formative evaluation to help students improve over time. Besides, the authors explore the use of simulation-based education in continuing professional development (CPD). They discuss the benefits of simulation-based education to support ongoing learning and development among healthcare professionals. These benefits include providing realistic and engaging learning experiences, allowing learners to practice new skills in a safe and controlled environment, and evaluating the effectiveness of continuing professional development programs [12].

Anesthesia trainees were the participants in research that Chen et al. carried out to investigate if there was a connection between education and stress levels, as measured by publicly accessible keyword data and in-training test results [13]. According to the article, the residents who got an education based on publicly accessible keyword data reported lower stress levels and higher performance on in-training exams than those who did not. The authors believe that increasing anesthesia trainees' education with the help of instruction based on keyword data accessible to the public might be a valuable tool [13].

Tallach and Brohi examine the significance of accepting uncertainty in the context of mass casualty catastrophes (MCI) [14]. They claim that the traditional approach to MCIs, built on command and control, may not be suited for the complicated and unexpected conditions experienced in real-life MCIs [14]. The authors hypothesize that training that is based on simulation may assist medical professionals in developing the competencies and mentality that are necessary to deal with the unpredictability and complexity of MCIs. Healthcare professionals need to be well-coordinated and efficient in reacting to mass casualty crises (MCIs) since managing MCIs is difficult and complicated. They state that healthcare providers struggle to react appropriately to MCIs because of the conditions' intrinsic ambiguity and unpredictability [14]. The authors also state that medical professionals should anticipate the unexpected and be flexible in their approach. Training in a simulated environment may help you acquire the knowledge and mindset to handle MCIs effectively. While it may not be practical to rehearse a healthcare provider's reaction to various MCIs in a safe and realistic setting, simulation-based training may give just that. Medical professionals may learn to communicate better with one another and fill up any knowledge gaps thanks to this training [14].

In addition, the fundamental communication, decision-making, and problem-solving skills for managing MCIs may be developed through simulation-based training [14]. Medical professionals may be trained to think clearly under pressure and respond appropriately to patients' evolving demands. Tallach and Brohi state that a successful approach to managing MCIs requires acknowledging and working with the situation's inherent complexity and ambiguity. Healthcare providers may learn the skills and mindset they need to deal with the unpredictability and complexity of MCIs via simulation-based training [14].

The authors describe using simulation-based training in MCI settings [14]. This training enables healthcare workers to practice their abilities in a safe and controlled environment. It also helps them build the capacity to react to unexpected occurrences and adapt to changing conditions. They contend that simulation training may assist in enhancing communication and cooperation among healthcare personnel and uncover gaps and flaws in already established MCI strategies and procedures [14].

Schulte-Uentrop et al. investigate the relationship between situational motivation and non-technical skills performance in medical students during simulation-based emergency training. Non-technical abilities, such as communication and collaboration, are essential for efficient crisis management, and they find that students with greater degrees of situational motivation perform better [15]. The authors recommend considering situational motivation while creating simulation-based crisis management training [15]. Moreover, an interprofessional training program for healthcare undergraduates in Geneva, Switzerland, is described by Van Gessel et al. [16]. Students from various healthcare specialties collaborate to resolve simulated medical crises during the program's simulation-based training. Faculty and students have expressed appreciation for the program, and the authors conclude that it has the potential to foster cooperation and collaboration among healthcare professionals.

Pharmacy students may learn about emergency resource management using simulation, as discussed by Tremblay [17]. The author contends that pharmacy students need to learn how to think and act in a crisis to provide their patients with the best possible treatment. Training based on simulations may provide students with the chance to hone their abilities in a risk-free setting. Tremblay emphasizes the requirement for healthcare practitioners to perform appropriately in times of crisis and the complexity of today's healthcare systems. The authors stress the need to learn crisis management skills such as communication, collaboration, leadership, and situational awareness [17].

The author elaborates on the benefits of simulation-based training in pharmacy school, giving students valuable hands-on experience [17]. The authors explain how students may be exposed to the stresses and difficulties of crisis management by participating in simulations meant to mirror real-life crises. Tremblay also discusses the importance of debriefing in simulation-based training, which allows students to reflect on their experiences and identify areas for improvement [17]. When assisting students in developing their abilities and confidence, the authors strongly emphasize the significance of receiving feedback and direction from seasoned healthcare experts.

According to Arab et al. the current practice in Saudi Arabian anesthesia training schools is to include simulation within the curriculum [18]. Moreover, Arab et al. state that anesthesiologists' performance in clinical settings may be improved by simulation-based training, leading to higher-quality anesthetic care for patients. Improved patient outcomes, less medical mistakes, and heightened patient safety are all possible results of this training [18]. In addition, simulation training makes it possible to standardize instruction and assessment, guaranteeing that all students are held to the same standards [18]. Simulation-based training can greatly improve the quality of anesthetic care and patient safety in Saudi Arabia, a country with a fast-developing healthcare system. The authors argue that simulation-based training has the potential to both increase the quality of training for practicing anesthesiologists and alleviate the current lack of such professionals. The article further shows the rising popularity of simulation-based training in Saudi Arabia, where an increasing number of anesthetic programs include simulation in their curriculum [18]. This trend is shown by the number of simulation-based training programs in Saudi Arabia has increased [18]. The authors point out that simulation is being utilized for a number of goals, such as training for crisis management, the development of technical skills, and evaluation.

The potential advantages of training based on simulation for anesthesia education are another topic covered in the article by Arab et al. [18]. The authors contend that simulation may improve the quality and safety of anesthetic treatment by allowing trainees to practice in a realistic and controlled setting. They believe that simulation may assist in bridging the gap between theory and practice by allowing students to build their abilities and confidence before dealing with actual patients. The authors Arab et al. also highlight some of the difficulties that are associated with simulation-based training in Saudi Arabia [18]. These difficulties include the requirement for ongoing investment in equipment and facilities and ongoing research and evaluation to guarantee that simulation-based training continues to be efficient and pertinent.

L'Her et al. found that simulation-based education effectively improves learners' technical and non-technical skills, such as crisis resource management and communication [5]. High-fidelity simulators allow students to hone their abilities and gain self-assurance before facing real-world challenges. Medical errors and other adverse events may be minimized using simulation-based instruction, as L'Her et al. suggested [5]. The authors further advocate for medical schools at both the undergraduate and graduate levels to use simulation-based learning. Many anesthesia students reported having fewer chances for training due to the pandemic, as indicated by Sneyd et al. [6]. With fewer chances to learn, students may become less prepared to handle serious circumstances like anesthetic emergencies. To lessen the influence of the pandemic on anesthesia trainee education, the authors suggest using other teaching approaches, such as simulation-based instruction.

Sheehan et al. discovered that teaching non-technical skills like cooperation, interaction, and situational awareness using simulations in undergraduate healthcare education might help students become more prepared to handle emergencies. The quality of the simulation, the process of debriefing, and the incorporation of simulation into the curriculum all contribute to the success of simulation-based education, as the authors point out. As is now being advocated, patient safety may be enhanced by including simulation-based instruction in undergraduate healthcare curriculum [7].

Learners' technical abilities, such as airway control, and their non-technical abilities, such as collaboration and communication, may benefit from simulation-based teaching [1]. The authors argue that simulation-based teaching should be included in pediatric anesthesia curricula to better equip students with the knowledge and abilities to handle emergencies. The research found that students' technical abilities, especially in airway control, were greatly enhanced by simulation-based teaching [1]. In light of the complexity of airway management and the need for expert performance in emergency settings, the authors deemed this conclusion paramount. This competency is crucial for safe and successful pediatric anesthesia, and the simulation-based teaching approach was able to help students acquire it.

This research also revealed that students' non-technical abilities, such as cooperation and communication, increased due to simulation-based learning [1]. This is an important discovery because it highlights the need for cooperation and communication in the high-pressure setting of pediatric anesthesia. The authors conclude that simulation-based teaching is an excellent means of providing students with the technical and non-technical training they need to handle emergency circumstances in pediatric anesthesia [1]. The research emphasizes the necessity of continual education and training in this profession. It underlines the usefulness of simulation-based education in enhancing the quality of care offered to pediatric patients [1].

According to research by Maneval et al., students who take clinical electives that use simulation-based education can get a more well-rounded education and hone their clinical abilities in a risk-free setting [8]. The authors suggest that clinical elective courses be a standard part of every undergraduate nursing curriculum. Also, an integrated scoping assessment of research and content analysis of curricular learning goals linked to non-technical abilities in simulation-based medical education [9]. Non-technical abilities, including communication, collaboration, leadership, and situational awareness, were examined, and many models and metrics of learning outcomes were established. While various models and measurements are utilized in simulation-based medical education, the authors discovered no agreement on which abilities were being evaluated and how.

Simulation-based evaluation is widely regarded as a good and trustworthy means of measuring technical competence [10]. The studies looked at vary in terms of the kind of simulation utilized, the technique of evaluation, and the amount of training of the participants, therefore, there is no agreement on the best ways to perform simulation-based evaluations. The authors disagreed about how to most effectively carry out simulation-based evaluations [10]. There was a wide range of simulation types, assessment strategies, and participant preparation levels throughout the research. Despite these differences, the authors showed that simulation-based assessment helped measure technical abilities across all fields, particularly medicine.

The authors also discovered that simulation-based evaluations were superior to traditional methods for assessing technical competence before performing rare or high-risk operations on patients [10]. Assessments based on simulation allowed students to hone their abilities in a risk-free setting before applying them to real patients. The authors emphasized the need for further studies to determine the most effective approaches to simulation-based evaluations [10]. They recommended that further research into improving the validity and reliability of simulation-based evaluations concentrate on creating standardized evaluation methodologies and tools.

The use of simulation in teaching healthcare personnel to handle critical care circumstances is discussed by Raymond-Dufresne's (2019) article on simulation for critical care [11]. The advantages of simulation-based training for enhancing team communication, decision-making, and technical abilities are discussed in this article. The author also discusses how high-fidelity mannequins and virtual reality simulations are employed in critical care teaching. In addition, the fundamentals of adult learning and how they might be implemented in simulation-based education are discussed [12]. Supporting students, encouraging their active involvement, and giving them constructive criticism and time for introspection are all topics covered in this article. The authors also stress the need for simulation-based education to be matched with learning goals and included in the larger curriculum.

In their work, Chen et al. investigate how to open keyword data might be used to enhance anesthesia training [13]. Education based on these findings was connected with lower stress levels and a more upward trend in anesthesia residents' performance on exams taken while they were still in training. The authors propose that this strategy might be used to tailor instruction in anesthesia to each student's unique requirements and preferences. To better prepare healthcare workers for MCIs, Tallach and Brohi discovered that conventional training techniques fall short because they cannot simulate the disorder and unpredictability of a true MCI [14]. However, simulation-based training may provide a risk-free setting where healthcare professionals can hone their abilities and learn to cope with ambiguity. To properly prepare providers for the unpredictability of MCIs, the authors stress the need to include uncertainty in simulation scenarios [14].

Schulte-Uentrop et al. (2020) agree by investigating the correlation between medical students' situational motivation and non-technical skills performance during simulation-based emergency training. They discovered that those with greater intrinsic motivation also had higher performance levels in areas that did not need technical expertise. This data demonstrates that motivation may influence the success of disaster preparation training using simulations. The research also found that those with higher levels of intrinsic drive had greater proficiency in non-technical skills. The authors emphasized the importance of this discovery to simulation-based training since intrinsically driven students are likely to be more involved in their education and achieve higher results.

Schulte-Uentrop et al. also revealed no significant relationship between extrinsic motivation and non-technical skill performance, indicating that external incentives or pressures may not be as efficient as an intrinsic drive in boosting performance during emergency training based on simulation [15]. Raymond-Dufresne's speculate that their research may have real-world applications in developing and delivering disaster preparation training programs that include simulation [11]. They point out that higher performance of non-technical skills in emergencies may result from attempts to promote intrinsic motivation among learners, such as stressing the relevance and necessity of the training [11].

Van Gessel et al. designed a simulation-based interprofessional training program for undergraduate healthcare students in Geneva, Switzerland. Medical, nursing, and physiotherapy students collaborated in a simulated clinical

setting as part of the curriculum [16]. The authors concluded that the students liked the curriculum and that it helped them become better communicators, team players, and clinicians [16]. Pharmacy students may benefit from Tremblay et al. research on the effectiveness of crisis resource management (CRM) training through simulation [17]. The author discovered that students' communication, cooperation, and decision-making abilities were much enhanced with simulation-based CRM training [17].

Furthermore, the research by Tremblay et al. found that students' abilities to handle stressful, complicated circumstances increased after receiving CRM training via a simulation. Essential abilities such as communication, cooperation, and decision-making were also honed during the program [17]. The author stressed the importance of these abilities, noting that pharmacy errors might devastate patients [17]. The research by Van Gessel et al. adds that by discovering that students who took part in CRM training based on simulations had better degrees of self-assurance in their capacity to handle difficult and high-pressure scenarios than students who did not take part in the training [16]. This was contrasted with students who did not take part in the training. This shows that training based on simulations may not only increase students' abilities but also their confidence in their ability to use such abilities in real-world settings [16].

Furthermore, Van Gessel et al. argue that simulation-based CRM training might significantly affect pharmacy education and practice [16]. Due to the training, students can practice and develop important skills in a safe and regulated setting, which may result in improved patient outcomes and higher practitioner confidence. The present practice of incorporating simulation into postgraduate anesthesia training programs in Saudi Arabia was researched by Arab et al [18]. They discovered that simulation was utilized most often for teaching technical abilities; however, there was also a rising interest in using simulation to teach skills that were not technical. The authors emphasize how important it is to keep developing and putting into practice simulation-based teaching and training in the field of anesthesia [18].

CONCLUSIONS

Using simulation for anesthesia crisis management in undergraduate curricula effectively improves the performance of non-technical skills, such as situational awareness, decision-making, communication, and teamwork. Students may get valuable experience handling challenging clinical settings through simulation-based training without putting actual patients in danger. The benefits of interprofessional training programs in preparing healthcare students for future collaborative practice have also been established. As has been established, simulation is already used in Saudi Arabia's postgraduate anesthesia training programs, suggesting it might be widely implemented elsewhere. The advantages of simulation-based training are undeniable, but the method has drawbacks. These include the high cost of simulation equipment and the need for a designated area and staff to facilitate simulation-based education. Simulation should be blended with other instructional modalities to guarantee further that students are well-prepared for real-world clinical practice. The long-term effects of simulation-based training on clinical results and patient safety also need further investigation.

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