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SYSTEMATIC REVIEW

Identifying patient safety competences among anesthesiology residents: systematic review

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Abstract

Introduction and objective: Patient safety is a concept of great importance to managers, health professionals, and patients and their families, given patient safety promotes more effective care and reduces costs. Moreover, while analyzing the area of anesthesiology, one can realize the epidemiological changes, increased complexity and number of procedures, and the adoption of a new matrix of essential skills mandatory for residents of anesthesiology in Brazil. Thus, it is relevant to identify current patient safety competences among anesthesiology residents.

Methods: A systematic review was elaborated using PubMed, SciELO, BVS, Cochrane Library, LILACS and CAPES databases with the descriptors “anesthesiology”, “patient safety”, “residency” and “competence”.

Results and conclusions: Thirteen articles published in the past 10 years were analyzed. The articles depicted competences grouped into three categories: knowledge (identification, prevention and management of adverse events; use of correct and up-to-date information; understanding of human factors; and continuous learning), skills (efficient communication; teamwork; leadership; decision-making; and self-confidence), and attitude (management of stress and fatigue; and infection control). All these skills can be developed and assessed through simulation and active learning methods, profiting from a multidisciplinary approach. Studies also reveal that residents perform poorly in certain patient safety domains due to lack of effective in-depth understanding, appreciation of the topic and ineffective teaching. As a result, greater investment in the topic is needed by teaching and health institutions and researchers.

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Introduction

The expression “patient safety” dates from the 19th century, when the English nurse Florence

Nightingale, working in the Crimean War and observing the precarious conditions of battlefield soldiers, proposed changes in hospital organization and hygiene, fundamental factors for satisfactory quality of care.¹

Early in the 21st century, the Institute of Medicine of the United States of America included patient safety as one of the parameters of patient care quality. It can be defined as

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the extent to which health services dedicated to patient or population care increase the likelihood of producing desired outcomes based on current scientific evidence.² In this scenario, patient safety can be recognized as the process seeking to reduce, to an acceptable minimum, preventable injury and damage that may result from health care to patients.²

This concept has acquired, all over the world, great importance not only for health professionals, but also for managers, patients and family members, in order to offer safer assistance.

Given the significance of the matter, the World Health Organization (WHO) has prioritized two measures to reduce the risks that result in harm to patients: the worldwide campaign of hand hygiene and the promotion of safer surgery. The latter, for example, is based on performing a checklist before, during, and after surgery.³

Moreover, in the past 10 years there have been epidemiological changes, such as aging of the population, introduction of new technological devices, and scientific progresses in healthcare. Worldwide, such changes have resulted in a significant increase in the number of surgeries and in the complexity of anesthetic procedures, demanding more investigation on patient safety practices in the domain of anesthesiology.

In the complex setting of an operating room, anesthesiology is configured as a clinical specialty which intensively applies concepts and knowledge of the basic sciences in a practical context. Familiarity and proficiency in these domains are critical for delivering good practice, attaining satisfaction in professional activity and achieving the safe patient care criteria established by WHO.²

Thus, as dictated by Resolution No. 2174/2017 of the Federal Council of Medicine (CFM)⁴, physician duties regarding the confirmation of safety conditions are the basis of the new CFM guidelines for routine clinical practice in anesthesiology. Consequently, it is necessary to understand the patient safety competences that anesthesiology residents acquire during their training.

The term competence, according to Fernandes et al.,⁵ was initially defined as a set of knowledge, skills and attitudes, that when collectively applied, make it possible to improve the use of technical and cognitive resources to diagnose and treat patients and promote lower morbidity and costs to health institutions. However, they must be performed considering professional ethics and current scientific evidence. Govaerts⁶ further develops this concept by adding that competences are context dependent, require experience and reflection on medical practice itself, in addition to the ability to keep continuous medical education activities throughout one's professional life.

Still in relation to the anesthesiology residency program, the skills to be acquired, and which are necessary for the training of residents, vary according to the country in which the training takes place.

In the US, for example, in 2013 the Accreditation Council on Graduate Medical Education (ACGME) proposed the creation of the Anesthesiology Milestone Project to assess physicians participating in American residency and fellowship programs. According to the Milestone Project, the resident can be assessed in the following 5 different domains: patient care (perioperative management); medical knowledge (biomedical, clinical, epidemiological and sociocultural); systems-based practice (coordination of care with the health system and

patient safety); practice-based learning and improvement (improvement in patient safety during clinical practice; autonomous learning; knowledge about patients, families, students, residents, and other health professionals); professionalism (responsibility, honesty, integrity and ethical behavior; proposing and accepting suggestions; maintaining personal health); interpersonal and communication skills (dealing with everyone involved in health care; leadership and teamwork skills).⁷

On the other hand, in Brazil through Resolution No. 11 of April 8, 2019, the National Medical Residency Committee (CNRM) created the competence matrix for Medical Residency Programs in Anesthesiology.⁸ The matrix became mandatory on March 1, 2020 and it has general and specific objectives, and competences for each year of the training program (at the end of the first, second and third year of residency).

Regarding patient safety, the matrix presents as one of its specific objectives "to carry out anesthesia safely throughout all its stages".⁸ Moreover, it values medical practice based on ethics and respect for sociocultural differences. It also states that the resident should show respect toward all those involved in health care at the end of the third year of anesthesiology residency (patients, family members, colleagues, and assistants); communication skills; emotional control; leadership skills and teamwork. Finally, the matrix declares that it is essential for anesthesiologists to be aware of their own limitations to constantly enable opportunity for improvement.

Thus, by analyzing the current competences that anesthesiology residents have regarding patient safety, it will be possible to point out whether there is a need for improvement and how to achieve it. In addition, an opportunity will be created to analyze, in the future, how the progress of competences took place following the implementation of several curriculum matrices worldwide during the past decades.

Therefore, the guiding question of this study was: "What are the patient safety competences of anesthesiology residents?". To answer this question, the objective of this systematic review study was to identify the competences, that is, knowledge, skills and attitudes of anesthesiology residents regarding patient safety.

Methods

As this is a systematic review, the guidelines of the Preferred Reporting Items for a Systematic Review and Meta-Analysis (PRISMA)⁹ checklist were followed. In addition, the study was registered on the international database PROSPERO,¹⁰ under the identification code CRD42020176724.

Search strategies

The systematic review used the following databases: PubMed, SciELO, BV5, Cochrane Library, LILACS and CAPES. The descriptors "anesthesiology" AND "patient safety" AND "residency" AND "competence" were used for searching articles. Such descriptors were defined using Medical Subject Headings (MeSH).¹¹ Furthermore, they were contained either in the title or in the abstract of the selected study. The articles were published in the past 10 years, between January 2011 and April 2020, and they were all written in Portuguese, English or Spanish. [Table 1](#) summarizes the initial search results.

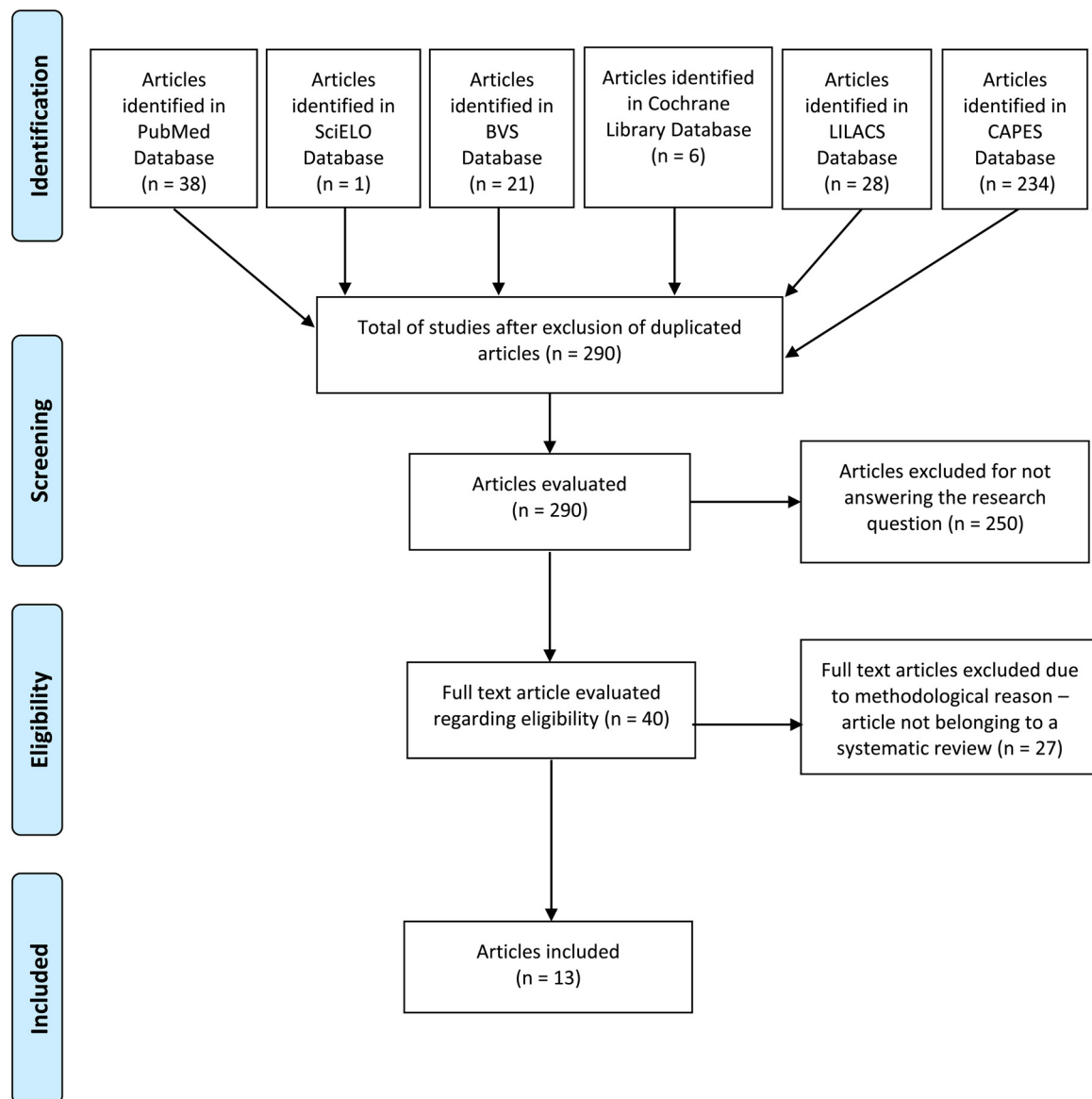


Figure 1 Flowchart of the article selection process according to the PRISMA model.⁹

Selection of articles

Duplicate studies were removed based on each article's title and authors. After this process, articles underwent a first reading by independent researchers, and were assessed according to inclusion and exclusion criteria. For inclusion, study participants of the article had to be anesthesiology residents. On the other hand, the following were excluded: (I) studies with resident physicians from other areas; (II) studies with participants that were already trained anesthesiologists; (III) or studies that had no correlation with the objectives of this systematic review.

A second reading of the abstract was carried out followed by an in-depth reading of the full articles

that made up the final sample of the present study. [Figure 1](#) depicts the selection process of the articles.

Presentation and discussion of results

After searching the databases depicted in [Table 1](#), initial evaluation, and elimination of articles incompatible with this systematic review, a total of 13 articles were obtained for analysis and discussion.

The articles were tabulated according to their authors, title, journal, year and country of publication, as presented in [Table 2](#).

Table 1 Number of articles found in the databases, according to search period and items.

Database	Search period	Search items	Number of articles found
PubMed	2011–2020	All fields	38
SciELO	2011–2020	All indexes	1
BVS	2011–2020	Title, abstract, topic	21
Cochrane Library	2011–2020	Title, abstract, keyword	6
LILACS	2011–2020	Words	28
CAPEs	2011–2020	Any	234

Table 2 Characteristics of selected articles.

Article number	Authors/ Journal	Title of publication	Year of publication	Country of publication
1	Fehr et al. ¹² / Anesthesiology	Simulation-based Assessment of Pediatric Anesthesia Skills	2011	USA
2	Riem et al. ¹³ / British Journal of Anaesthesia	Do technical skills correlate with non-technical skills in crisis resource management: a simulation study	2012	UK
3	Oliveira Junior et al. ¹⁴ / Anesthesia & Analgesia	The prevalence of burnout and depression and their association with adherence to safety and practice standards: a survey of United States anesthesiology trainees	2013	USA
4	BLUM et al. ¹⁵ / Anesthesiology	Simulation-based Assessment to Identify Critical Gaps in Safe Anesthesia Resident Performance	2014	USA
5	Iblher et al. ¹⁶ / BMC Medical Education	What motivates young physicians? – a qualitative analysis of the learning climate in specialist medical training	2015	UK
6	Doyle et al. ¹⁷ / BMJ Quality and Safety	Self-reported patient safety competence among Canadian medical students and post-graduate trainees: a cross-sectional survey	2015	UK
7	Dalband; Mohseni; Rosani ¹⁸ / Advances in Natural and Applied Sciences	The impact of anesthesiologists' level of expertise on orodental injuries in patients undergoing general anesthesia	2015	Jordan
8	Kumar et al. ¹⁹ / Anesthesia Essays and Researches	Perioperative communication practices of anesthesiologists: A need to introspect and change	2016	India
9	Corvetto et al. ²⁰ / BMC Anesthesiology	Validation of the imperial college surgical assessment device for spinal anesthesia	2017	UK
10	Gauger et al. ²¹ / International Journal of Pediatric Otorhinolaryngology	A Multidisciplinary International Collaborative Implementing Low Cost, High Fidelity, 3D Printed Airway Models to Enhance Ethiopian Anesthesia Resident Emergency Cricothyrotomy Skills	2018	Netherlands
11	Blum et al. ²² / Anesthesiology	Simulation-based Assessment to Reliably Identify Key Resident Performance Attributes	2018	USA
12	Komasawa; Berg; Minami ²³ / PLoS ONE	Problem-based learning for anesthesia resident operating room crisis management training	2018	USA
13	Kumari et al. ²⁴ / Saudi Journal of Anesthesia	Assessment of procedural skills in residents working in a research and training institute: An effort to ensure patient safety and quality control	2018	India

Table 3 Characteristics of selected articles.

Article number	Objective	Type of study
1	a) Develop a relevant set of pediatric perioperative simulations and determine their effectiveness in evaluating anesthesia residents and pediatric anesthesia fellows. b) Determine how experience and training time in pediatric anesthesia has affected a resident's ability to care for a variety of critical events in pediatric anesthesia.	Cross-sectional study
2	Assess the relationship between technical (T) and non-technical (NT) skills during a simulated intraoperative crisis scenario.	Cross-sectional study
3	Determine the prevalence of burnout and depression in anesthesiology residents in the USA.	Cross-sectional study
4	Design and test the use of an anchored behavioral scale, as part of a multiple scenario and a simulation-based rating system to elucidate the high and low performance characteristics of first-year anesthesia residents.	Prospective observational study
5	a) Investigate the preferences and concerns that German residents have about their learning. b) Highlight how German residents assess the quality of their postgraduate training and learning environment.	Qualitative study
6	a) Describe and compare self-reported patient safety competence acquired in lectures and clinical settings. b) Compare self-reported patient safety along the years of the residency program.	Cross-sectional study
7	a) Determine the impact of anesthesiologists' level of expertise on orodental injuries in patients under general anesthesia during oral intubation. b) Determine the prevalence of orodental injuries during oral intubation.	Descriptive Cross-sectional study
8	a) Check (using a questionnaire) communication skills during the perioperative period of anesthesiology residents. b) Report the level of psychosocial support anesthesiology residents provided to patients and family members. c) Report communication among residents and colleagues in the operating room.	Cross-sectional study
9	Assess (by video) hand movement in a simulated spinal anesthesia model.	Cross-sectional study
10	Assess the knowledge and ability of anesthesiology residents to perform needle cricothyroidotomy using a simulator	Cross-sectional study
11	a) Assess whether there are important gaps in the performance of anesthesiology residents. b) Validate an assessment based on several simulation scenarios for residents (regarding patient safety).	Cross-sectional study
12	a) Teach anesthesiology residents emergency airway procedures, pain and venous access using PBL. b) Additionally assess the non-technical skills of residents (self-confidence, for example).	Cross-sectional study
13	a) Evaluate the competence of residents and the impact of various corrective measures using educational lectures and of clinical skill demonstration in providing several anesthesia procedures. b) Evaluate such procedures by PSC and GRS scores.	Cross-sectional study

Regarding the articles chosen for analysis, 38.46% of the studies were carried out in North America, 38.46% in Europe, and 23.07% in Asia. The US and UK had the highest number of publications, with 5 (38.46%) and 4 (30.77%) articles, respectively.

On the other hand, concerning the research design, 11 (84.60%) articles were cross-sectional studies, 1 (7.70%)

was observational prospective, and 1 (7.70%) was qualitative, as revealed in [Table 3](#), which depicts the specific characteristics of each article selected.

All articles were submitted to an analysis of risk of bias using the QUADAS-2²⁵ tool. During this process, four domains were examined: selection of residents, index test, reference standard, and flow and time. Such data are shown in [Figure 2](#).

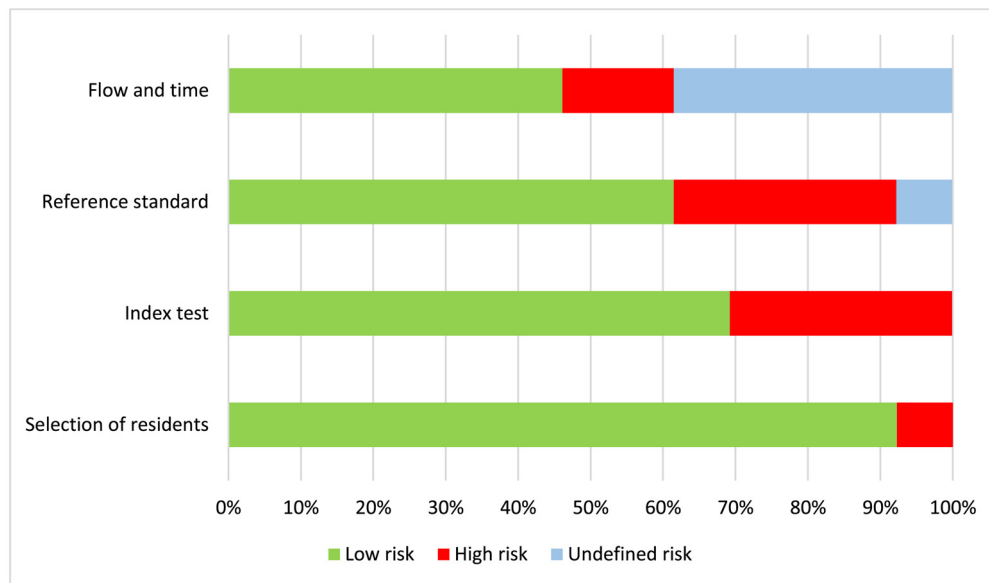


Figure 2 Proportion of articles with low, high or undefined risk of bias according to the QUADAS-2 tool.²⁵

As for the first domain, that is, how study participants were selected, 92.3% of the articles had a low risk of bias. These studies reported the total number of residents who participated in the survey and avoided unnecessary exclusions. However, article 7 reported only the number of patients seen by residents during the study.

Regarding the index test, that is, the instrument applied by the author in the research, 69.2% of the articles had a low risk of bias (authors described the tool and how it was used and interpreted), while 30.7% had a high risk of bias. For example, articles 2 and 5 offered a comprehensive description of the instruments, however, both tools were original and have not been validated by other authors, increasing the risk of bias. On the other hand, article 8 did not offer a satisfactory description of the tool or describe how it was interpreted. Article 13 did not elucidate whether residents were assessed in simulation or in a clinical practice setting and, consequently, did not assess the risk of bias that both settings may have.

As for the reference standard, that is, other non-authorial instruments that inspired the authors during the research, 61.5% of the articles had a low risk of bias (they offered an adequate tool description); 30.7% presented high risk of bias (in articles 4, 5, 7 and 12 tools are only mentioned, but not described); and 7.7% had an undefined risk of bias (article 8 did not elucidate whether the tool used has devised by the article's author or based on other studies).

On the other hand, in the flow and time domain, that is, how the study was conducted, 46.1% of the articles had a low risk of bias (there was suitable time between pre- and post-test; the tool was applied to each resident, at the same time and in the same manner, and all data were included in the analysis); 15.4% had a high risk of bias (articles 5 and 6 did not discriminate the study results by medical specialty); and 38.4% had an undefined risk of bias. As to the latter, articles 1, 2, 4 and 13 did not specify whether the study was conducted using the same residents and at the same time. Article 7 had no description on how the study was conducted.

In general, the 13 articles selected presented different types of patient safety competences that can be classified into three categories: (1) knowledge, (2) skills and (3) attitude, that are described below.

Category 1: knowledge

Regarding the knowledge category, a set of theory knowledge acquired by the rationale, experience or information received, the articles underline as fundamental: the identification, prevention and management of adverse events and possible errors arising from the comprehensive assessment of the patient, and from the understanding and training of the procedures and medications to be used, recognition and reporting of errors^{14, 16-18}; the use of accurate and updated information by practicing Evidence-Based Medicine and using technology^{12, 15, 21}; the understanding of human factors^{13, 15, 17, 18, 22}; and continuous learning, that is, learning and teaching at the workplace, and the existence of dedicated and receptive teachers and active methodologies can help in this process.^{16, 17, 23}

Category 2: skills

Regarding skills, the ability to put acquired knowledge into practice, a great emphasis was given to efficient communication, a factor that directly impacts interpersonal relationships. Hence, during clinical care or adverse events, residents must always honestly report what is the actual situation to the patient and family; obtain consent to perform procedures; perform shared (with patient and team) and individual anesthetic plans; be clear and assertive; show mutual respect; be interactive, empathetic and a good listener; be willing to give and receive feedback.^{12, 15-17, 19, 22, 24} Teamwork and the demonstration of leadership through recognition of their role and that of other team members; decision-making; self-confidence; and good communication were also valued.^{13, 15-17, 22-24} In order for all the aforementioned skills to be developed, interdisciplinarity during the

anesthesiology residents' learning is critical in order to ensure an integral perception of the health-disease process.^{17, 21}

Category 3: attitude

In the attitude category, that is, the behavior while facing a scenario, was underlined: the management of stress and fatigue through the awareness of one's self-limitations, acting according to an adequate workload, use of coping techniques, and requesting help when required^{14-16, 22}; and infection control by hand hygiene, antiseptic techniques and proper use of personal protective equipment (gloves, mask and gown).^{14, 17, 24}

Additionally, it is possible to point out the Six International Patient Safety Goals, advocated by the World Health Organization, whose objective is to achieve high standards of quality in care, with measures that help this development, such as behavioral changes and technological innovation in care¹. Knowing and applying the assumptions emanating from them is vital so that the anesthesiology resident can provide a positive attitude towards patient safety.

All skills regarding patient safety, and even in other areas, can be developed, improved and evaluated through simulations, a matter explored in most of the articles selected in this systematic review. Fehr et al.,¹² for example, submitted 35 residents and fellows to 10 scenarios using pediatric perioperative simulation, while Blum et al.¹⁵ submitted 30 residents and fellows to seven scenarios focusing on perioperative care pertaining to first-year residents, together with a behavioral scale.

Both concluded that this method was able to assess the actual level of the residents, since the performance of a scenario was related to overall performance. In the study by Fehr et al.,¹² the lowest scores were achieved in the scenario of appendicitis with sepsis, and the highest in the scenario of bronchospasm.

In the study by Blum et al.,¹⁵ based on the average performance of participants, scenario 5 (management of anaphylaxis in a patient with transurethral resection of the prostate and bladder biopsy) was considered the most difficult, and scenario 6 (management of one patient presenting delayed awakening in the operating room after transurethral resection of the prostate) was considered the easiest. In this study, the authors report that 98% of the residents rated the simulations as more instructive than a day in the operating room, demonstrating the importance of such a teaching method for learning patient safety, especially regarding communication skills. Simulation in multiple scenarios helps to identify gaps in residents' performance and enables adjusting teaching-learning programs.

Additional studies were carried out by other investigators, like Gauger et al.,² who assessed 12 residents after being trained to perform needle cricothyroidotomy; Kumari et al.,²⁴ in which 95 residents received suggestions on corrective measures during lectures and practical training sessions; and Blum et al.,²² who enrolled 67 residents to participate in seven simulation scenarios focusing on perioperative care. These three groups of investigators revealed that, after the administration of simulation scenarios and feedback, there is significant improvement in residents'

skills in the three categories (knowledge, skills, and attitude). Moreover, in Blum's study, 98% of the residents indicated simulation scenarios as more educational than actual routine situations in the operating room.

Corvetto et al.²⁰ enrolled 30 residents to perform spinal anesthesia simulations and evaluated the number of movements made by trainees, and time for executing the procedure. The authors observed that the highest scores were obtained by third-year residents. According to the authors, the analysis was carried out with procedures in compliance to patient safety. Such teaching methodology demonstrates that there was improvement in the way procedural skills are taught when the authors state and acknowledge that the traditional method must be replaced by a structured method for acquiring technical skills.

Fehr et al.¹² used 10 pediatric perioperative simulation scenarios for 35 residents and fellows and reported that higher scores were obtained by participants with more training and experience. They also identified that simulation, as a learning method, enables characterizing residents' progress during the different years of residency. Thus, it is still possible to identify likely gaps while teaching residents and provide support to resolve these issues before residents are granted specialist status.

Furthermore, Komasa, Berg and Minami²³ analyzed the skills of 35 residents before and after training and reported performance improvement for all scenarios, and Gauger et al.²¹ also stated that study methods such as Problem Based Learning (PBL) or other types of simulations can enhance a resident's self-confidence. This is a fundamental factor for residents to put into practice everything they have learned and to question the procedures performed by themselves and by others around them.

Articles such as those by Riem et al.,¹³ in which improvement in technical and non-technical skills in 50 residents followed their exposure to a simulated scenario of intraoperative cardiac arrest secondary to a malignant arrhythmia; by Doyle et al.,¹⁷ in which medical students, 13 residents of anesthesiology and other areas answered a questionnaire on patient safety; and by Komasa, Berg and Minami²³ also reported a close correlation between technical (hand hygiene; infection control; safe medication practices) and non-technical (trust; decision making; teamwork) skills. Therefore, developing one of these domains automatically improves overall performance by residents. Despite this, in the survey by Doyle et al.,¹⁷ most residents claimed to have more confidence in learning technical patient safety skills and less confidence in learning patient sociocultural aspects.

Regarding this matter, similarly, Ibber et al.¹⁸ asked 198 anesthesiology residents about what would be the fundamental factors for medical training. From the responses obtained, 10 categories were created. Among them appear learning methodology, with the benefits of simulations and active methodologies already evidenced here; patient safety; supervision; and personal safety.

As for supervision, the study done by Doyle et al.,¹⁷ enrolling medical students and residents, including 13 anesthesiology residents, indicated that the majority (78%) believed it was hard to question authority, and 39% agreed that there is consistency in how patient safety is dealt with by different tutors.

Based on these data, the need to guarantee that the anesthesiologists trained before the curricular changes have access to patient safety knowledge is evident. In addition, as a professional requirement, these specialists must continue learning and improving themselves.

Personal safety is another category created in the study by Iblher et al.¹⁶ On this topic, Oliveira Junior et al.,¹⁴ administering a questionnaire to 1508 residents, concluded that 41% of the participants had a high risk of burnout and 22% had positive results for depression. Risk factors included excessive workload (> 70h per week); alcohol intake (> 5 drinks per week); tobacco use; and female gender. Among respondents, the authors identified a percentage of 33% at high risk of burnout and depression, who reported making medication errors, and concluded the study discussing the actual prevalence of depression and even suicidal ideation, relating such symptoms to patient safety or lack of safety.

These data underlined the significance of physical, but also mental care for residents. In this sense, it is possible to rely on the emotional support of colleagues and superiors and gain new insights from the experiences they have already undergone. It is also crucial that residents recognize their limits and seek professional help when needed. Finally, education and health institutions must maintain a firm imposition to ensure that residents do not exceed the maximum workload established – 60 hours per week.²⁶

Oliveira Junior et al.¹⁴ state that residents with burnout or depression had worse practical performance, compromising quality of care and patient safety. Dalband, Mohseni and Rosani¹⁸ also corroborated this concept by reporting after questionnaire administration to 683 patients undergoing orotracheal intubation during general anesthesia, that 67% of tooth damages caused by residents were due to negligence during the procedure and lack of adequate training, and were considered as adverse events.

Communication with the team and with patients and their families is another fundamental factor ensuring patient safety and appropriate resident performance. Kumar et al.¹⁹ verified, in a questionnaire administered to 127 anesthesiology residents and professionals in the area, that anesthesiologists practicing in private settings are more communicative than those who are tutors at a teaching institution or residents; that there is greater interest in intraoperative communication than in relation to the anesthetic plan; and that the discussion with the surgeon on the postoperative pain control strategy is not prioritized, even in university centers. This lack of communication among team members reduces care efficiency and places patient safety at risk. Furthermore, it does not contribute to promoting a harmonious and less stressful work environment.

Doyle et al.¹⁷ also stated that only 78% of respondents reported having enough opportunities to learn and interact with members of interdisciplinary groups. Thus, it is necessary that practicing good communication be fostered and developed.

None of the authors of the selected articles demonstrated improvement in health care quality associated with a Hospital Accreditation process. It is known that this procedure greatly assists in raising the quality of care, mainly by providing organized and strategic management. Health

institutions that undergo accreditation advance in their daily reflection on work processes, and consequently, towards the promotion of a positive organizational culture.

Final considerations

Given what was exposed in this research, the absence of more in-depth and effective understanding, or of residents' appreciation of the topic places quality of care at risk, which is reinforced by the lack of conformity when working with the subject at graduation or residency. In addition, many residents praise technical skills over non-technical and sociocultural aspects, which impacts on the quality of care. Communication, one of the International Patient Safety Goals, is yet another area that needs to be much improved in all its scopes, demanding better interaction among colleagues, professionals from other areas and tutors, including when posing questions and criticism. Finally, a great devaluation of residents' self-safety is still observed, reflecting on their physical and mental health and resulting in increase in medical errors.

When revisiting the proposed objective, evidence indicates that anesthesiology residents, to ensure the safety of their patients, must have appropriate skills, such as: identification, prevention and management of adverse events and possible medical errors; use of accurate and updated information that best favors patient clinical outcome; understanding of human factors; continuous learning; efficient communication among team members, patients and their families; empathy and respect for those around; willingness to provide and receive feedback; team work; showing leadership and decision making; self-confidence; managing stress and fatigue, always seeking to recognize self-limitations and asking for help when required; and infection control through good hygiene and antiseptic practices and the use of personal protective equipment.

Regardless of the specialty, patient safety is a fundamental theme in medical education. Therefore, it is necessary that faculty staff and institutions value teaching during graduation and residency, facilitating discussions and constructive feedback. Simulations and active methodologies are effective strategies for this purpose, as they enable the improvement of technical and non-technical skills and the identification of gaps in resident competences.

In this scenario, interdisciplinarity enhances such methods and prepares future anesthesiologists for the reality of the specialty. In addition, further studies are required given the lack of data on the competences needed for providing safe care, especially in the area of anesthesiology residency, which limited the present study. We suggest that other databases should be consulted for searching publications that identify evidence on the matter arriving from different countries, with regional specificities regarding their teaching programs on patient safety.

Author's contribution

FSHP contributed to the study design, data collection and analysis, and wrote and reviewed the manuscript. DBG contributed to study design, wrote and reviewed the

manuscript. ERR coordinated all phases of the study and contributed to the study design and reviewed the manuscript.

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Conflicts of interest

The authors declare no conflicts of interest.

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