PERIOPERATIVE NURSE COMPETENCIES IN ROBOTIC SURGERY: A SCOPING REVIEW

Competências do enfermeiro perioperatório em cirurgia robótica: uma revisão scoping

Competencias del enfermero perioperatorio en cirugía robótica: una revisión scoping

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ABSTRACT

Background: the introduction of robotic surgery modifies the dynamics of the surgical team, making it necessary to identify the competencies required of the perioperative nurse. **Objective:** to map the available scientific evidence on the competencies of perioperative nurses in robotic surgery. **Methodology:** a scoping review was conducted following the Joanna Briggs Institute methodology (2020 version). The search was performed in Medline Complete and PubMed Central via the PubMed platform. Through EBSCOhost, the following databases were accessed: CINAHL Complete, Nursing & Allied Health Collection, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, and Cochrane Methodology Register. Additional searches were conducted in SciELO, Google Scholar, and RCAAP. **Results:** ten studies were included. Analysis of the selected articles revealed four main competency groups: specialized care, safety, professional learning, and management and leadership. **Conclusion:** the review suggests that the competencies of nurses in robotic surgery are multifaceted and include several essential skills. This work may contribute to defining and consolidating a competency profile for perioperative nurses in robotic surgery and support the development of training programs in this field.

Keywords: robotic surgical procedures; professional competence; clinical competence; perioperative nursing

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RESUMO

Enquadramento: a introdução da cirurgia robótica modifica a dinâmica da equipa cirúrgica, o que torna necessária a identificação das competências do enfermeiro perioperatório. **Objetivo**: mapear a evidência científica disponível sobre as competências do enfermeiro perioperatório em cirurgia robótica. **Metodologia**: realização de uma revisão scoping, segundo a metodologia proposta pelo Joanna Briggs Institute, versão de 2020. A pesquisa foi realizada na Medline Complete e no PubMed Central, através da plataforma PubMed. Via EBSCOhost, CINAHL Complete, Nursing & Allied Health Collection, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews e Cochrane Methodology Register. Foi também realizada pesquisa nas bases de dados da SciELO, Google Académico e RCAAP. **Resultados**: foram incluídos 10 estudos na revisão scoping. Da análise dos artigos selecionados, emergiram quatro grupos de competências: cuidado especializado, segurança, aprendizagem profissional, gestão e liderança. **Conclusão**: a revisão sugere que as competências do enfermeiro em cirurgia robótica são multifacetadas e identificou várias competências essenciais. Este trabalho pode contribuir para determinar e consolidar um perfil de competências para enfermeiros que atuam no perioperatório em cirurgia robótica e auxiliar o desenvolvimento de programas de formação nesta área.

Palavras-chave: procedimentos cirúrgicos robóticos; competência profissional; competência clínica; enfermagem perioperatória

RESUMEN

Marco contextual: la introducción de la cirugía robótica modifica la dinámica del equipo quirúrgico, lo que hace necesaria la identificación de las competencias del enfermero perioperatorio. **Objetivo:** mapear la evidencia científica disponible sobre las competencias del enfermero perioperatorio en cirugía robótica. **Metodología:** se realizó una *scoping review* según la metodología del Joanna Briggs Institute (2020). La búsqueda se efectuó en Medline Complete y PubMed Central, mediante la plataforma PubMed. A través de EBSCOhost se accedió a CINAHL Complete, Nursing & Allied Health Collection, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews y Cochrane Methodology Register. También se consultaron SciELO, Google Académico y RCAAP. **Resultados:** se incluyeron 10 estudios. Del análisis emergieron cuatro grupos de competencias: cuidado especializado, seguridad, aprendizaje profesional, y gestión y liderazgo. **Conclusión:** la revisión indica que las competencias del enfermero en cirugía robótica son multifacéticas e incluye competencias esenciales. Este trabajo puede contribuir a definir y consolidar un perfil competencial para enfermeros perioperatorios en cirugía robótica, y apoyar el desarrollo de programas formativos en esta área.

Palabras clave: procedimientos quirúrgicos robóticos; competencia profesional; competencia clínica; enfermería perioperatoria

INTRODUCTION

The increasing integration of technology into the surgical field has led to significant advancements, particularly in optics and surgical instruments, enabling the development of new approaches in minimally invasive surgery (MIS).

Robotic systems reflect this evolution. Originally developed for military purposes to enable remote and secure surgical interventions, they have since been adapted for the healthcare sector to address and overcome the technical limitations associated with laparoscopy (Kuris et al., 2022).

In robotic surgery (RS), there is a detachment from the direct manipulation of surgical instruments. The robot's mechanical arms are maneuvered to perform various functions during procedures, where, despite computer assistance, there is no autonomy, as no independent movements or pre-programmed actions are executed (Davies, 2000).

The introduction of RS represents a substantial shift in contemporary surgical practice, and its expansion into various surgical specialties introduces new challenges for surgical teams.

The surgical robot, in addition to influencing workflow dynamics and altering individual and collective responsibilities, may impact team performance and the ability to detect and respond to adverse events (Gillespie et al., 2021).

Mathew et al. (2018) identified three primary factors affecting safety and decision-making in RS. The first is intraoperative communication, which is influenced by different communication patterns arising from the team's physical layout, leading to complex interactions that may result in errors. The second factor is teamwork, which can be hindered by distance and visual or physical barriers, resulting also in diminished situational awareness among professionals. The third factor involves disruptions to the surgical flow, such as technical failures, which can jeopardize the procedure.

Perioperative nurses play a crucial role in ensuring patient safety and well-being throughout the surgical process. In RS, perioperative nurses perform interventions that require a high level of technological competence, including the preparation, calibration, and positioning of the system, as well as handling robotic arms and surgical instrumentation (Redondo-Sáenz et al., 2023).

The development of different approaches to care is essential, encompassing non-technical skills related to decision-making and communication (Mathew et al., 2018).

The increased technical responsibility and the lack of specific policies regarding these procedures create uncertainty regarding their roles. A study conducted by Uslu et al. (2019) highlighted the necessity to define the competencies of perioperative nurses involved in RS to promote consistency and uniformity in clinical practice.

The development of a surgical program in this area requires that each team member comprehends their integrated interventions within the team (Møller et al., 2023).

Carlos and Saulan (2018) highlight the importance of a structured training program that fosters the development of skills necessary to address the challenges and risks associated with these procedures.

Despite these considerations and the anticipated evolution of RS, scientific evidence predominantly focuses on international studies within the medical field, emphasizing surgical technique and economic feasibility.

It is imperative to broaden the understanding of the complex intersection between technology and nursing care. A literature review is deemed pertinent to map the competencies of perioperative nurses in robot-assisted minimally invasive surgical interventions.

The efficient use of available technological resources to maximize patient benefits, not only demonstrates technical proficiency but also reflects a commitment to nursing.

METHODOLOGICAL REVIEW PROCEDURES

A scoping review (SR) was selected as the methodological approach to map the extent, range, and nature of existing scientific evidence in the emerging and rapidly evolving field of RS. The conduct and synthesis of this review adhered to the recommendations of the theoretical-methodological framework provided by the Joanna Briggs Institute (JBI), as outlined by Peters et al. (2020).

To ensure transparency, methodological rigor, and the credibility of the study, an SR protocol was developed, approved by a research unit, and presented at a scientific conference.

The PCC acronym (Population, Concept, and Context) was used to delineate the key elements and formulate the review question. In this study, the population refers to nurses, the central concept addresses nursing competencies in RS, and the context of practice is limited to the perioperative setting.

Based on these parameters, the review question was articulated as: "What are the competencies of perioperative nurses in RS?" Selection criteria were established, as detailed in Table 1.

Table 1

Search criteria

Inclusion Criteria	Exclusion Criteria
Articles addressing the concept of perioperative nurses' competencies.	
Articles including robotics associated with minimally invasive surgery.	Articles addressing robotics or robots without relation to minimally invasive surgery.
Full-text articles.	Articles without full-text availability.
Articles published in Portuguese, English, or Spanish.	Articles published in other languages.
Due to the exploratory nature of a SR, studies employing qualitative, quantitative, or mixed-methods paradigms were included, as well as primary and secondary studies, and relevant grey literature for the proposed mapping. Given the evolution of the concepts targeted in this review, no chronological restriction was applied. As RS exists in paediatric settings, no age limit was established. All articles were considered, regardless of access condition (open or restricted).	

As recommended by the JBI, a three-step search strategy was adopted.

In the first step, a preliminary search was performed on the PUBMED and EBSCOhost platforms, as well as within the MEDLINE Complete, PubMed Central, and CINAHL Complete databases, to identify indexing terms and keywords used by authors in articles pertinent to the topic under investigation.

In the second step, a Boolean search string was developed incorporating the terms "Robotic Surgical

Procedures," "Professional Competence," "Clinical Competence," and "Perioperative Nursing," applying truncation and combining the Boolean operators "OR" and "AND."

The search was conducted between May 6 and 13, 2024, in MEDLINE Complete and PubMed Central via the PubMed platform (Table 2). Additionally, searches were performed on EBSCOhost in the CINAHL Complete, Nursing & Allied Health Collection, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, and Cochrane Methodology Register databases. Searches were also performed in the Scientific Electronic Library Online, the Open Access Scientific Repository of Portugal, and Google Scholar.

Table 2

Example of a research strategy in the MEDLINE database (via PubMed)

	Research Strategy	Number of articles
#1	(robotic surgical procedures [MeSH Terms]) OR (robotic*[Title/Abstract]) Filters: Full text, English, Portuguese, Spanish	56,711
#2	((Professional Competence [MeSH Terms]) OR (Clinical Competence [MeSH Terms])) OR (competenc*[Title/Abstract]) Filters: Full text, English, Portuguese, Spanish	182,174
#3	(Perioperative Nursing [MeSH Terms]) OR (nurs*[Title/Abstract]) Filters: Full text, English, Portuguese, Spanish	379,720
#4	#1 AND #2 AND #3	40
((((Professional Competence[MeSH Terms]) OR (Clinical Competence[MeSH Terms])) OR (competenc*[Title/Abstract]) AND ((fft[Filter]) AND (english[Filter] OR portuguese[Filter] OR spanish[Filter]))) AND ((robotic surgical procedures[MeSH Terms]) OR (robot*[Title/Abstract]) AND ((fft[Filter]) AND (english[Filter] OR portuguese[Filter] OR spanish[Filter])))) AND ((Perioperative Nursing[MeSH Terms]) OR (nurs*[Title/Abstract]) AND ((fft[Filter]) AND (english[Filter] OR portuguese[Filter] OR spanish[Filter]))) Filters: Full text, English, Portuguese, Spanish		

In the third step, additional information sources were identified through the reference lists of the selected studies.

Study selection was carried out by two independent researchers in accordance with predefined criteria using the online platform Rayyan. Following this, a validated data extraction tool was employed to gather information from the articles, which was subsequently analyzed narratively in relation to the review question. The SR was registered in the Open Science Framework under the title "Perioperative Nurse Competencies in Robotic Surgery: A Scoping Review," with the identifier DOI: 10.17605/OSF.IO/AJQBS.

RESULTS

The article selection and assessment process resulted in the identification of 440 articles. Bibliographic references from various databases were exported in Research Information Systems format and subsequently imported into the Rayyan platform.

An automatic search identified and removed six duplicate records after thorough comparison. A preliminary screening of the remaining 434 articles was conducted based on titles and abstracts, leading to the selection of 17 articles for full-text review. Upon evaluating the full texts, seven articles were excluded

for not meeting the eligibility criteria, as they did not address the central concept.

Finally, the reference lists of the ten included studies were examined, yielding no additional articles.

To illustrate the study selection process, a flowchart is provided in Figure 1, adhering to the structure recommended for PRISMA flow diagrams (Page et al., 2021).

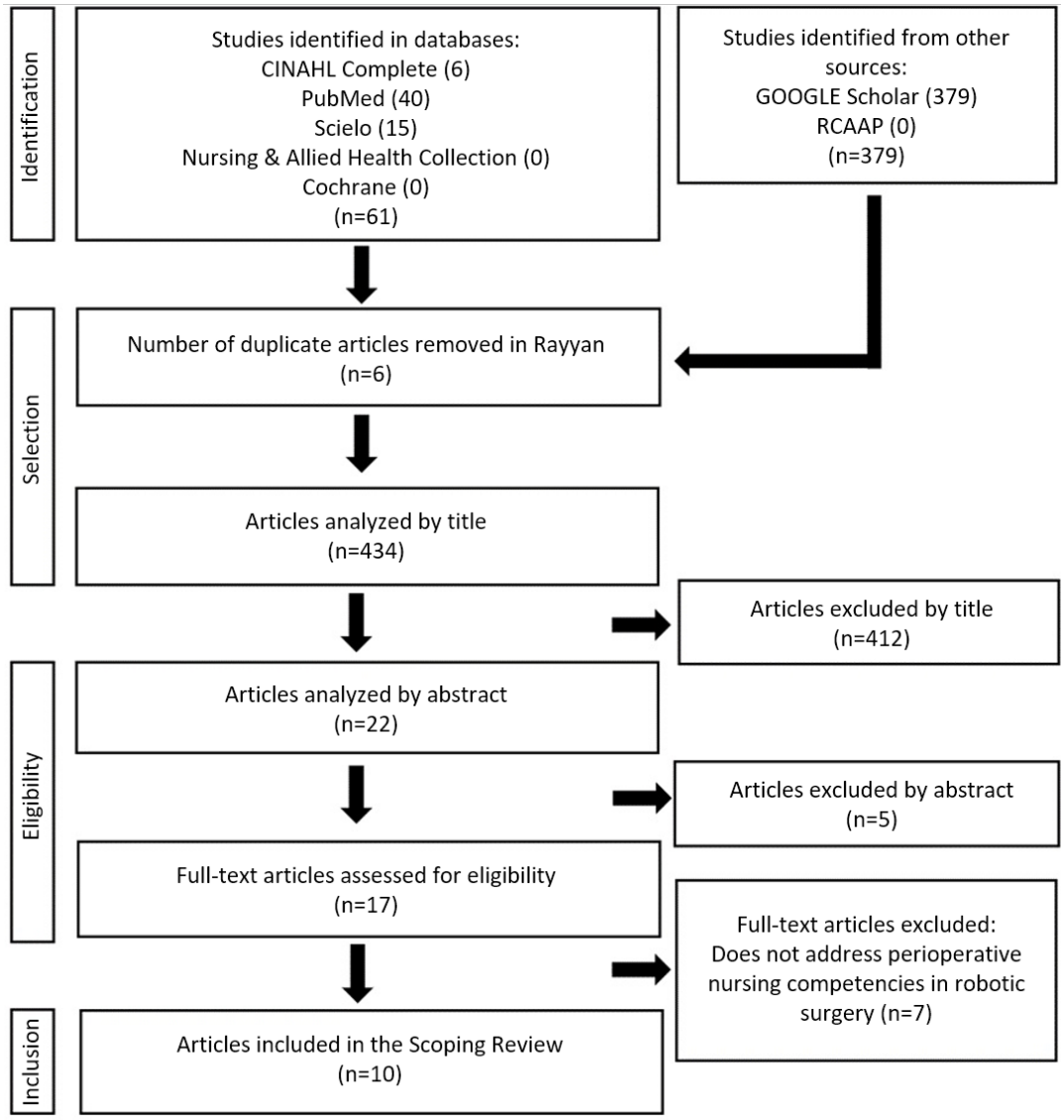

Figure 1

Flowchart of the study selection process

The ten included studies cover a period from 2006 to 2023, with 2023 exhibiting the highest number of publications. All selected studies were published in English in international journals, with the majority (three) originating from the United States of America (USA).

Data from the selected studies were extracted in May 2024 and are presented in Table 3.

Table 3

Data extraction

Title	Author(s), Year, Country	Objectives	Study Type, Method
E1 - Robotic Uro-Oncological Surgery: Nursing Skills and Future Perspectives.	(Giammaria et al., 2023) Italy.	To describe the role of nursing in RS within the field of urological oncology.	Narrative review.
Contributions to the review question: The study reports technical competencies related to surgical equipment and sterile technique. It also addresses competencies in patient monitoring and assessment, communication and teamwork, critical thinking and problem-solving, and documentation and data recording. It specifies the nurse's roles as a circulating nurse (preoperative preparation; safety; data management and documentation), scrub nurse (preparation of surgical instruments; management of material resources; communication), and RS coordinator (human resource management; team planning and organization; training and professional development; leadership and communication). The Revised Perioperative Competence Scale was used to assess competencies.			
E2 - Perioperative Nursing Role in Robotic Surgery: An Integrative Review.	(Redondo-Sáenz et al., 2023) Spain.	To understand the role of perioperative nursing in RS according to the Perioperative Patient-Focused Model.	Integrative review / Whittemore and Knafl methodology. Study appraisal strategy proposed by Dixon-Woods.
Contributions to the review question: The study differentiates the four domains of the Perioperative Patient-Focused Model and addresses aspects specific to RS: Health systems: professional training, teamwork, and postoperative consultation. Safety: patient positioning; inadvertent retention of surgical items; maintenance of robotic system sterility; management of sentinel events; communication. Behavioural response: providing patients with information about the procedure and potential complications; clarifying misconceptions regarding the functioning of the robot. Physiological response: identification and management of postoperative complications.			
E3 - Identifying curriculum content for operating room nurses involved in RS: a Delphi study	(Møller et al., 2023) Denmark.	To identify learning objectives for a curriculum aimed at operating room nurses working in RS, and to investigate which learning methods should be employed.	Qualitative study — three-round Delphi approach. Questionnaires administered using the online software SurveyXact (Rambøll Management Consulting, Aarhus, Denmark).
Contributions to the review question: The study identified 55 learning objectives, classified into 11 domains: one related to competencies required prior to working with RS (previous experience in minimally invasive surgery); nine related to technical competencies (robotic system and equipment; practical preparation for RAS; patient positioning; docking; management of unexpected events/problem-solving; emergency procedures; technical skills); and one related to non-technical competencies (communication). The highlighted learning methods include supervised intraoperative training, e-learning, and team-based simulation training.			
E4 - Perceptions and experiences of perioperative nurses and nurse anaesthetists in RAS.	(Schuessler et al., 2020) United States of America.	To explore the perceptions and experiences of perioperative nurses in robotic-assisted laparoscopic surgery and to identify factors that influence nursing care for patients undergoing robotic-assisted laparoscopic procedures.	Qualitative descriptive study. Semi-structured interviews were conducted. Data were analyzed through the identification of meaning units, followed by categorization and thematic extrapolation.
Contributions to the review question: The study highlights three essential competencies required for working in RS: ensuring safety, possessing technological knowledge and problem-solving abilities, and recognizing the importance of management for optimization and efficiency. It also outlines competencies across different surgical phases: Preoperative phase: assessment and identification of risk factors specific to RS. Intraoperative phase: documentation, communication, and teamwork. Postoperative phase: monitoring the patient's physiological status and managing injuries resulting from extreme surgical positioning.			
E5 - The process of nurse adaptation to robotic surgery: a qualitative study.	(Uslu et al., 2019) Turkey.	To explore nurses' experiences with RS and their adaptation to this surgical approach.	Qualitative study using focus groups with semi-structured interviews. Data were analysed using Colaizzi's phenomenological method of interpretation.

Contributions to the review question: The study emphasizes that, beyond possessing technological competence, nurses must have professional experience and the skills necessary to ensure patient safety. It underscores the importance of effective communication, teamwork, and continuous professional learning.			
E6 - Nursing performance in robotic surgeries: integrative review.	(Martins et al., 2019) Brazil.	To identify the role of nurses during the three perioperative phases of RS.	Integrative review. The included articles were assessed according to their level of evidence, based on the New JBI Levels of Evidence.
Contributions to the review question: The implementation of a structured training program for nurses engaged in specialized care supports the development of competencies across all perioperative phases, leading to risk reduction and improved patient outcomes. Preoperative phase: preparation of the operating room and patient positioning. Intraoperative phase: management of the patient cart, setup and configuration of the robotic system, completion of checklists, prevention of inadvertent retention of surgical items, and handling of surgical approach conversions. Postoperative phase: providing patient information and postoperative support.			
E7 - Nurse role in robotic surgery: challenges and prospects.	(Pinto et al., 2018) Brazil.	To identify the main challenges and prospects of the nurse's role in RS.	Integrative Review / Synthesis of information extracted from selected articles according to the Oxford Centre for Evidence-Based Medicine
Contributions to the review question: Links the acquisition of competencies to more precise decision-making regarding safety (management of robotics-associated equipment and devices; patient positioning; maintaining a suitable environment with aseptic technique). It highlights the importance of team training (updating the knowledge of nursing team members; promoting the development of IT skills; fostering evidence-based research).			
E8 - Robotic nurse duties in the urology operative room: 11 years of experience.	(Abdel Raheem et al., 2017) South Korea.	To present the roles and experiences of the nursing team in urological RS.	A retrospective study of institutional experience.
Contributions to the review question: Outlines the competencies of the RS Nurse Coordinator: management (scheduling; robotic system); supervision (robot preparation, patient preparation, and nurses' performance); education and training (orientation, skills training, and development of training programs); and research. It highlights safety in patient positioning, proficiency in performing robot draping and docking techniques, and troubleshooting robotic system errors.			
E9 - Robot-Assisted Thoracic Surgery: Perioperative Nursing Professional Development Program.	(Sarmanian, 2015) United States of America.	To describe a professional competency development program for circulating and scrub nurses in robot-assisted thoracic surgery.	Descriptive study based on a literature review.
Contributions to the review question: Emphasis is placed on competencies related to safety management (surgical positioning, patient cart manoeuvring, and CMI experience) and surgical team management (conducting pre-operative briefings, performing the surgical time-out, and carrying out simulation exercises).			
E10 - Evolution of robotics in surgery and implementing a perioperative robotics nurse specialist role.	(Francis, 2006) United States of America.	To describe the role of the Robotic Surgery Clinical Nurse Specialist.	Narrative Review.
Contributions to the review question: It outlines the competencies of the perioperative robotics nurse specialist, including: the ability to work with CMI and within the robotic surgery specialty; knowledge of data collection, research methodologies, and protocols; proficiency in software applications; leadership skills; the ability to assess competencies in RS; accountability for professional development; communication and teamwork; and liaising with other professionals.			

Based on the conducted analysis and to more effectively address the research objective, the results were categorized into competency groups.

In alignment with the competencies outlined in the framework for perioperative nursing established by the Portuguese Order of Nurses (Ordem dos Enfermeiros, 2018), the groups "Specialized Care" and "Safety" were created. Furthermore, referencing the regulations on common competencies for Clinical Nurse Specialists in Medical-Surgical Nursing by the Order of Nurses (Ordem dos Enfermeiros, 2019), competency groups pertaining to "Professional Learning" and "Management and Leadership" were identified.

A summary of the identified competency groups is presented in Figure 2.

Figure 2

Competency groups of the perioperative nurse in RS

DISCUSSION

The analysis of the literature indicates that RS presents new challenges for perioperative nurses, demanding the development of specific competencies. Defining these competencies is essential to ensure that nurses possess the necessary knowledge and skills to provide safe, high-quality care to perioperative patients.

Of particular note is the competency group related to specialized perioperative care in RS.

Redondo-Sáenz et al. (2023) highlight the critical role of nurses during the preoperative phase, emphasizing their responsibility in assessing specific risk factors for RS, delivering information, addressing patient inquiries, and alleviating the fears and anxieties of both patients and their families regarding the robotic technology utilized in surgery.

In the postoperative period, it is essential to acknowledge that outcomes may not always meet the expectations set by the use of this technology. Consequently, it is fundamental to offer support and guidance for the patient's adjustment (Martins et al., 2019).

It has been observed that the most significant differentiation of competencies within the scope of perioperative nursing occurs during the intraoperative phase. This differentiation is largely attributed to the heightened demand for technological proficiency in RS compared to other surgical approaches (Schuessler et al., 2020).

While technological proficiency is essential in RS, professional experience also plays a crucial role. Uslu et al. (2019) highlight the significance of a nurse's expertise in minimally invasive techniques and the

specific surgical specialty for effectively managing stress and making decisions in high-pressure situations.

Communication and teamwork are also core competencies in RS care. The surgeon relies on the surgical team to perceive and comprehend the surrounding environment. Furthermore, the complexity of the robotic system's components can hinder coordination and communication among the various professionals involved (Schuessler et al., 2020). Research indicates that teams demonstrating effective communication and shared situational awareness significantly enhance both safety and outcomes in robotic procedures (Abdel Raheem et al., 2017; Sarmanian, 2015).

Another critical competency identified is safety, which encompasses the perioperative nurse's responsibilities in risk assessment, risk management, and emergency response.

In RS, the risk of positioning-related injuries is increased due to extended surgical procedures, the necessity for extreme positioning, and the limitations on surgical table adjustments imposed by robotic docking (Martins et al., 2019).

The nurse is responsible for identifying and assessing the patient's risks associated with surgical positioning to ensure secure immobilization on the surgical table and to prevent complications. They aim to achieve a position that promotes both comfort and safety, taking into account the patient's individual characteristics and the specific requirements of the procedure, all while striving to provide optimal surgical exposure (Francis, 2006; Schuessler et al., 2020).

In the event of a robotic system malfunction or error, the ability to swiftly and effectively identify, address, and resolve adverse events is critical for ensuring the safety and continuity of the surgical procedure (Abdel Raheem et al., 2017).

In such situations, literature emphasizes the importance of competencies derived from experience, including decisive action and adaptability. These skills are essential for minimizing the time required for converting a surgical approach, which is particularly significant in RS due to the need to undock the robot and have the surgeon scrub in to join the team at the operative field (Sarmanian, 2015).

Surgical site infection represents a significant threat to patients in the perioperative setting. The RS nurse is responsible with ensuring the rigorous application of infection control techniques to mitigate this risk. Abdel Raheem et al. (2017) emphasize the critical importance of the draping technique, which involves protecting the robot's central column and arms with specific sterile drapes. This procedure requires a high level of skill to prevent contamination and maintain surgical asepsis.

Given their complexity and the presence of multiple moving parts, robotic instruments require meticulous, cleaning, irrigation and verification by the scrub nurse following the procedure, prior to their transfer to the sterile processing unit (Giammaria et al., 2023).

The competency group identified as professional learning, focuses on the development of the perioperative nurse in RS.

Currently, there are significant disparities in nurse training for RS. Only a limited number of professionals receive formal training that includes both theoretical and practical components at specialized centers. For the majority, initial training predominantly occurs on-the-job within the clinical setting, under the supervision of a mentor (Uslu et al., 2019).

In their study on perceptions and experiences in RS, Schuessler et al. (2020) found that nurses who received

comprehensive training reported higher levels of engagement and commitment to the program, as well as less difficulty in achieving expert status. Conversely, those lacking this opportunity expressed feelings of inadequacy in their training, resulting in stress and insecurity in their practice. The authors therefore advocate for the establishment and implementation of certified, standardized competency development programs for RS.

The literature emphasizes the significance of perioperative nurses engaging in scientific research within the relatively underexplored field of RS.

As early as 2006, Francis recommended the establishment of a clinical nurse specialist role in RS to spearhead research initiatives and develop a national network of these professionals, aimed at improving data collection and sharing (Francis, 2006).

Martins et al. (2019) emphasize the importance of developing and implementing evidence-based emergency procedures, algorithms, and protocols, especially during critical incidents such as surgical conversions or system and instrument failures.

The management and leadership competency group is dedicated to resource management and ongoing team development.

The investment required for the acquisition and maintenance of robotic systems significantly increases the costs associated with surgical procedures. However, Pinto et al. (2018) contend that the presence of a dedicated RS nurse coordinator can improve program efficiency and promote the cost-effective utilization of the robotic system.

The extensive competencies of this professional enable them to serve as a liaison among departments, hospital units, and the robotic system vendor. This role facilitates streamlined decision-making and prioritization regarding surgical scheduling, coordination of routine maintenance, and resolution of urgent issues (Francis, 2006).

As multi-use medical devices, robotic surgical instruments require careful management to guarantee timely replenishment while avoiding excess or waste.

Abdel Raheem et al. (2017) recommend the implementation of a tracking system with the instrument's serial number to document its journey from arrival to final use. This system should record the number of uses, the date of the last use, any malfunctions, scheduled maintenance, and repairs. By maintaining this log, perioperative nurses can effectively monitor instrument usage by surgeon or procedure, which facilitates the organization of instruments, both individually and within surgical trays. Such practices can reduce the workload of the sterile processing unit and mitigate unnecessary wear on the instruments (Schuessler et al., 2020).

Leadership in a field as demanding as RS requires the ability to inspire and motivate team development. Strong leadership skills are vital for overcoming the challenges associated with implementing this approach, while maintaining an unwavering focus on patient care and safety (Pinto et al., 2018).

It is important to acknowledge several limitations. This research identified a lack of national literature on the topic of nursing in RS, highlighting a scientific research gap in Portugal that is likely due to the recent implementation of this technology in the country. Additionally, the evidence presented does not uniformly capture the diverse nursing roles within the intraoperative phase. For example, the role of the anaesthesia nurse varies significantly across countries, influenced by differing healthcare systems and

regulations. As a result, the findings may not accurately reflect the competencies required for this specific role. These limitations hinder a comprehensive assessment of the perioperative nurse's competencies in RS. Therefore, it is essential that future studies address these issues to generate consistent and clinically applicable scientific evidence.

CONCLUSION

The future of nursing is closely intertwined with technological advancements. The development of RS signifies a transformative shift in the surgical field, raising critical questions about the integration of technology into human-centered care delivery. Consequently, RS presents new challenges for perioperative nurses, particularly the need to develop specific competencies that enable technology to augment, rather than replace, human care.

This literature review identifies nursing competencies in RS that encompass various facets of care while reflecting the quality standards and values integral to nursing practice during robotic surgical procedures.

To synthesize the evidence from this research, these competencies were categorized into four primary groups: specialized care, safety, professional learning, and management and leadership.

To fully leverage the benefits of this technology, it is essential to establish regulations that mandate team certification in this area. This can be accomplished through training programs based on the identified competencies, thereby creating clear benchmarks for quality and safety.

The advancement of robotic technology requires ongoing updates of the competencies outlined. Moreover, the specific aspects of the anesthesia nurse's role may require further exploration. It is crucial for nurses to actively participate in technological development for the integration of automated technology and artificial intelligence into patient care. This involvement will ensure that, even as responsibilities are delegated to technology, nursing continues to prioritize its core mission: the delivery of holistic care.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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