






Contributions of point-of-care ultrasound (POCUS) in intensive care nursing: an integrative review

Contribuições do ultrassom point-of-care (POCUS) na assistência de enfermagem intensivista: uma revisão integrativa

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ABSTRACT | OBJECTIVE: To analyze the scientific production on the main contributions of the use of point-of-care ultrasound (POCUS) in intensive nursing care. **METHOD:** Integrative literature review (period: February to July 2024), conducted through an electronic search in the LILACS and PubMed databases, covering primary studies in full text in which POCUS was performed by nurses, in Portuguese and English. The recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses were followed. **RESULTS:** A total of 806 papers were found; 11 were included in this study, mostly published in 2022 ($n=3$) and in English ($n=8$). The main contributions of using POCUS in nursing care were: guidance for the insertion and confirmation of the location of invasive devices (venous and arterial catheters and feeding tubes), assessment of cardiac and pleural changes, measurement of gastric and bladder volume, and the prevention, detection, and monitoring of pressure injuries. **CONCLUSION:** POCUS is established as a tool for inserting and confirming invasive device placement and assessing clinical changes. It is consolidating itself as an innovative practice that strengthens the autonomy and safety of intensive care nursing in the care of critically ill patients.

KEYWORDS: Nursing Care. Nursing. Ultrasound. Intensive Care Units.

RESUMO | OBJETIVO: Analisar a produção científica sobre as principais contribuições do uso do ultrassom *point-of-care* (POCUS) na assistência de enfermagem intensiva. **MÉTODO:** Revisão integrativa da literatura (período: fevereiro a julho de 2024), realizada por meio de pesquisa eletrônica nas bases de dados LILACS e PubMed, abrangendo estudos primários em texto completo nos quais o POCUS fosse realizado por enfermeiros, nos idiomas português e inglês. Foram seguidas as recomendações do *Preferred Reporting Items for Systematic Reviews and Meta-Analyses*. **RESULTADOS:** Foram encontrados 806 artigos; 11 foram incluídos neste estudo, em sua maioria publicados em 2022 ($n=3$) e em inglês ($n=8$). As principais contribuições do uso do POCUS na assistência de enfermagem foram: guia para a inserção e confirmação da localização de dispositivos invasivos (cateteres venosos e arteriais e sondas para alimentação); avaliação de alterações cardíacas e pleurais; mensuração de volume gástrico e vesical; e a prevenção, detecção e monitoramento de lesão por pressão. **CONCLUSÃO:** O uso do POCUS configura-se como uma ferramenta para a inserção e a confirmação da localização de dispositivos invasivos, bem como para a avaliação de alterações clínicas. Consolidando-se como uma prática inovadora que fortalece a autonomia e a segurança da enfermagem intensivista na assistência ao paciente crítico.

PALAVRAS-CHAVE: Cuidados de Enfermagem. Enfermagem. Ultrassonografia. Unidades de Terapia Intensiva.

1. Introduction

The Intensive Care Unit (ICU) is a hospital unit considered a highly complex setting, intended for the care of patients in critical condition who require specific interventions and specialized assistance¹. This setting has a multidisciplinary care team composed of professionals from different categories, including nursing professionals. The nursing team comprises nursing technicians and nurses, who are responsible for providing individualized, holistic, and humanized care and for direct care throughout the patient's stay in this setting².

Thus, in the daily routine of this sector, the nursing professional is responsible for performing various activities of high or low complexity, such as monitoring hemodynamic, neurological, and ventilatory parameters, administering medications and solutions, performing invasive procedures, and evaluating and monitoring the patient's clinical status. Thus, it is essential to have competence and security in the practice of care³.

Recently, nurses have used technological resources to support their care practices, especially in intensive care, which requires greater clinical surveillance and continuous monitoring, thereby enabling rapid and accurate analysis of clinical conditions⁴. These technologies contribute to a faster, more accurate, and safer clinical assessment of health conditions. Among these resources, the use of point-of-care ultrasound (POCUS) stands out, a technology that employs non-ionizing radiation, that is, low frequency and low energy, making it possible to visualize body structures through sound waves. Therefore, it is considered a safe, painless, economical, and non-invasive exam⁵.

In nursing, POCUS has multiple applications in clinical practice, such as aiding the performance of physical examinations, measuring urine volume and gastric residue, and performing venous and arterial punctures⁶. Thus, nurses have legal support to perform this exam, as long as they have specific training, and the issuance of a report is prohibited, as well as the use of this technological resource for diagnostic purposes⁷.

Using POCUS in the intensive care setting offers advantages for patient and professional care, as it enables the acquisition of crucial information that guides the execution of technical procedures⁸. Thus, it contributes to nurses having greater autonomy in taking conduct aimed at the patient's well-being and safety, in addition to allowing the qualification of care, since the use of this tool complements the nursing care practice⁹.

In view of the lack of published studies that summarize the indications for the use of POCUS in nursing care for critically ill patients, this research is justified by the need to strengthen the scientific basis that supports the use of this tool in clinical practice, contributing to the qualification of care, the reduction of adverse events, and the promotion of better health outcomes¹⁰. In addition, the study is relevant because it investigates the use of a technological resource that directly contributes to advanced nursing practices aimed at establishing excellent care and obtaining better results for patients, families, and health services^{2,8}.

By demonstrating the potential of POCUS, this research also supports expanding the scope of nurses' activities, aligning them with contemporary demands for innovation problem-solving capacity, and safety in health services, and collaborating with the development of an increasingly technological, critical, and evidence-based nursing¹¹. In this context, this research aimed to analyze the scientific production on the main contributions of the use of POCUS in intensive care.

2. Method

This is an integrative literature review, conducted in accordance with the recommendations proposed in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), adapted for an integrative review¹². The following guiding question for the electronic survey was defined: "How can the use of POCUS collaborate with nursing care in the Intensive Care Unit?" The PICO¹³ strategy was used to elaborate it, in which "P" (population) corresponds to critically ill patients, "I" (phenomenon of interest) to the contributions of POCUS use, and "Co" (context) to nursing care in the ICU.

As eligibility criteria, we included primary studies available in full, in Portuguese and English, that addressed the use of POCUS by nurses in the intensive care setting, with no time limit. The inclusion of primary studies is justified by the need to obtain empirical evidence directly related to the phenomenon under investigation. The language restriction was adopted due to operational feasibility and adequate understanding of the studies. Theses, dissertations, opinion articles, editorials, letters to the editor, and case studies were excluded. Studies aimed at pediatric and neonatal populations were also excluded, considering the physiological, clinical, and care specificities different from those of the critical adult public, which could compromise the homogeneity of the analysis.

The bibliographic survey was conducted from February to July 2024 in the Medical Literature Analysis and Retrieval System Online (MEDLINE) via PubMed and the Latin American and Caribbean Literature on Health Sciences (LILACS) databases. The choice of these databases is justified by their wide coverage of the international biomedical literature and the representativeness of scientific production from Latin America and the Caribbean. Specifically, this allows us to contemplate both global and regional evidence relevant to nursing practice.

To develop the search strategy, the Health Sciences Descriptors (DeCS) and the Medical Subject Headings (MeSH) were used, combined with natural language terms through Boolean operators (AND and OR), aiming to increase the sensitivity and reach of the search. The same search strategy was adopted in the two chosen databases: The descriptors in Portuguese "*Enfermagem*" OR "*Cuidados de Enfermagem*" AND "*Ultrassonografia*" AND "*Unidades de Terapia Intensiva*" OR "*Enfermagem em Cuidados Intensivos*" OR "*Cuidados Críticos*" and the descriptors in English "Nursing" OR "Nursing Care" AND "Ultrasonography" AND "Intensive Care Units" OR "Critical Care Nursing" OR "Critical Care".

In the process of selecting the studies, the Mendeley software was used to organize references and the Rayyan¹⁴ platform was used to identify and remove duplicates. Two independent reviewers conducted the screening process, in a blind manner, which ensured

greater methodological rigor and reduced biases in selecting the studies. Initially, the titles and abstracts were read, and, subsequently, the potentially eligible articles were read in full. In cases of disagreement between the reviewers, the differences were solved by consensus between the two evaluators, through careful reanalysis of the eligibility criteria.

The studies were finally selected after the texts were fully read, and the selection was concluded in July 2024. The citations present in the included studies were also analyzed, and those that met the eligibility criteria were included in this review. Next, data were extracted using a previously developed tool, which included information such as authors, year of publication, objective, method, main results, and conclusions.

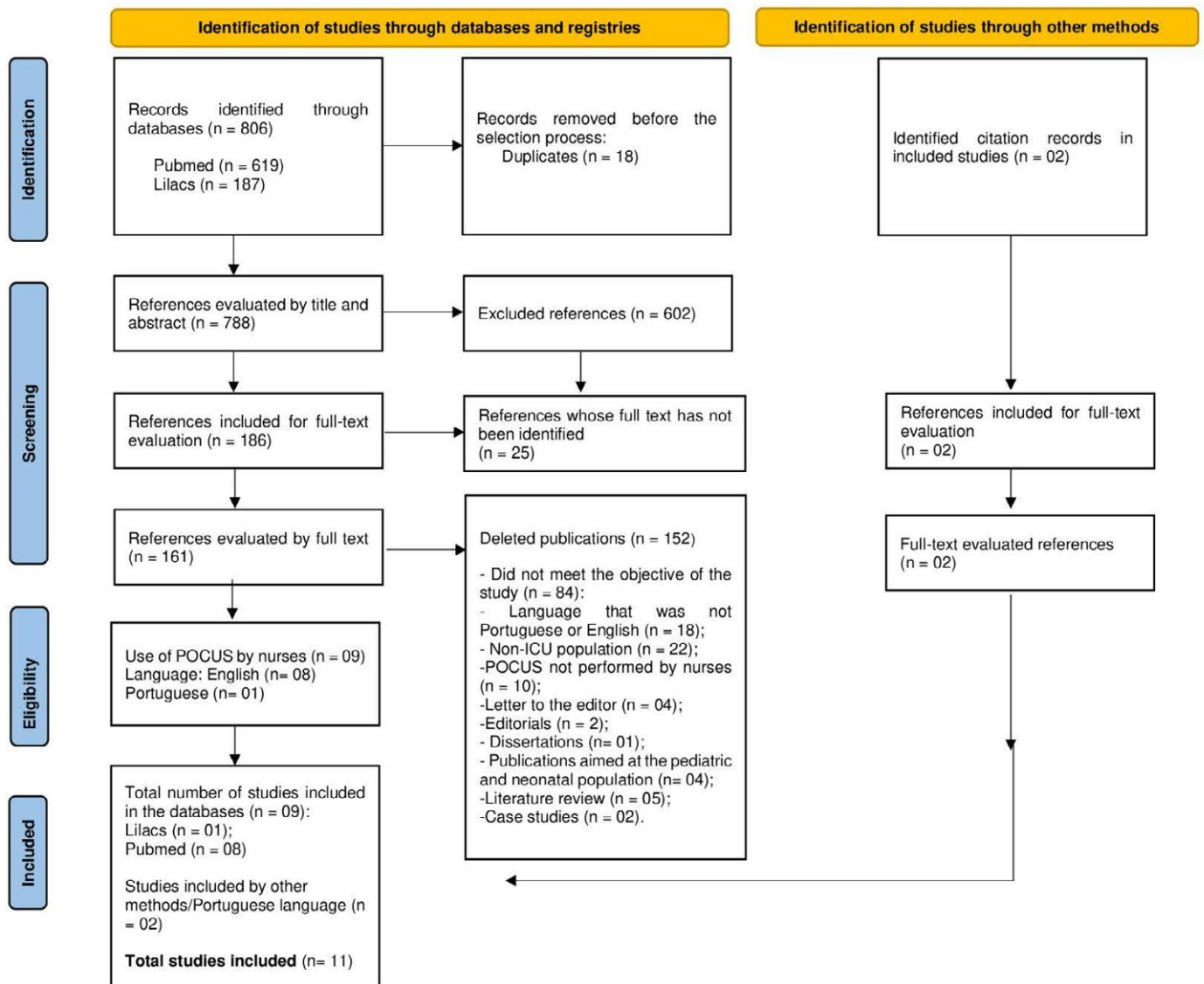
Regarding the evaluation of the methodological quality of the included studies, no specific checklist was adopted. This decision is based on the nature of the integrative review, which allows the inclusion of diverse methodological designs and prioritizes the broad analysis of the knowledge produced¹⁵. However, a critical analysis of the studies regarding methodological consistency, clarity of objectives, adequacy of methods, and relevance of findings for nursing practice was carried out.

The findings were then interpreted and summarized, enabling identification of the main contributions of POCUS in intensive care nursing, as well as gaps in scientific knowledge. Finally, the final considerations were developed, consolidating the main results of the integrative review.

3. Results

Of the 806 studies found, 18 were excluded due to duplication, leaving 788 for titles and abstract reading. Of these, 25 full texts were not identified, leaving 161 available for analysis. After this stage, nine studies met the eligibility criteria. Subsequently, two publications were identified from citations in studies already included that met the eligibility criteria. At the end of this process, 11 studies were included. Figure 1 shows the search and selection process for the studies included in this review.

Figure 1. Flowchart of the steps of identification and selection of studies for the integrative review



Adapted from: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71.¹²

Table 1 summarizes the characterization of the 11 selected papers, mostly published in 2022 ($n=3$) [E6, E7, E8], in English ($n=8$) [E1-E5, E8, E9, E11]. Regarding the large area of publication, almost all studies were published in medical journals ($n=7$) [E2, E3-E5, E7, E8, E11], followed by nursing journals ($n=4$) [E1, E6, E9, E10].

Regarding the purpose of the use of POCUS, there is a wide variety of clinical applications, among them the prevention, detection, and monitoring of pressure injuries in patients at risk [E2]; prevention of catheter-associated urinary tract infections (CAUTIs) and unnecessary catheterizations [E1]; measurement of urinary residue after removal of the indwelling urinary catheter [E10]; puncture and cannulation of the radial artery in patients in shock [E3, E5]; evaluation of gastric residual volume and positioning of the nasogastric tube [E8]; insertion of a nasogastrojejunal tube [E4]; location of the nasoenteric tube [E6]; peripheral venous access puncture in patients with difficult venous access [E7, E11]; and evaluation of cardiac and pleural alterations [E9].

Table 1. Characterization of the studies included in the integrative literature review

Nº/ Authors (Year)	Title	Journal	Purpose of POCUS
E1 Alexaitis and Broome (2014) ¹⁶	Implementation of a Nurse-Driven Protocol to Prevent Catheter- Associated Urinary Tract Infections.	<i>Journal of Nursing Care Quality</i>	Prevention of catheter-associated urinary tract infections and unnecessary catheterizations.
E2 Grap et al. (2015) ¹⁷	Use of high-frequency ultrasound to detect changes in skin integrity: An image evaluation validation procedure.	<i>Intensive and Critical Care Nursing</i>	Prevention, detection and monitoring of pressure injury in patients at risk.
E3 Li et al. (2016) ¹⁸	Ultrasonic Technology Improves Radial Artery Puncture and Cannulation in Intensive Care Unit (ICU) Shock Patients.	<i>Medical Science Monitor</i>	Radial artery puncture and cannulation in patients in shock in the intensive care unit.
E4 Li et al. (2018) ¹⁹	Semi-automated ultrasound guidance applied to nasogastrojejunal tube replacement for enteral nutrition in critically ill adults.	<i>BioMedical Engineering OnLine</i>	Insertion of nasogastrojejunal tube.
E5 Imbriaco et al. (2021) ²⁰	Radial artery cannulation in intensive care unit patients: Does distance from wrist joint increase catheter durability and functionality?	<i>The Journal of Vascular Access</i>	Cannulation of the radial artery.
E6 Ferraboli and Beghetto (2022) ²¹	Bedside ultrasonography for the confirmation of gastric tube placement: agreement between nurse and doctor.	<i>Revista Gaúcha de Enfermagem</i>	Location of the nasoenteric tube.
E7 Souza et al. (2022) ²²	Ultrasound in clinical nurses practice: Peripheral venous access.	<i>Brazilian Journal of Development</i>	Peripheral venous access puncture.
E8 Brotfain et al. (2022) ²³	Nurse-performed ultrasound assessment of gastric residual volume and enteral nasogastric tube placement in the general intensive care unit.	<i>Intensive and Critical Care Nursing</i>	Evaluation of gastric residual volume and nasogastric tube positioning.
E9 Sørensen et al. (2023) ²⁴	Point-of-care examinations using handheld ultrasound devices performed by intensive care nurses in a cardiac intensive care unit.	<i>European Journal of Cardiovascular Nursing</i>	Evaluation of cardiac alterations.
E10 Lopes et al. (2023) ²⁵	Use of ultrasonography in the evaluation of urinary retention in critically ill patients.	<i>Revista Latino-Americana de Enfermagem</i>	Measurement of urinary residue after removal of the indwelling urinary catheter.
E11 Hansen and Solbakken (2024) ²⁶	Experiences and perceptions of critical care nurses on the use of POCUS to establish peripheral venous access in patients with difficult intravenous access: a qualitative study.	<i>British Medical Journal</i>	Insertion of peripheral intravenous access in patients with difficult venous access.

POCUS - Point-of-Care Ultrasound.

Regarding the characteristics of the studies analyzed, there was a variety of international studies ($n=5$) [E1, E5, E8, E9, E11], but Brazil had the highest number of records ($n=3$) [E6, E7, E10]; the most used research designs were cross-sectional studies ($n=4$) [E6, E8, E9, E10], followed by descriptive studies ($n=3$) [E1, E2, E7]. Regarding the study scenario, most papers had the General ICU ($n=4$) [E5, E6, E8, E10] and the Neurological ICU ($n=2$) [E1, E2] as the locus of research (Table 2).

Regarding the contributions of POCUS to intensive care nursing care, the use of this tool makes it possible to visualize the venous network, leading to success in the insertion of peripheral venous access in patients with puncture difficulties ($n=2$) [E7, E11], reducing patient suffering and the risk of complications. Additionally, it beneficially influences time management and nurses' professional satisfaction ($n=2$) [E7, E11]. In addition, two studies reported the use of this technology for radial artery cannulation, contributing to its success [E5] and to reducing procedure time and the risk of associated complications [E3, E5].

Table 2. Results found in the studies included in the integrative literature review

Nº/Authors (Year)	Objective	Country/Design/ Study Scenario	Contributions of using POCUS in Nursing Care
E1 Alexaitis and Broome (2014) ¹⁶	To describe a quality improvement project to reduce catheter-associated urinary tract infections (CAUTIs).	United States/ Descriptive study/ Neurological ICU.	The protocol developed, which included bladder USG, reduced the incidence of CAUTIs, the length of stay in catheter use, and the length of stay in ICU, in addition to reducing the costs of drugs and supplies associated with the treatment of these infections.
E2 Grap et al. (2015) ¹⁷	To develop and test the reliability of criteria for overall image quality and for evaluating changes in tissue integrity (dermal and hypodermic layer thickness, dermal, and hypodermic layer density).	Not informed/ Descriptive and longitudinal study/ Respiratory clinical ICU, trauma surgical ICU, and neurological ICU.	Measurements of dermal and hypodermic thicknesses and densities performed by high-frequency ultrasound can be useful for early identification of changes in tissue integrity, such as tissue edema, which can cause skin lesions or ulcers.
E3 Li et al. (2016) ¹⁸	To observe the efficacy of the ultrasonic technique with out-of-plane orientation and in-plane orientation in radial artery puncture and cannulation in patients in shock in the ICU to show the effect of this technique on the Cannulation safety.	Not Informed/ Prospective Study/ Not Informed.	Using the US for radial artery cannulation contributes to the success of the first puncture, reduced puncture time, and associated complications (hemorrhage, infection, and catheter-related thrombosis).
E4 Li et al. (2018) ¹⁹	To report the use of saline solution as an acoustic window in providing enteral nutritional support to critically ill patients, using the nasogastrojejunal approach guided by semi-automatic Ultrasound.	Not Informed/ Clinical Trial/Not Informed.	Ultrasonography is an effective method for inserting the nasogastrojejunal tube for enteral nutrition in critically ill adults, using saline solution as an acoustic window and a metal wire as a screening target.
E5 Imbriaco et al. (2021) ²⁰	To evaluate some variables commonly applied during different individual approaches by intensive care physicians and nurses in radial artery cannulation of critically ill patients, and their possible correlation with longer and more effective catheter functionality.	Italy/Prospective cohort/General ICU- surgical and General ICU-trauma.	Ultrasound-guided radial artery cannulation showed a higher success rate, especially in patients with hypotension and shock, and reduced the risk of bleeding, hematomas, and infectious complications. Catheters inserted at a distance of 4 to 10 cm from the wrist had greater durability but required the use of USG due to the vessel's depth.
E6 Ferraboli and Beghetto (2022) ²¹	To evaluate the agreement between nurse and physician in determining the location of the enteral tube by ultrasonography, and to describe the difficulties the nurse encounters while performing the technique.	Brazil/Cross-sectional study/ General ICU.	The trained nurse presented similar results to the medical professional in determining the location of the enteral tube.
E7 Souza et al. (2022) ²²	To understand the perspective of the professional nurse working in an intensive care unit regarding the use of ultrasonography for the puncture of peripheral venous access in a regional hospital in Western Amazonia.	Brazil/Field research, descriptive and qualitative-quantitative/Not informed.	It optimizes the procedure by making it possible a single puncture, provides greater satisfaction to the professional who performs the procedure and to the patient, as well as safe and effective assistance.
E8 Brotfain et al. (2022) ²³	To validate a novel ultrasound method to assess gastric residual volume and nasogastric tube positioning performed by trained nursing staff in the intensive care unit, compared to a standard nursing care protocol.	Israel/Cross-sectional study/ general ICU.	A strong correlation between the use of ultrasound to assess gastric residual volume and the position of the nasogastric tube, and the unit's standard protocol.
E9 Sørensen et al. (2023) ²⁴	To evaluate the level of agreement between the findings of ultrasound examinations of critically ill patients with cardiac alterations performed by intensive care nurses and conventional ultrasound examinations performed by Physicians.	Norway/Cross-sectional study/ cardiac ICU.	Trained intensive care nurses can perform an ultrasound of the superior vena cava and the pleural and pericardial cavities, with results ranging from moderate to near-perfect agreement when compared to those performed by the medical team.
E10 Lopes et al. (2023) ²⁵	To measure urine volume by means of bladder ultrasound, performed by a nurse in critically ill patients, after removing the indwelling urinary catheter, and to verify the factors related to urinary retention.	Brazil/Cross-sectional study/ General ICU.	Bladder ultrasound was effective for measuring urine volume and may aid in identifying urinary retention. By means of bladder USG, the following nursing diagnoses were identified: urinary retention, risk of urinary retention, overflow incontinence, and impaired urination. Bladder ultrasound offers confidence and security to the professional to define the right time to perform bladder catheterization.
E11 Hansen and Solbakken (2024) ²⁶	To explore and describe critical care nurses' experiences and perceptions of using POCUS to establish peripheral venous access in patients with difficult intravenous access.	Norway and Sweden/ Qualitative study with hermeneutic approach/Not informed.	It allows the nurse to visualize the inside of the patient's body, provides high-quality care, reduces patient distress, enables safe and delay-free administration of infusions, and reduces the risk of serious complications. It improves nurses' readiness for action, time management, and job satisfaction.

CAUTIs - Catheter-associated Urinary Tract Infections; UGS - Ultrasonography; ICU - Intensive Care Unit.

Three papers [E4, E6, E8] showed positive results when evaluating the use of POCUS as a guide for nasogastric tube insertion, for determining the location of nasogastric and nasoenteric tubes, as well as for measuring gastric residual volume. Two studies evaluated the use of ultrasound to identify possible alterations in the genitourinary system [E1, E10]. A single study [E9] mentioned that properly trained intensive care nurses can use POCUS to evaluate the superior vena cava and the pleural and pericardial cavities. Study E2 indicated that changes in the density of the dermal or hypodermic layer identified by ultrasonography means tissue inflammation caused by the deprivation of oxygen and other nutrients.

4. Discussion

This integrative review summarized the results of 11 studies on the contributions of POCUS to intensive care nursing care, identifying the broad clinical applicability of this resource. Nurses who have specific training in ultrasonography can perform the examination at the bedside, as this tool supports the performance of care of greater technical complexity, thus being an innovation in nursing practice⁷.

A total of four studies [E3, E5, E7, E11]^{18,20,22,26} described the use of POCUS to guide vein and artery puncture. It is known that critically ill patients are susceptible to shock situations and, in these cases, their hemodynamic parameters become unstable, requiring blood pressure to be continuously monitored, as well as serial collection of blood gases and lactate dosage, which is provided by introducing a catheter into an artery²⁷. The trained nurse is authorized to perform the arterial puncture procedure for these purposes and can thus use POCUS to support this practice²⁸.

Studies indicate that the use of POCUS is a promising practice for venipuncture, especially in individuals with difficulty in visualizing the venous network, such as geriatric, dehydrated and/or capillary fragility patients, as it allows the professional to visualize the exact location of the blood vessel and select the vein with the appropriate diameter and length^{11,29}.

In addition, other studies report that using this tool minimizes possible complications caused by excessive attempts, allowing real-time visualization of the punctured area, thus increasing the success rates of the procedure on the first attempt^{22,26}.

A study carried out in a General ICU in Brazil mentions that bladder ultrasonography performed by a nurse, by means of POCUS, can be considered a complement to the physical examination, being useful to measure urine volume, thus favoring the early detection of urinary retention, characterized by the accumulation of urine above 400 ml in adults²⁵. In addition, another study reports that using this resource can help nurses in analyzing diuresis, helping to evaluate the need to perform bladder catheterization, since using this device indiscriminately or for a long time increases the risk of infections, urethral injury or stenosis, and hematuria³⁰. Thus, POCUS is an effective tool in assessing urine volume and substantially reduces the use of indwelling urinary catheters (IUC), as well as making it possible to determine which patients have a real indication for their insertion and when is the appropriate time to perform a relieving urinary catheterization^{25,30}.

In addition to the urinary system, studies have also addressed other areas of POCUS application. For example, a study conducted in Norway showed the use of POCUS to evaluate cardiac patients during physical examination²⁴. This evaluation allows the early identification of relevant changes, such as pleural and pericardial effusions, even before changes in vital signs. This way, the application of POCUS favors continuous monitoring and the decision together with the medical team on immediate local drainage²⁴.

The use of POCUS is considered a safe, innovative, and effective practice for ICU nurses in evaluating gastric residual volume and nasogastric tube positioning, as it enables monitoring nutritional tolerance, preventing regurgitation, and detecting the risk of bronchial aspiration²³. Considering that critically ill patients are at higher risk of bronchial aspiration due to reduced gastrointestinal motility, evolution with dysphagia and/or esophageal reflux, as well as needing to use enteral diet, invasive mechanical ventilation, and central nervous system depressant medications, it is important to verify residual gastric volume, contributing to care surveillance in the intensive care setting^{31,32}.

Currently, POCUS has been used as an alternative to verify the positioning of the nasogastric tube^{19,21,23}. This alternative allows the device's path to be evaluated in real time, without requiring patient displacement or radiation exposure^{19,21}. Although radiography remains the gold standard for confirming the position of gastrointestinal tubes²¹.

In addition, it is known that individuals admitted to the ICU usually undergo daily X-rays of the thoracic region to check the position of the orotracheal tube, and that the constant and long-term use of ionizing radiation can lead to complications, such as organ and tissue damage and genetic mutations³³. Thus, the use of POCUS is a method on the rise in intensive care and, in addition to being useful for verifying the positioning of the nasogastric tube, it can guide its insertion³⁴.

A descriptive, longitudinal study conducted in ICUs with different profiles (respiratory, trauma, surgical, and neurological) demonstrates the use of POCUS to prevent, detect, and monitor pressure injuries in patients at risk. This innovative tool in the field of care enables early identification of tissue alterations even before clinical signs are visible¹⁷.

In addition to the clinical applicability found in this literature review, POCUS has other functionalities for nursing in the intensive care setting, such as measuring the optic nerve sheath, enabling the evaluation of intracranial pressure, since continuous monitoring of this brain parameter is important in neurocritical patients, such as those with traumatic brain injury³⁵.

In addition, using this tool can be useful to identify reversible causes of cardiorespiratory arrest, such as cardiac tamponade, tension pneumothorax, hypovolemia, and massive pulmonary embolism, although the literature indicates that the use of this technology may be contraindicated in this critical clinical situation, given the potential risk of it interfering with the quality and continuity of cardiopulmonary resuscitation maneuvers³⁶.

Pulmonary POCUS is also an efficient tool for assessing blood volume in patients with acute kidney injury (AKI) and for identifying the nursing diagnosis of excess fluids, as evidenced by ultrasound-detected pulmonary congestion³⁷.

Thus, given the wide variety of clinical applications of POCUS, it is important to emphasize that the use of this resource in the ICU by intensive care nurses will only be possible with this equipment being available in this care setting, as well as with the continuous training on the indications, technique, and interpretation of the images provided by this technology, thus ensuring its assertive and safe use²⁹.

As limitations of this review, conducting the electronic search in only two databases may have narrowed the scope of identified relevant studies, increasing the risk of selection bias. In addition, the scarcity of international studies on nurses' use of POCUS highlights a scientific gap that directly affects the consistency of the available evidence. In addition, the inclusion criteria adopted, such as the restriction to Portuguese and English and the delimitation of the adult population, may have led to relevant research being excluded. Similarly, the exclusion of grey literature is a limitation, as it restricts access to complementary evidence that is not indexed in traditional databases.

Regarding the contributions of this review, POCUS allows direct assistance in the execution of invasive procedures such as venous and/or arterial cannulation^{18,20,22,26,38,39}, insertion of intestinal tubes, and confirmation of device positioning^{19,21,23,31,32}. This way, it complements the physical examination, contributing directly to the recognition of possible clinical alterations and supporting the nursing assessment and diagnosis, as well as the construction of individualized care plans, aiming to promote patient safety and care quality¹⁰.

5. Final considerations

This integrative literature review identified multiple contributions of POCUS in intensive care nursing, including the management of invasive devices and the clinical evaluation of critically ill patients. In addition, using POCUS reduces the time to puncture blood vessels and the complications associated with invasive procedures. These findings can contribute to greater safety and satisfaction for the professional and the patient.

Thus, using POCUS in the intensive care setting is an innovative tool, as it benefits the establishment of higher-quality care, while providing greater autonomy and security to the professional in complex decision-making. Furthermore, continuing education should be a crucial tool for spreading the importance and use of this resource to advance nursing practice. Finally, it was evident that more studies on the topic are needed, especially field research aimed at exploring potential areas where nurses can use POCUS in the care of critically ill patients.

Authors' contributions

The authors declared that they had made substantial contributions to the study in terms of the conception or design of the research, the acquisition, analysis, or interpretation of data for the work, and the writing or critical review of relevant intellectual content. All authors approved the study's final version for publication and agreed to take public responsibility for all aspects of the study.

Competing interests

No financial, legal, or political conflicts involving third parties (government, private companies, and foundations, etc.) were declared for any aspect of the submitted study (including but not limited to grants and funding, advisory board membership, study design, manuscript preparation, statistical analysis, etc.).

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