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PROTOCOL

Impact Of Nurse-Performed Point-Of-Care Ultrasound (Pocus) In Intensive Care: A Systematic Review Protocol

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Findings:

The systematic review proposed in this protocol aims to evaluate the effectiveness of nurse-performed point-of-care ultrasound in intensive care units.

ABSTRACT

BACKGROUND: Point-of-care ultrasound (POCUS) is increasingly used in critical care to support real-time clinical decision-making. Although traditionally performed by physicians, recent advances have enabled nurses to integrate POCUS into their practice. In the intensive care unit (ICU), where timely and accurate assessments are critical, POCUS performed by nurses can improve diagnostic accuracy, guide clinical interventions, and improve patient outcomes. However, the overall impact of this practice has not yet been systematically evaluated. **Aim:** This systematic review aims in terms of clinical decision-making, diagnostic accuracy, timeliness of care, and patient-related outcomes.

MATERIALS AND METHODS: The protocol follows the PRISMA-P 2015 guidelines and is registered in PROSPERO (N. CRD420251114795). A comprehensive literature search will be conducted in four databases: PubMed, Scopus, CINAHL, and Web of Science. The review will include primary peer-reviewed studies involving adult ICU patients and assessing POCUS performed by nurses. The quality of the study will be evaluated using the JBI Critical Appraisal Tools. Data will be synthesized narratively and quantitatively, where possible.

EXPECTED RESULTS: This review will provide a structured synthesis of existing evidence on nurse-led POCUS in intensive care. It will explore its clinical utility and influence on decision-making, care quality, and patient outcomes.

DISCUSSION: Findings are expected to inform clinical practice, training strategies, and policy development to integrate nurse-performed POCUS into ICU protocols. This review may also identify gaps in the literature to guide future research.

KEYWORDS: *Nurse-performed ultrasound, Intensive care, POCUS, Critical care nursing, Clinical decision-making, Systematic review*

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PROTOCOLLO

Impatto dell'ecografia point-of-care (POCUS) eseguita dagli infermieri in terapia intensiva: protocollo di revisione sistematica

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Riscontri:

La revisione sistematica proposta in questo protocollo si propone di valutare l'efficacia dell'ecografia point-of-care effettuata dagli infermieri nelle terapie intensive.

ABSTRACT

BACKGROUND: L'ecografia point-of-care (POCUS) è sempre più utilizzata nell'ambito delle cure critiche per supportare il processo decisionale clinico in tempo reale. Sebbene tradizionalmente fosse eseguita unicamente dai medici, i recenti sviluppi hanno consentito anche agli infermieri di integrare la POCUS nella propria pratica clinica. In unità di terapia intensiva (ICU), dove valutazioni tempestive e accurate sono fondamentali, la POCUS eseguita dagli infermieri può migliorare l'accuratezza diagnostica, guidare gli interventi clinici e migliorare gli esiti dei pazienti. Tuttavia, l'impatto complessivo di questa pratica non è stato ancora valutato in modo sistematico. Obiettivo: Questa revisione sistematica mira a valutare l'efficacia della POCUS eseguita dagli infermieri nelle ICU in termini di processo decisionale clinico, accuratezza diagnostica, tempestività dell'assistenza ed esiti correlati al paziente.

MATERIALI E METODI: Il protocollo segue le linee guida PRISMA-P 2015 ed è registrato su PROSPERO (N. CRD420251114795). Verrà condotta una ricerca esaustiva della letteratura in quattro database: PubMed, Scopus, CINAHL e Web of Science. La revisione includerà studi primari sottoposti a peer-review che coinvolgono pazienti adulti ricoverati in ICU e che valutano la POCUS eseguita dagli infermieri. La qualità degli studi sarà valutata utilizzando i JBI Critical Appraisal Tools. I dati saranno sintetizzati in modo narrativo e, ove possibile, quantitativo.

RISULTATI ATTESI: Questa revisione fornirà una sintesi strutturata delle evidenze esistenti sull'utilizzo della POCUS infermieristica in terapia intensiva. Verrà esplorata la sua utilità clinica e la sua influenza sul processo decisionale, sulla qualità dell'assistenza e sugli esiti dei pazienti.

DISCUSSIONE: I risultati attesi potranno informare la pratica clinica, le strategie formative e lo sviluppo di politiche per l'integrazione della POCUS eseguita dagli infermieri nei protocolli di terapia intensiva. Inoltre, la revisione potrà identificare lacune nella letteratura, orientando la ricerca futura.

KEYWORDS: *Ecografia infermieristica, Terapia intensiva, POCUS, Assistenza infermieristica in area critica, Processo decisionale clinico, Revisione sistematica*

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BACKGROUND

1. Introduction

Point-of-care ultrasound (POCUS) has emerged as a pivotal diagnostic tool in contemporary intensive care units (ICUs), enabling real-time, bedside imaging that facilitates the prompt assessment and management of critically ill patients (1). Traditionally employed by physicians—such as intensivists, emergency physicians, and anesthesiologists—its use is increasingly being extended to trained nursing professionals, particularly within critical care settings (2,3). Preliminary evidence suggests that nurse-performed POCUS is both feasible and potentially impactful, especially in the early identification and management of septic patients, where it may significantly enhance clinical decision-making timelines (4).

Incorporating POCUS into nursing practice in the ICU has the potential to advance early recognition of clinical deterioration, guide timely interventions, and ultimately improve patient outcomes (1,5). Clinical applications relevant to nursing practice include pulmonary assessments (e.g., detection of pleural effusion or pneumothorax), cardiac evaluations (e.g., estimation of left ventricular function), vascular access guidance, and fluid status evaluation through inferior vena cava assessment (3,6). With appropriate training and structured competency frameworks, nurse-led POCUS may reduce diagnostic delays, enhance workflow efficiency, and promote greater clinical autonomy among nursing staff (5,7).

Despite its promise, the integration of POCUS into nursing practice remains inconsistent and lacks formal standardization. The current body of evidence on its safety, effectiveness, and clinical utility when performed by nurses is limited and dispersed (2,4). While several studies have evaluated training feasibility and skill acquisition among nurses, relatively few have systematically analyzed the clinical outcomes associated with nurse-performed POCUS in ICU settings (6). Furthermore, the influence of this practice on key patient management metrics—such as length of stay, complication rates, and response times to clinical deterioration—remains unclear (3,5).

Recent qualitative research has also highlighted the experiential challenges and benefits perceived by ICU nurses implementing POCUS, pointing to gaps in support, training, and clinical integration (3). In parallel, efforts to develop validated assessment tools and standardized competency milestones for nurse-performed POCUS are underway, supporting the need for formal curricula and credentialing systems (8).

A systematic review of the available literature is therefore warranted to synthesize existing evidence, identify research gaps, and inform the development of clinical guidelines, training curricula, and policy frameworks. Such a review could facilitate the safe and effective implementation of nurse-performed POCUS in critical care, ultimately supporting its integration into routine nursing practice.

Aim:

The primary aim of this systematic review is to evaluate the clinical impact of nurse-performed point-of-care ultrasound in intensive care units. Specifically, the review will assess how POCUS use by nurses influences diagnostic accuracy, clinical decision-making, timeliness of interventions, and patient outcomes in critically ill adult populations. Secondary objectives include identifying the most common areas of ultrasound application by nurses and exploring healthcare professionals' perceptions

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regarding the safety, utility, and integration of POCUS into routine nursing care in ICUs.

2. Materials and Methods

This review will follow the PRISMA-P 2015 statement and will be registered on PROSPERO.

2.1. Eligibility Criteria

This preliminary review protocol is designed to ensure that the selection of studies is fully aligned with the objectives of the systematic review. The review will adhere to PRISMA guidelines, with PRISMA-P serving as the framework for protocol development (9,10), and the final manuscript will follow PRISMA standards.

The inclusion criteria will encompass all primary studies published in peer-reviewed journals that evaluate the use of point-of-care ultrasound (POCUS) performed by nurses in intensive care units (ICUs). Eligible designs include observational studies, cohort studies, cross-sectional studies, quasi-experimental studies, randomized controlled trials (RCTs), non-randomized controlled trials, and interventional studies. Only studies published in English or Italian will be considered. This linguistic restriction is intended to ensure consistency in the interpretation of findings, mitigate translation-related limitations, and focus on the primary languages used in high-impact scientific publications.

Exclusion criteria will be defined to maintain the rigor and focus of the review. Studies will be excluded if they do not directly address nurse-performed POCUS, its clinical applications, or related outcomes. Conference abstracts, theses, and unpublished studies will not be considered, as these sources often lack sufficient peer-review and complete datasets. Editorials, opinion pieces without primary data, animal studies, and laboratory or experimental models will also be excluded. Studies that exclusively address pediatric populations (<18 years) will not be eligible.

The exclusion of non-English or non-Italian studies, as well as grey literature, is acknowledged as a potential source of language or publication bias. Nevertheless, this approach prioritizes methodological rigor, feasibility, and the inclusion of high-quality evidence. These criteria will be applied systematically to ensure that the review incorporates all relevant and reliable studies.

2.2. Information Sources

The review will include primary studies such as randomized controlled trials, cohort studies, cross-sectional studies, case-control studies addressing our research question, and qualitative studies. This review protocol used the PIO (Population-Intervention-Outcome) framework to ensure a robust methodological approach that directly addresses our research question.

To conduct a comprehensive review, carefully designed search terms will be identified and applied across multiple databases. This approach will enable a broad exploration of resources, including PubMed, Scopus, CINAHL, and Web of Science. All relevant studies up to the extraction date will be included. Given the relevance of our research question, the PIO framework will allow us to clearly define the study area (Table 1).

Table 1. PIO Framework

Population	Patients admitted to intensive care units (ICUs)
Intervention	Nurse-performed point-of-care ultrasound (POCUS)

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Confront	Standard nursing care without direct use of ultrasound
Outcome	Changes in clinical management, diagnostic accuracy, timeliness of decision-making, and reduction in complications

Table 2 presents the key terms used to conduct the search. Subsequently, we will use Rayyan software (Rayyan Enterprise, Cambridge, MA, USA, https://www.rayyan.ai/ (accessed on February 8, 2024)) to eliminate duplicates (11). Two authors will independently select articles for inclusion in the review, and a fourth author will resolve potential conflicts. Full texts will be reviewed once the articles are selected, and a final decision will be made regarding their inclusion or exclusion.

Table 2. Key terms and search strategy

PUBMED ("intensive care" OR "critical care" OR ICU) AND (nurse* OR "critical care nurse*" OR "intensive care nurse*") AND ("ultrasound" OR "point-of-care ultrasound" OR POCUS OR "bedside ultrasound") AND ("clinical decision making" OR "patient management" OR "diagnostic accuracy" OR outcomes OR "patient care")
SCOPUS TITLE-ABS-KEY("intensive care" OR "critical care" OR ICU) AND TITLE-ABS-KEY(nurse* OR "critical care nurse*" OR "intensive care nurse*") AND TITLE-ABS-KEY("ultrasound" OR "point-of-care ultrasound" OR POCUS OR "bedside ultrasound") AND TITLE-ABS-KEY("clinical decision making" OR "patient management" OR "diagnostic accuracy" OR outcomes OR "patient care")
CINAHL (formato EBSCOhost): ((MH "Intensive Care Units" OR "intensive care" OR "critical care" OR ICU) AND (nurse* OR "critical care nurse*" OR "intensive care nurse*") AND ("ultrasound" OR "point-of-care ultrasound" OR POCUS OR "bedside ultrasound") AND ("clinical decision making" OR "patient management" OR "diagnostic accuracy" OR outcomes OR "patient care"))
WEB OF SCIENCE: TS=("intensive care" OR "critical care" OR ICU) AND TS=(nurse* OR "critical care nurse*" OR "intensive care nurse*") AND TS=("ultrasound" OR "point-of-care ultrasound" OR POCUS OR "bedside ultrasound") AND TS=("clinical decision making" OR "patient management" OR "diagnostic accuracy" OR outcomes OR "patient care")

2.3. Search Strategy

The systematic search was developed following the PIO framework described in Table 1.

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2.4. Selection Process

The methodological quality of all included studies will be assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tools, selected according to the study design—namely tools for case-control studies, cohort studies, case reports, case series, quasi-experimental studies, and randomized controlled trials (12). These standardized checklists include a series of items for which responses are categorized as "yes," "no," "unclear," or "not applicable."

The review process will follow the PRISMA 2020 and PRISMA-P 2015 guidelines (9,10). The selection and data extraction procedures will be conducted in two phases. In the first phase, two reviewers will independently screen the titles and abstracts of all retrieved records using Rayyan software (11). This preliminary screening will help identify studies that potentially meet the inclusion criteria. Any disagreements between reviewers will be resolved through discussion; a third reviewer will be consulted when consensus cannot be reached.

In the second phase, the same reviewers will independently assess the full texts of the selected articles to confirm eligibility and to extract relevant data. To ensure methodological rigor and reliability, a structured extraction process will be implemented. The extracted data will include the following variables: the name(s) of the author(s), year and country of publication, study design, target population, clinical setting, type of intervention (nurse-performed POCUS), primary and secondary outcomes measured, and key results. This information will be systematically recorded in a standardized data collection form.

This dual-reviewer approach is intended to minimize bias, enhance reproducibility, and ensure the accuracy of the synthesized evidence. All extracted data will later be organized using Microsoft Excel® to facilitate narrative synthesis and, where applicable, quantitative aggregation.

2.5. Data Collection Process

A PRISMA-compliant flow diagram will be included to provide a visual summary of the study selection process, detailing the number of records identified, screened, included, and excluded, along with justifications for exclusion at each stage.

This review will adopt a systematic and transparent approach to data extraction, employing a standardized tool specifically developed for this purpose. From each eligible study, relevant information will be extracted, including study design, characteristics of the study population, clinical setting, details of the POCUS intervention performed by nurses, and outcome measures.

Quantitative findings will be synthesized descriptively through a structured narrative summary, with attention to consistency and variations in the reported outcomes. When feasible, data will be pooled for statistical synthesis. In the case of qualitative data, a thematic synthesis approach will be used to identify and interpret recurring themes, patterns, and contextual insights across studies.

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All included studies will be classified according to their level of evidence, enabling a comparative assessment of methodological robustness and relevance. This review will follow a mixed-methods synthesis strategy, combining quantitative and qualitative findings to produce a comprehensive evaluation of the impact of nurse-performed POCUS on patient management and clinical outcomes in intensive care settings. This integrated perspective will help highlight not only the effectiveness of the intervention but also the contextual and professional factors influencing its implementation.

2.6. Study Risk of Bias Assessment

The risk of bias for each included study will be assessed independently by at least two reviewers using the ROBINS-E (Risk Of Bias In Non-Randomized Studies of Exposures) tool, which is specifically designed for evaluating observational research. Any discrepancies between reviewers will be resolved through discussion, and if needed, a third reviewer will be consulted to reach consensus.

The ROBINS-E tool assesses seven key domains of potential bias: confounding, selection of participants, classification of exposures, deviations from intended exposures, missing data, measurement of outcomes, and selection of reported results. Each domain will be rated individually, and these evaluations will inform an overall judgment of the study's risk of bias, categorized as low, some concerns, high, or critical.

This structured and systematic approach will ensure transparency and methodological rigor in the appraisal of the included evidence.

2.7. Synthesis methods

In line with the Joanna Briggs Institute (JBI) data extraction framework, data from all full-text articles included in the review will be independently extracted by at least two reviewers to ensure accuracy and completeness. The following variables will be collected for each study: author(s) and year of publication, country in which the study was conducted, study aim, sample characteristics (including population and sample size), study design and methodology, type of intervention (nurse-performed POCUS), outcome measures, and main findings. All extracted data will be entered into a Microsoft Excel® spreadsheet and used to generate structured summary tables.

Study results will be synthesized narratively, with a focus on identifying trends, patterns, and thematic insights across the included studies. The narrative synthesis will follow a structured approach that facilitates comparisons within and between studies, allowing for the identification of recurring themes and the mapping of findings according to intervention type, population characteristics, and outcomes assessed. Quantitative data will be reported descriptively, while qualitative results will undergo thematic analysis to extract meaningful insights.

Where the data are sufficiently homogeneous in terms of population, intervention, and outcomes, a meta-analysis will be conducted using RevMan 5.3 software. A random-effects model will be applied to account for potential between-study heterogeneity. Statistical heterogeneity will be assessed using the I^2 statistic, with thresholds of 25%, 50%, and 75% representing low, moderate, and high heterogeneity, respectively. Sensitivity analyses will also be performed to evaluate the stability of pooled estimates.

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By integrating a robust narrative synthesis with the possibility of quantitative aggregation, this review aims to offer a comprehensive and methodologically sound evaluation of the impact of nurse-performed POCUS in intensive care settings, while also accounting for variability in study design, intervention, and outcomes.

2.8. Measures and Outcomes

To ensure a comprehensive evaluation of the effectiveness of nurse-performed POCUS in intensive care settings, this review will focus on the following primary outcomes: clinical decision-making, diagnostic accuracy, timeliness of intervention, and patient-related outcomes such as complication rates and length of stay.

3. Impact of the Review

This systematic review will synthesize evidence from original studies involving adult patients (≥18 years old) admitted to intensive care units, with a focus on evaluating the clinical impact of nurse-performed point-of-care ultrasound (POCUS). The review aims to assess how the integration of POCUS into nursing practice influences decision-making processes, diagnostic accuracy, timeliness of clinical interventions, and patient outcomes such as complication rates, length of stay, and overall care quality.

To ensure a structured and theory-informed approach to evidence synthesis, this review will be conceptually aligned with frameworks of advanced nursing practice and clinical reasoning. These models support the analysis of how technical skills, such as ultrasound use, contribute to more autonomous and efficient nursing interventions, and how these, in turn, affect patient-centered outcomes.

This systematic review will synthesize evidence on the use of nurse-performed POCUS in intensive care, providing critical insights for clinical practice and education. The findings may guide healthcare organizations in developing structured training programs and protocols to support the safe and effective implementation of POCUS by nurses. Additionally, the review may support policy development related to the expansion of nursing roles and the standardization of bedside ultrasound use in critical care settings.

If the findings demonstrate that nurse-performed POCUS improves clinical efficiency and patient outcomes, this intervention could represent a low-cost, scalable, and sustainable strategy to enhance quality of care in high-acuity environments. The review may also inform the design of continuing education programs, clinical guidelines, and institutional protocols aimed at strengthening the role of nurses in diagnostic and interventional processes.

Ultimately, the synthesis will contribute to advancing evidence-based nursing practice, optimizing interdisciplinary collaboration, and promoting patient safety and clinical excellence in the intensive care context.

4. Discussion: Outcome and Prioritization

This systematic review protocol aims to evaluate the clinical and operational impact of nurse-performed point-of-care ultrasound (POCUS) in intensive care settings, with a particular focus on outcomes that reflect patient-centered, timely, and evidence-based care (1,6). The primary outcomes of interest will include clinical decision-making, diagnostic accuracy, timeliness of intervention, and patient-related outcomes such as complication rates, length of stay, and overall care quality (2,5). These outcomes have been prioritized as they directly reflect the capacity of POCUS to support early recognition of

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deterioration, improve procedural guidance, and enhance the responsiveness of nursing care in high-acuity environments (3).

This review prioritizes outcomes related to the use of nurse-performed POCUS in ICU settings, focusing on clinical decision-making, diagnostic accuracy, and patient-centered outcomes (1,2,5). Future directions may include developing competency-based training and evaluation frameworks for nurses to ensure safe and effective implementation of ultrasound in critical care (8,13).

The review will also consider secondary outcomes related to professional practice, such as nurses' autonomy, confidence, and interdisciplinary collaboration (2). As the role of critical care nurses continues to expand through advanced practice competencies, the integration of bedside diagnostic tools such as POCUS represents an important area of clinical development (3,6). In this regard, structured training, supervised clinical application, and adherence to standardized protocols are critical to ensuring that nurse-performed POCUS contributes meaningfully to both individual patient outcomes and the broader healthcare delivery model (7,8).

In addition, the growing integration of digital health solutions—such as tele-ultrasound supervision, remote instruction, and mobile learning tools—offers opportunities to enhance learning, standardize competencies, and facilitate real-time feedback (14–16). Comparative studies have shown that tele-ultrasound POCUS training during the COVID-19 pandemic was as effective as traditional in-person training in achieving knowledge gains and learner satisfaction (14). A scoping review has also confirmed the expanding role of tele-ultrasound in educational settings across disciplines (15). Feasibility of remote, real-time POCUS supervision in prehospital environments has been demonstrated (17). A recent systematic review concludes that tele-ultrasound is not inferior to in-center ultrasound in terms of diagnostic quality and service delivery (18).

Ultimately, the findings from this review will provide evidence-based insights for healthcare professionals and nursing leaders, helping to define the clinical utility, training needs, and implementation strategies required to incorporate POCUS safely and effectively into everyday intensive care nursing practice (1,4,8).

Implications for Clinical Practice

Patients in intensive care often present with rapidly evolving clinical conditions that require prompt assessment and timely intervention. In this context, nurse-performed point-of-care ultrasound (POCUS) offers a valuable opportunity to enhance patient-centered care by equipping nurses with a real-time diagnostic tool that supports early clinical decision-making and facilitates more targeted interventions.

To ensure safe and effective use of POCUS, nurses must be adequately trained in both the technical execution and the clinical interpretation of ultrasound findings. Structured educational programs and ongoing competency assessments are essential to empower nurses in confidently performing POCUS and integrating it into routine practice. This expanded scope of practice allows nurses to actively contribute to timely diagnoses, monitor treatment responses, and reduce delays in care, ultimately improving patient outcomes.

The implementation of nurse-performed POCUS can also reduce the need for unnecessary diagnostic imaging and

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delays associated with resource constraints or interprofessional bottlenecks. By enabling bedside assessments, POCUS enhances workflow efficiency and fosters greater autonomy within the nursing role-particularly in high-acuity settings where clinical conditions can deteriorate rapidly.

Beyond its clinical benefits, the integration of POCUS into nursing practice can have a positive impact on professional identity and job satisfaction. As nurses gain competence in this advanced skill, they may feel more empowered, engaged, and valued within the multidisciplinary team. This, in turn, may improve retention, reduce burnout, and promote a culture of continuous learning and innovation.

Overall, the adoption of nurse-performed POCUS represents a practical and scalable strategy to improve the quality, safety, and responsiveness of care in intensive care settings. With appropriate training, governance, and interprofessional collaboration, this approach has the potential to become a cornerstone of advanced nursing practice in critical care.

5. Limitations

Although the inclusion of only English- and Italian-language studies may introduce a degree of language bias, this decision was made to ensure a more manageable and coherent review process. English remains the predominant language in which high-quality, peer-reviewed clinical research is published, particularly in the field of critical care and diagnostic innovation. At the same time, the inclusion of Italian-language studies was considered essential to capture relevant local evidence that may not be available in international databases, thus enhancing the contextual relevance of the review.

It is acknowledged, however, that the exclusion of studies published in other languages may have resulted in the omission of potentially valuable data. This limitation could affect the comprehensiveness of the evidence base and may restrict the generalizability of the findings to a broader global context.

In addition, variability in the study designs, populations, and outcome measures across the included studies reflects the evolving and heterogeneous nature of POCUS implementation in nursing practice. While such heterogeneity presents challenges for data synthesis and comparative analysis, it also highlights the adaptability of nurse-performed POCUS across different intensive care settings. The presence of diverse training protocols, ultrasound applications, and outcome indicators limits the potential for meta-analysis but allows for the identification of key themes and context-specific findings.

Despite these limitations, the review's systematic approach, adherence to PRISMA guidelines, and the use of rigorous critical appraisal tools enhance the reliability and transparency of the process. The findings are expected to provide a valuable foundation for developing standardized protocols, competency-based training frameworks, and future research directions aimed at optimizing the role of nurses in performing bedside ultrasound in intensive care units.

6. Meta-Bias

This systematic review will account for potential meta-biases, including publication bias—such as the tendency to favour studies reporting positive or statistically significant results—as well as language bias resulting from the inclusion of only English- and Italian-language studies. Selection bias may also arise from variability in study

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designs, reporting quality, and inclusion criteria. Additionally, heterogeneity in the implementation of nurse-performed POCUS protocols, training modalities, and outcome measures may influence the interpretability and comparability of findings.

To mitigate these risks, a highly sensitive and systematic search strategy will be applied, combined with a rigorous screening and appraisal process. The use of standardized critical appraisal tools and independent review by multiple authors will ensure methodological transparency, enhance reliability, and support a comprehensive and balanced synthesis of the available evidence.

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