DOENTE CRÍTICO
REVISTA CIENTÍFICA DA SOCIEDADE PORTUGUESA DE ENFERMAGEM EM DOENTE CRÍTICO

Rito, S., Ferreira, B., Pereira, I., Paiva, I., Santos, E., Baptista, R., & Loureiro, L. (2026). Educação e Treino de Profissionais de Saúde na Aplicação da Ventilação Não Invasiva: Um Protocolo de Revisão Escopo. *Doente Crítico – Revista Científica da Sociedade Portuguesa de Enfermagem em Doente Crítico*, 1(1).
https://doi.org/10.63176/txbzm174

**ARTIGO ORIGINAL | *ORIGINAL ARTICLE* | *ARTÍCULO ORIGINAL***

# EDUCAÇÃO E TREINO DE PROFISSIONAIS DE SAÚDE NA APLICAÇÃO DA VENTILAÇÃO NÃO INVASIVA: UM PROTOCOLO DE REVISÃO ESCOPO

## *EDUCATION AND TRAINING OF HEALTHCARE PROFESSIONALS IN THE APPLICATION OF NON-INVASIVE VENTILATION: A SCOPING REVIEW PROTOCOL*

## *FORMACIÓN Y CAPACITACIÓN DE PROFESIONALES SANITARIOS EN LA APLICACIÓN DE LA VENTILACIÓN NO INVASIVA: UN PROTOCOLO DE REVISIÓN DE ALCANCE*

Sandra Rito[*1,5] Bruno Ferreira[3,5] Inês Pereira[1, 5] Ivo Paiva[2, 5] Eduardo Santos[4. 5]
Rui Baptista[2, 5] Luís Loureiro[2, 5]

**Afiliações**
[1] Serviço de Medicina Intensiva, Unidade Local de Saúde de Coimbra. Coimbra, Portugal
[2] Escola Superior de Enfermagem da Universidade de Coimbra. Coimbra, Portugal
[3] Escola Superior de Saúde – Instituto Politécnico de Setúbal. Setúbal, Portugal
[4] Escola Superior de Saúde de Viseu – Instituto Politécnico de Viseu. Setúbal, Portugal
[5] Unidade de Investigação em Ciências da Saúde: Enfermagem (UCISA: E), Escola Superior de Enfermagem da Universidade de Coimbra. Coimbra, Portugal

**Palavras-chave**
Educação em Enfermagem; Profissionais de saúde; Ventilação Não Invasiva; Capacitação em serviço

***Keywords***
*Education, nursing; Health personnel; Noninvasive ventilation; Inservice training*

***Palabras clave***
*Educación en Enfermería; Personal de salud; Ventilación no invasiva; Capacitación em servicio*

Autor Correspondente/*Corresponding Author*[*]: Sandra Rito
Correio eletrónico: sandrarito129@gmail.com

**Received**: 17th october 2025 | **Submissão**: 17 outubro 2025

**Accepted**: 26th march 2026 | **Aceitação**: 26 março 2026

**RESUMO**

**Enquadramento:** As doenças do aparelho respiratório continuam a representar uma das principais causas de morbilidade e mortalidade a nível mundial, muitas vezes exigindo suporte ventilatório. A Ventilação Não Invasiva (VNI) é uma estratégia eficaz, mas a sua implementação depende de formação profissional adequada. No entanto, as evidências revelam lacunas significativas na educação e heterogeneidade na prática clínica, bem como a falta de protocolos padronizados. Essas questões comprometem a eficácia das intervenções e a segurança dos doentes.

**Objetivo:** Mapear programas de educação e formação para profissionais de saúde na aplicação da Ventilação Não Invasiva e seus componentes

**Critérios de Inclusão:** Esta revisão irá considerar estudos que abordam a educação e a formação de profissionais de saúde (enfermeiros, fisioterapeutas, médicos e outros profissionais clínicos) sobre o uso da VNI em adultos (≥ 18 anos). Serão incluídos estudos qualitativos e quantitativos, bem como estudos de métodos mistos, juntamente com literatura cinzenta. Serão considerados estudos com foco em programas educacionais e de formação ou iniciativas de desenvolvimento profissional em vários contextos clínicos, académicos ou institucionais. Estudos focados exclusivamente em aspetos técnicos ou fisiopatológicos, sem componente de formação, serão excluídos.

**Métodos:** Esta revisão seguirá a metodologia do Joanna Briggs Institute (JBI) para revisões de escopo. As pesquisas serão realizadas nas seguintes bases de dados: MEDLINE (via PubMed), CINAHL (via EBSCOhost), Scopus, Web of Science e outras fontes de literatura cinzenta. Serão realizadas duas avaliações de qualidade independentes, com um terceiro revisor a resolver quaisquer discrepâncias. Os dados serão extraídos utilizando uma ferramenta pré-desenvolvida e sintetizados em formato tabular. Isto será acompanhado por uma narrativa descritiva que mapeia as características pedagógicas e identifica lacunas nas evidências

***ABSTRACT***

***Background:*** *Respiratory diseases are a major cause of morbidity and mortality worldwide, often necessitating ventilatory support. Non-Invasive Ventilation (NIV) is an effective strategy, but its implementation depends on adequate professional training. However, evidence reveals significant gaps in education and heterogeneity in clinical practice, as well as a lack of standardised protocols. These issues compromise the effectiveness of interventions and patient safety.*

***Objective:*** *To map education and training programs for healthcare professionals in the application of Non-Invasive Ventilation and its components.*

***Inclusion criteria:*** *This review will consider studies addressing education and training for healthcare professionals (nurses, physiotherapists, doctors and other clinical staff) on the use of NIV in adults (≥18 years). Both qualitative and quantitative studies, as well as mixed-methods studies, will be included, along with grey*

*literature. Studies focusing on educational and training programs or professional development initiatives in various clinical, academic or institutional settings will be considered. Studies focusing exclusively on technical or pathophysiological aspects without a training component will be excluded.*

***Methods:*** *This review will follow the Joanna Briggs Institute (JBI) methodology for scoping reviews. Searches will be conducted in the following databases: MEDLINE (via PubMed), CINAHL (via EBSCOhost), Scopus, Web of Science and other grey literature sources. Two independent quality appraisals will be conducted, with a third reviewer resolving any discrepancies. Data will be extracted using a pre-developed tool and synthesised in tabular format. This will be accompanied by a descriptive narrative mapping pedagogical features and identifying evidence gaps.*

***RESUMEN***

***Marco Contextual****: Las enfermedades respiratorias son una de las principales causas de morbilidad y mortalidad en todo el mundo, y a menudo requieren asistencia respiratoria. La Ventilación No Invasiva (VNI) es una estrategia eficaz, pero su implementación depende de una formación profesional adecuada. Sin embargo, las pruebas revelan importantes lagunas en la formación y heterogeneidad en la práctica clínica, así como una falta de protocolos estandarizados. Estas cuestiones comprometen la eficacia de las intervenciones y la seguridad de los pacientes.*

***Objetivo:*** *Mapear los programas de educación y formación para los profesionales sanitarios en la aplicación de la Ventilación No Invasiva y sus componentes.*

***Criterios de inclusión:*** *Esta revisión tendrá en cuenta los estudios que aborden la educación y la formación de los profesionales sanitarios (enfermeros, fisioterapeutas, médicos y otro personal clínico) sobre el uso de la VNI en adultos (≥18 años). Se incluirán tanto estudios cualitativos como cuantitativos, así como estudios de métodos mixtos, junto con la literatura gris. Se tendrán en cuenta los estudios centrados en programas educativos y de formación o en iniciativas de desarrollo profesional en diversos entornos clínicos, académicos o institucionales. Se excluirán los estudios centrados exclusivamente en aspectos técnicos o fisiopatológicos sin un componente formativo.*

***Metodos:*** *Esta revisión seguirá la metodología del Instituto Joanna Briggs (JBI) para las revisiones de alcance. Las búsquedas se realizarán en las siguientes bases de datos: MEDLINE (a través de PubMed), CINAHL (a través de EBSCOhost), Scopus, Web of Science y otras fuentes de literatura gris. Se realizarán dos evaluaciones de calidad independientes, y un tercer revisor resolverá cualquier discrepancia. Los datos se extraerán utilizando una herramienta previamente desarrollada y se sintetizarán en formato tabular. Esto irá acompañado de una descripción narrativa que mapeará las características pedagógicas e identificará las lagunas en la evidencia.*

## INTRODUCTION

Respiratory diseases are one of the leading causes of morbidity and mortality worldwide, with a significant impact on health systems and quality of life. According to the World Health Organization, more than 300 million people worldwide live with chronic respiratory diseases such as chronic obstructive pulmonary disease (COPD), asthma or neuromuscular diseases, which are responsible for more than 4 million deaths annually (World Health Organisation, 2024). In the context of acute exacerbation or respiratory failure, these clinical conditions require ventilatory support to prevent clinical deterioration and reduce complications (Fujishima, 2023).

Non-invasive ventilation (NIV) appears to be an effective and widely recommended therapeutic strategy for the treatment of different respiratory conditions, including COPD exacerbations, acute pulmonary oedema, neuromuscular diseases, and hypoventilation syndromes (Global Initiative for Chronic Obstructive Lung Disease, 2023; Sirakaya & Esquinas, 2025). By providing ventilatory support without the need for endotracheal intubation, NIV reduces the risk of complications associated with invasive ventilation, airway injury, mortality, and length of hospital stay (Aswanetmanee et al., 2023; Ferreyro et al., 2020; Hess & Kallet, 2023; Ruzsics et al., 2022).

Although its clinical value is proven, the effectiveness of NIV depends on multiple interrelated factors, such as appropriate patient selection, continuous monitoring, precise adjustment of parameters and management of potential complications. These aspects require healthcare professionals with the necessary technical and cognitive skills to act safely and appropriately. However, the international literature highlights significant gaps in training and inconsistencies in the application of the technique, as well as a lack of standardised institutional protocols (Karim et al., 2019; Kordkandi et al., 2025; Raurell-Torredà et al., 2019).

Despite the frequent use of NIV in clinical practice, many healthcare professionals have not received formal training in the technique or have limited access to structured training programs (Gírio & Sousa, 2024; Mehna et al., 2025). A study conducted in Saudi Arabia with respiratory physiotherapists found that 43% of participants cited lack of training as one of the main barriers to the implementation of NIV (Alqahtani et al., 2021). Similarly, a European multicenter survey showed that structured training programs on NIV are unevenly available, concentrated mainly in countries with greater economic development (Crimi et al., 2010). In a cross-sectional analysis conducted with 280 nurses in intensive care units, 68.9% had inadequate knowledge about the management of patients on NIV (Mehna et al., 2025). Additionally, a descriptive study in four Spanish hospitals reported that the overall level of correct answers regarding technical knowledge of NIV was only 50%, confirming significant gaps in the preparation of professionals (Raurell-Torredà et al., 2019).

In Portugal, Gírio and Sousa (2024) found that 78.9% of nurses in a Post-Anesthesia Care Unit had never received prior training in NIV and considered themselves generally unprepared for its application. Silva et al. (2024) identified that 79% of NIV use occurred outside intensive care units, associating clinical success with

the quality of monitoring and the level of technical training of professionals. Insufficient theoretical and technical preparation of professionals is associated with higher rates of complications, such as facial pressure ulcers, discomfort, patient-ventilator asynchrony, and poor pressure titration, compromising the effectiveness of the intervention and patient safety (Kordkandi et al., 2025).

In recent years, different approaches have been developed to address these training gaps. The literature identifies initiatives that include classroom-based theoretical training, supervised practical training, the use of simulation scenarios, and the incorporation of technological tools to support clinical decision-making (Daoud et al., 2025; Kim et al., 2021; Pla-Canalda et al., 2025). However, these initiatives vary widely in terms of duration, content, teaching methodologies, target audiences, and implementation contexts. This heterogeneity makes it difficult to obtain a consolidated view of existing training formats, the contexts in which they are implemented, and the clinical, pedagogical, and structural components that comprise them.

Although some studies show that NIV training improves clinical skills and patient outcomes, the evidence is still very limited, especially in some developed countries. Education and training in NIV have the potential to increase staff knowledge and skills (Bambi et al., 2022; Karim et al., 2019; Pla-Canalda et al., 2025). However, there are no clinical trials that examine the impact of NIV education and training as their primary objective. The development of an organised NIV education and training programme appears to be a necessity in various types of disciplines and care settings. Nevertheless, the available evidence is limited and scattered, which justifies this scoping review (Barbagelata et al., 2019). Preliminary research was therefore conducted in the following databases on 16 October 2025 CINAHL (via EBSCO Host), MEDLINE (via PubMed), Cochrane Database of Systematic Reviews, PROSPERO, JBI Evidence Synthesis and Google Scholar. This research did not identify any recent or ongoing scoping reviews on this topic.

Given the relevance of the phenomenon, as well as its impact and the need for a deeper understanding, this scoping review aims to map education and training programs for healthcare professionals in the application of non-invasive ventilation and its components.

## REVIEW QUESTIONS

To address this objective, the following review questions were formulated:

i) What training programs exist to train healthcare professionals in the application of NIV?
ii) What are the structural components that make up the training programs for healthcare professionals in the application of NIV?
iii) What clinical content and interventions comprise training programs for healthcare professionals in the application of NIV?
iv) What teaching strategies comprise training programs for healthcare professionals in the application of NIV?
v) What are the gains and benefits of training programs for healthcare professionals in the

application of NIV?

## METHODS

The proposed review will be conducted in accordance with the JBI methodology for scoping reviews (Peters et al. 2020) and in compliance with the items in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Reviews (PRISMA-ScR) (Peters et al., 2020; Tricco et al., 2020).

## INCLUSION CRITERIA

### PARTICIPANTS

This review will consider studies and academic articles that address healthcare professionals involved in training programs or interventions for the use of NIV in adults (≥ 18 years). For this review, healthcare professionals will be defined as individuals who are trained and work in clinical settings, with an emphasis on nurses, but may also include physiotherapists and doctors, provided they participate in training or capacity-building processes related to the application of NIV (World Health Organization, 2013). Healthcare professionals considered include nurses, physiotherapists, doctors, among other related areas directly involved in clinical practice with NIV.

### CONCEPT

The central concept is the education and training of healthcare professionals for the use of NIV (Barbagelata et al., 2019). In this review, the terms “education” and “training” are used in a complementary manner to encompass both theoretical knowledge acquisition and practical skill development related to the application of NIV. Studies that describe, analyze, or evaluate educational programs, training initiatives, or professional development strategies aimed at acquiring the skills required for the application of NIV will be included. These programs may take different formats and methodologies, including, but not limited to, face-to-face or distance learning, clinical simulation, in-service training, practical workshops, implementation of institutional protocols, or hybrid teaching models. Initiatives targeting healthcare professionals at different stages of their professional careers (undergraduate, continuing, or specialized training) will be considered, provided they explicitly address clinical, educational, and/or structural components related to NIV practice (Karim et al., 2019; Leinster et al., 2021). Studies focusing exclusively on technical or pathophysiological aspects, without involving training processes, as well as those centered on patient or informal caregiver populations, will be excluded.

### CONTEXT

This scoping review will consider studies conducted in any clinical, academic or educational setting. These

may include hospital units (such as intensive care, medical and surgical wards, and emergency departments), primary healthcare settings, home settings, higher education institutions, vocational training centres, and other clinical or educational settings. There will be no geographical restrictions, and studies from any country will be included provided they meet the eligibility criteria defined in this review protocol. Relevant articles from primary and secondary sources will be included.

**TYPES OF STUDIES**

This scoping review will include qualitative, quantitative and mixed-methods studies of any level of evidence, including descriptive-exploratory, randomised and non-randomised clinical trials, intervention studies and observational studies. Grey literature will include academic articles, theses, dissertations, research reports, government documents and conference communications. Additionally, systematic reviews that meet the inclusion criteria, as well as articles with textual evidence, will be considered for inclusion in this scoping review.

## SEARCH STRATEGY

The search strategy will be designed to identify both published and unpublished studies. Initially, a preliminary search was conducted in MEDLINE (via PubMed) and CINAHL (via EBSCO host) to locate articles relevant to the topic. Based on terms extracted from the titles and abstracts of the identified articles, as well as corresponding indexing terms, a detailed search strategy was developed for MEDLINE (via PubMed) (see Appendix I). This strategy includes all the selected keywords and indexing terms and will be adapted for each information source consulted. Additionally, the reference lists of all the studies included in the critical appraisal will be analysed to identify any additional relevant studies.

To increase the sensitivity of the search, no limits will be applied to the date or language of publication. For documents in languages other than English, Portuguese, Spanish, and French, we will use DeepL Translate software to assess whether they meet the inclusion criteria. When documents are published in a language other than English, Portuguese, Spanish, and French, and meet the inclusion criteria, DeepL Translate translations will be reviewed by a person fluent in the language of the manuscript included in the review. If necessary, the authors of the articles will be contacted once to obtain further information. The databases to be included are: MEDLINE (via PubMed), CINAHL Complete (via EBSCO host), Scielo, Scopus and Web of Science Core Collection. For grey literature and unpublished studies, the sources covered will include Google Scholar (the first 10 pages), the Open Access Scientific Repository in Portugal (RCAAP), MedNar, ProQuest Dissertations and Theses Global (ProQuest) and DART-Europe.

## STUDY SELECTION

After conducting the search, all identified references will be aggregated and integrated into Mendeley

V1.19.8 software (Mendeley Ltd.), and duplicate records will be subsequently deleted. After this process, these records will be imported into Rayyan (Qatar Foundation online software). A pilot test will then be conducted, after which the titles and abstracts will be scrutinized by two independent reviewers, who will assess their eligibility based on the inclusion criteria previously established for the review. Studies considered potentially relevant will be obtained in full, and their bibliographic information will be imported into the JBI System for Unified Management, Assessment and Review of Information (JBI SUMARI; JBI, Adelaide, Australia) (Munn et al., 2018).

The full texts of the selected references will undergo detailed analysis, conducted by two independent reviewers, based on the defined inclusion criteria. The reasons for excluding full-text studies that do not meet the inclusion criteria will be duly documented and presented in the scope review. Any disagreement between reviewers during the selection process will be resolved through discussion or, if necessary, with the intervention of a third reviewer. The search results will be presented in the final review graphically using a PRISMA-ScR flow diagram (Page et al., 2021).

## DATA EXTRACTION

Data extraction will be performed from the studies included in the review by two independent reviewers, using the data extraction tool developed specifically for this purpose (Appendix II). Data extraction will be performed as an interactive process, and any changes or amendments to this tool will be described in the final review (Lockwood et al., 2020). Specific data will be collected on participant characteristics, concept, context, and other information relevant to the review questions. Modifications will be detailed in the scope review. The level of detail in data extraction will be defined when selecting studies and described in the methodological section of the review.

Pilot tests for reviewers will be conducted to minimize errors during all stages of data extraction (1 - Title/Abstract; 2 - Full text; 3 - Critical appraisal; 4 - Data extraction). Any disagreements between reviewers will be resolved through discussion or, if necessary, with the intervention of a third reviewer. Where applicable, the authors of the studies will be contacted to request clarification or missing supplementary data. If no response is received within three weeks, the team will send a formal reminder and wait an additional three weeks. If no response is received after these two attempts, the team will proceed with its deliberations based on the information available in the published source. This will ensure methodological rigour and transparency in the process.

## DATA ANALYSIS AND PRESENTATION

The extracted data will be presented in tabular format. A schematic map of the evidence will also be produced, emphasising the level and quantity of evidence found for each strategy. A narrative summary will accompany the tabular results, describing how they relate to the review's objectives and questions.

(Appendix III).

## ACKNOWLEDGEMENTS

This article will contribute to SR PhD in nursing. The authors would like to thank the Health Sciences Research Unit: Nursing (UICISA: E), based at the School of Nursing of the University of Coimbra (ESEUC), for its support, and the Foundation for Science and Technology (FCT).

## AUTHORS CONTRIBUTION

**SR:** Conceptualization, Formal analysis, Research, Methodology, Project management, Resources, Validation, Writing - Preparation of the Original Draft, Writing - Review and Editing.

**BF:** Conceptualization, Formal analysis, Methodology, Validation, Writing - Preparation of the Original Draft, Writing - Review and Editing.

**ISP:** Conceptualization, Methodology, Validation, Writing - Review and Editing.

**ICP:** Conceptualization, Formal analysis, Methodology, Supervision, Validation, Writing - Preparation of the Original Draft, Writing - Review and Editing.

**ES:** Conceptualization, Formal analysis, Methodology, Supervision, Validation, Writing - Review and Editing.

**RB:** Conceptualization, Data processing, Research, Methodology, Project management, Resources, Validation, Visualization, Writing - Preparation of the Original Draft, Writing - Review and Editing.

**LL:** Conceptualization, Data processing, Research, Methodology, Project management, Resources, Validation, Visualization, Writing - Preparation of the Original Draft, Writing - Review and Editing.

All authors approved the final version to be published.

## ETHICAL DISCLOSURES

**Conflicts of Interest:** The authors have no conflicts of interest to declare.

**Funding Sources:** There were no external funding sources for the production of this article.

## BIBLIOGRAPHICAL REFERENCES

Alqahtani, J., Aldabayan, Y., AlAhmari, M., AlRabeeah, S., Aldhahir, A., Alghamdi, S., Oyelade, T., Althobiani, M., & Alrajeh, A. (2021). Clinical practice and barriers of ventilatory support management in COVID-19 patients in Saudi Arabia: A survey of respiratory therapists. *Saudi Journal of Medicine and Medical Sciences*, *0*(0), 0. https://doi.org/10.4103/sjmms.sjmms_58_21

Aswanetmanee, P., Limsuwat, C., Maneechotesuwan, K., & Wongsurakiat, P. (2023). Noninvasive ventilation in patients with acute hypoxemic respiratory failure: A systematic review and meta-analysis of randomized controlled trials. Scientific Reports, 13, 8283. https://doi.org/10.1038/s41598-023-35323-0

Bambi, S., Parente, E., Bardacci, Y., Baldassini Rodriguez, S., Forciniti, C., Ballerini, L., Caruso, C., El Aoufy, K., Poggianti, M., Bonacaro, A., Rona, R., Rasero, L., & Lucchini, A. (2023). The Effectiveness of NIV and CPAP Training on the Job in COVID-19 Acute Care Wards: A Nurses' Self-Assessment of Skills. Nursing Reports, 13(1), 17-28. https://doi.org/10.3390/nursrep13010002

Barbagelata, E., Perazzo, T., Ferraioli, G., Mario, S., & Nicolini, A. (2019). The importance of education and training for noninvasive ventilation: suggestions from the literature. *The Egyptian Journal of Internal Medicine*, *31*(4), 435–441. https://doi.org/10.4103/ejim.ejim_45_19

Crimi, C., Noto, A., Princi, P., Esquinas, A., & Nava, S. (2010). A European survey of noninvasive ventilation practices. *European Respiratory Journal*, *36*(2), 362–369. https://doi.org/10.1183/09031936.00123509

Daoud, A., Cramer-Bour, C., Venkat, D., & Sankari, A. (2025). Innovative Blended Learning Curriculum in Noninvasive Ventilation for Pulmonary and Critical Care Fellows. *Avicenna Journal of Medicine*, *15*(03), 131-135.

Ferreyro, B. L., Angriman, F., Munshi, L., Del Sorbo, L., Ferguson, N. D., Rochwerg, B., Ryu, M. J., Saskin, R., Wunsch, H., & Brodie, D. (2020). Association of noninvasive oxygenation strategies with all-cause mortality in adults with acute hypoxemic respiratory failure: A systematic review and meta-analysis. JAMA, 324(1), 57–67. https://doi.org/10.1001/jama.2020.9524

Fujishima, S. (2023). Guideline-based Management of Acute Respiratory Failure and Acute Respiratory Distress Syndrome. *Journal of Intensive Care*, *11*(1). https://doi.org/10.1186/s40560-023-00658-3

Gírio, R., & Sousa, J. S. (2024). Impacte de uma intervenção educativa na melhoria dos conhecimentos dos enfermeiros sobre ventilação não invasiva. Revista Investigação em Enfermagem, 7(2), e370. https://doi.org/10.37914/riis.v7i2.370

Global Initiative for Chronic Obstructive Lung Disease (GOLD). (2023). *GLOBAL STRATEGY FOR PREVENTION, DIAGNOSIS AND MANAGEMENT OF COPD: 2023 Report*. Global Initiative for Chronic Obstructive Lung

Disease - GOLD. https://goldcopd.org/2023-gold-report-2/

Hess, D. R., & Kallet, R. H. (2023). Noninvasive ventilation. In StatPearls. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK578188/

Karim, H. M. R., Burns, K. E. A., Ciobanu, L. D., El-Khatib, M., Nicolini, A., Vargas, N., Hernández-Gilsoul, T., Skoczyński, S., Falcone, V. A., Arnal, J.-M., Bach, J., Santo, L. S. D., Lucchini, A., Steier, J., Purro, A., Petroianni, A., Sassoon, C. S., Bambi, S., Aguiar, M., & Soubani, A. O. (2019). Noninvasive ventilation: education and training. A narrative analysis and an international consensus document. *Advances in Respiratory Medicine*, *87*(1), 36–45. https://doi.org/10.5603/ARM.a2019.0006

Kim, M. S., Seo, M. H., Jung, J. Y., & Kim, J. (2021). The Effect of a Non-Invasive Positive Pressure Ventilation Simulation Program on General Ward Nurses' Knowledge and Self-Efficacy. *International journal of environmental research and public health*, *18*(6), 2877. https://doi.org/10.3390/ijerph18062877

Kordkandi, M. H., Adib, M., Mohamadi, T. K., & Saman Maroufizadeh. (2025). Nurses' care coordination competence in mechanically ventilated patients in intensive care units: a cross-sectional study. *BMC Health Services Research*, *25*(1). https://doi.org/10.1186/s12913-025-12478-2

Leinster, S. J., Pereira, J. H., Down, S., & Simpson, A. D. (2021). Blended Learning in Healthcare Education. *Medical Research Archives*, *9*(8). https://doi.org/10.18103/mra.v9i8.2527

Lockwood, C., Porritt, K., Munn, Z., Rittenmeyer, L., Salmond, S., Bjerrum, M., et al. (2020). Revisões sistemáticas de evidências qualitativas. *Manual JBI para Síntese de Evidências.* JBI. Disponível em: https://synthesismanual.jbi.global

Mehna, S., Gauba, A., & Chakrabarti, S. (2025). A study to assess the effectiveness of educational training for nurses regarding non-invasive positive pressure ventilation. International Journal of Research in Medical Sciences, 13(1), 248–258. https://doi.org/10.18203/2320-6012.ijrms20244123

Munn, Z., Aromataris, E., Tufanaru, C., Stern, C., Porritt, K., Farrow, J., Lockwood, C., Stephenson, M., Moola, S., Lizarondo, L., McArthur, A., Peters, M., Pearson, A., & Jordan, Z. (2018). The development of software to support multiple systematic review types. *International Journal of Evidence-Based Healthcare*, *17*(1), 1. https://doi.org/10.1097/xeb.0000000000000152

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ, 372, n71. https://doi.org/10.1136/bmj.n71

Peters MDJ, Godfrey C, McInerney P, Munn Z, Tricco AC, Khalil, H. Revisões de Escopo (2020). Aromataris E, Lockwood C, Porritt K, Pilla B, Jordan Z, editores. *Manual do JBI para Síntese de Evidências* . JBI; 2024. Disponível em: https://synthesismanual.jbi.global

Pla-Canalda, E., Jiménez-Herrera, M. F., Fernández-Sáez, J., Concha-Martínez, P., & Martínez-Segura, E. (2025).

Impact of Educational Intervention on NIMV: 'Impact of Educational Intervention on Noninvasive Ventilation (NIV) in Nurses and Students'. *The clinical teacher*, *22*(5), e70168. https://doi.org/10.1111/tct.70168

Raurell-Torredà, M., Argilaga-Molero, E., Colomer-Plana, M., Ródenas-Francisco, A., & Garcia-Olm, M. (2019). Conocimiento y habilidades de enfermeras y médicos en ventilación mecánica no invasiva: equipamiento e influencias contextuales. *Enfermería Intensiva*, *30*(1), 21–32. https://doi.org/10.1016/j.enfi.2018.04.006

Ruzsics, I., Matrai, P., Hegyi, P., Nemeth, D., Tenk, J., Csenkey, A., Eross, B., Varga, G., Balasko, M., Petervari, E., Veres, G., Sepp, R., Rakonczay, Z., Jr, Vincze, A., Garami, A., & Rumbus, Z. (2022). Noninvasive ventilation improves the outcome in patients with pneumonia-associated respiratory failure: Systematic review and meta-analysis. *Journal of infection and public health*, *15*(3), 349–359. https://doi.org/10.1016/j.jiph.2022.02.004

Silva, N., Baptista, C., Melo, E., & Tavares, J. (2024). Ventilação não invasiva em pessoas internadas em serviços de medicina: Estudo retrospetivo. Revista de Enfermagem Referência, 6(3), e32475. https://doi.org/10.12707/RVI23.95.32475

Sırakaya, H. A., & Esquinas, A. M. (2025). Noninvasive mechanical ventilation in acute cardiogenic pulmonary edema in the emergency department: A limited sum of factors determining response. *Turkish journal of emergency medicine*, *25*(4), 324–325. https://doi.org/10.4103/tjem.tjem_86_25

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., Moher, D., Peters, M. D. J., Horsley, T., Weeks, L., Hempel, S., Akl, E. A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M. G., Garritty, C., & Lewin, S. (2018). PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Annals of Internal Medicine*, *169*(7), 467–473. https://doi.org/10.7326/M18-0850

World Health Organisation. (2024). *Chronic obstructive pulmonary disease (COPD)*. World Health Organisation. https://www.who.int/news-room/fact-sheets/detail/chronic-obstructive-pulmonary-disease-(copd)

World Health Organization. (2013). *Transforming and Scaling up Health Professionals' Education and Training*. Nih.gov; World Health Organization. https://www.ncbi.nlm.nih.gov/books/NBK298950/

## APPENDIX I – SEARCH STRATEGY

MEDLINE (via PubMed). The search was conducted on 16 October 2025. The search string will be adjusted as necessary for the remaining databases mentioned in this protocol

| Search | Query | Filters | Records retrieved |
|---|---|---|---|
| #13 | #3 AND #6 AND #9 AND #12 | | 1.036 |
| #12 | ("hospitals"[MeSH Terms] OR "health facilities"[MeSH Terms] OR "clinical competence"[MeSH Terms] OR "patient simulation"[MeSH Terms] OR "simulation training"[MeSH Terms] OR "education, nursing"[MeSH Terms]) **OR** (hospital*"[Title/Abstract] OR "clinic*"[Title/Abstract] OR "clinical setting*"[Title/Abstract] OR "academic setting*"[Title/Abstract] OR "educational setting*"[Title/Abstract] OR "simulated environment*"[Title/Abstract] OR "training environment*"[Title/Abstract] OR "learning environment*"[Title/Abstract] OR "practice setting"[Title/Abstract] OR "respiratory unit"[Title/Abstract] OR "post-anesthesia care unit"[Title/Abstract] OR "general ward"[Title/Abstract] OR "covid-19 pandemic"[Title/Abstract]) | | 7.887.252 |
| #11 | (hospital*"[Title/Abstract] OR "clinic*"[Title/Abstract] OR "clinical setting*"[Title/Abstract] OR "academic setting*"[Title/Abstract] OR "educational setting*"[Title/Abstract] OR "simulated environment*"[Title/Abstract] OR "training environment*"[Title/Abstract] OR "learning environment*"[Title/Abstract] OR "practice setting"[Title/Abstract] OR "respiratory unit"[Title/Abstract] OR "post-anesthesia care unit"[Title/Abstract] OR "general ward"[Title/Abstract] OR "covid-19 pandemic"[Title/Abstract]) | | 7.319.521 |
| #10 | "hospitals"[MeSH Terms] OR "health facilities"[MeSH Terms] OR "clinical competence"[MeSH Terms] OR "patient simulation"[MeSH Terms] OR "simulation training"[MeSH Terms] OR "education, nursing"[MeSH Terms] | | 1.130.418 |
| #9 | ("Noninvasive ventilation"[MeSH Terms] OR "Positive-Pressure Respiration"[MeSH Terms] OR "Continuous Positive Airway Pressure"[MeSH Terms] OR "respiration, artificial"[MeSH Terms]) **OR** ("Non-invasive ventilation"[Title/Abstract] OR "Noninvasive ventilation"[Title/Abstract] OR "Non-invasive positive pressure ventilation"[Title/Abstract] OR "Non invasive mechanical ventilation"[Title/Abstract] OR "Continuous Positive Airway Pressure ventilation"[Title/Abstract] OR "bi-level positive airway pressure"[Title/Abstract] OR "bilevel positive airway pressure"[Title/Abstract] OR "intermittent positive-pressure ventilation"[Title/Abstract] OR "positive-pressure respirations"[Title/Abstract] OR "positive end expiratory pressure"[Title/Abstract] OR "Pressure support ventilation"[Title/Abstract] OR "Non invasive positive pressure"[Title/Abstract] OR "ventilator support"[Title/Abstract] OR "ventilatory support"[Title/Abstract] OR "NIV"[Title/Abstract] OR "NIPPV"[Title/Abstract] OR "NPPV"[Title/Abstract] OR "BiPAP"[Title/Abstract] OR "CPAP"[Title/Abstract] OR "PEEP"[Title/Abstract] OR "PSV"[Title/Abstract]) | | 116.747 |
| #8 | ("Non-invasive ventilation"[Title/Abstract] OR "Noninvasive ventilation"[Title/Abstract] OR "Non-invasive positive pressure ventilation"[Title/Abstract] OR "Non invasive mechanical ventilation"[Title/Abstract] OR "Continuous Positive Airway Pressure ventilation"[Title/Abstract] OR "bi-level positive airway pressure"[Title/Abstract] OR "bilevel positive airway pressure"[Title/Abstract] OR "intermittent positive-pressure ventilation"[Title/Abstract] OR "positive-pressure respirations"[Title/Abstract] OR "positive end expiratory pressure"[Title/Abstract] OR "Pressure support ventilation"[Title/Abstract] OR "Non invasive positive pressure"[Title/Abstract] OR "ventilator support"[Title/Abstract] OR "ventilatory support"[Title/Abstract] OR "NIV"[Title/Abstract] OR "NIPPV"[Title/Abstract] OR "NPPV"[Title/Abstract] OR "BiPAP"[Title/Abstract] OR "CPAP"[Title/Abstract] OR "PEEP"[Title/Abstract] OR "PSV"[Title/Abstract]) | | 47.456 |
| #7 | ("Noninvasive ventilation"[MeSH Terms] OR "Positive-Pressure Respiration"[MeSH Terms] OR "Continuous Positive Airway Pressure"[MeSH Terms] OR "respiration, artificial"[MeSH Terms]) | | 94.456 |
| #6 | ("education, nursing"[MeSH Terms] OR "Inservice training"[MeSH Terms] OR "education, professional"[MeSH Terms] OR "competency-based education"[MeSH Terms] OR "clinical competence"[MeSH Terms] OR "simulation training"[MeSH Terms] OR "education, continuing"[MeSH Terms]) **OR** ("training"[Title/Abstract] OR "education"[Title/Abstract] OR "educational training"[Title/Abstract] OR "educational intervention*"[Title/Abstract] OR "professional development"[Title/Abstract] OR "capacity building"[Title/Abstract] OR "skill acquisition"[Title/Abstract] OR "simulation based"[Title/Abstract] OR "simulation program*"[Title/Abstract] OR "technical training"[Title/Abstract] OR "didactic sessions"[Title/Abstract] OR "team-based learning"[Title/Abstract] OR "course material"[Title/Abstract] OR "Knowledge"[Title/Abstract] OR "attitude"[Title/Abstract] OR "self-efficacy"[Title/Abstract] OR "developing"[Title/Abstract] OR "implementing"[Title/Abstract]) | | 3.270.421 |

| | | | |
|---|---|---|---|
| #5 | (“training"[Title/Abstract] OR "education"[Title/Abstract] OR "educational training"[Title/Abstract] OR "educational intervention*"[Title/Abstract] OR "professional development"[Title/Abstract] OR "capacity building"[Title/Abstract] OR "skill acquisition"[Title/Abstract] OR "simulation based"[Title/Abstract] OR "simulation program*"[Title/Abstract] OR "technical training"[Title/Abstract] OR "didactic sessions"[Title/Abstract] OR "team-based learning"[Title/Abstract] OR "course material"[Title/Abstract] OR "Knowledge"[Title/Abstract] OR "attitude"[Title/Abstract] OR "self-efficacy"[Title/Abstract] OR "developing"[Title/Abstract] OR "implementing"[Title/Abstract]) | | 3.068.993 |
| #4 | (“education, nursing"[MeSH Terms] OR "Inservice training"[MeSH Terms] OR "education, professional"[MeSH Terms] OR "competency-based education"[MeSH Terms] OR "clinical competence"[MeSH Terms] OR "simulation training"[MeSH Terms] OR "education, continuing"[MeSH Terms]) | | 436.487 |
| #3 | ("nurses"[MeSH Terms] OR "Nursing staff"[MeSH Terms] OR "health personnel"[MeSH Terms] OR "medical staff"[MeSH Terms] OR "Allied Health Personnel"[MeSH Terms]) **OR** ("nurse*"[Title/Abstract] OR "nursing professional"[Title/Abstract] OR "healthcare worker*"[Title/Abstract] OR "medical staff"[Title/Abstract] OR "respiratory therapist*"[Title/Abstract] OR "physiotherapist*"[Title/Abstract] OR "health professional*"[Title/Abstract] OR "clinical staff"[Title/Abstract] OR "healthcare provider*"[Title/Abstract]) | | 1.030.226 |
| #2 | ("nurse*"[Title/Abstract] OR "nursing professional"[Title/Abstract] OR "healthcare worker*"[Title/Abstract] OR "medical staff"[Title/Abstract] OR "respiratory therapist*"[Title/Abstract] OR "physiotherapist*"[Title/Abstract] OR "health professional*"[Title/Abstract] OR "clinical staff"[Title/Abstract] OR "healthcare provider*"[Title/Abstract]) | | 524.205 |
| #1 | ("nurses"[MeSH Terms] OR "Nursing staff"[MeSH Terms] OR "health personnel"[MeSH Terms] OR "medical staff"[MeSH Terms] OR "Allied Health Personnel"[MeSH Terms]) | | 663.908 |

## APPENDIX II – DRAFT DATA EXTRACTION INSTRUMENT

| Study | Protocol/ Program | Clinical component | Education component | Structural component | Barriers and facilitators | Context/ Scenario | Results | Limitations / Future implications | Key findings |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |

## APPENDIX III – TEMPLATE OF DATA PRESENTATION FOR SCOPING REVIEW QUESTIONS

| | |
|---|---|
| Studies included | |
| Author, country | |
| Study design | |
| Year of publication | |
| Number of studies per design | |
| Strategies of the include studies (review question 1) | |
| Author, Year | |
| Training program (name/description) | |
| Target profissionals | |
| Context/setting | |
| Country/region | |
| Duration/format | |
| Strategies of the include studies (review question 2) | |
| Author, Year | |
| Structural component (e.g., modality, workload, assessment, certification, resources) | |
| Description / Details | |
| Programs where identified | |
| Strategies of the include studies (review question 3) | |
| Author, Year | |
| Clinical topic / Intervention (e.g., indications/contraindications, parameter adjustment, interfaces, monitoring, complications) | |

| | |
|---|---|
| Description /Approach in the program | |
| Programs where identified | |
| Strategies of the include studies (review question 4) | |
| Author, Year | |
| Pedagogical strategy (e.g., lecture, clinical simulation, e-learning, blended learning, bedside teaching) | |
| Application (frequency, duration, resources) | |
| Programs where identified | |
| Strategies of the include studies (review question 5) | |
| Author, Year | |
| Benefit / Outcome (e.g., knowledge, practical skills, confidence, NIV adherence, time to initiation, adverse events, patient outcomes) | |
| Indicator / Measure used | |
| Findings (summary) | |
| General notes (limitations, gaps, recommendations) | |
| | |