AN EDUCATIONAL INTERVENTION IMPACT IN IMPROVING NURSES' KNOWLEDGE OF NONINVASIVE VENTILATION

Impacte de uma Intervenção Educativa na melhoria dos conhecimentos dos Enfermeiros sobre Ventilação Não Invasiva

Impacto de una Intervención Educativa en la mejora de los conocimientos de los Enfermeros sobre la Ventilación No Invasiva

Ricardo Gírio*, Joana Pereira Sousa**

ABSTRACT

Background: non-invasive ventilation (NIV) has emerged as a potentially safe and relatively low-cost therapeutic approach for a wide range of respiratory conditions. However, recent evidence shows that the lack of up-to-date and recurrent training in this area is the main obstacle to providing quality care to people in need of NIV. **Objective**: to assess the impact of an Educational Intervention (EI) on the level of knowledge of nurses in a Post-Anesthesia Care Unit (PACU) in central Portugal. **Methodology**: quasi-experimental study, without a control group, with pre- and post-intervention evaluation. The EI followed the recommendations proposed by Karim et al. (2019) and included seven hours of theoretical and practical training. Nurses (N = 19) were assessed using a questionnaire previously developed by Palma (2018). **Results**: between the pre- and post-intervention periods, there was an improvement in performance in terms of knowledge about NIV (84.2%), especially in indications, contraindications, therapeutic goals, possible associated complications, BIPAP modality, interface selection and ventilatory parameters. **Conclusion**: the developed EI proved to be an effective and positive contribution to the nursing team in a PACU, enhancing evidence-based practice and more effective, timely, and safe nursing care in this field.

Keywords: non-invasive ventilation; nurses; knowledge

*MSc, Escola Superior de Saúde de Leiria; Centro Hospitalar e Universitário de Coimbra, Portugal - https://orcid.org/0009-0002-0763-0630

**PhD, Escola Superior de Saúde de Leiria, Instituto Politécnico de Leiria; Center For Innovative Care And Health Technology-Citechcare, Portugal - https://orcid.org/0000-0001-5515-0696

Autor de correspondência:
Ricardo Gírio
ricardo.a.girio@gmail.com

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RESUMO

Enquadramento: a ventilação não invasiva (VNI) surgiu como uma abordagem terapêutica potencialmente segura e de baixo custo indicada para uma miríade de condições respiratórias. Porém, evidência recente estabelece que a falta de formação atualizada e recorrente nesta área constitui o principal obstáculo à prestação de cuidados de qualidade às pessoas que necessitam de VNI. **Objetivo**: avaliar o impacte de uma Intervenção Educacional (IE) no nível de conhecimento de enfermeiros de uma Unidade de Cuidados Pós-Anestesia (UCPA) no centro de Portugal. **Metodologia**: estudo quasi-experimental, sem grupo de controlo, com avaliação pré e pós-intervenção. A IE seguiu as recomendações propostas por Karim et al. (2019) e incluiu sete horas de formação teórico-prática. Os conhecimentos dos enfermeiros (N= 19) foram avaliados com recurso a um questionário desenvolvido por Palma (2018). **Resultados**: entre os períodos pré e pós-intervenção, verificou-se uma melhoria nos conhecimentos sobre VNI (84,2%), especialmente no que respeita às suas indicações, contraindicações, objetivos terapêuticos, possíveis complicações associadas, modalidade BIPAP, seleção de interface e parâmetros ventilatórios. **Conclusão**: a IE desenvolvida mostrou ser um contributo positivo para a equipa de enfermagem da UCPA, potenciando a sua prática baseada em evidência e prestação de cuidados de enfermagem mais efetivos, oportunos e seguros neste âmbito.

Palavras-chave: ventilação não invasiva; enfermeiros; conhecimento

RESUMEN

Marco Contextual: la Ventilación No Invasiva (VNI) ha surgido como un enfoque terapéutico potencialmente seguro y de coste relativamente bajo para una amplia gama de afecciones respiratorias. Sin embargo, las pruebas recientes muestran que la falta de formación actualizada y recurrente en esta área es el principal obstáculo para proporcionar una atención de calidad a las personas que necesitan VNI. **Objetivo**: evaluar el impacto de una Intervención Educativa (IE) en el nivel de conocimientos del personal de enfermería de una Unidad de Cuidados Posanestésicos (UCP) del centro de Portugal. **Metodología**: estudio cuasiexperimental, sin grupo control, con evaluación pre y post-intervención. La IE siguió las recomendaciones propuestas por Karim et al. (2019) e incluyó siete horas de formación teórica y práctica. Los enfermeros (N = 19) fueron evaluados mediante un cuestionario previamente desarrollado por Palma (2018). **Resultados**: entre los periodos pre y post-intervención, hubo una mejora en el rendimiento en cuanto a conocimientos sobre VMNI (84,2%), especialmente en indicaciones, contraindicaciones, objetivos terapéuticos, posibles complicaciones asociadas, modalidad de BIPAP, selección de interfaz y parámetros ventilatorios. **Conclusión**: la IE desarrollada demostró ser una contribución eficaz y positiva para el equipo de enfermería de una UPA, mejorando la práctica basada en la evidencia y los cuidados de enfermería más eficaces, oportunos y seguros en este campo.

Palabras clave: ventilación no invasiva; enfermeros; conocimiento

INTRODUCTION

Similar to international trends, in Portugal, respiratory system pathologies continue to be one of the primary causes of illness, accounting for 9.1% of total deaths in 2020 (Instituto Nacional de Estatística, 2023). Even though a significant number of these clinical conditions are preventable or treatable with accessible therapeutic approaches, there has not been a significant reduction in their overall incidence.

Noninvasive Ventilation (NIV) emerges as one of the preferred therapeutic interventions in an era marked by an increase in respiratory disorders (Duarte et al., 2019). Since its inception, in the first half of the 20th century, with subsequent technological updates, this intervention has been prominently featured in the international literature as a safe, efficient, timely, and relatively low-cost approach compared to traditional methods (Borel et al., 2019).

NIV involves the application of positive pressure ventilatory support through a mask or another interface at the level of the nasal or oronasal airways (MacIntyre, 2019). NIV shares a set of physiological mechanisms with invasive ventilation, i.e., through an artificial airway (Duarte et al., 2019). However, there are significant differences to highlight. Firstly, due to inherent leaks, NIV systems may not always deliver volumes and pressures comparable to invasive ventilation, despite sophisticated leak compensation features. These leaks can also trigger sensitivity and patient-ventilator synchrony during the respiratory cycle (MacIntyre, 2019).

Nevertheless, NIV is considered a high-quality and relevant approach in a multitude of clinical scenarios, with its application standing out in critically ill patients with acute respiratory failure or immunocompromised individuals (Cammarota et al., 2022). Concerning its applicability across clinical settings, NIV has proven to be an essential approach to providing care in highly specialized and complex environments (Borel et al., 2019). Numerous advantages are attributed to it, including the reduction of direct risks, infections or endotracheal trauma, decreased average length of stay in the Intensive Care Unit or hospitalization, reduced need for sedation or the preservation of airway defense mechanisms (Gonçalves et al., 2020; Wu et al., 2020).

Given the numerous advantages and increasing application of NIV in various clinical settings, it is crucial for healthcare professionals, particularly nurses, to possess a solid understanding and knowledge of NIV, as the impact of its absence is a key factor in the quality and safety of care provided to person undergoing NIV.

BACKGROUND

Healthcare quality is characterized by the delivery of accessible and equitable care with a high professional standard, taking into consideration available resources while ensuring citizen adherence and satisfaction.

Although this is a universal imperative for any process within healthcare organizations and systems, it is equally applicable when focusing on a clinical intervention, such as NIV (Fernandes & Branco, 2023). However, in Portugal, nursing training in the application and maintenance of NIV at the undergraduate level is still lacking, with most nurses accessing formal training in this field within their respective clinical institutions.

To address this gap, incorporating Transformational Learning Theory into the NIV training could be highly beneficial. This educational model focuses on the process of inducing change in individuals through critical reflection, challenging existing assumptions,

and fostering a deeper understanding of the subject matter. By applying this theory, nursing education can shift from merely transferring knowledge to transforming the nurse's perspective, enabling them to integrate and apply their skills more effectively in clinical practice. Such an approach not only enhances the competency of nurses in applying and maintaining NIV but also aligns with the broader goals of improving healthcare quality through more skilled and reflective practice (Tsimane & Downing, 2020).

In a systematic literature review, Green & Bernoth (2020) identified that the primary barriers to evidence-based practice among nurses in the context of NIV revolve around the lack of current and recurring training, impaired communication within the multidisciplinary team, and a deficiency in knowledge and adherence to existing norms and guidelines. These challenges have been documented in previous research conducted in Portugal (Fragoso, 2014; Palma, 2018) and may explain why the care outcome indicators found did not meet the quality standards expected by both regulatory bodies and citizens alike. Thus, the following research question emerged: What is the effect of an Education Intervention (EI) on the knowledge level of nurses regarding NIV in a Post-Anesthesia Care Unit (PACU) in central Portugal?

METHODOLOGY

We conducted a single-group quasi-experimental study, with pre-and post-intervention assessments. This study took place in the PACU of a major tertiary hospital in central Portugal, spanning from December 2022 to March 2023.

The structure and content of the educational program were designed following the recommendations put forth by Karim et al. (2019), who advocate a multimodal educational intervention, based on minimum program contents and a structured theoretical and practical approach. To minimize the risk of bias, the education and training of the entire nursing team were overseen by a consistent member of the research team.

During the implementation of the educational program at PACU, a theoretical 60 minute-session was held on March 27th, 2023. The session covered topics such as respiratory insufficiency, major concepts and objectives in NIV therapy, health benefits, indications and contraindications, selection criteria, advantages, disadvantages, ventilatory parameters, ventilatory modes, necessary equipment, interface selection, nursing care during NIV initiation, monitoring, maintenance, complications (e.g., interface, pressure, and flow), and success factors.

Practical sessions occurred on March 28th, 30th, and 31st. To ensure all participants had access, sessions were repeated during both morning and afternoon shifts on the first and third dates. Each session lasted a maximum of 2 hours and involved groups of 2 to 5 participants. Practical training focused on equipment, circuit assembly (including filter selection and placement), interface selection, ventilator interface setup, proper interface sizing, personalized interface fitting, skin assessment in pressure areas, and strategies to prevent pressure sores.

Participant recruitment was carried out in December 2022 within the selected study setting. The accessible population consisted of nurses working in the PACU of a hospital in the central region (N = 26). Inclusion criteria comprised all nurses working in the PACU who would continue their professional activities during the post-intervention period and those providing nursing care to individuals requiring NIV in the unit.

Conversely, the study excluded nurses engaged in advanced training within the unit (e.g., master's students) and those on extended work leave.

Thus, the study sample consisted of 19 nurses, all of whom willingly agreed to participate in the study after a formal presentation and comprehensive clarification regarding its objectives and procedures. Overall, 84.2% (N = 16) were female, with an average age of 45.5 years (SD = 8.5). Most participants held a nursing degree (N = 18), while one had a bachelor degree. Six nurses (31.6%) held specialist titles in various nursing areas: medical-surgical nursing (N = 3), rehabilitation (N = 1), community health (N = 1), and mental health nursing (N = 1). In terms of years of professional experience, the sample's average was approximately 23 years (SD = 8.3).

Data collection occurred both before and after the intervention, using an adapted version of the questionnaire originally developed by Palma (2018). This questionnaire comprises three main sections: i) sociodemographic and professional characterization of the study sample; ii) thirty-two true or false statements aimed at assessing nurses' knowledge about NIV; iii) twenty-five statements designed to evaluate nurses' care delivery to patients undergoing NIV. This section employs a Likert Scale, ranging from a score of one (indicating "strongly disagree") to five (indicating "strongly agree"). Additionally, a fourth section was added to the post-implementation questionnaire to determine nurses' perceptions regarding the effectiveness of the program in enhancing their NIV-related competencies. To ensure timely participation and minimize the risk of data loss, the adapted questionnaire was administered in a paper format both before and after the educational intervention.

The research study followed ethical principles, including respect, beneficence, and justice, as outlined in the Helsinki Declaration and Oviedo Convention for research involving humans. The nursing team at PACU participated voluntarily and anonymously after providing clear and concise informed consent. Participant recruitment took place in December 2022 after Ethics Committee for Health approval (reference 372/CES). Data collection instruments were anonymized with individual codes, and access was restricted to the research team and participants. After data collection, all identifying information was removed, and original paper records were destroyed to ensure confidentiality.

Descriptive and inferential statistical analysis was conducted using IBM Statistical Package for the Social Sciences Statistics, version 28.0. Descriptive statistics were employed to characterize the sample and variables under study, specifically using absolute and relative frequency distribution, measures of central tendency (mode, median, and mean), and dispersion (minimum and maximum, standard deviation). Consistent with the previous study by Palma (2018), non-parametric tests were used for inferential statistical analysis, given the small sample size. The knowledge of the nursing team in the PACU before and after the educational intervention was compared using the Wilcoxon Test (Z) for paired samples. The analysis of the relationship between two continuous variables was performed using the Spearman Correlation test (rs). The randomness of the frequency with which sample elements are distributed across the classes of the studied qualitative variables was assessed using the Chi-square test (χ^2). For all tests utilized, a significance level (p) of <0.05 was considered.

RESULTS

During the pre-intervention period, most nurses (78.9%) had never attended specific training in the field of NIV. The remaining participants had undergone previous training either within the context of in-service education or institutionally sponsored, with a total duration ranging from 3 to 14 hours. All participants (100%) considered that their knowledge in this field was not sufficient to ensure quality care for individuals in need of NIV.

In the pre-intervention phase, within the second section of the questionnaire, scores across participants ranged from 20 to 30 points (M = 25.4, ± 2.8), out of a possible 32. In the post-intervention phase, scores ranged from 27 to 32 points (M = 30.1, ±1.7). Overall, 16 participating nurses demonstrated an improvement in their performance, while the remaining three nurses maintained their scores unchanged after the intervention (Z = -3.525, $p < 0.001$). Both before and after the actions were implemented, the nursing team was asked about their level of agreement with a set of care interventions related to NIV (Table 1).

Table 1

Differences in the nurses' response pattern between pre- and post-intervention regarding Part III of the questionnaire (nursing care for individuals on NIV)

Statements	Correct Answers (%)		
	Pre-intervention	Post-intervention	Differences
1. Before starting NIV, the nurse should...			
1.1. Assess Vital Signs and SpO2 levels	89.5%	94.7%	Z = -0.577, p = 0.564
1.2. If possible, obtain the person's verbal informed consent	63.2%	84.2%	Z = -1.897, p = 0.058
1.3. Explain to the person the objectives and possible complications of NIV, except in cases of emergency	73.7%	84.2%	Z = -1.414, p = 0.157
1.4. Assess the person's state of consciousness and their ability to understand the information transmitted	84.2%	89.5%	Z = -0.447, p = 0.655
1.5 Position the person with the headboard down, because it is crucial to the success of NIV	89.5%	94.7%	Z = -1.000, p = 0.317
2. Interface and Person-Ventilator Synchrony...			
2.1 The absence of significant leakage is a sign of person-ventilator synchrony	10.5%	15.8%	Z = -1.248, p = 0.212
2.2 The mask and harness should be applied at maximum tension	36.8%	73.7%	Z = -1.990, p = **0.047**
2.3 Due to the interface barrier and to prevent person fatigue, verbal communication should not be encouraged	5.3%	36.8%	Z = -2.651, p = **0.008**
2.4 The use of two antimicrobial filters is important	5.3%	78.9%	Z = -2.064, p = **0.039**
2.5 Dentures should be retained if the person is conscious	21.1%	63.2%	Z = -2.579, p = **0.01**
2.6 The use of sedation for person adaptation to NIV should always be considered	31.6%	68.4%	Z = -1.956, p = 0.051
3. Concerning the person under NIV, nurses should monitor...			
3.1 The Level of Consciousness	47.4%	94.7%	Z = -2.652, p = **0.008**
3.2 Relief of dyspnea	73.7%	94.7%	Z = -1.633,

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Statements	Correct Answers (%)		
	Pre-intervention	Post-intervention	Differences
			p = 0.102
3.3 Tidal volumes and respiratory rate	63.2%	84.2%	Z = -1.725, p = 0.084
3.4 Leak, without attaching importance to leaks exceeding 40 L/min	36.8%	68.4%	Z = -2.689, p = **0.007**
4. Regarding the maintenance of the comfort of the person under NIV...			
4.1 The positioning of the person should be according to his preference and comfort	0%	5.3%	Z = -1.273, p = 0.203
4.2 A nasogastric tube should always be placed to avoid bloating	21.1%	47.4%	Z = -1.955, p = 0.051
4.3 The transfer to the armchair is not contraindicated	31.6%	73.7%	Z = -2.675, p = **0.007**
4.4 The individual should remain fasting on the first day of NIV	15.8%	10.5%	Z = -0.036, p = 0.971
4.5 The satisfaction of other physiological needs must be postponed	73.7%	78.9%	Z = -1.040, p = 0.298
5. Concerning skin and mucous membrane care...			
5.1 If disconnecting from NIV is not recommended, oral hygiene and mucosal hydration should not be performed	42.1%	42.1%	Z = -0.916, p = 0.359
5.2 Lip hydration and oral cavity humidification should be included in the care plan for individuals on NIV	73.7%	89.5%	Z = -1.134, p = 0.257
5.3 Before commencing NIV, the skin should be prepared, and a dressing should be applied to protect the nasal bridge	52.6%	57.9%	Z = -0.726, p = 0.468
5.4 The assessment of skin and mucosal condition in individuals on NIV is the responsibility of the nurse	79%	89.5%	Z = -1.000, p = 0.317
5.5 The use of artificial tears is not recommended for individuals on NIV.	47.4%	84.2%	Z = -2.653, p = **0.008**

All nurses (100%) acknowledged that the implemented actions had contributed to improving their knowledge in this area of interdependent intervention. However, since the actions were implemented, only nine nurses (47.4%) in the team reported having provided care to individuals undergoing NIV. When asked about which areas of nursing intervention had benefited the most from the implemented actions, they highlighted mask size adjustment (94.7%), filter selection and placement (89.5%), mask selection on the ventilator (84.2%), and initial mask adaptation by two nurses (84.2%). With lesser representation, they noted areas such as NIV circuit assembly (73.7%), oral hygiene and mucosal hydration (73.7%), skin assessment in pressure areas (63.2%), and dressing application in pressure areas (52.6%).

DISCUSSION

The success of NIV depends on several factors, including the type and severity of the underlying clinical condition, appropriate ventilator settings, the selection of a user-friendly interface, and strict and continuous monitoring of hemodynamic response during its use (Davies et al., 2018). Therefore, ensuring quality care for individuals in need of NIV is a challenge that demands healthcare professionals to practice informed by current scientific evidence and a patient-centred approach (Davies et al., 2018).

These recommendations contrast with the findings in the pre-intervention phase, where 78.9% of nurses had never undergone specific training in NIV, a higher percentage than that identified by Palma (2018), both in terms of frequency and the maximum duration of

training sessions (14 hours versus 16 hours). Some studies highlight previous efforts to update the skills of healthcare professionals in NIV (Erdelja et al., 2020; Karim et al., 2019; Raurell-Torredà et al., 2019), driven by the needs imposed by the COVID-19 pandemic (Bambi et al., 2022; Jackson et al., 2022).

In this study, we assumed that the care provided to individuals in need of NIV in the clinical context under study, at the start of this research, was not standardized among the nursing team members and occasionally deviated from the available scientific evidence, which could compromise the expected level of quality and care experience. In addition to the research team's observations, at the beginning of this study, all participating nurses considered themselves to lack updated knowledge in the field of NIV that would ensure high-quality and adverse event-free practice for individuals. This result is higher both quantitatively and qualitatively compared to national findings by Palma (2018) and Fragoso (2014).

Based on this challenge, we proposed the implementation of an educational intervention for the nursing team at PACU, using a theoretical-practical approach in line with the latest international recommendations in this area (Karim et al., 2019). Based on the results of the inferential statistical analysis conducted, it is possible to identify a significant overall improvement in the level of knowledge about NIV among the PACU nursing team before and after the educational intervention ($Z = -3.525$, $p < 0.001$). In fact, between the pre- and post-intervention periods, 16 nurses (84.2%) showed an improvement in NIV knowledge. Significant gains were observed in the change of nurses' responses to questions concerning the contraindications of this technique ($Z = -2.841$, $p = 0.005$) and complications associated with the individual ($Z = -2.970$, $p = 0.003$). Similarly, there was an improvement in nurses' knowledge regarding the BIPAP mode ($Z = -2.081$, $p = 0.037$) and ventilator parameters ($Z = -2.440$, $p = 0.015$).

The results in this study are more favorable than those identified by Raurell-Torredà et al. (2019), who focused on the knowledge of NIV among doctors (N = 48) and nurses (N = 181) in four Spanish hospitals. Regarding nurses' knowledge, the authors found that only 25.1% of participants correctly answered the questionnaire, with no statistically significant differences between practice settings (e.g., intensive care, emergency department, post-surgical units). Overall, 50.2% of the sample answered correctly regarding the appropriate mask size to select, a more positive result than the nurses' responses to questions about the type and characteristics of the mask to choose (17.1%) and mask application (7.7%). This result falls short of what was found in the current study, where there was an improvement in nurses' responses to questions about the interfaces used in NIV, with an increase from 63.2% to 94.7% of nurses correctly answering all questions, a statistically significant improvement ($Z = -2.271$, $p = 0.023$). However, in a systematic literature review, Pierucci et al. (2022) highlighted that highly trained teams in NIV may face a lack of suitable material resources, compromising the selection of an interface that truly suits the individual.

Jackson et al. (2022) conducted a three-day educational intervention using team-based learning exercises and simulation scenarios, involving 36 healthcare professionals, including eight nurses. Between the pre- and post-intervention periods, professionals assessed their confidence levels in providing care to individuals in need of NIV, focusing

on different typologies/modes, general and exceptional indications, as well as practical applications (Jackson et al., 2022). Comparing the pre- and post-intervention periods, the authors found a statistically significant increase in overall scores (24.6% versus 64.22%; $p < 0.001$), like what was reported in our study. The same authors highlighted the "general indications" domain as the most improved among participants, with a 41.66% increase in scores in the post-intervention period (Jackson et al., 2022). Similarly, in the post-intervention period of our study, the PACU nursing team demonstrated more systematic knowledge regarding the indications for NIV, with an increase from 31.6% to 73.7% in the number of nurses who correctly answered all questions in this area, a result with statistical significance (Z = -3.169, p = 0.002).

In the third part of the questionnaire, regarding nursing care for individuals in need of NIV, there was a positive trend in most of the subgroups of questions. However, the high level of agreement among the PACU nursing team is notable, even in the pre-intervention period, with essential care before starting NIV (e.g., vital sign assessment, assessing the individual's level of consciousness and capacity to understand conveyed information, obtaining consent). This result may partly explain the absence of statistically significant differences in this subgroup, although there is an improvement in nurses' responses in the post-intervention period.

Regarding the second subgroup (interface and person-ventilator synchrony), statistically significant improvements in nurses' responses were observed in the application of the mask and harness (Z = -1.990, p = 0.047), the need to encourage verbal communication by the individual in NIV (Z = -2.651, p = 0.008), the use of two antimicrobial filters as a strategy to mitigate the risk of respiratory infection (Z = -2.064, p = 0.039), and the need to maintain dentures for conscious individuals (Z = -2.579, p = 0.01). However, in our study, only a marginally significant improvement (Z = -1.956, p = 0.051) was observed in the question regarding the need for sedation of the individual. These results are similar to those found by Palma (2018), who reported a statistically significant improvement in average scores for all questions, except for the question about the need to encourage communication (Z = -1.914, p = 0.056).

Regarding the third subgroup (monitoring individuals on NIV), we found an improvement in nurses' response patterns for all questions, with statistically significant differences in questions related to the need to monitor the level of consciousness (Z = -2.652, p = 0.008) and leaks in the system (Z = -2.689, p = 0.007). Regarding the maintenance of individual comfort, contrary to what was found by Palma (2018) and Kim et al. (2021), no statistically significant differences were identified in nurses' response patterns after the educational intervention, except for the item related to transferring individuals in need of NIV from the bed into a chair (Z = -2.675, p = .007). A plausible explanation for this finding may be the difference in clinical settings, with this study taking place in PACU instead of a short-stay inpatient unit as in the study by Palma (2018) or an internal medicine unit (Kim et al., 2021).

Nevertheless, it is considered necessary to continue intervening with the nursing team in this thematic area, recognizing their indispensable role in "responding to the needs of the individual, particularly in the physical, environmental, and sociocultural relief of discomfort caused by these traumatic stimuli"

(Fragoso, 2014, p. 50). It is essential to empower the nursing team to identify, intervene, and evaluate the results of their actions in this area since physical and psychological discomfort is one of the main complications experienced by individuals in need of NIV in a clinical context (Bambi et al., 2022; Kim et al., 2021). The discomfort experienced by individuals with NIV is also one of the main predictors of inconsistent use in a clinical setting (Cammarota et al., 2022).

Regarding skin and mucous membrane care, a positive trend was observed in the nurses' response patterns in the pre-intervention period for most items, which did not change after the educational intervention. However, there was a statistically significant change in the question about the application of artificial tears (Z = -2.653, p = 0.008). which raised uncertainties in 21.1% of participants in the pre-intervention phase.

Despite the positive findings highlighted, the study's limitations include the close timing between the educational intervention and the questionnaire completion in the post-intervention period, given the recent exposure to theoretical-practical sessions. Thus, we suggest that future studies include follow-up assessments with the participants, allowing for a greater time gap between the intervention and evaluation, as well as a higher probability of providing nursing care to individuals in need of NIV (which only occurred for 47.4% of participants). The implementation of follow-up evaluation measures will help determine whether nurses' knowledge in the field of NIV is consolidated.

Furthermore, based on the definition and types of competencies, we consider that it was only possible to support the team in the development of their cognitive and functional competence regarding NIV. Additionally, the assessment conducted between the pre- and post-intervention periods focused solely on cognitive competence. Therefore, as a future recommendation, we consider it equally important to intervene and assess the team's performance in other competency domains that relate to NIV, including communication, ethics, social/behavioral, and leadership.

Comparing the outcomes of this educational intervention with those conducted by other authors, at both national and international, levels poses challenges due to variations in the interventions (such as teaching methods, strategies, content, session frequency, and duration) and the diverse assessment parameters used to measure potential improvements (including knowledge, self-efficacy, or professional confidence levels). This heterogeneity in the literature makes direct comparisons of results difficult, except for the study conducted by Palma (2018), which employed the author's assessment tool. Therefore, future research should focus on developing educational interventions following the latest recommendations in this field (Karim et al., 2019), as demonstrated in this study and employing standardized assessment tools to enable meaningful result comparisons.

CONCLUSION

The educational intervention significantly enhanced nurses' knowledge of NIV, particularly in terms of its therapeutic goals, indications, contraindications, ventilatory parameters, interface selection, and monitoring of associated complications. The educational intervention allowed for greater standardization among the team's responses in delivering nursing care to individuals requiring NIV. This improved consistency could lead to more cohesive

care practices, ultimately enhancing the overall care experience for PACU patients.

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