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SELEÇÃO DA MÁSCARA NO INÍCIO DA VENTILAÇÃO MECÂNICA NÃO INVASIVA AO DOENTE COM INSUFICIÊNCIA RESPIRATÓRIA AGUDA

MASK SELECTION AT THE BEGINNING OF NON-INVASIVE MECHANICAL VENTILATION FOR PATIENTS WITH ACUTE RESPIRATORY FAILURE

SELECCIÓN DE LA MASCARILLA AL INICIO DE LA VENTILACIÓN MECÁNICA NO INVASIVA PARA PACIENTES CON INSUFICIENCIA RESPIRATORIA AGUDA

Ana Romano[1] *https://orcid.org/0009-0006-6888-0659*
Joana Sousa[2,3] *https://orcid.org/0000-0001-5515-0696*

[1] Unidade Local de Saúde de Castelo Branco, Castelo Branco, Portugal
[2] Instituto Politécnico de Leiria, Leiria, Portugal
[3] Center for Innovative Care and Health Technology (ciTechCare), Leiria, Portugal

Ana Romano - anaromano1997@gmail.com | Joana Sousa - joana.sousa@ipleiria.pt

Corresponding Author:
Ana Romano
Avenida 25 de Abril, Bloco A, 2º esq
6200-034 – Covilhã - Portugal
anaromano1997@gmail.com

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RESUMO

Introdução: A Ventilação Mecânica Não Invasiva (VMNI) pressupõe um suporte ventilatório que consiste na aplicação de uma pressão positiva nas vias aéreas através de uma máscara/interface. As intervenções de Enfermagem ao doente sob VMNI são determinantes para o bem-estar do doente e para o sucesso da técnica, nomeadamente a escolha e adequação da máscara.
Objetivo: Capacitar a equipa de Enfermagem relativamente à seleção da máscara mais adequada ao doente com IR no início da VMNI, num serviço de medicina; comparar o desempenho do uso entre as MON (máscara oro-nasal) e MFT (máscara facial-total) nas 24 horas de VMNI.
Métodos: Realizou-se um estudo quantitativo prospetivo experimental. Para colheita de dados foi submetido um questionário aos enfermeiros sobre os cuidados de enfermagem ao doente sob VMNI. Para análise dos conteúdos, foram recolhidos dados relativos aos valores de gasometria, em doentes submetidos a VMNI, nos anos de 2021-2022.
Resultados: Constatou-se que as variações mais pronunciadas ocorreram na utilização da MFT na IRA hipercápnica, com uma taxa de variação de 85,7% da MFT para 85,0% da MON no pH; e de 78,6% (MFT) para 70,0% (MON) na variável PaCO2, demonstrando variações estatisticamente muito significativas (p<0,01).
Conclusão: A MFT é a mais adequada para o início da VMNI em doentes com IRA hipercápnica, em comparação com a MON. A formação em serviço promove a atualização de conhecimentos e melhoria da prestação de cuidados aos doentes sob VMNI.

Palavras-chave: ventilação mecânica não invasiva; enfermeiro especialista; insuficiência respiratória aguda; máscara oro-nasal; máscara facial total

ABSTRACT

Introduction: Non-Invasive Mechanical Ventilation (NIMV) involves ventilatory support consisting of applying positive pressure to the airways via a mask/interface. Nursing interventions for patients under NIMV are crucial to the patient's well-being and the success of the technique, particularly the choice and suitability of the mask.
Objective: To train the nursing team in the selection of the most appropriate mask for patients with IR at the start of NIMV in a medical service; to compare the performance of use between MON (oro-nasal mask) and MFT (total face mask) during 24 hours of NIMV.
Methods: An experimental prospective quantitative study was carried out. To collect data, a questionnaire was sent to nurses about nursing care for patients under NIMV. For content analysis, data were collected on blood gas values in patients undergoing NIMV in the years 2021-2022.
Results: It was found that the most pronounced variations occurred in the use of MFT in hypercapnic ARF, with a variation rate from 85.7% to 85.0% of MON in pH, and from 78.6% (MFT) to 70.0% (MON) in PaCO2, demonstrating statistically very significant variations (p<0.01).
Conclusion: MFT is more suitable for starting NIV in patients with hypercapnic ARF, compared to MON. In-service training promotes the updating of knowledge and the improvement of care for patients under NIMV.

Keywords: non-invasive mechanical ventilation; nurse specialist; acute respiratory failure; oro-nasal mask; full face mask

RESUMEN

Introducción: la ventilación mecánica no invasiva (VMNI) consiste en la aplicación de presión positiva a las vías respiratorias a través de una mascarilla/interfaz. Las intervenciones de enfermería en los pacientes sometidos a VMNI son cruciales para el bienestar del paciente y el éxito de la técnica, especialmente la elección y adecuación de la mascarilla.
Objetivo: Formar al equipo de enfermería en la selección de la mascarilla más adecuada para pacientes con ITR al inicio de la VMNI en un centro médico; comparar el rendimiento del uso de la MON (mascarilla oro-nasal) y la MFT (mascarilla facial completa) durante 24 horas de VMNI.
Métodos: Se realizó un estudio cuantitativo prospectivo experimental. Para recoger los datos, se envió un cuestionario al personal de enfermería sobre los cuidados de enfermería a los pacientes sometidos a VMNI. Para analizar el contenido, se recogieron datos sobre los valores de gases en sangre en pacientes sometidos a VMNI en los años 2021-2022.
Resultados: Se observó que las variaciones más pronunciadas se produjeron en el uso de la MFT en la IRA hipercapnia, con una tasa de variación del 85,7% al 85,0% de la MON en el pH, y del 78,6% (MFT) al 70,0% (MON) en la PaCO2, demostrando variaciones altamente significativas estadísticamente (p<0,01).
Conclusión: La MFT es más adecuada para iniciar la VMNI en pacientes con IRA hipercapnia, en comparación con la MON. La formación continuada favorece la actualización de conocimientos y la mejora de la atención a los pacientes sometidos a VMNI.

Palabras Clave: ventilación mecánica no invasiva; enfermera especialista; insuficiencia respiratoria aguda; mascarilla oro-nasal; mascarilla facial completa

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INTRODUCTION

Respiratory failure (RF) is defined as an impairment in gas exchange through oxygenation, resulting in hypoxia, without necessarily involving hypercapnia, and can develop either acutely or chronically. The therapeutic approach to this complex and unique condition varies according to the type and severity of the situation (Martins et al., 2022). According to the European Respiratory Society (ERS), the treatment of acute respiratory failure (ARF) involves the use of ventilatory strategies, with particular emphasis on the importance of non-invasive mechanical ventilation (NIV) (Oliveira, 2018; Scala & Heunks, 2018). The selection of the most appropriate mask for the patient is one of the autonomous interventions that the nurse must consider during the NIV process. At a national level, literature addressing this issue remains scarce, representing a significant gap in nursing care. In this context, the challenge of selecting between oronasal masks (ONM) or full-face masks (FFM) during NIV for patients with ARF was identified in a medical inpatient service. Therefore, the primary objective established was to empower the nursing team regarding the selection of the most suitable mask for patients with RF at the initiation of NIV in a medical ward.

1. THEORETICAL FRAMEWORK

The respiratory system plays a fundamental role in ensuring gas exchange, maintaining blood gas levels within ranges compatible with cellular metabolism. This system performs four distinct functions: ventilation, gas diffusion across the alveolar membrane, transport of gases between cells, and regulation of ventilation (Otero et al., 2016). Hypoxemic acute respiratory failure (ARF), or type I, is characterized by hypoxia without hypercapnia, in which the partial arterial oxygen pressure (PaO2) is below 60 mmHg under an inspired oxygen fraction (FiO2) of 21%. Hypercapnic ARF, or type II, is defined by the presence of hypoxia accompanied by a partial arterial carbon dioxide pressure (PaCO2) above 45 mmHg at FiO2 21% (Duarte et al., 2019).

Non-invasive mechanical ventilation (NIV) is a method involving the application of positive airway pressure through a ventilator. This therapy aims to improve oxygenation, reduce hypercapnia, correct respiratory acidosis, and enhance pulmonary compliance—all without the need for invasive techniques such as endotracheal intubation (ETI) (Caldas & Pereira, 2022; Palma, 2018; Pinto & Sousa, 2017).

At the initiation of NIV, certain clinical and blood gas criteria must be considered. Regarding gasometrical criteria, the presence of hypercapnia with PaCO2 above 45 mmHg, associated with acidaemia (pH below 7.35), is a significant indicator (Agency Clinical Innovation [ACI], 2023; Chawal et al., 2020; Rochwerg et al., 2017; Sanchez et al., 2014). The European Respiratory Society (ERS) strongly recommends NIV use in cases of exacerbation of chronic obstructive pulmonary disease (COPD) and acute pulmonary oedema, as well as in the development of pneumonia in immunocompromised patients, neuromuscular diseases, obesity hypoventilation syndrome, postoperative or trauma situations, as a palliative measure, and finally as an alternative or weaning strategy from invasive mechanical ventilation (IMV) (Rochwerg et al., 2017).

NIV is delivered via a mask/interface fitted to the patient's face, allowing them to maintain communication and airway protection. The ventilator is connected through a circuit—either single or double—that permits airflow. The Agency Clinical Innovation (ACI) published guidelines on Non-Invasive Ventilation for Adult Patients with Acute Respiratory Failure in 2014, updated in 2023. It asserts that, in selecting and applying all available masks for NIV, it is essential to consider patient characteristics, the therapeutic goals, and the type of respiratory failure. Accordingly, the choice/selection of the most appropriate mask for NIV is an autonomous nursing intervention (Garcia & Veiga-Branco, 2022).

For an informed decision, nurses must consider the type of mask, its fit, the patient's skin integrity, patient-ventilator synchrony, the type of circuit and ventilator used, and the potential presence of leaks. Thus, mask selection relies on a set of criteria aimed at optimizing patient comfort. This approach can reduce drawbacks and adverse effects, promoting patient adaptation to the ventilator (ACI, 2023; BTS/ICS, 2016; Sanchez et al., 2014). The research question to be addressed is: "Which mask is most appropriate for initiating NIV in patients with acute respiratory failure, as selected by nurses in an inpatient medical service?".

2. METHODS

Based on the theoretical framework presented, a methodological approach was chosen to allow an in-depth exploration of the identified dimensions, ensuring coherence between the study objectives and the data collection and analysis instruments.

Having established the general objective, the specific objectives considered were to compare the performance of the use of oronasal masks (ONM) and full-face masks (FFM) during the first 24 hours of NIV; to conduct an integrative literature review; and to analyse the selection of NIV masks. Initially, an ethics approval request was submitted to the Ethics Committee of the hospital where the study was conducted, which was granted. Consequently, a prospective experimental quantitative study was developed using statistical data collected from the hospital service database, referring to patients undergoing NIV.

An integrative literature review (ILR) was also conducted using Medline via PubMed and CINAHL databases, covering a ten-year period. After applying inclusion and exclusion criteria, and selecting studies based on titles and abstracts, six primary studies were retained.

Subsequently, an in-service training session lasting four hours was delivered to the nursing team, covering the pathophysiology of acute respiratory failure, the principles of NIV, equipment selection and handling, and finally, nursing interventions.

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2.1 Sample

The sample was a convenience sample, consisting of nurses from a medical ward in a hospital located in the central region of the country, who consented to participate. Nurses on prolonged absence from the service were excluded. Although the sample size was adequate for exploratory purposes, the small number of participants represents a significant limitation regarding the generalizability of the findings.

2.2 Data collection instruments and procedures

Data collection was divided into several phases: in the first phase, for situational diagnosis, a questionnaire was administered to nurses via Google Forms, addressing sociodemographic and professional characterization of the nursing team, as well as aspects related to care provision, namely the selection and application of masks during NIV. For content analysis, blood gas values of patients undergoing NIV in the years 2021–2022 were retrieved from the database.

2.3 Statical analysis

The retrospective data collected to support the study were coded and processed using the IBM Statistical Package for the Social Sciences (SPSS®), version 28.0.0.0. The chi-square test and the Wilcoxon test were chosen for statistical analysis.

3. RESULTS

Nineteen responses (82.6%) were obtained from the questionnaire administered to the team, corresponding to the study sample. The sample consisted of 78.9% females, with a mean age of 35.4 years (SD ± 5.11). The average professional experience was 11.24 years (SD ± 4.57). Regarding academic qualifications, 68.4% of the nurses held a bachelor's degree, while 21.1% had completed a master's degree or specialization. When asked about specific training in NIV, 52.6% reported having no training in this area. Regarding knowledge of international guidelines issued by the BTS/ICS (2018) and ERS/ATS (2017), 36.8% stated they were "not familiar," 26.3% said they "have heard of them but never consulted or applied them," and 31.6% indicated that they "know and apply them in clinical practice."

Only one nurse (5.3%) reported being unfamiliar with both oronasal masks (ONM) and full-face masks (FFM). Concerning the importance of the mask as a predictor of success, 100% of the team agreed with this statement. The FFM was the least selected mask by nurses (26.3%) compared to the ONM (73.7%), with 57.9% of respondents stating that they do not select the mask solely based on the patient's face size.

Regarding the retrospective data, 34 patients undergoing NIV were analysed. A normality test using Shapiro-Wilk was conducted, indicating a normal distribution concerning the sex of the sample in this dataset. The analysis of patient age revealed a mean of 78.71 years (SD ± 13.21), ranging from 46 to 99 years, with most patients aged over 80 (61.8%), which was not statistically significant (χ^2=0.971; p=0.681). Regarding sex, 52.9% were male and 47.1% female (χ^2=0.169; p=0.681), with no statistically significant differences, like the patients' origin (χ^2=3.724; p=0.155).

An attempt was then made to characterize various blood gas parameters according to the mask type and evaluation timing based on standardized blood gas values (Table 1).

Table 1 – Characterization of various blood gas parameters according to mask type and timing of evaluation

State	Normal		Acidaemia		alkalaemia	
Parameters	**nº**	**%**	**nº**	**%**	**nº**	**%**
PH (inicial)						
MON	1	5,0%	17	85,0%	2	10,0%
MFT	2	14,3%	11	78,6%	1	7,1%
CO2 (inicial)						
MON	1	5,0%	18	90,0%	1	5,0%
MFT	0	0,0%	12	85,7%	2	14,3%
HCO3- (inicial)						
MON	6	30,0%	1	5,0%	13	65,0%
MFT	2	14,3%	3	21,4%	9	64,3%
PH (at 24h)						
MON	9	45,0%	8	40,0%	3	15,0%
MFT	6	42,9%	5	35,7%	3	21,4%
CO2 (at 24h)						
MON	3	15,0%	15	75,0%	2	10,0%
MFT	1	7,1%	13	92,9%	0	0,0%
HCO3- (at 24h)						
MON	3	15,0%	1	5,0%	16	80,0%
MFT	2	14,3%	2	14,3%	10	71,4%

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In patients treated with the oronasal mask (ONM), it was observed that among the 85.0% of acidotic patients at admission, 40.0% showed improvement. There was a decrease from 90.0% to 75.0% in patients with elevated PaCO2, and the proportion of patients with normal pH increased from 5.0% to 45.0%. Metabolic compensation occurred in 80.0% of patients.
Conversely, among patients using the full-face mask (FFM), 35.7% demonstrated improvement regarding acidaemia, while the proportion of patients with PaCO2 above 45 mmHg increased to 92.9%. Additionally, the percentage of patients with normal pH rose to 42.9%, and 71.4% of patients exhibited alkalemia.
Table 2 highlights the characterization of the variation in blood gas parameters between the two assessments, indicating a rate of change in pH of 85.7% (FFM) and 85.0% (ONM), and for PaCO2, 78.6% (FFM) versus 70.0% (ONM) (Table 2).

Table 2 – Characterization of the variation in various blood gas parameters between the two assessments, according to mask type.

Variation	Decreased		Maintained		Increased	
Parameters	**nº**	**%**	**nº**	**%**	**nº**	**%**
PH						
MON	3	15,0%	0	0,0%	17	85,0%
MFT	2	14,3%	0	0,0%	12	**85,7%**
PaO2						
MON	8	40,0%	1	5,0%	11	**55,0%**
MFT	8	57,1%	0	0,0%	6	42,9%
PaCO2						
MON	14	70,0%	2	10,0%	4	20,0%
MFT	11	**78,6%**	0	0,0%	3	21,4%
HCO3-						
MON	9	45,0%	1	5,0%	10	50,0%
MFT	6	42,9%	0	0,0%	8	57,1%
SpO2						
MON	2	10,0%	0	0,0%	18	90,0%
MFT	8	57,1%	1	7,1%	5	35,7%
Lactat						
MON	11	55,0%	0	0,0%	9	45,0%
MFT	9	64,3%	1	7,1%	4	28,6%

The following presents the evaluation of the variation in various blood gas parameters between the two assessments using the Wilcoxon test, according to mask type. It was observed that with the oronasal mask (ONM), there was a significant increase in pH values (*p < 0.05), whereas in the case of the full-face mask (FFM), the differences in both pH and PaCO2 were highly statistically significant (**p < 0.01) (Table 3).

Table 3 – Evaluation of the variation in various blood gas parameters between the two assessments using the Wilcoxon test, according to mask type.

Variation	MON	Wilcoxon (MON)		MFT	Wilcoxon (MFT)	
Parameters	**n. º**	**z**	**p**	**n. º**	**z**	**p**
PH	20	***-2,168***	***0,030****	13	***-3,361***	***0,001****
PaO2	20	-1,099	0,272	13	-0,765	0,445
PaCO2	20	-1,947	0,052	13	***-3,201***	***0,001****
HCO3-	20	-0,725	0,469	13	-1,413	0,158
SpO2	20	***-3,585***	***0,000****	13	0,000	1,000
Lactato	20	-1,045	0,296	13	-1,433	0,152

4. DISCUSSION

The sociodemographic characterization of the study sample revealed a predominance of female nurses (78.9%). According to data from the Portuguese Nurses' Order (OE, 2023), out of 83,115 registered nurses in Portugal, 68,722 are female and 14,393 are male, corroborating the results of this study's sample. It was also found that 52.6% of the sample reported having no training on the topic.
Regarding the use of two types of masks, the oronasal mask (ONM) and the full-face mask (FFM), no relationship was found between patient age, sex, or origin and the efficacy and performance of the masks.
More recently, Ekiz et al. (2022) compared the efficacy of these two masks in patients with hypercapnic respiratory failure in a prospective study involving 60 individuals. All patients underwent blood gas analysis at the 1st, 6th, 24th, and 72nd hours of therapy. These authors demonstrated improvement in hypercapnic respiratory failure by observing pH and PaCO2 values up to the first 72 hours in the FFM group, showing it as the most effective (Ekiz et al., 2022). Silva et al. (2013) also identified in their study that the FFM was the most used by the team, as it was perceived to provide better care and greater patient comfort. Although the ONM is more commonly used in hospital settings, the FFM offers advantages such as reduced air leakage, enabling the application of higher IPAP values, and a lower rate of pressure ulcers associated with prolonged therapy, thus making it more comfortable for the patient.

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In the present study, when comparing the six blood gas parameters evaluated in patients at admission and during the first 24 hours of NIV, both masks proved effective in improving pH, PaCO2, and lactate values. However, PaO2 values improved in patients using the ONM but worsened in those using the FFM. This is possibly because many patients had PaO2 values above 100 mmHg at admission due to high FiO2 concentrations in the pre-NIV context. Metabolic compensation in response to respiratory acidosis was notably higher in patients treated with the FFM compared to the ONM. Characterizing the variation in blood gas parameters between the two assessments according to mask type showed more pronounced changes with the FFM, with a variation rate of 85.7% versus 85.0% for the ONM in pH, and 78.6% (FFM) versus 70.0% (ONM) in PaCO2. Additionally, a more significant decrease in lactate was observed in patients treated with the FFM.

Regarding the variation of blood gas parameters between admission and 24 hours based on mask type, the ONM showed a significant increase in pH ($p < 0.05$) and SpO2 ($p < 0.001$). However, the use of the FFM demonstrated highly statistically significant differences in increased pH and decreased PaCO2 ($p < 0.01$), showing considerably satisfactory performance compared to the ONM.

Supporting Sadeghi et al. (2017), significant improvements in PaCO2 and HCO3 values at 6 hours were identified in the group using the FFM. These improvements were limited to the acute phase of the disease, leading the authors to conclude that the FFM performs better in respiratory failure but not after clinical stabilization.

Although the focus was on the comparison of blood gas values between masks, considering patient comfort would have provided a broader perspective, as this factor can directly influence treatment adherence and, consequently, the outcomes. This dimension was acknowledged as relevant, emphasizing the need for its inclusion in future studies.

After analysing all results and receiving ethical committee approval, an in-service training was developed addressing the topic, alongside the creation of an informative and motivating tool to promote best practices for patients. Thus, a flowchart (Figure 1) was developed and made available to all nurses providing direct care to patients under NIV, facilitating decision-making.

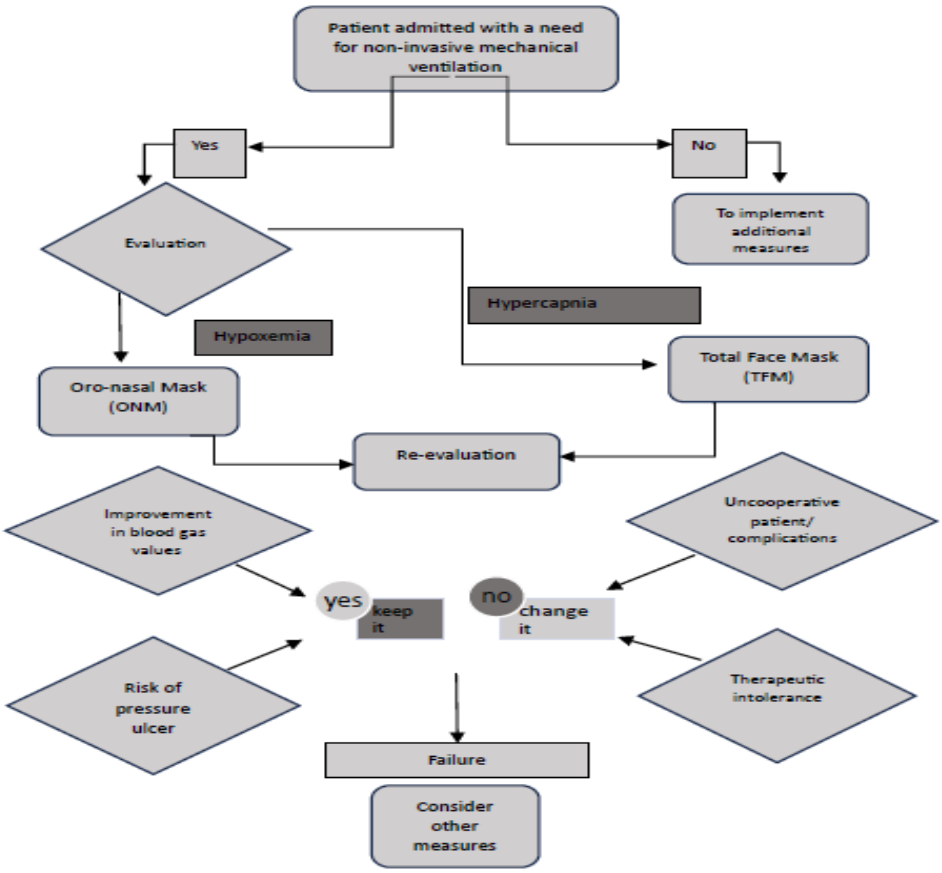

Figure 1. Decision-making flowchart for mask selection in Non-Invasive Mechanical Ventilation

CONCLUSION

The development of this study highlighted the full-face mask (FFM) as the most suitable interface for initiating non-invasive mechanical ventilation (NIV) in patients with hypercapnic respiratory failure, compared to the oronasal mask (ONM), as it more effectively normalizes pH and PaCO2 values. However, it is important to emphasize the need for further multicentred studies with

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larger samples and greater methodological rigor to validate these findings and broaden their generalizability across different clinical settings. Additionally, research should focus on developing strategies to facilitate communication with patients undergoing NIV, thereby defining improved approaches and effective practices to optimize care delivery.

AUTHOR'S CONTRIBUTION

Conceptualization, A.R. and J.S.; data curation, A.R. and J.S.; formal analysis, A.R.; investigation, A.R. and J.S.; methodology, A.R. and J.S.; project administration, A.R. and J.S.; resources, A.R.; supervision, J.S.; validation, A.R. and J.S.; visualization, A.R. and J.S.; writing-original draft, A.R. and J.S.; writing-review and editing, A.R. and J.S.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

Caldas, L. S., & Pereira, M. A. (2022). The critically ill patient in the context of a basic emergency service: Development of a nursing procedure in the scope of non-invasive mechanical ventilation [Professional internship report, master's in medical-surgical Nursing, Polytechnic Institute of Viana do Castelo]. https://abrir.link/lPyGB

Chawla, R., Dixit, S. B., Zirpe, K. G., Chaudhry, D., Khilnani, G. C., Mehta, Y., Khatib, K. I., Jagiasi, B. G., Chanchalani, G., Mishra, R. C., Samavedam, S., Govil, D., Gupta, S., Prayag, S., Ramasubban, S., Dobariya, J., Marwah, V., Sehgal, I., Jog, S. A., & Kulkarni, A. P. (2020). ISCCM guidelines for the use of non-invasive ventilation in acute respiratory failure in adult ICUs. *Indian Journal of Critical Care Medicine, 24* (Suppl 1), S61–S81. https://doi.org/10.5005/jp-journals-10071-G23186

Duarte, T. I., Pocinho, R., Pires, P., Antunes, L., & Baptista, I. (2019). Non-invasive mechanical ventilation: How to identify the therapeutic response? *Internal Medicine, 26* (2), 113–119. https://doi.org/10.24950/rspmi/O/17/19/2/2019

Ekiz, B. C., Koksal, N., Tuna, T., & Gullu, Y. T. (2022). Comparison of the efficacy of facial mask and oronasal mask in patients with hypercapnic respiratory failure receiving non-invasive mechanical ventilation. *Tuberk Toraks, 70* (2), 157–165. https://doi.org/10.5578/tt.20229806

Garcia, S. R., & Veiga-Branco, M. A. (2022). Autonomous nursing interventions as quality indicators in care for critically ill patients under non-invasive mechanical ventilation. [Final internship report not published, master's in medical-surgical Nursing, Polytechnic Institute of Bragança].

BTS/ICS Guideline Group. (2016). BTS/ICS guidelines for the ventilatory management of acute hypercapnic respiratory failure in adults. *Thorax, 71* (2). https://doi.org/10.1136/thoraxjnl-2015-208209

NSW Agency for Clinical Innovation. (2023*). Non-invasive ventilation for patients with acute respiratory failure: Clinical practice guide*. ACI. https://aci.health.nsw.gov.au/__data/assets/pdf_file/0004/820372/ACI-Non-invasive-ventilation-for-patients-with-acute-respiratory-failure.pdf

Oliveira, R. A. (2018). Non-invasive mechanical ventilation in acute respiratory failure. [Master's thesis not published, University of Porto, Abel Salazar Biomedical Sciences Institute].

Palma, A. C. (2018). Effectiveness of training in the acquisition of knowledge about caring for patients under non-invasive mechanical ventilation. [Master's dissertation, Polytechnic Institute of Leiria]

Pinto, C. J., & Sousa, P. M. (2017). *Non-invasive mechanical ventilation—development of guidelines using the Delphi methodology*. In M. Dixe & P. S. (Eds.), Building knowledge in nursing for critically ill patients (pp. 105–123). Polytechnic Institute of Leiria. https://iconline.ipleiria.pt/entities/publication/9e1b9c35-8559-4b31-a93e-e941579d6b86

Rochwerg, B., Brochard, L., Elliott, M. W., Hess, D., Hill, N. S., Nava, S., Paolo Navalesi, (members of the Steering Committee), Antonelli, M., Brozek, J., Conti, G., Ferrer, M., Guntupalli, K., Jaber, S., Keenan, S., Mancebo, J., Mehta, S., & Suhail Raoof (2017). Official ERS/ATS clinical practice guidelines: Noninvasive ventilation for acute respiratory failure. *European Respiratory Journal, 50*(2). https://doi.org/10.1183/13993003.02426-2016

Sadeghi, S., Fakharian, A., Nasri, P., & Kiani, A. (2017). Comparison of comfort and efficacy of total face mask and oronasal mask in non-invasive positive pressure ventilation in patients with acute respiratory failure: A case report. *Canadian Respiratory Journal*. https://doi.org/10.1155/1027/2048032

Sanchez, D., Smith, G., Piper, A., & Rolls, K. D. (2014). *Non-invasive ventilation guidelines for adult patients with acute respiratory failure. Agency for Clinical Innovation (NSW).* https://abrir.link/EzFfb

Scala, R., & Heunks, L. (2018). Highlights in acute respiratory failure. *European Respiratory Review, 27* (147), 1–4. https://doi.org/10.1183/16000617.0008-2018

Silva, R. M., Timenetsky, K. T., Neves, R. C. M., Shigemichi, L. H., Kanda, S. S., Maekawa, C., Silva, E., & Eid, R. A. C. (2013). Adaptation to different noninvasive ventilation masks in critically ill patients. *Jornal Brasileiro de Pneumologia, 39*, 469–475. https://doi.org/10.1590/S1806-37132013000400011