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THE BENEFITS OF NON-INVASIVE VENTILATION IN THE PRE-HOSPITAL CARE: AN INTEGRATIVE REVIEW OF THE LITERATURE

AS VANTAGENS DA VENTILAÇÃO NÃO INVASIVA NO PRÉ-HOSPITALAR: UMA REVISÃO INTEGRATIVA DA LITERATURA

LOS BENEFICIOS DE LA VENTILACIÓN NO INVASIVA EN LA PREHOSPITALARIA: UNA REVISIÓN INTEGRATIVA DE LA LITERATURA

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ABSTRACT

Introduction: Providing quality care to patients with respiratory failure is a priority in nursing practice, which implies a broad understanding of the principles underlying the various ventilation techniques. Non-invasive ventilation is increasingly being used in the pre-hospital context, thus reducing intubation rates, which cause so much discomfort to patients. Thus, this literature review will investigate the main advantages of non-invasive ventilation in the pre-hospital context.

Methodology: For the present study, an Integrative Literature Review was developed, using the following MeSH and key words: ((“Noninvasive Ventilation”) AND (“Pre-hospital Care”) AND (“Respiratory Insufficiency”)) and their corresponding terms in Portuguese in the PubMed, Medline and CINAHL databases. A total of 98 articles were found, and 34 articles were submitted for full-text reading.

Results: After applying the inclusion and exclusion criteria, 9 articles were included in this review, and the following benefits associated with pre-hospital noninvasive ventilation were identified: decreased rates of endotracheal intubation; decreased length of hospital stay; decreased mortality rate and contribution to the maintenance of vital signs.

Conclusion: Noninvasive ventilation is an important tool for successful clinical practice in patients with respiratory failure, and its use should be encouraged in the pre-hospital setting.

Keywords: Noninvasive Ventilation; Nursing; Pre-hospital Care; Respiratory Insufficiency.

RESUMO

Introdução: A prestação de cuidados de qualidade a doentes com insuficiência respiratória constitui uma prioridade da prática de enfermagem, o que implica uma ampla compreensão dos princípios subjacentes às diversas técnicas de ventilação. Cada vez mais, a ventilação não invasiva é utilizada no contexto pré-hospitalar, diminuindo-se assim as taxas de entubação, que tanto desconforto traz aos doentes. Deste modo, para a presente revisão da literatura vão-se investigar quais as principais vantagens da ventilação não invasiva em contexto pré-hospitalar.

Metodologia: Para o presente trabalho desenvolveu-se uma revisão integrativa da literatura, realizando-se uma pesquisa com os seguintes termos MeSH e chaves de pesquisa: ((“*Noninvasive Ventilation*”) AND (“*Pre-hospital Care*”) AND (“*Respiratory Insufficiency*”)), e seus correspondentes em português, nas bases de dados PubMed, Medline e CINAHL, obtendo-se

um total de 98 artigos, tendo sido submetidos para leitura do texto integral 34 artigos.

Resultados: Após aplicados os critérios de inclusão e exclusão incluíram-se 9 artigos na presente revisão, tendo-se identificado as seguintes vantagens associadas à ventilação não invasiva no pré-hospitalar: diminuição das taxas de entubação endotraqueal; diminuição do tempo de internamento; diminuição da taxa de mortalidade e contribuição para a manutenção dos sinais vitais.

Conclusão: A ventilação não invasiva revela ser uma importante ferramenta para o sucesso da prática clínica nos doentes com insuficiência respiratória, devendo apostar-se na sua utilização em contexto pré-hospitalar.

Palavras-chave: Assistência Pré-hospitalar; Enfermagem; Insuficiência Respiratória; Ventilação Não Invasiva.

RESUMEN

Introducción: Proporcionar una atención de calidad a los enfermos con insuficiencia respiratoria es una prioridad en la práctica de la enfermería, lo que implica un amplio conocimiento de los principios que subyacen a las distintas técnicas de ventilación. La ventilación no invasiva se utiliza cada vez más en el contexto prehospitalario, con lo que se reducen las tasas de intubación, que tantas molestias causan a los enfermos. Así, esta revisión bibliográfica investigará los principales beneficios de la ventilación no invasiva en el contexto prehospitalario.

Metodología: Para este trabajo se desarrolló una revisión integrativa de la literatura, utilizando los siguientes MeSH y palabras clave: ((“*Noninvasive Ventilation*”) AND (“*Pre-hospital Care*”) AND (“*Respiratory Insufficiency*”)), y sus correspondientes términos en portugués, en las bases de datos PubMed, Medline y CINAHL, obteniendo un total de 98 artículos, siendo sometidos para lectura de texto completo 34 artículos.

Resultados: Después de aplicar los criterios de inclusión y exclusión, se incluyeron 9 artículos en esta revisión. Se identificaron los siguientes beneficios asociados a la ventilación no invasiva prehospitalaria: disminución de las tasas de intubación endotraqueal; disminución de la duración de la estancia hospitalaria; disminución de la tasa de mortalidad y contribución al mantenimiento de los signos vitales.

Conclusión: La ventilación no invasiva revela ser una herramienta importante para el éxito de la práctica clínica en los enfermos con insuficiencia respiratoria, debiendo apostar por su uso en el contexto prehospitalario.

Descriptores: Atención Prehospitalaria; Enfermería; Insuficiencia Respiratoria; Ventilación No Invasiva.

INTRODUCTION

Ventilation is one of the prime areas of advanced life support, whose compromise puts the person at risk of life. Intervention with people with respiratory failure can be considered one of the achievements of the last century, which has contributed to the difference of hospital care and the creation of specific units in the area.

Looking back at history, in recent decades, the technique of Non-Invasive Ventilation (NIV) has seen its therapeutic value recognized and assumes a trend and protagonist use, both in hospitals and in the community. It was during the poliomyelitis epidemic (1930-1950) that the application of NIV began, using negative pressure ventilation (steel lung). In the 40s and 50s, positive pressure NIV was developed, which only became relevant in the 80s, with the introduction of Continuous Positive Airway Pressure (CPAP) for the treatment of Obstructive Sleep Apnea Syndrome (OSAS)[1].

It can be seen that NIV is has been in progress, and it is currently being adopted as a first-line treatment in various situations of cardiac-related respiratory failure. It contributes to lower morbidity and mortality and consequent health gains[2].

NIV can be defined as ventilatory therapy without the use of invasive methods, with the aim of improving lung compliance, allowing the recruitment of atelectasis alveoli and, consequently, increasing the area of gas exchange. On the other hand, it increases intrathoracic pressure, which promotes a decrease in pulmonary edema, decreasing preload and promoting improvement in cardiac function[3]. The general aims of NIV are to reduce the work of breathing, rest the respiratory muscles, improve gas exchange and, in patients with COPD, decrease auto-PEEP (Positive Expiratory End Pressure)[1].

Comparing invasive ventilation with NIV, NIV is a safer, more effective and more comfortable mode of ventilation for the patient and can be used intermittently. It is a method that does not cause injuries to the airway, since the endotracheal tube is not used and tracheostomy is not used, thus representing a lower risk of infection associated with health care[1]. There is also a shorter hospital stay, lower cost, easier weaning and lower mortality[4].

In NIV and invasive ventilation, there are two main ventilation modes: pressure-regulated ventilation or volume-regulated ventilation. In general, pressure-regulated ventilators are used in NIV, because they represent a lower cost, greater capacity to manage and compensate for leaks, the devices are portable, better tolerated by patients and can be used in acute or chronic situations[1].

In this sense, the essential aim of NIV is to increase alveolar ventilation in order to correct gas exchanges without resorting to invasive airway techniques, such as endotracheal intubation and tracheostomy, thus avoiding the possible complications arising therefrom, such as pneumonia, tracheal stenosis and pneumothorax, which may lead to prolonged hospitalization[5].

The most important factors for the success of NIV are careful patient selection, immediate application, type of approach to the patient, as well as adequate and comfortable equipment, location and interfaces, and, above all, that the professional is trained in the technique. The same authors refer to other predictive factors for the success of NIV, such as the absence of pneumonia, lower initial severity, scarce secretions, younger age, patient's ability to cooperate, patient/ventilator synchrony, better neurological score, good adaptation to the interface (no leaks), $PaCO_2$ between 92 mmHg and 45 mmHg, arterial blood pH between 7.35 and 7.10 and clinical and gas exchange improvement in the first two hours with NIV[1].

The principle for the success of NIV is the patient's collaboration and tolerance and that the effectiveness of this technique is not subordinated to the ventilator, but also to the choice of interface. In this way, NIV intolerance is related to poor use of interfaces, and it is estimated that 50% of failures are due to misuse[6]. The choice of interface is a crucial aspect for the success of NIV. According to the same authors, there are currently several interfaces available: nasal masks, face masks (oronasal masks), full face masks, helmet, mouthpieces and nasal pillows[1].

Considering the pandemic that the world has experienced in the last two years, marked by the spread of the respiratory infection caused by SARS-CoV-2, in a pre-hospital context, the use of NIV has been increasing, leading to a decrease in what concerns intubation rates as well as a reduction in the mortality rate[7]. Therefore, and in regard to respiratory failure, health professionals should think about the form of ventilation with the most benefits and the least risks, considering the patient's situation. Thus, this article will investigate the main advantages of NIV in a pre-hospital context, regarding the evidence that emerges from professional practice.

METHODOLOGY

In order to deepen knowledge about NIV, namely about the advantages that this practice has in a pre-hospital context, an integrative literature review (ILR) was carried out.

For the construction of the research question, the search terms were used, considering the guidelines of the PCC terminology – Population, Context and Concept, as described in Chart 1↗.

Thus, the following research question was formulated: "What are the advantages of NIV, in patients with respiratory failure, in a pre-hospital context?"

The selected Health Sciences (DeCS) and Medical Subject Headings (MeSH) Descriptors were grouped according to the Boolean expression ("Noninvasive Ventilation") AND ("Pre-hospital Care") AND ("Respiratory Insufficiency").

The research was carried out in the CINAHL, Medline and PubMed databases, obtaining a total of 98 articles, subsequently submitted to analysis, according to the defined inclusion and exclusion criteria (Chart 2↗).

A total of 34 articles were submitted to reading the full text, of which, considering the application of the aforementioned inclusion and exclusion criteria, 9 were selected. Figure 1↗ shows the flow diagram according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology, presenting each of the phases until reaching the final number of articles included in this integrative literature review.

RESULTS

Nine articles were selected for this review, as they fulfilled the previously identified requirements. A descriptive summary of the main aspects of each of the studies is presented in Chart 3↗.

DISCUSSION

The application of NIV in a pre-hospital context seems to improve vital signs compared to the application of exclusive pharmacological treatment. At the same time, there is a trend towards a lower intubation rate later, in the context of hospitalization[8].

In another study, the reduction in the rate of intubation was also identified, as well as the reduction in mortality, and the relationship between the cost of the technique and its effectiveness was also evaluated, proving to be appropriate[9]. Also in victims with acute pulmonary edema, NIV when started in a pre-hospital context proves to be quite effective, significantly reducing the need for endotracheal intubation in these patients, being described as a measure that promotes clinical efficacy in the treatment of this disease[10]. In fact, all identified international trials have shown that NIV initiated in a pre-hospital setting is more effective than standard pharmacological treatment in terms of reducing the need for intubation and invasive ventilation in a hospital setting[11].

Even when the distance between the place of occurrence and the hospital is short, prehospital treatment with NIV, in patients with an acute exacerbation of chronic obstructive pulmonary disease and acute cardiogenic pulmonary edema, proves to be quite effective, also presenting a stabilizing effect on the victims' vital signs[12].

NIV is very effective in prehospital settings, as well as in poorly differentiated units with access to fewer resources and can be considered a first-line option in patients with mild fatigue or significant hypercapnia, including those suffering from obstructive pulmonary disease. associated chronic. The high-flow nasal cannula is an alternative for patients who need prolonged ventilation or those who show little tolerance for invasive ventilation techniques[13]. It has also proven to be a very effective method in patients with chronic obstructive pulmonary disease with altered levels of consciousness and acidosis, thus avoiding endotracheal intubation in these patients[14].

The administration of NIV in a prehospital context is only effective if emergency transport is well equipped and professionals well trained in this ventilation technique. In general, and as confirmed by previous studies, there is a reduction in the intubation rate, a decrease in the mortality rate and in the length of hospital stay[15]. In the specific case of Covid-19, it is important to adapt procedures related to NIV in order to minimize the risk of contagion of health professionals and to optimize the treatment of patients[15]. In fact, the adequacy of NIV is responsible for its success, as patients with inadequate NIV had a higher rate of in-hospital intubation than patients with indicated NIV[16].

CONCLUSION

In recent years there has been a growing enthusiasm for the use of NIV. Conclusively, we state that non-invasive ventilation is a technique with proven relevance in the treatment of respiratory problems, constituting a widely accepted therapeutic strategy in respiratory failure of different etiologies, with applicability in the pre-hospital context. The interest is very high, since this is a technique that offers many advantages compared to invasive ventilation.

The development of studies in the area of NIV must prevail, in order to identify its applications, new benefits and possible complications, and consequently, specific measures to minimize its existence, in order to promote comfort measures for people in need of treatment with NIV.

REFERENCES

1. Ferreira S, Nogueira C, Conde S, Taveira N. Ventilação não invasiva. Revista Portuguesa de Pneumologia. 2009;XV(4):655-667. Available from: https://doi.org/10.1016/S0873-2159(15)30162-8

2. Esquinas M. Princípios da Ventilação Mecânica Não Invasiva – Do Hospital ao Domicílio, 1.ª ed. Portugal, Vila do Conde: Gasin Médica; 2011.

3. Pereira J, Sequeira R, Marques M, Oliveira N, Realista S. Ventilação não- invasiva: opção terapêutica nos cuidados ao doente com dispneia em contexto pré-hospitalar. Nursing Magazine Digital; 2016:1-14. [cited 2022 Nov 15]. Available from: https://www.researchgate.net/publication/320934759

4. Felgueiras J, Lohmann C, Delerue F, Barata J. Ventilação Não Invasiva numa Unidade de Cuidados Intermédios. Revista da Sociedade Portuguesa de Medicina. 2006;13(2):73-78. [cited 2022 Nov 21]. Available from: https://www.spmi.pt/revista/vol13/vol13_n2_2006_073_078.pdf

5. Roque B, Branco E, Caetano F, Seixas I, Alves L, Fernandes R, et al. Ventilação Não Invasiva – Manual, 1ª ed. Portugal, Lisboa: Centro Hospitalar Lisboa Norte; 2014.

6. Magano C, Reis M, Guedes P, Brito R, Mourisco S. Ventilação Não Invasiva. Sinais Vitais. 2007;72:13-19

7. Al Ahmari M, Sreedharan J. Noninvasive ventilation in prehospital settings: A narrative review. Indian Journal of Respiratory Care. 2020; 9(1):20. Available from: https://doi.org/10.4103/ijrc.ijrc_54_19

8. Bakke S, Botker M, Riddervold I, Kirkegaard H, Chirstesnsen E. Continuous positive airway pressure and noninvasive ventilation in prehospital treatment of patients with acute respiratory failure: a systematic review of controlled studies. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine. 2014;22(6):1-13. Available from: https://doi.org/10.1186/s13049-014-0069-8

9. Pandor A, Thokaala P, Goodacre S, Poku E, Stevens J, Ren S, et al. Pre-hospital non-invasive ventilation for acute respiratory failure: a systematic review and cost-effectiveness evaluation. Health Technology Assessment. 2015; 19(42):1-130. Available from: https://doi.org/10.3310/hta19420

10. Alves M, Cunha M, Marques N. Ventilação não invasiva no edema agudo do pulmão. Investigação Qualitativa em Saúde, 2016:654-659. [cited 2022 Nov 21]. Available from: https://proceedings.ciaiq.org/index.php/ciaiq2016/article/view/ 806/792

11. McCreesh S. Non-invasive ventilation as a prehospital intervention for acute COPD exacerbation. Journal of Paramedic Practice. 2019; 11(9):376-380. Available from: https://doi.org/10.12968/jpar.2019.11.9.376

12. Hensel M, Struden M, Tank S, Gagelmann N, Wirtz S, Kerner T. Prehospital non-invasive ventilation in acute respiratory failure is justified even if the distance to hospital is short. American Journal of Emergency Medicine, 2018;37:651-656. Available from: https://doi.org/10.1016/j.ajem.2018.07.001

13. Masin J. Noninvasive Ventilation in Acute Heart Failure. Current Heart Failure Reports. 2019; 16:89-97. Available from: https://doi.org/10.1007/s11897-019-00429-y

14. Fubini P, Suppan L. Prehospital reversal of profound respiratory acidosis and hypercapnic coma by noninvasive ventilation: a report of two cases. International Journal of Emergency Medicine. 2020;13(22):1-3. Available from: https://doi.org/10.1186/s12245-020-00284-y

15. Marques T, Neves D. Ventilação Não Invasiva (VNI) No Pré-Hospitalar Em Tempos De Covid-19. Live Saving, 2021;9:35-43. [cited 2022 Nov 21]. Available from: https://www.chualgarve.min-saude.pt/wp-content/uploads/sites/2/2021/05/Lifesaving-20.pdf

16. Pinczon J, Terzi N, Usseglio-Polatera P, Gheno G, Savary D, Debaty G, et al. Outcomes of Patients Treated with Prehospital Noninvasive Ventilation: Observational Retrospective Multicenter Study in the Northern French Alps. Journal of Clinical Medicine, 2021;10(1359):1-8. Available from: https://doi.org/10.3390/jcm10071359

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Authors' contributions
SP: Study coordination, study design, data collection, storage and analysis, review and discussion of results.
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CC: Study design, data analysis, review and discussion of results.
NR: Study design, data analysis, review and discussion of results.
RA: Study design, data analysis, review and discussion of results.
TA: Study design, data analysis, review and discussion of results.
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Chart 1 – Construction of the research question – PCC terminology.

Research terminology	Research terms
Population **(P)**	Patients with respiratory failure
Context **(C)**	Pre-hospital context
Concept **(C)**	Advantages of Non-Invasive Ventilation

Chart 2 – Inclusion and exclusion criteria for articles analyzed in IRL.

Inclusion criteria for articles	Exclusion criteria for articles
a) Access to the full text; b) Articles in Portuguese and English; c) Studies on NIV; d) Pre-hospital context; d) Articles published between 2012 and 2022.	a) Duplicate articles; b) Articles in languages other than those considered in the inclusion criteria; c) Studies on Invasive Ventilation; d) Studies on other health practices; e) Studies developed in other contexts; f) Studies published before 2012.

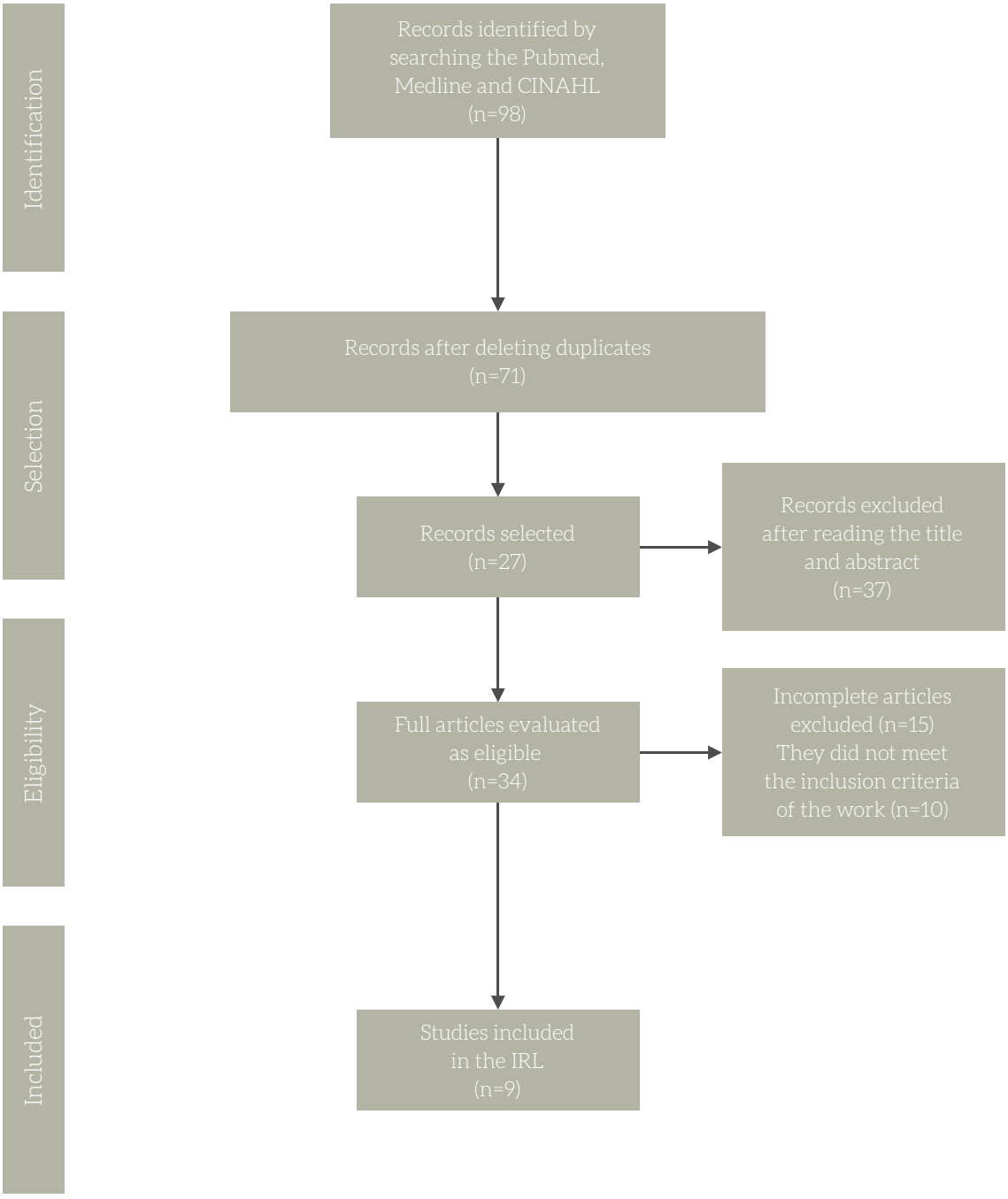


Figure 1 – PRISMA article selection flowchart.[↖]

Chart 3 – Descriptive summary of the included studies.

Title	Authors/Year/ Country/Publication	Objectives	Methodology and evidence level	Results	Main conclusions/ implications for practice
Continuous positive airway pressure and noninvasive ventilation in pre-hospital treatment of patients with acute respiratory failure: a systematic review of controlled studies.	Bakke S, Botker M, Riddervold I, Kirkegaard H, Chirstesnsen E. 2014. Denmark. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine.	Our aim was to evaluate the evidence of NIV as an adjunct to standard medical care only on the following outcome measures: mortality, length of hospital stay, length of stay in the intensive care unit and intubation rate.	Systematic review of the literature. Evidence level: 3a.	The four studies examine prehospital CPAP. Of these, only a small randomized controlled trial shows reduced mortality and reduced intubation rate with supplemental CPAP. The other three studies have neutral results, but in two of these, there is a trend towards a lower intubation rate. The effect of supplemental NIV has only been evaluated in smaller studies with insufficient power to conclude on our endpoints. None of these studies showed a effect on neither mortality nor intubation rate, but two small trials show a reduction in length of stay in the intensive care unit and a trend towards a lower rate of intubation.	When CPAP is used in the pre-hospital setting on a supplement basis appears to improve vital signs compared to using standard medical treatment alone and there is a trend towards a lower rate of intubation.
Pre-hospital non-invasive ventilation for acute respiratory failure: a systematic review and cost-effectiveness evaluation.	Pandor A, Thokaala P, Goodacre S, Poku E, Stevens J, Ren S, Cantrell A, Perkins G, Ward M, Penn-Asman. 2015. The United Kingdom. Health Technology Assessment.	To determine the clinical efficacy and cost-effectiveness of NIV in the pre-hospital setting compared to usual care for adults presenting to emergency departments with acute respiratory failure.	Systematic review of the literature. Evidence level: 3a.	Pooled data suggest that CPAP was the most effective treatment in terms of mortality (probability = 0.989) and intubation rate (probability = 0.639), and reduction of both mortality rates and intubation rates compared with standard care. The meta-analysis suggested that gender was a statistically significant modifier of the treatment effect on mortality compared with standard care.	Prehospital NIV can reduce mortality and intubation rates, but cost-effectiveness is uncertain and the value of further randomized evaluation depends on the incidence of suitable patients. Cost-effectiveness is appropriate.

Chart 3 – Descriptive summary of the included studies.

Title	Authors/Year/ Country/Publication	Objectives	Methodology and evidence level	Results	Main conclusions/ implications for practice
Non-invasive ventilation in acute pulmonary edema.	Alves M, Cunha M, Marques N. 2016. Portugal. Qualitative investigation in health.	To analyze the evidence from studies on the effectiveness of Non-Invasive Ventilation (NIV) in victims with Acute Lung Edema (ALE), in Prehospital (PH), regarding the need for endotracheal intubation and the Influence on Mortality.	Systematic review of the literature. Evidence level: 3a.	The application of NIV significantly reduced the need for endotracheal intubation compared to the use of standard medical treatment alone. However, and despite the benefits, the use of NIV associated with standard pre-hospital medical treatment did not translate into significant differences in survival.	The use of NIV in patients with ALE in the pre-hospital setting compared to the exclusive application of standard medical treatment reduces the need for endotracheal intubation, a result that supports NIV as a therapeutic measure that promotes clinical efficacy.
Pre-hospital non-invasive ventilation in acute respiratory failure is justified even if the distance to hospital is short.	Hensel M, Struden M, Tank S, Gagelmann N, Wirtz S, Kerner T. 2018. Germany. American Journal of Emergency Medicine.	Evaluation of the effectiveness of pre-hospital non-invasive ventilation (NIV) in patients with acute exacerbation chronic obstructive pulmonary disease (COPD) and cardiogenic pulmonary edema (CPE).	Prospective study. Evidence level: 3b.	A total of 99 patients were analyzed (NIV group 1: n= 41, NIV group 2: n= 58). The control group consisted of 30 patients. All endpoints showed significant improvement in the NIV groups compared to the control group. The stabilizing effect of NIV in terms of vital parameters were comparable between the two groups undergoing NIV, regardless of treatment duration.	Pre-hospital treatment with NIV should be performed in patients with COPD and CPE, even if the distance between the place of occurrence and the hospital unit is short.

Chart 3 – Descriptive summary of the included studies.

Title	Authors/Year/ Country/Publication	Objectives	Methodology and evidence level	Results	Main conclusions/ implications for practice
Noninvasive ventilation in acute heart failure.	Masip J. 2019. Spain. Current Heart Failure Reports.	Evaluate the role of non-invasive ventilation in acute heart failure (AHF).	Narrative review of the literature. Evidence level: 5.	Non-invasive ventilation is equally effective in the pre-hospital setting and in less differentiated units and may be preferable in patients with mild fatigue or significant hypercapnia, including those suffering from chronic obstructive pulmonary disease (COPD). The high-flow nasal cannula is an alternative for patients who require prolonged ventilation or those who show little tolerance for these techniques.	NIV should be used as first-line therapy in all patients with acute cardiogenic pulmonary edema and should be considered in stable cardiogenic shock and AHF associated with COPD.
Non-invasive ventilation as a pre-hospital intervention for acute COPD exacerbation.	McCreesh S. 2019. The United Kingdom. Journal of Paramedic Practice.	To examine the suitability of NIV as a pre-hospital intervention in chronic obstructive pulmonary disease.	Narrative review of the literature. Evidence level: 5.	International trials have shown that pre-hospital NIV is more effective than standard medical treatment in terms of reducing the need for intubation and the use of invasive ventilation in the hospital.	More research is needed before NIV is introduced widely into UK pre-hospital practice.
Pre-hospital reversal of profound respiratory acidosis and hypercapnic coma by noninvasive ventilation: a report of two cases.	Fubini P, Suppan L. 2020. Switzerland. International Journal of Emergency Medicine.	Report of two cases of acute respiratory failure in patients with chronic obstructive pulmonary disease who were successfully treated by pre-hospital NIV despite contraindications.	Case study. Evidence level: 4.	Although the clinical response using a well-adjusted NIV or medical treatment can be both rapid and spectacular, the contraindications described in the literature are likely to encourage clinicians to proceed with tracheal intubation. Some studies report that NIV was not even considered in 60% of patients who could have benefited from this treatment, although complications related to invasive ventilation could have been avoided if NIV had been successfully applied.	In patients with COPD who present with acute respiratory failure, treatment with NIV could be considered even when relative contraindications are present, such as an altered level of consciousness or severe respiratory acidosis.

Chart 3 – Descriptive summary of the included studies.

Title	Authors/Year/ Country/Publication	Objectives	Methodology and evidence level	Results	Main conclusions/ implications for practice
Outcomes of patients treated with pre-hospital noninvasive ventilation: Observational retrospective multicenter study in the Northern French Alps.	Pinczon J, Terzi N, Usseglio-Polatera P, Gheno G, Savary D, Debaty G, Peigne V. 2021. France. Journal of Clinical Medicine.	The aim of this study was to assess the appropriateness of using NIV in a pre-hospital setting, where diagnosis is primarily based on clinical examination.	Retrospective multicenter observational study. Evidence level: 2b.	Prehospital NIV was inadequate for 32 (21%) patients. Patients with inadequate NIV had a higher rate of in-hospital intubation than patients with appropriate NIV (38% vs. 8%; $p < 0.001$).	This high frequency of inappropriate NIV could be reduced through improved prehospital detection of pneumonia.
Non-invasive ventilation (NIV) in the pre-hospital in times of Covid-19.	Marques T, Neves D. 2021. Portugal. Live Saving.	To present the adequacy of NIV in the context of Covid-19.	Narrative review of the literature. Evidence level: 5.	In the current era of the Covid-19 pandemic, it is essential to know how to adapt all clinical practice to ensure the safety of healthcare professionals without placing jeopardize the health of patients. NIV is a technique that leads to the dispersion of aerosols, so the your institution should be readjusted to minimize the risk.	The administration of NIV in pre-hospital context can be effective if emergency transport is well equipped and if health professionals health are well trained in this modality. in patients selected, there is a reduction in the intubation rate, a decrease in mortality rate and length of hospital stay. Against the Covid-19 pandemic, it is important to know how to adjust the procedures related to the institution of NIV in order to minimize the risk of contagion and to optimize the treatment of patients.