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Review article

Comparison between High Flow Nasal Cannula and Non-Invasive Mechanical Ventilation in the Management of Patients with Acute Respiratory Failure: a Meta-Analysis

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Abstract:

Background: Acute respiratory failure is potentially life threatening. It does not require immediate intubation and the likelihood of a positive result hinges on the doctor's capacity to promptly identify the syndrome and implement suitable actions to aid and recover respiratory system function. **Objectives:** The research aimed to contrast the use of high-flow nasal cannula and non-invasive mechanical ventilation in treating patients experiencing acute respiratory failure. Study design: A meta-analysis study adhering to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines-was conducted. **Methods:** Online databases (PubMed, EMBASE, Biomed, and the Cochrane Central Register of Controlled trials)-were utilized to detect all published randomized studies that compare the impact of high-flow nasal cannula with non-invasive ventilation in patients dealing with acute respiratory failure. **Results:** Thirteen trials, encompassing a total of 1284 patients, were incorporated in the study. The risk of bias was minimal. The results revealed no substantial decrease in mortality. There was a significant reduction in length of hospital stay and a significant improvement in comfort score favouring the high flow nasal cannula group. However, there was no significant change in length of ICU stay, intubation rate, PaCO2, PaO2, PaO2/FiO2 ratio, SpO2, MAP and HR. **Conclusion:** This meta-analysis showed no significance of high flow nasal cannula over non-invasive mechanical ventilation in reducing mortality rates. However, high flow nasal cannula is associated with reduction of length of hospital stay and improvement of comfort score.

Keywords: Non-invasive mechanical ventilation; High flow nasal cannula; Acute respiratory failure; Meta-analysis; Randomized trials.

Introduction

Acute respiratory failure (ARF) is marked by critical disturbances in acid-base balance and arterial blood gases that occur within hours or days. While ARF may not necessitate immediate intubation, it can pose a life-threatening condition. [1].

In Acute Exacerbation of Chronic Obstructive Pulmonary Disease (AECOPD), ARF is distinguished by the exacerbation of hypoxemia and varying levels of carbon dioxide (CO2) build-up and acidosis. In AECOPD, the primary reason for hypoxemia is typically the deterioration in the ventilation-to-perfusion ratio (V/Q mismatch), characterized by an increase in physiological dead space and wasted ventilation. Non-Invasive Ventilation (NIV) is considered the initial treatment choice for patients experiencing AECOPD in these situations. [2]

Patients suffering from severe acute hypoxic respiratory failure (AHRF) receive oxygen therapy via either high-flow nasal cannula (HFNC) or non-invasive ventilation (NIV) [3] .

Non-invasive ventilation (NIV) using a mask was introduced in the 1990s with the main objective of reducing the requirement for invasive mechanical ventilation (IMV) and the associated complications linked to IMV [4].

High-flow nasal cannula oxygen therapy (HFNC) is a delivery system for gases that furnishes warmed and humidified air through a nasal cannula, along with supplementary oxygen as needed. [5]

HFNC supportive therapy has emerged as a secure and beneficial treatment for respiratory failure, enhancing both comfort and oxygenation levels. [6]

Nonetheless, the likelihood of a positive outcome in patients with acute respiratory failure (ARF) significantly hinges on the early recognition of the syndrome by physicians and their skill in implementing suitable measures to support and restore respiratory system function. [7]

This meta-analysis aims to compare the efficacy of HFNC and NIV in the management of type I and type II respiratory failure.

Materials and Methods:

This study follows the guidelines for reporting items for systematic reviews and meta-analysis (PRISMA). [8] No patient consent was required as all analysed data were collected from previously published literature. The Research Ethics Committee (REC) code and number is {M.S.38.10.2022}. This study was conducted over a period of 6 months from February 2023 to July 2023 at the department of Anaesthesia and Intensive Care, Faculty of Medicine, Benha University.

Search Strategy:

To identify all published randomized studies comparing the impact of high-flow nasal cannula and non-invasive ventilation in acute respiratory failure patients, we searched PubMed, MEDLINE, EMBASE, and Cochrane databases.

Furthermore, we utilized a backward snowballing approach, which involved examining the references of the articles we retrieved and relevant reviews, to acquire additional studies. We did not impose any language restrictions during this process. The used PubMed search strategy is provided as Supplementary Material.

Selection of studies:

We identified relevant articles through the following search terms: “non-invasive ventilation”, "high flow nasal cannula,", "acute respiratory failure," and "randomized trials." Our focus was on studies involving adult human subjects. Additionally, we reviewed the reference lists of related articles. In cases where we encountered duplicate reports of the same study in preliminary abstracts and full articles, we analysed data from the most

comprehensive dataset available. It's important to note that approval from the Institutional Review Board was not deemed necessary for this study.

Exclusion criteria:

Studies were excluded if they did not adhere to the eligibility criteria, fell under the categories of letter to editors, case studies, systematic reviews, or meta-analyses. Additionally, studies were excluded in case of lacked data, and the authors of the studies were unreachable or did not respond when additional trial data were needed. Furthermore, exclusion was done for studies with outcomes not pertinent to the research objectives.

Data extraction:

Independent data extraction was done from each report by the authors, utilizing a data-recording form specifically designed for this task. Subsequently, the extracted data were meticulously reviewed and cross-referenced. In cases where disagreements arose between the two data extractors, a consensus was reached among the investigators to resolve them. Additionally, when necessary, further information pertaining to a particular study was acquired through direct communication with the principal investigator.

Definition of endpoints:

The outcomes of interest in this review were oxygenation parameters, vital signs, need for intubation, mortality and hospital stay.

Quality assessment and risk of bias:

We assessed the quality of the trials by employing the risk of bias assessment tools recommended by the Cochrane Collaboration. For various criteria such as random sequence generation, allocation concealment, blinding, completeness of outcome data, selective reporting, and other potential sources of bias- we categorized our judgments as "high," "unclear," or "low." In cases where differences in these assessments arose, we resolved them through deliberations and discussions among the members of our research team.

Statistical analysis:

The objective of this analysis was to combine the findings of trials that compared the impact of high-flow nasal cannula and non-invasive ventilation in patients with acute respiratory failure. We conducted this analysis using Review Manager (RevMan), Version 5.3, which is a software developed by The Nordic Cochrane Centre, the Cochrane Collaboration, in 2014.

To assess heterogeneity among the included studies, we utilized the I2 statistic. For pooling the results, we employed random-effects models. When analysing continuous outcomes, we calculated the mean difference (MD) along with the corresponding 95% confidence intervals (CIs). Statistical significance was determined based on a two-sided α level of 0.05, and our interpretations regarding clinical significance were primarily based on the CIs.

Results

Literature search study:

Our comprehensive search initially yielded a total of 7530 studies from various sources, including database searches and other means. Following the removal of duplicate entries and the exclusion of irrelevant records, we subjected 298 studies to eligibility assessment. Ultimately, 13 trials met the inclusion criteria and were selected for analysis, while the remaining studies were excluded, as indicated in the PRISMA flow diagram (**Figure 1**).

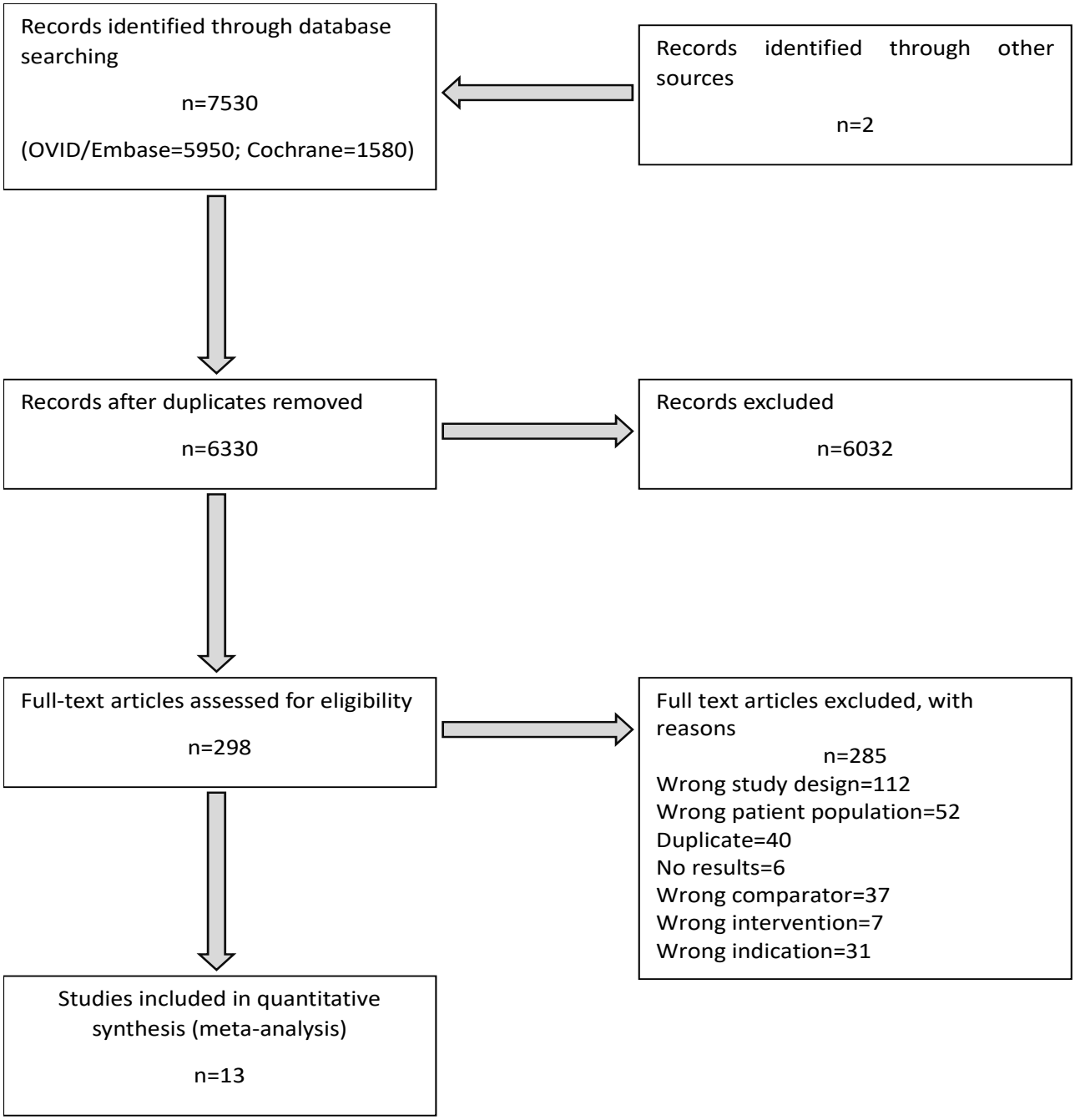

Figure (1). Literature search strategy

Characteristics and quality of studies included in the meta-analysis:

Table (1) shows the studies that were incorporated into the analysis. A total of 13 studies were identified for inclusion in this study, encompassing 1284 patients. Notably, the bias risk in 12 trials was generally assessed to be low, as depicted in **Figure (2)**.

Table (1a): Characteristics of included studies:

Study ID	Sub group	Study design	Setting	Age	Cause of ARF	No of patients	Interventions	Femal e/male	BMI	Comorbidity	Concomitant medication
Schwabbauer et al, 2014 [9]	HFNC	RCT	ICU	NR	Pneumonia Alveolar haemorrhage Connective tissue disease	14	55 L/min Fio2 60%	NR	NR	NR	NR
	NIV						PEEP 3-5 cm H2O Expiratory TV 6-8ml/kg				
Vargas et al, 2015 [10]	HFNC	Prospective RCT	ICU	63(59-73)	Acute hypoxemic RF HF CAP Nosocomial pneumonia Immunosuppressed	12	60L/min Temp37C	NR	NR	NR	NR
	NIV						BiPAP vision CPAP 5 cm H2O				
Frat et al, 2015 [11]	HFNC	Prospective multicentre RCT	ICU	61±16	Acute hypoxemic RF (Pneumonia)	106	50L/min FiO2 100%	31/75	25±5	NR	NR
	NIV			61±17		110	TV 7-10ml/kg PEEP 2-10 cmH_2O FiO_2 optimized to maintain SO_2 92%	36/74	26±6		
Doshi et al, 2017 [12]	HFNC	Multicentre, randomized trial	ED	63.4±13.6	Asthma Acute decompensated HF AECOPD Acute hypercapnic RF Acute hypoxic RF Acute hypoxic and hypercapnic RF Pneumonia/ sepsis	104	Flow 35 (up to 40) L/min FiO_2 100% Temp 35-37°C	60/44	31.8±11.2	NR	NR
	NIV			63.3±14.8		100	IPAP 10-20 cmH_2O EPAP 5-10 cmH_2O FiO_2 100%	54/46	31.2(11.3)		
Tan et al, ٢٠١٨ [13]	HFNC	Multicentre randomized controlled trial	ICU	٦٨.٤+9.3	COPD with hypercapnic respiratory failure	٤٨	50L/min Humidity 44 mgH2O/L Tem37 C FIO2 adjusted to maintain SPO2 88-92%	17/27	NR	HTN (25) DM (10) Liver (2) Renal (12) Malignancy (6) Cerebrovascular (13) Coronary (13)	NR
	NIV			٧١.٤+7.8		٤٨	EPAP 4 cmH2O gradually increased IPAP 8 cmH2O gradually increased FIO2 adjusted to maintain SPO2 88-92% and RR ≤ 28	19/23		HTN (17) DM (14) Liver (5) Renal (8) Malignancy (3) Cerebrovascular (7) Coronary (16)	
Lee et al,2018 [2]	HFNC	Prospective observational trial	ED	73(68-79)	AECOPD (pneumonia, HF, pulmonary embolism, unknown)	44	Flow 35L/min Fio2 more than50% Titrate flow to 45-60L/min Fio2 adjusted to maintain SPO2≥92%	16/28	21.1(19.9-22.8)	HTN (19) DM (12) HF (6) Old TB (6}	Corticosteroid Long-acting muscarinic antagonist Long acting B2 agonist
	NIV			77(71-80)		44	Bilevel Expiratory TV 7-10 ml/Kg for ideal body weight IPAP 10 cmH2O and increment 2-4 to 20 cmH2O or to maximum tolerated over 1 hour BiPAP level adjusted to maintain SPO2≥92%	15/29	21.5(18.5-23.3)	HTN (22) DM (17) HF (11) Old TB (8)	
Jing et al, 2019 [14]	HFNC	A pilot RCT	ICU	77.4±6.8	Pulmonary encephalopathy Chronic corpulmonale Bronchiectasis Coronary disease Cerebral infarction	22	Temp 37°C FiO_2 optimized to maintain SpO_2 88-92% 8 hours daily	NR	NR	Chronic core pulmonale (19) Bronchiectasis (0) Coronary disease (7) Cerebral infarction (3	NR
	NIV			73.9±6.9		20	IPAP 10-12 EPAP 4-5 FiO_2 optimized to maintain SpO_2 88-92% 8 hours daily			Chronic core pulmonale (18) Bronchiectasis (2) Coronary disease (4) Cerebral infarction (1)	

Table (1b): Characteristics of included studies:

Study ID	Sub group	Study design	Setting	Age	Cause of ARF	No of patients	Interventions	Female/male	BMI	Comorbidity	Concomitant medication
Cong et al, 2019 [15]	HFNC	RCT Prospective	ICU	66.91±7.38	AECOPD HF Pneumonia	84	Flow 30 35L/minTemp37°c	36/48		NR	Antibiotic Bronchodilator glucocorticoid
	NIV			67.88±8.38		84	IPAP 10cmH2O EPAP 5 cmH2O	34/50	NR		
Cortegioni et al, 2020 [16]	HFNC	Multicentre RCT	ICU	74±13	AECOPD	40	Flow 60L/min Temp 37 °C	19/21	30.5±8.7	NR	sedation
	NIV			77±12		39	PEEP 3-5 cmH2O Expiratory TV 6-8 ml/kg	20/19	26.7±5.5		
Papachatzakis et al, 2020 [17]	HFNC	Randomized Clinical Trial	ICU	77.0+11.0	Hypercapnic respiratory failure	20	35(up to45-50) L/min to maintain Sa2 more than 90%	10/10	25.9(8.0)	DM (9) CHF (8) COPD (14)	Pulmonary medication
	NIV			76+13.4		20	BiPAP in spontaneous/timed mode Inspiratory and expiratory pressure gradually increased to the maximum tolerated over 1 h to maintain So2 more than 90%	1/19	30.9 (8.5)	DM (9) CHF (9) COPD (11)	
Thille et al¸ 2021 [18]	HFNC	Post hoc analysis of multicentre RCT	ICU	66±9	Post extubation failure have (smoking, COPD or hyperinflation during mechanical ventilation	64	Flow rate 50±3L /min Fio242±0.13	16/48	14	NR	NR
	NIV			66±9		86	PS 7.9±2.4 cmH2O PEEP 5.2±1.3cmH2O Fio2 0.34±0.3 Resulting in TV 8.8±3.6 ml/Kg for first 14 h in first 24h after extubation and for 23 h in48h	14/25	25		
Grieco et al¸ 2021 [19]	HFNC	A Randomized multicentre trial	ICU	63(55-69)	Covid -19	55	Flow 60L/min Decrease in case of intolerance and titrated to maintain SPO2(92-98%) Temp (34-37ºc	9/46	28(26-31)	HTN (33) Type 2 DM (10) Immunocompromised (5)	Dexamethasone Remidisvir
	NIV			66(57-72)		54	Ps(10-12)cmH2o increased to flow 100L/min PEEP 10-12 cmH2O Fio2 titrated to maintain SPO2 (92-98%) After 48h Fio2 ≤25 PEEP 8 cm H2O SPO2 92%	12/42	27(26-30)	HTN (24) Type 2 DM (13) Immunocompromised (3)	
Mohamed et al, 2022 [20]	HFNC	Prospective RCT	ICU Chest department	37-85 mean ±SD 62±11.7	Sever pneumonia	20	Fio2 100% adjusted to SPO2≥92% Flow titrated downward in 5L/min till flow 20L/min Fio2 down ward till Fio2 50% SPO292% SPO2/Fio2To RR after 12h	14/6	NR	NR	NR
	NIV			21-81 mean±SD 59.5±19.8		20	PS adjusted to TV5-8 ml/Kg Initial PEEP8 cmH2O Fio2¸PEEP level adjusted to maintain SPO2 92% for minimum 8h/ day For 2 days at least	10/10			

Table (1a, b): All data are presented as mean ± standard deviation or median (interquartile range). ARF, acute respiratory failure; NIV, non-invasive ventilation; HFNC, high flow nasal cannula; RCT, randomized controlled trial; ICU, intensive care unit; PEEP, positive end-expiratory pressure; TV, tidal volume; PS, pressure support; BiPAP, bilevel positive airway pressure; IPAP, inspiratory positive airway pressure; EPAP, expiratory positive airway pressure; Temp, temperature; CAP, community acquired pneumonia; HF, heart failure; CHF, congestive HF; COPD, chronic obstructive pulmonary disease; AECOPD, acute exacerbation of COPD; HTN, hypertension; DM, diabetes mellitus; TB, tuberculosis; NR, not recorded.

Figure (2): (A) risk of bias graph illustrates the review authors' judgments regarding each risk of bias item, represented as percentages across all the studies included in the analysis. (B) Risk of bias summary presents the review authors' judgments about each risk of bias item for each individual study included in the analysis.

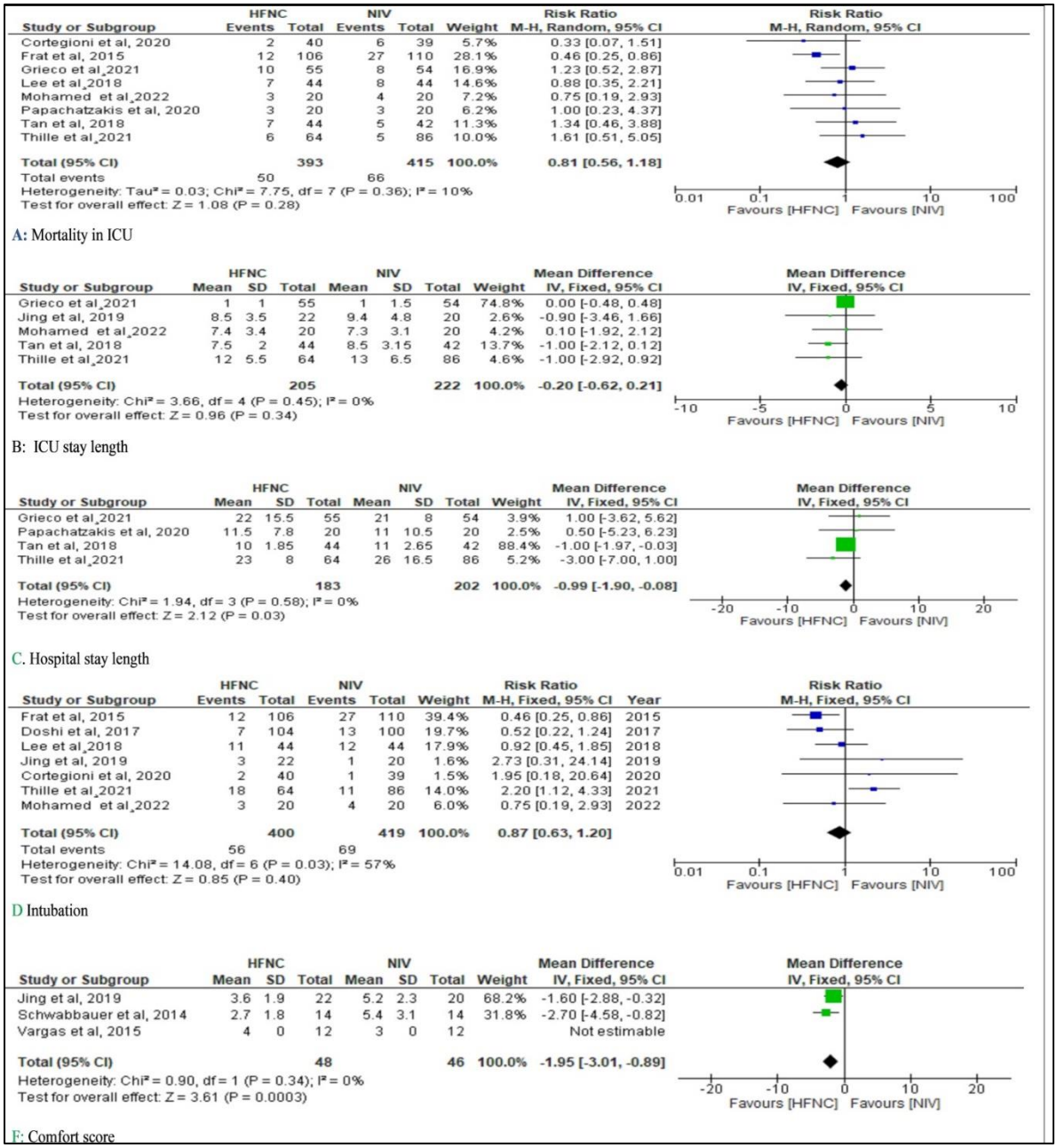

Figure (3): **(A):** Eight studies, involving a total of 808 patients (393 in the HFNC group and 415 in the NIV group), and provided data on the number of deaths. The calculated risk ratio, along with its 95% confidence interval (CI), was 0.81 (0.56, 1.18) units, with an I2 value of 10%. The result did not reach statistical significance (p=0.28) when applying a fixed-effects model. **(B):** In five studies involving 427 patients (205 in the HFNC group and 222 in the NIV group) that reported the length of ICU stay, the pooled mean difference (MD) was -0.20, with a 95% CI of -0.62, 0.21 units. The I^2 value was 0%, indicating low heterogeneity. The result was not statistically significant (p=0.34) when utilizing a fixed-effects model. **(C):** In four studies involving a total of 385 patients (183 in the HFNC group and 202 in the NIV group) that reported the length of hospital stay, the pooled mean difference (MD) was -0.99, with a 95% CI of -1.99, -0.08 units. The I^2 value was 0%, indicating low heterogeneity. The results reached statistical significance (p=0.03) when applying a fixed-effects model. **(D):** Seven studies with 819 patients (HFNC group: 400; NIV group: 419) reported on endotracheal intubation. The risk ratio (95% CI) was 0.87(0.63, 1.20) units, I2=57%. The outcome does not achieve statistical significance utilizing a fixed-effects model, with a p-value of 0.40. **(F):** In three studies involving a total of 498 patients (48 in the HFNC group and 46 in the NIV group) that reported comfort scores, the pooled mean difference (MD) was -1.95, with a 95% CI of -3.01, -0.89 units. The I^2 value was 0%, indicating low heterogeneity. These results reached statistical significance (p=0.0003) and favoured the HFNC group employing a fixed-effects model.

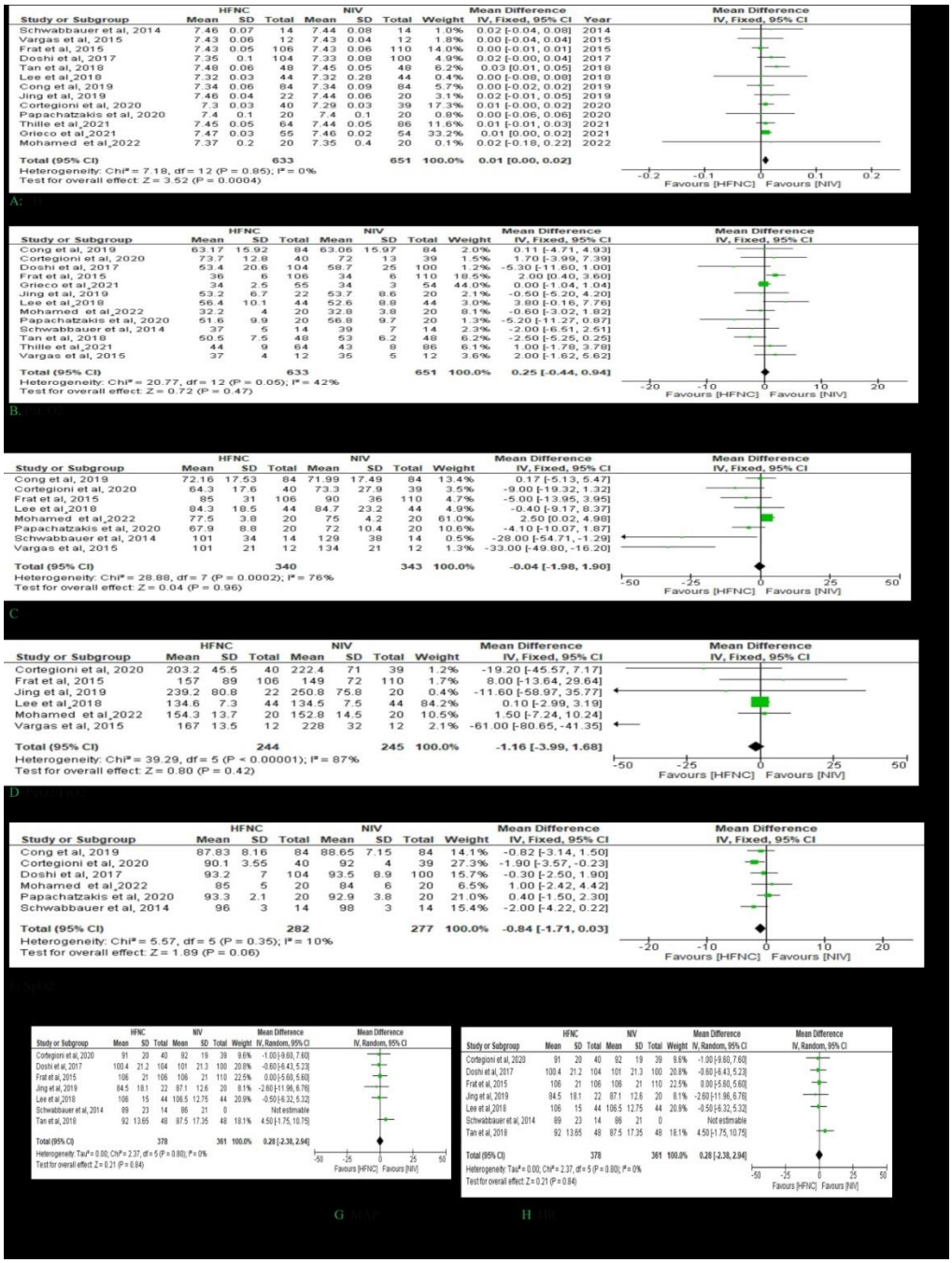

Figure (4): A: Thirteen studies with 1284 patients (HFNC group: 633; NIV group: 651) reported on PH the pooled MD (95% CI) was 0.01(0.00, 0.02) units, I2=0%. These results attained statistical significance (p=0.0004) and favoured the NIVC group when applying a fixed-effects model. **B:** Thirteen studies with 1284 patients (HFNC group: 633; NIV group: 651) reported on Paco2 the pooled MD (95% CI) was 0.25(-0.44 - 0.94) units, I2=42%. The outcome does not attain statistical significance, with a p-value of 0.47, utilizing a fixed-effects model. **C:** Eight studies with 683 patients (HFNC group: 340; NIV group: 343) reported on Pao2 the pooled MD (95% CI) was -0.04(-1.98,-1.90) units, I2=76%. The outcome remains statistically insignificant, as indicated by a p-value of 0.96, with the application of a fixed-effects model. **D:** Six studies with 489 patients (HFNC group: 244; NIV group: 245) reported on Pao2/Fio2 the pooled MD was -1.16, with a 95% CI of -3.99, 1.68 units, I^2=87%. The result remains statistically insignificant, with a p-value of 0.42, when employing a fixed-effects model. **F:** In seven studies involving a total of 559 patients (282 in the HFNC group and 277 in the NIV group) reporting on Spo2 levels, the pooled mean difference (MD) was -0.84, with a 95% CI of -1.71, 0.03 units, with an I^2 value of 10%. However, the result did not reach statistical significance (p=0.06) when a fixed-effects model was applied. **G:** Six studies with 472 patients (HFNC group: 242; NIV group: 230) reported on

MAP the pooled MD was 1.49, with a 95% CI of -078, 3.77 units, I^2=80%. The outcome remains statistically insignificant, as indicated by a p-value of 0.20, with the application of a fixed-effects model. **H:** In seven studies involving 739 patients (378 in the HFNC group and 361 in the NIV group) that reported on heart rate (HR), the pooled mean difference (MD) was 0.28, with a 95% CI of -2.38, 2.94 units. The I^2 value was 0%. However, the result did not achieve statistical significance (p=0.84) when utilizing a fixed-effects model.

Discussion

Acute respiratory failure is one of the top 5 reasons for patients to come to the emergency department whether is acute hypoxemic or hypercapnic respiratory failure [12].

Acute hypoxic respiratory failure is a serious complication of various diseases, which leads to ICU admissions large number of patients often requires mechanical ventilation [20].

Acute hypercapnic respiratory failure frequently arises as a serious complication of COPD, often necessitating endotracheal intubation and mechanical ventilation for severe cases [13].

High-flow nasal cannula (HFNC) has been employed as a means of delivering respiratory support, especially in cases where simple oxygen therapy is insufficient. In contrast to traditional nasal cannula therapy, HFNC can provide oxygen concentrations of up to 100% and deliver it at flow rates of up to 60 litres per minute via a nasal cannula. It has been demonstrated to create a gentle positive pressure, enhancing both ventilation and oxygenation efficiency. HFNC is also known for promoting comfort and tolerance among patients [10].

Oxygen can also be administered through facial or full-face masks when utilizing non-invasive ventilation (NIV). non-invasive ventilation (NIV) offers the advantage of being able to apply positive end-expiratory pressure (PEEP). It's worth noting that the use of NIV is more established and commonly employed in cases of hypercapnic respiratory failure compared to hypoxemic respiratory failure. This discrepancy may be attributed to the fact that some patients may have difficulty tolerating NIV, which can affect its suitability for certain individuals [9].

Our study seeks to perform a comprehensive systematic review and meta-analysis to assess both the effectiveness and safety of HFNC compared to NIV in adults experiencing acute respiratory failure, encompassing both hypercapnic and hypoxemic conditions. While earlier systematic reviews have focused on comparing HFNC to NIV individually for the treatment of hypercapnia or hypoxemia, our study aims to provide a more holistic evaluation of HFNC in the context of acute respiratory failure, regardless of the specific underlying respiratory issue.

In this systematic review and meta-analysis encompassing thirteen randomized controlled trials with a total of 1284 patients, no significant differences were observed in terms of the need for endotracheal intubation, mortality at the longest follow-up, or the duration of stay in the ICU. However, the HFNC group did show favourable outcomes in terms of hospital duration of stay and comfort scores.

Furthermore, there were no substantial changes in blood gas parameters or hemodynamic variables (such as PaCO2, PaO2, SPo2, heart rate, or mean arterial pressure) when comparing HFNC to NIV in patients with acute respiratory failure. Notably, the only significant difference observed was an increase in pH, which favoured the NIV group.

High-flow nasal cannula (HFNC) is increasingly being utilized in cases of acute hypoxic respiratory failure, and it holds the potential to assist in ventilation while offering improved comfort and tolerance compared to NIV. Recent guidelines from the European Respiratory Society (ERS) have conditionally recommended a trial of NIV before

considering HFNC in patients with COPD and acute hypercapnic respiratory failure, primarily due to a significant advantage in pH favouring NIV over HFNC. However, it is acknowledged that the evidence is primarily limited to COPD patients, and more research is needed to identify other patient populations where HFNC might be considered before NIV [21].

This study's strengths include a peer-reviewed electronic search strategy, exclusive analysis of RCTs up to October 2022, and independent review by three assessors for screening, risk of bias, and certainty of evidence.

Our findings differ from previous systematic reviews, possibly due to variations in the selection of trials.

In contrast to our results, a meta-analysis by Glenardi, et al [22] which included 10 studies involving a total of 750 patients with COVID-19, showed lower mortality rates in the HFNC group. It is important to note that the majority of the studies included were observational, not randomized controlled.

Another meta-analysis by He, Y., Zhuang, et al [23] which included 9 studies with a total of 1582 patients with COVID-19, showed lower mortality at day 28 in the HFNC group but non-significant effect on overall mortality (no-time limit). It also showed a shorter hospital length of stay in the HFNC group although there was no significant change in the length of ICU stay. Similar to our results, the rate of IMV was not significant, but the PaO2/FiO2 ratio favoured the HFNC group. Again, only one of the included studies was randomized controlled which may affect the adequacy of the comparison.

In 2022, a meta-analysis by Ovtcharenko, et al [21] which included a total of 8 RCTs involving 528 patients with acute hypercapnic respiratory failure was similar to ours in terms of mortality, intubation, length of ICU stays, PaO2 and PaCO2 but not in length of hospital stay or comfort as both were non-significant between the two groups.

Similarly, a meta-analysis by Chaudhuri et al [3], which included a total of 9 RCTs involving 1539 patients with acute hypoxemic respiratory failure, was similar to ours in terms of mortality, intubation, and length of ICU stay but not length of hospital stays which was not significant.

All of the above-mentioned meta-analyses targeted more homogenous patients in terms of the type of respiratory failure, which were acute hypoxemic and acute hypercapnic respiratory failure or a more specific aetiology of respiratory failure i.e., COVID-19. Our meta-analysis included studies with both types of respiratory failure with various aetiologies, which may also affect the adequacy of the comparison.

Conclusion

This meta-analysis showed no significance of high flow nasal cannula over non-invasive mechanical ventilation in reducing mortality rates. However, high flow nasal cannula is associated with reduction of length of hospital stay and improvement of comfort score.

References:

1. Liu Y, Zhao J, Tang H. Non-invasive ventilation in acute respiratory failure: a meta-analysis. Clinical Medicine: Journal of the Royal College of Physicians of London. 2016;16(6):514-523.
2. Lee M K, Choi J, Park, B, Kim B, Lee S J, Kim S H, .et al. High flow nasal cannulae oxygen therapy in acute-moderate hypercapnic respiratory failure. *Clin Respir J*. 2018;12(6):2046-2056. doi:10.1111/crj.12772
3. Chaudhuri D, Trivedi V, Lewis K, Rochwerg B. High-Flow Nasal Cannula Compared With Noninvasive Positive Pressure Ventilation in Acute Hypoxic Respiratory Failure: A Systematic Review and Meta-Analysis. *Crit Care Explor*. 2023;5(4):e0892. Published 2023 Mar 28. doi:10.1097/CCE.0000000000000892
4. Lemiale V, Resche-Rigon M, Azoulay E. Early non-invasive ventilation for acute respiratory failure in immunocompromised patients (IVNIctus): study protocol for a multicenter randomized controlled trial. Trials. 2014; 15:372.

5. Nagata, K., Horie, T., Chohnabayashi, N., Jinta, T., Tsugitomi, R., Shiraki, A., et al. Home High-Flow Nasal Cannula Oxygen Therapy for Stable Hypercapnic COPD: A Randomized Trial. American Journal of Respiratory and Critical Care Medicine. 2022.
6. Roca, O., Hernández, G., Díaz-Lobato, S., Carratalá, J. M., Gutiérrez, R. M., Masclans, J. R., et al. Current evidence for the effectiveness of heated and humidified high flow nasal cannula supportive therapy in adult patients with respiratory failure. Critical Care : the Official Journal of the Critical Care Forum. 2016;20(1):109.
7. Yang K.L., Guiterrez G. Mechanical Ventilator Support // Surgical Critical Care / Ed. by Abrams J.H., Druck P., Cerra F.B. — 2nd ed. — Boca Raton: Taylor & Francis Group, 2005. — P. 489-500.
8. Moher D, Liberati A, Tetzlaff J, Altman DG. The PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. PLoS Med 2009;6:e1000097
9. Schwabbauer N, Berg B, Blumenstock G, Haap M, Hetzel J, Riessen R. Nasal high-flow oxygen therapy in patients with hypoxic respiratory failure: effect on functional and subjective respiratory parameters compared to conventional oxygen therapy and non-invasive ventilation (NIV). BMC Anesthesiol. 2014;14:66. Published 2014 Aug 7. doi:10.1186/1471-2253-14-66
10. Vargas F, Saint-Leger M, Boyer A, Bui NH, Hilbert G. Physiologic Effects of High-Flow Nasal Cannula Oxygen in Critical Care Subjects. Respir Care. 2015;60(10):1369-1376. doi:10.4187/respcare.03814
11. Frat, J. P., Thille, A. W., Mercat, A., Girault, C., Ragot, S., Perbet, S., et al. High-flow oxygen through nasal cannula in acute hypoxemic respiratory failure. *N Engl J Med*. 2015;372(23):2185-2196. doi:10.1056/NEJMoa1503326
12. Doshi, P., Whittle, J. S., Bublewicz, M., Kearney, J., Ashe, T., Graham, R.,et al. High-Velocity Nasal Insufflation in the Treatment of Respiratory Failure: A Randomized Clinical Trial. Ann Emerg Med. 2018;72(1):73-83.e5. doi:10.1016/j.annemergmed.2017.12.006
13. Tan, D., Walline, J. H., Ling, B., Xu, Y., Sun, J., Wang, B.et al. High-flow nasal cannula oxygen therapy versus non-invasive ventilation for chronic obstructive pulmonary disease patients after extubation: a multicenter, randomized controlled trial. *Crit Care*. 2020;24(1):489. Published 2020 Aug 6. doi:10.1186/s13054-020-03214-9
14. Jing, G., Li, J., Hao, D., Wang, T., Sun, Y., Tian, H. et al. Comparison of high flow nasal cannula with noninvasive ventilation in chronic obstructive pulmonary disease patients with hypercapnia in preventing postextubation respiratory failure: A pilot randomized controlled trial. *Res Nurs Health*. 2019;42(3):217-225. doi:10.1002/nur.21942
15. Cong, L., Zhou, L., Liu, H., & Wang, J. (2019). Outcomes of high-flow nasal cannula versus non-invasive positive pressure ventilation for patients with acute exacerbations of chronic obstructive pulmonary disease. Int J Clin Exp Med 2019;12(8):10863-10867
16. Cortegiani, A., Longhini, F., Madotto, F., Groff, P., Scala, R., Crimi, C., et al. High flow nasal therapy versus noninvasive ventilation as initial ventilatory strategy in COPD exacerbation: a multicenter non-inferiority randomized trial. *Crit Care*. 2020;24(1):692. Published 2020 Dec 14. doi:10.1186/s13054-020-03409-0
17. Papachatzakis Y, Nikolaidis PT, Kontogiannis S, Trakada G. High-Flow Oxygen through Nasal Cannula vs. Non-Invasive Ventilation in Hypercapnic Respiratory Failure: A Randomized Clinical Trial. Int J Environ Res Public Health. 2020 Aug 18;17(16):5994. doi: 10.3390/ijerph17165994. PMID: 32824771; PMCID: PMC7459687.
18. Thille, A. W., Coudroy, R., Nay, M. A., Gacouin, A., Decavèle, M., Sonneville, R., et al. Non-invasive ventilation alternating with high-flow nasal oxygen versus high-flow nasal oxygen alone after extubation in COPD patients: a post hoc analysis of a randomized controlled trial. *Ann Intensive Care*. 2021;11(1):30. Published 2021 Feb 9. doi:10.1186/s13613-021-00823-7
19. Grieco, D. L., Menga, L. S., Cesarano, M., Rosà, T., Spadaro, S., Bitondo, M. M. et al. Effect of Helmet Noninvasive Ventilation vs High-Flow Nasal Oxygen on Days Free of Respiratory Support in Patients With COVID-19 and Moderate to Severe Hypoxemic Respiratory Failure: The HENIVOT Randomized Clinical Trial. *JAMA*. 2021;325(17):1731-1743. doi:10.1001/jama.2021.4682
20. Ali Mohammed, Ahmed S.; El Maraghi, Sameh K.; Saber, Hamdy M.; Mohammed, Ahmed Y.. High-flow nasal cannula versus noninvasive positive pressure ventilation in patients with acute respiratory failure: which is more effective?. Research and Opinion in Anesthesia and Intensive Care 9(3):p 234-239, Jul–Sep 2022. | DOI: 10.4103/roaic.roaic_59_21

21. Ovtcharenko, N., Ho, E., Alhazzani, W., Cortegiani, A., Ergan, B. E. G. Ü. M., Scala, R., and Lewis, K. High-flow nasal cannula versus non-invasive ventilation for acute hypercapnic respiratory failure in adults: a systematic review and meta-analysis of randomized trials. Crit Care. 2022;26(1):348. Published 2022 Nov 9. doi:10.1186/s13054-022-04218-3
22. Glenardi G, Chriestya F, Oetoro BJ, Mangkuliguna G, Natalia N. Comparison of high-flow nasal oxygen therapy and noninvasive ventilation in COVID-19 patients: a systematic review and meta-analysis. *Acute Crit Care*. 2022;37(1):71-83. doi:10.4266/acc.2021.01326
23. He, Y., Zhuang, X., Liu, H., and Ma, W. Comparison of the efficacy and comfort of high-flow nasal cannula with different initial flow settings in patients with acute hypoxemic respiratory failure: a systematic review and network meta-analysis. *j intensive care* **11**, 18 (2023). https://doi.org/10.1186/s40560-023-00667-2

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