Published by
**Saidu Medical College**

OPEN ACCESS

**ISSN (P):** 1819-4583
**ISSN (E):** 3007-9470

**Copyright ©** Copyright (c) 2026 The authors retain the copyrights. Authors are permitted and encouraged to post their work online (e.g. in institutional repositories or on their website), as it can lead to productive exchanges, as well as greater citation of published work.

**Citation:**
Siddiqui A, Ahmed S, Khalil U, Salman S, Iqbal S, Shahid K. Outcome of Early Bi-Level Positive Airway Pressure (BiPAP) Use in Patients with Acute Exacerbation of Chronic Obstructive Pulmonary Disease. *J Saidu Med Coll.* 2026;16(1):65–71.

**Corresponding Author:**
Dr. Afshan Siddiqui
Assistant Professor,
Department of Medicine,
Dow University of Health Sciences,
Karachi, Pakistan
afshan.siddiqui@duhs.edu.pk

**Funding:**
The authors received no external funding for this study.

**Conflicts of Interests:**
The authors have declared that no competing interests exist.

**Data Sharing Statement:**
The data that support the findings of this study are available on request from the corresponding author. The data is not publicly available due to privacy or ethical restrictions.

**Received:** January 23, 2025
**1st Revision:** May 23, 2025
**2nd Revision:** October 01, 2025
**8th Revision:** December 08, 2025
**Accepted:** December 08, 2025

Check for updates

Original Article

# Outcome of Early Bi-Level Positive Airway Pressure (BiPAP) Use in Patients with Acute Exacerbation of Chronic Obstructive Pulmonary Disease

**Afshan Siddiqui[1], Shaista Ahmed[2], Urooj Khalil[3], Salma Salman[1], Sadia Iqbal[1] & Kanza Shahid[1]**

[1]Dow University of Health Sciences, Karachi, Pakistan
[2]Karachi Medical and Dental College, Karachi, Pakistan
[3]Memon Medical Institute Hospital, Karachi, Pakistan

https://doi.org/10.52206/jsmc.2026.16.1.1209

## Abstract

**Background:** Chronic obstructive pulmonary disease (COPD) is a major global health problem and a leading cause of morbidity and mortality worldwide. Acute exacerbations of COPD frequently result in acute hypercapnic respiratory failure, necessitating ventilatory support. Noninvasive ventilation (NIV), particularly bi-level positive airway pressure (BiPAP), has emerged as a preferred modality during acute exacerbations due to its ability to improve gas exchange, reduce the work of breathing, and decrease the need for invasive mechanical ventilation.

**Objective:** To determine the outcome of early Bi-level positive airway pressure (BiPAP) use in patients presenting with acute exacerbation of COPD at a tertiary care hospital in Karachi.

**Methodology:** This prospective observational cohort study was conducted in the Department of Medicine, Abbasi Shaheed Hospital, Karachi, from January 7, 2021, to June 7, 2021. A total of 118 patients aged 30–70 years with a diagnosis of COPD for more than one year, presenting with acute exacerbation and hypercapnic respiratory failure, were enrolled using non-probability consecutive sampling. Early BiPAP therapy was initiated alongside standard medical treatment. Clinical parameters and arterial blood gas values were monitored. Outcomes were categorized as successful or failed based on the need for invasive mechanical ventilation. Data were analyzed using SPSS version 16.

**Results:** Out of 118 patients, 96 (81.4%) achieved a successful outcome following early BiPAP therapy, while 22 (18.6%) experienced treatment failure. The mean age was 57.87 ± 15.64 years. Significant improvement was observed in post-NIV arterial pH, $PaO_2$, and $PaCO_2$ levels. Multivariate analysis demonstrated that post-NIV pH and $PaCO_2$ were independent predictors of BiPAP success ($p < 0.05$).

**Conclusion:** Early initiation of BiPAP in patients with acute exacerbation of COPD was generally well tolerated and associated with a high success rate. This noninvasive strategy has the potential to reduce the need for invasive mechanical ventilation, hospital morbidity, and healthcare costs.

**Keywords:** Acute COPD Exacerbation, Bi-Level Positive Airway Pressure, Noninvasive Ventilation.

## Introduction

Chronic obstructive pulmonary disease (COPD) is a heterogeneous respiratory disorder characterized by persistent airflow limitation, progressive dyspnea, and chronic cough with sputum production, resulting from pathological changes in the airways and alveoli [1]. COPD is currently recognized as a major public health concern and is projected to become the third leading cause of death globally [2]. According to the Burden of Obstructive Lung Disease (BOLD) study, the prevalence of COPD is estimated to be 11.8% in men and 8.5% in women, with an overall global prevalence of approximately 10.3% [3].

The Global Initiative for Chronic Obstructive Lung Disease (GOLD) reports that COPD prevalence is more than twice as high in men compared to women and is marginally higher in low- and middle-income countries [4]. Notably, a considerable proportion of COPD cases occur in individuals who have never smoked, highlighting the role of environmental exposures and host susceptibility [3]. The pathogenesis of COPD reflects a complex interplay between genetic predisposition and environmental factors such as tobacco smoke, household air pollution, occupational exposures, and accelerated lung aging [5,6].

COPD is characterized by periods of clinical stability punctuated by acute exacerbations, which are defined as episodes of worsening respiratory symptoms, particularly dyspnea and cough over a short period, typically within 14 days [7]. These exacerbations are commonly triggered by respiratory infections, air pollution, or sudden climatic changes and are associated with increased airway and systemic inflammation [2]. Acute exacerbations of COPD are a leading cause of hospitalization and contribute substantially to disease progression, healthcare utilization, and mortality [5].

During severe exacerbations, patients may develop acute respiratory failure marked by hypoxemia, hypercapnia, and respiratory acidosis due to impaired ventilatory mechanics and gas exchange [8]. Management of such cases requires prompt pharmacological therapy along with ventilatory support, which may include oxygen therapy, noninvasive ventilation (NIV), or invasive mechanical ventilation. Current clinical guidelines strongly recommend the use of NIV, particularly in the form of BiPAP, as first-line ventilatory support in acute hypercapnic respiratory failure secondary to COPD exacerbation, provided there are no contraindications [9,10].

BiPAP has been shown to improve arterial blood gas parameters, reduce respiratory muscle workload, shorten hospital stay, and lower mortality rates when compared to invasive ventilation [11,12]. Despite these advantages and guideline endorsements, data on the outcomes of early BiPAP use in acute COPD exacerbations remain limited in the South Asian region, including Pakistan. Given the substantial economic burden of invasive mechanical ventilation and prolonged ICU stays in resource-limited settings, evaluating the effectiveness of early BiPAP initiation is of particular clinical relevance. Therefore, this study was conducted to assess the outcomes of early BiPAP use in patients with acute exacerbation of COPD presenting with hypercapnic respiratory failure in a tertiary care hospital in Karachi.

## Methodology

### Study Design

This study employed a prospective observational cohort design to evaluate the clinical outcomes of early initiation of bi-level positive airway pressure (BiPAP) therapy in patients presenting with acute exacerbation of chronic obstructive pulmonary disease (COPD) complicated by hypercapnic respiratory failure. The study was conducted over a six-month period, from January 7, 2021, to June 7, 2021, allowing systematic follow-up from initiation of noninvasive ventilation through clinical resolution or treatment failure.

### Ethics

Ethical approval for the study was obtained from the relevant institutional review and ethics committee (Approval No. CPSP/REU/MED-2017-174-13087). Written informed consent was obtained from all participants or their legally authorized attendants prior to enrollment. Confidentiality of patient data was strictly maintained throughout the study, and all procedures were conducted in accordance with the Declaration of Helsinki and institutional ethical guidelines.

### Setting

The study was carried out in the Department of Medicine at Abbasi Shaheed Hospital, a tertiary care teaching hospital in Karachi, Pakistan. The hospital serves a large urban population and has dedicated facilities for the management of acute respiratory illnesses, including noninvasive ventilation support and arterial blood gas monitoring.

### Participants

A total of 118 patients were enrolled using non-probability consecutive sampling. Eligible participants were male and

female patients aged 30–70 years with a documented diagnosis of COPD for more than one year who presented with acute exacerbation within 12 hours of symptom onset. Acute exacerbation was defined by the presence of one or more of the following criteria: respiratory rate >25 breaths/min, oxygen saturation ≤90% on 2 L/min nasal oxygen, arterial pH ≤7.35, $PaO_2$ ≤60 mmHg, and $PaCO_2$ ≥45 mmHg. Patients with a prior diagnosis of asthma, bronchiectasis, pneumothorax, malignancy, or significant comorbid conditions such as congestive cardiac failure, chronic renal failure, chronic liver disease, or stroke were excluded. Patients who had received BiPAP therapy within the preceding month were also excluded to minimize confounding effects.

**Variables**

The primary outcome variable was BiPAP treatment outcome, categorized as either successful or failed. Success was defined as clinical improvement allowing discontinuation of BiPAP within 48 hours without the need for invasive mechanical ventilation, accompanied by stabilization of arterial blood gas parameters. Failure was defined as the requirement for invasive mechanical ventilation at any time following initiation of BiPAP due to worsening clinical status or persistent derangement of arterial blood gases. Independent variables included age, gender, body mass index (BMI), duration of COPD, duration of BiPAP use, educational status, occupational status, obesity status, and post-NIV arterial blood gas parameters (pH, $PaO_2$, $PaCO_2$).

**Data Sources/Measurement**

BiPAP therapy was administered using a nasal mask interface with an initial inspiratory positive airway pressure (IPAP) of 10 $cmH_2O$ and expiratory positive airway pressure (EPAP) of 5 $cmH_2O$, alongside standard medical management for acute COPD exacerbation. Oxygen supplementation was titrated to maintain target oxygen saturation between 88% and 92%. Patients were monitored clinically, with continuous pulse oximetry and serial arterial blood gas analysis. BiPAP was discontinued once patients achieved clinical stability, $SpO_2$ ≥92% on $FiO_2$ ≤0.4, and absence of respiratory distress. Demographic and clinical data were recorded on a structured proforma.

**Bias**

Selection bias was minimized by enrolling consecutive eligible patients presenting during the study period. Standardized criteria for initiation, monitoring, and discontinuation of BiPAP therapy were applied uniformly to all participants to reduce performance bias. Objective outcome definitions based on clinical parameters and arterial blood gas measurements were used to limit observer bias.

**Study Size**

Sample size estimation was performed using WHO sample size calculation software, assuming an outcome failure rate of 12.6%, a confidence level of 95%, and an absolute precision of 6%. Based on these parameters, the minimum required sample size was calculated as 118 patients.

**Quantitative Variables**

Quantitative variables, including age, BMI, duration of COPD, duration of BiPAP use, and post-NIV arterial blood gas values (pH, $PaO_2$, $PaCO_2$), were summarized using means and standard deviations. These variables were treated as continuous measures for statistical analysis.

**Statistical Methods**

Data were analyzed using SPSS version 16. Descriptive statistics were computed for all study variables. Categorical variables were expressed as frequencies and percentages, while continuous variables were summarized as mean ± standard deviation. Post-stratification chi-square tests were applied to assess associations between categorical variables and BiPAP outcomes, with a p-value ≤0.05 considered statistically significant. Variables demonstrating potential association were entered into a multivariate logistic regression model to identify independent predictors of BiPAP success, with adjusted odds ratios (AORs) and 95% confidence intervals reported.

## Results

**Participants**

A total of 118 patients with acute exacerbation of chronic obstructive pulmonary disease (COPD) complicated by hypercapnic respiratory failure were included in the final analysis. Among these, 64 patients (54.2%) were male and 54 (45.8%) were female. All enrolled participants completed the study protocol and were evaluated for treatment outcomes following early initiation of Bi-level positive airway pressure (BiPAP) therapy.

**Descriptive Data**

The mean age of the study population was 57.87 ± 15.64 years, with ages ranging from 35 to 70 years. The mean duration of COPD was 4.41 ± 1.24 years, while the mean duration of BiPAP use was 22.72 ± 14.87 hours. The mean body mass index (BMI) was 29.66 ± 5.31 kg/m², indicating a predominance of overweight and obese individuals. Pre-NIV arterial blood gas analysis revealed a mean pH of 7.28 ± 0.04, $PaCO_2$ of 58.4 ± 6.7 mmHg, and $PaO_2$ of 52.1 ± 7.9

mmHg, reflecting significant respiratory acidosis and hypoxemia at presentation. Post-NIV measurements demonstrated improvement, with mean pH of 7.36 ± 0.56, $PaO_2$ of 85.9 ± 10.04 mmHg, and $PaCO_2$ of 38.7 ± 4.15 mmHg. Detailed descriptive statistics are summarized in Table 01.

**Outcome Data**

Following early BiPAP therapy, 96 patients (81.4%) achieved a successful outcome, defined as clinical improvement with stabilization of arterial blood gases and discontinuation of BiPAP within 48 hours without the need for invasive mechanical ventilation. Treatment failure was observed in 22 patients (18.6%), all of whom required invasive mechanical ventilation due to persistent or worsening respiratory failure. The mean length of hospital stay was comparable between the success and failure groups (6.0 ± 1.8 days vs. 6.2 ± 1.9 days, respectively), with no statistically significant difference (Figure 02).

**Main Results**

Stratified analysis showed no statistically significant association between BiPAP outcome and age group, gender, duration of COPD, duration of BiPAP use, obesity status, occupational status, or educational level ($p > 0.05$) (Table 02). Patients aged 30–50 years accounted for 34.4% of successful outcomes, while those aged 51–70 years comprised 65.6% of successful cases; however, this difference was not statistically significant ($p = 0.21$). Similarly, treatment success rates were comparable between male and female patients ($p = 0.58$). Multivariate logistic regression analysis identified post-NIV arterial pH and $PaCO_2$ as significant independent predictors of BiPAP success ($p < 0.05$) (Table 02). Patients demonstrating early improvement in acid–base status and reduction in $PaCO_2$ following BiPAP initiation had significantly higher odds of successful treatment without progression to invasive ventilation.

**Table 1: Descriptive Statistics.**

| Variables | Mean ± SD | Min-Max |
|---|---|---|
| **Age (Years)** | 57.87±15.64 | 35-70 |
| **Duration Of COPD (Years)** | 4.41±1.24 | 01-06 |
| **Duration Of Bi-PAP Use (Hours)** | 22.72±14.87 | 06-48 |
| **BMI (Kg/m$^2$)** | 29.66±5.31 | 24-34 |
| **PH (Post NIV)** | 7.36±0.56 | 7.1-7.8 |
| **PAO$^2$ (Post NIV)** | 85.9±10.04 | 40-98 |
| **PACO$^2$ (Post NIV)** | 38.7±4.15 | 30-50 |

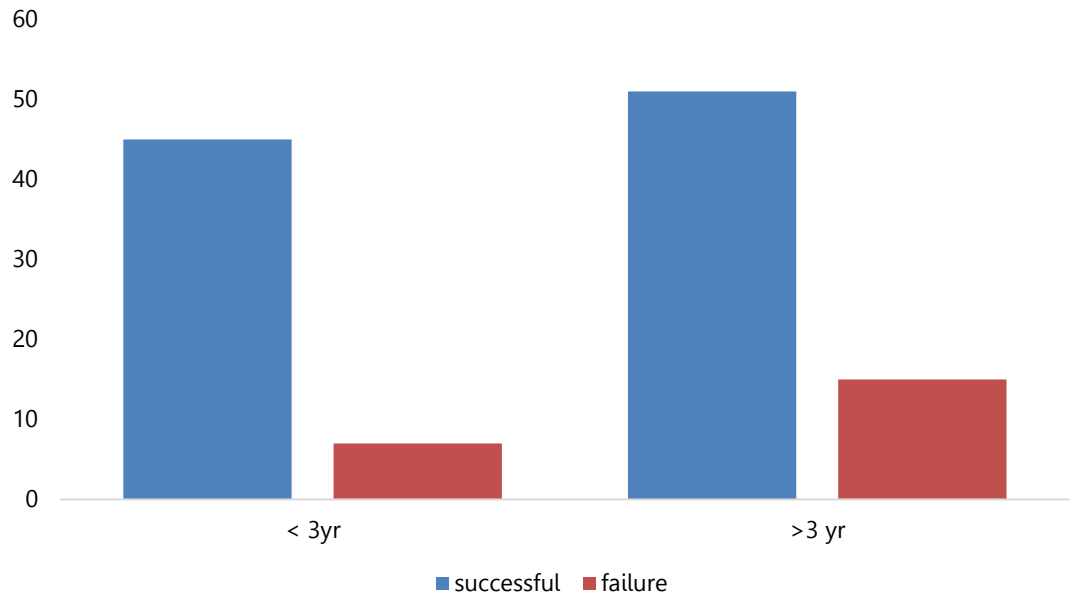



**Figure 1: Outcome of early Bi-Level positive airway pressure use according to duration of COPD.**

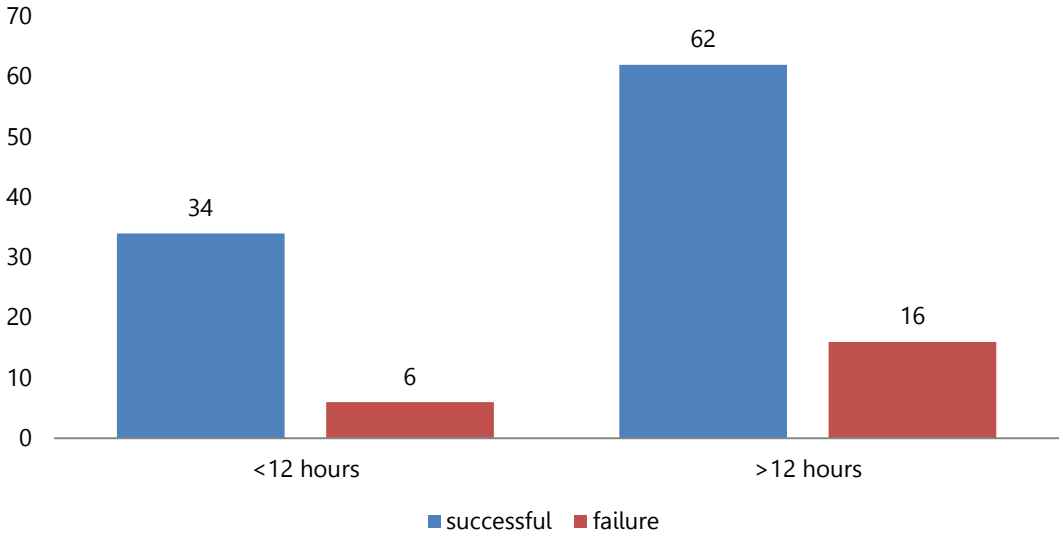



**Figure 2: Outcome of early bi-level positive airway pressure use according to duration of Bi-PAP use.**

**Table 2: Outcome of early bi-level positive airway pressure use according to obesity status, occupational status, level of educational.**

| Variables | Outcome of early bi-level positive airway pressure use | | Total | p-value |
|---|---|---|---|---|
| | Successful | Failure | | |
| **Obesity Status** | | | | |
| Yes | 42 (86%) | 07 (14%) | 49 | 0.210 |
| No | 54 (78%) | 15 (22%) | 69 | |
| **Occupational Status** | | | | |
| Employed | 51 (53.1%) | 10 (45.5%) | 61 | 0.340 |
| Unemployed | 45 (46.9%) | 12 (54.5%) | 57 | |
| **Level Of Education** | | | | |
| Illiterate | 05 (83%) | 01 (17%) | 6 | 0.750 |
| Primary | 09 (75%) | 03 (25%) | 12 | |
| Secondary | 37 (86%) | 06 (14%) | 43 | |
| Higher | 45 (79%) | 12 (21%) | 57 | |

*Chi-square test; p<0.05 is considered statistically significan

## Discussion

The present study evaluated the outcomes of early initiation of bi-level positive airway pressure (BiPAP) in patients presenting with acute exacerbation of chronic obstructive pulmonary disease (COPD) complicated by hypercapnic respiratory failure. Our findings demonstrate a high overall success rate of 81.4% with early BiPAP use, supporting current international and regional guideline recommendations that advocate noninvasive ventilation as first-line ventilatory support in this clinical setting [7,9,10,13].

The observed success rate in our cohort is comparable to previously published studies. Shaheen et al. reported favorable outcomes with NIV in acute COPD exacerbations, emphasizing improved gas exchange and reduced need for invasive ventilation [14]. Similarly, randomized and observational studies by Osadnik et al. and Bajaj et al. documented success rates ranging from 76% to 85%, along with reductions in ICU stay and intubation rates [12,15]. In contrast, Hussain et al. reported a markedly higher effectiveness rate of 98% in a Pakistani cohort [16]. This discrepancy may be attributable to differences in patient selection, as their study primarily included patients with preserved consciousness, which is a known determinant of NIV success due to better airway protection and secretion clearance.

A key finding of this study was the significant association between post-NIV arterial blood gas parameters and treatment outcome. Improvement in arterial pH and reduction in $PaCO_2$ emerged as independent predictors of BiPAP success, consistent with earlier reports indicating that early correction of respiratory acidosis is strongly associated with favorable NIV outcomes [13,17]. These findings reinforce the importance of close arterial blood gas monitoring during the early phase of BiPAP therapy to guide clinical decision-making [18].

The role of body mass index (BMI) in COPD outcomes remains complex and somewhat controversial. In our study, the mean BMI was 29.66 kg/m², with a substantial proportion of patients classified as obese. Although obese patients demonstrated a slightly higher success rate with BiPAP, this difference was not statistically significant. Similar observations were reported by Gürsel et al., who found no significant impact of obesity on NIV success [19,20]. Other studies have suggested that obese COPD patients may require longer durations of NIV to achieve adequate reductions in $PaCO_2$ [21]. The so-called "obesity paradox," where overweight and obese patients demonstrate better outcomes compared to underweight individuals, has also been described in COPD populations [22].

In the present analysis, demographic and socioeconomic variables including age, gender, duration of COPD, duration of BiPAP use, educational status, and occupational status, did not significantly influence BiPAP outcomes. While some studies suggest that higher educational status and employment are associated with better disease management and reduced readmissions due to improved treatment adherence [23–25], these associations have not been specifically evaluated in the context of early BiPAP use during acute hypercapnic respiratory failure. Our findings suggest that physiological response to NIV may play a more critical role than sociodemographic factors in determining short-term outcomes.

Psychological factors such as anxiety and depression, which are prevalent in COPD patients and may negatively affect treatment compliance, were not formally assessed in this study. However, previous research indicates that BiPAP therapy may contribute to improvement in both respiratory function and psychological symptoms, potentially enhancing overall treatment tolerance [17]. Future studies incorporating standardized psychological assessments could provide further insight into this relationship.

Several limitations should be acknowledged. First, patients were enrolled irrespective of their level of consciousness, which may have influenced the observed failure rate, as impaired consciousness is a recognized predictor of NIV failure. Second, the study was conducted at a single tertiary care center, which may limit the generalizability of the findings. Third, the specific causes of BiPAP failure were not systematically analyzed, highlighting the need for further research to identify modifiable factors associated with unsuccessful NIV outcomes in this population.

## Conclusion

Early initiation of bi-level positive airway pressure (BiPAP) in patients with acute exacerbation of chronic obstructive pulmonary disease was generally well tolerated and associated with a high rate of successful outcomes. Significant improvement in arterial blood gas parameters, particularly pH and $PaCO_2$, was strongly predictive of treatment success. Given its noninvasive nature, ease of use, and cost-effectiveness, early BiPAP represents a valuable therapeutic strategy for managing acute hypercapnic respiratory failure in COPD, particularly in resource-limited settings. Wider implementation of this approach has the potential to reduce the need for invasive mechanical ventilation, lower morbidity, and decrease healthcare costs.

## Authors' Contributions:

All authors meet the ICMJE criteria for authorship.

Author 1: Substantial contribution to conception and design, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 2: Substantial contribution to conception and design, data acquisition, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 3: Analysis and interpretation of data, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 4: Analysis and interpretation of data, critical revision, final approval, agreed to be accountable for all the work.
Author 5: Substantial contribution to conception and design, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 6: Substantial contribution to conception and design, data acquisition, drafting the manuscript, final approval, agreed to be accountable for all the work.

## References

1. Pahal P, Hashmi MF, Sharma S. Chronic obstructive pulmonary disease compensatory measures. In: StatPearls [Internet]. *Treasure Island (FL): StatPearls Publishing;* 2023 Jun 26.

2. Celli B, Fabbri L, Criner G, Martinez FJ, Mannino D, Vogelmeier C, et al. Definition and nomenclature of chronic obstructive pulmonary disease: time for its revision. *Am J Respir Crit Care Med.* 2022;206(11):1317-1325. https://doi.org/10.1164/rccm.202204-0671PP
3. Chuchalin AG, Avdeev SN, Aisanov ZR, Belevskiy AS, Leshchenko IV, Ovcharenko SI, et al. Federal guidelines on diagnosis and treatment of chronic obstructive pulmonary disease. *Pulmonologiya.* 2022;32(3):356-392. https://doi.org/10.18093/0869-0189-2022-32-3-356-392
4. Adeloye D, Song P, Zhu Y, Campbell H, Sheikh A, Rudan I, et al. Global, regional, and national prevalence of, and risk factors for, chronic obstructive pulmonary disease (COPD) in 2019: a systematic review and modelling analysis. *Lancet Respir Med.* 2022;10(5):447-458. https://doi.org/10.1016/S2213-2600(21)00511-7
5. Alpaydin AO, Ozuygur SS, Sahan C, Tertemiz KC, Russell R. Thirty-day readmission after an acute exacerbation of chronic obstructive pulmonary disease is associated with cardiovascular comorbidity. *Turk Thorac J.* 2021;22(5):369. https://doi.org/10.5152/TurkThoracJ.2021.0189
6. Agusti A, Melen E, DeMeo DL, Breyer-Kohansal R, Faner R. Pathogenesis of chronic obstructive pulmonary disease: understanding the contributions of gene-environment interactions across the lifespan. *Lancet Respir Med.* 2022;10(5):512-524. https://doi.org/10.1016/S2213-2600(21)00555-5
7. Agustí A, Celli BR, Criner GJ, Halpin D, Anzueto A, Barnes P, et al. Global Initiative for Chronic Obstructive Lung Disease 2023 report: GOLD executive summary. *Respirology.* 2023;28(4):316-338. https://doi.org/10.1111/resp.14486
8. O'Donnell DE, Parker CM. COPD exacerbations. 3: Pathophysiology. *Thorax.* 2006;61(4):354-361. https://doi.org/10.1136/thx.2005.041830
9. Bräunlich J, Köppe-Bauernfeind N, Petroff D, Franke A, Wirtz H. Nasal high-flow compared to non-invasive ventilation in treatment of acute acidotic hypercapnic exacerbation of chronic obstructive pulmonary disease: protocol for a randomized controlled noninferiority trial (ELVIS). *Trials.* 2022;23(1):28. https://doi.org/10.1186/s13063-021-05978-z
10. Ahmad H, Zaman M. An audit of the management of patients admitted with acute exacerbation of COPD at a tertiary care hospital. *Pak J Chest Med.* 2015;21(2):68-75.
11. Gay PC, Owens RL; ONMAP Technical Expert Panel. Executive summary: Optimal NIV Medicare Access Promotion. *Chest.* 2021;160(5):1808-1821. https://doi.org/10.1016/j.chest.2021.05.074
12. Li J, Ran L. Efficacy of non-invasive ventilation in chronic obstructive pulmonary disease management: a systematic review and meta-analysis of randomized controlled trials. *BMC Pulm Med.* 2025;25(1):485. https://doi.org/10.1186/s12890-025-03857-w
13. Chawla RK, Yadav V, Banerjee S, Chaudhary G, Chawla A. Predictors of success and failure of non-invasive ventilation use in type 2 respiratory failure. *Indian J Tuberc.* 2021;68(1):20-24. https://doi.org/10.1016/j.ijtb.2020.10.002
14. Shaheen M, Daabis RG, Elsoucy H. Outcomes and predictors of success of non invasive ventilation in acute exacerbation of COPD. *Egypt J Bronchol.* 2018;12:329-339. https://doi.org/10.4103/ejb.ejb_112_17
15. Bajaj A, Kumar S, Inamdar AH, Agrawal L. Non invasive ventilation in acute hypoxic respiratory failure in medical ICU: a study in rural medical college. *Int J Crit Illn Inj Sci.* 2019;9(1):36-42. https://doi.org/10.4103/IJCIIS.IJCIIS_40_18
16. Hussain R, Hashir M, Awan ZI, Abid N. Effect of BiPAP on outcomes in COPD patients with hypercapnic respiratory failure. *Pak J Med Health Sci.* 2018;12(2):839-841.
17. Zhang CH, Liu JH, Zhao JQ, Zhang ZH, Gu X. Effect of BiPAP therapy on COPD complicated with anxiety and depression. *Pak J Med Sci.* 2023;39(5):1502-1506. https://doi.org/10.12669/pjms.39.5.7259
18. Mehta AB, Douglas IS, Walkey AJ. Hospital NIV case volume and outcomes of acute COPD exacerbations. *Ann Am Thorac Soc.* 2016;13(10):1752-1759. https://doi.org/10.1513/AnnalsATS.201603-209OC
19. Zewari S, Vos P, van den Elshout F, Dekhuijzen R, Heijdra Y. Obesity in COPD: revealed and unrevealed issues. *COPD.* 2017;14(6):663-673. https://doi.org/10.1080/15412555.2017.1383978
20. Orbell SL, Morris JL, Scott PW, Baniak LM, Imes CC, Jeon B, et al. The triple overlap of COPD, severe obesity, and high risk of OSA: insights from an NHANES analysis. *BMC Pulm Med.* 2025;25(1):282. https://doi.org/10.1186/s12890-025-03752-4
21. Mahul M, Capdevila M, Galia F, De Jong A, Jaber S. Physiological comparison of non invasive ventilation and CPAP on inspiratory efforts after extubation in critically ill patients with morbid obesity: a post-hoc analysis. *Ann Intensive Care.* 2025;15(1):180. https://doi.org/10.1186/s13613-025-01603-3
22. Türk M, Aydoğdu M, Gürsel G. Effects of modes, obesity, and body position on NIV success in ICU. *Turk Thorac J.* 2018;19(1):28-35. https://doi.org/10.5152/TurkThoracJ.2017.17036
23. Cecere LM, Slatore CG, Uman JE, Evans LE, Udris EM, Bryson CL, et al. Adherence to long-acting inhaled therapies among COPD patients. *COPD.* 2012;9(3):251-258. https://doi.org/10.3109/15412555.2011.650241
24. Lange P, Marott JL, Vestbo J, Ingebrigtsen TS, Nordestgaard BG. Socioeconomic status and COPD prognosis in Denmark. *COPD.* 2014;11(4):431-437. https://doi.org/10.3109/15412555.2013.869580
25. Jacobsen PA, Kragholm KH, Torp-Pedersen C, Janssen DJA, Spruit MA, Weinreich UM. Employment status, readmission, and mortality after COPD exacerbation. *Int J Chron Obstruct Pulmon Dis.* 2021;16:2257-2265. https://doi.org/10.2147/COPD.S319840