Original Article

# Acute Exacerbation of Chronic Obstructive Pulmonary Disease in Rural Area: Why, How, and What Next?

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## Abstract

**Background:** Acute exacerbation of chronic obstructive pulmonary disease (AECOPD) leads to fall in lung function, quality of life, and ultimately disease progression. The present study is an effort to study in detail about COPD exacerbation in a rural tertiary hospital. **Aim:** To study demographic, clinical, and laboratory profile of hospitalized patients of AECOPD. **Methodology:** Retrospective data of 170 consecutive patients of AECOPD were collected from records, were divided into two groups based on severity, and were analyzed: Group 1 for admission in the wards and Group 2 for intensive care unit (ICU) admissions. **Results:** A total of 141 (82.9%) patients were hospitalized in the wards, whereas 29 (17.1%) were admitted in the ICU. The mean age was 62.36 years in the wards and 64.89 years in the ICU. Nearly 89.4% of patients were smokers. Dyspnea (100%) was the most common symptom followed by cough (99%) and expectoration (98%). The mean respiratory rate at the time of presentation was 26/min in the wards and 31.56/min in the ICU. The mean oxygen saturation was 93% in the wards and 88.62% in the ICU. The mean post forced expiratory volume in 1 s ($FEV_1$) was 43.98% in ward patients and 29.28% among ICU patients. Arterial blood gas revealed mean $PaCO_2$ of 44.25 mmHg in the wards and 63.24 mmHg in the ICU. The mean pH in the ward was 7.48 compared to 7.34 in the ICU. The mean pulmonary arterial pressure (PAP) was higher in the ICU (53.74 mmHg) than in the ward (38.87 mmHg). **Conclusion:** The ratio of hospitalization in ICU to ward was 1:5. The site of treatment depends on respiratory rate, oxygen saturation, post-$FEV_1$%, PAP, pH, and $PaCO_2$.

**Keywords:** Chronic obstructive pulmonary disease, exacerbation of chronic obstructive pulmonary disease, inhaler therapy, nonpharmacological measures

## Introduction

Chronic obstructive pulmonary disease (COPD) is a common, preventable, and treatable inflammatory respiratory disease. It is characterized by persistent respiratory symptoms and airflow limitation due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases.[1] Smoking is the leading cause of COPD worldwide. Other common causes are biomass fuel consumption, indoor and outdoor pollution, poorly treated and controlled asthma, and postinfective sequel. Reduction of risk factors such as smoking cessation and oxygen therapy can modify the disease outcome by reducing decline in lung function. Other management strategies such as pharmacotherapy, immunization, and pulmonary rehabilitation are supportive and improve the quality of life and prevent exacerbations.[1-3] However, they are not potentially implemented in every case of COPD due to various factors which leads to severe-to-very severe exacerbations.[2,3]

COPD exacerbation manifests as a change in patient's baseline symptoms such as worsening breathlessness and increase in cough along with increase in sputum amount and purulence.[1,3] Lower respiratory tract infections are the most common cause of exacerbations, while the remaining causes are exposure to indoor or outdoor air pollutants, changes in weather, and several host factors including prior compliance to therapy.[2,3] Various independent risk factors contribute to COPD exacerbations.[3-7] Very few studies are available from India on risk factors for exacerbations

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of COPD, more so from rural area.[4] Though adequate COPD control measures and guidelines are mentioned worldwide in the medical field, patients still experience episodes of exacerbations frequently with a huge impact on the overall health condition, both physically and mentally. Moreover, COPD exacerbation incurs a huge cost and can cause significant dent in pulmonary function and the quality of life.[1,3] COPD is often described and discussed with a focus on definition, etiology, treatment, and outcomes. Less focus is aimed at the clinical assessment and presentation of the patient with an acute exacerbation, probably because this is seen as one of every clinician's basic medical skills. Demographic profile, addiction history, etiology of acute exacerbation of COPD (AECOPD), presentation of acute exacerbation, use of inhaler bronchodilators, and implementation of nonpharmacological measures can vary in different populations, whether rural or urban.

The objective of this study was to examine the demographic, clinical, and laboratory profile of patients admitted with AECOPD. The study also aimed to compare patients' profile between mild-to-moderate exacerbations requiring admissions in low-dependency area (ward) and severe-to-very severe exacerbations requiring care in high-dependency area (intensive care unit [ICU]).

## Methodology

Approval of institutional ethical committee was taken prior to the study. Retrospective data of 170 patients with AECOPD hospitalized for 12 months were analyzed. The patients were divided into two groups: "Group 1" with mild-to-moderate exacerbations requiring treatment in low-dependency areas (wards) and "Group 2" with severe exacerbations requiring treatment in high-dependency areas (ICUs). The following data were collected:

- Demographic data, addiction history, occupation, and body mass index (BMI)
- Presenting symptoms such as breathlessness, cough with purulent sputum, fever, chest pain, altered sensorium, previous history of diseases including COPD, and other comorbid conditions (hypertension, diabetes, ischemic heart disease, and tuberculosis)
- Spirometry parameters such as postbronchodilator forced expiratory volume in 1 s (post $FEV_1$% predicted) and forced vital capacity (predicted)
- Arterial blood gas analysis reports at the time of admission.

Blood reports, specifically white blood cell count with neutrophilic response to check infection; echocardiography reports for pulmonary arterial pressure (PAP); and other relevant history were recorded and analyzed.

History of usage of oral and inhaler bronchodilators; type of pharmacological group of bronchodilators; and type of inhaler devices such as dry powder inhaler (DPI), metered dose inhaler (MDI), and nebulizer were studied.

Comparisons between the two groups were done among various parameters. Statistical analysis was carried out with STATA (Statistics/Data analysis) software 14 version of StataCorp. Texas, USA with the use of appropriate statistical tests.

## Results

Out of 170 patients, 141 (82.9%) were admitted in the wards (Group 1) and 29 (17.05%) were admitted in the ICU (Group 2). A total of 155 (91%) patients were male. The mean age of ward patients was 62.36 years and that of ICU patients was 64.89 years.

A total of 152 (89.4%) patients were smokers: 123 patients were current smokers, whereas 29 patients were ex-smokers. In the smoking history 36.61 smoke pack years was average in the patients admitted in ward wheres as in the patients admitted in ICU it was 34.93 smoke pack years. In nonsmokers, 8.8% of patients had COPD due to exposure to biomass fuel. The most common occupation was farming (58/170, 34.11%). There was a seasonal pattern for exacerbation, with maximum number of exacerbations from August to March and least numbers in the remaining months [Figure 1].

Dyspnea was the most common presenting symptom (170 patients, 100%) followed by cough (168 patients, 99%) with expectoration (167 patients, 98%). Fifty-four (31.67%) patients had fever and 11 (6.47%) had altered sensorium.

A majority of patients had Grade 2 and Grade 3 dyspnea as per the Modified Medical Research Council grading.

Fifty-three patients (31.18%) had a past history of tuberculosis, 16 patients (9.41%) had ischemic heart disease, 12 patients (7%) had diabetes, and 34 (20%) patients had hypertension, whereas 115 patients (67.65%) had no comorbid conditions.

Radiological parameters revealed that 83 (49%) patients had emphysematous changes, 51 (30%) had prominent bronchovascular markings, 11 (6.47%) patients had infiltrations, 9 (5.29%) patients had bronchiectasis, and 8 (4.70%) patients had lobar consolidation. Six (3.53%) patients had fibrocavitary lung and two patients (1.18%) had pneumothorax.

Sputum Gram staining revealed isolated Gram-negative bacilli (GNB) in 19 patients (11.18%), Gram-positive cocci (GPC) in 17 patients (10%), and both GPC and GNB in 6 patients. One patient had Gram-positive coccobacilli in his sputum. In 126 sputum samples of patients gram staining did not revealed any organism.

Culture from sputum revealed *Pseudomonas aeruginosa* in 12 patients, *Escherichia coli* in 5 patients, *Klebsiella pneumoniae* in 1 patient, *Acinetobacter baumanni* in 1 patient, *Citrobacter freundii* in 1 patient, *Staphylococcus aureus* in 1 patient, *Streptococcus pneumoniae* in 3 patients, and *Branhamella catarrhalis* in 2 patients. No organism was isolated in 143 patients.

Comparison of various parameters between the two groups is summarized in Table 1.

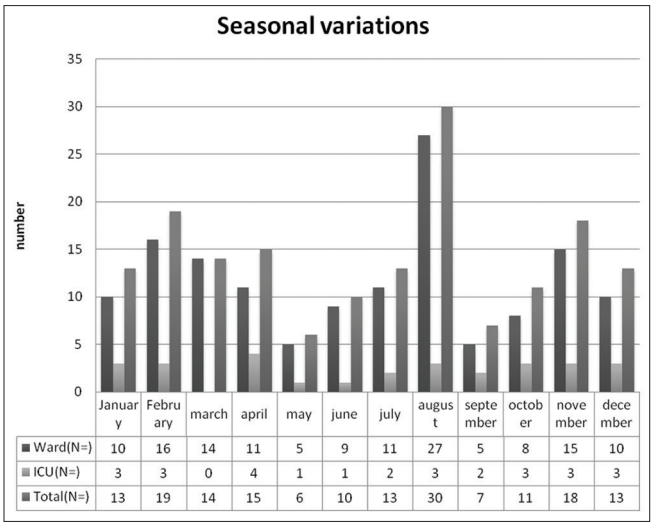


**Figure 1:** Seasonal pattern

Regarding treatment, DPI was the most common inhaler (60/170, 35.29%) used by patients in routine management followed by nebulizer (30/170, 17.65%) and MDI (6/170, 3.5%). Beta-2 agonists were used by 96% of patients overall, inhaled corticosteroids by 52.9%, and anticholinergics were used by 32.35% of patients. Use of oral bronchodilators was significantly higher (93%), whereas use of inhaler medicines was noted only in 54.7% of patients. Immunization was done for influenza only in 21 (12.35%) patients. Only 95 of 170 (55.9%) patients underwent pulmonary rehabilitation.

## Discussion

Smoking was the leading cause of COPD in this study, similar to that mentioned in GOLD study.[1] No significant association was observed between age, sex, severity of exacerbation, and level of care. Similar results were found in a study conducted by Mohapatra and Janmeja.[4] The maximum number of exacerbations was seen between August and March, possibly due to high humidity, cold weather, increased possibility of mold contamination, or viral exacerbations. Various studies including the present study showed seasonal pattern of exacerbation, with the maximum being in winter season.[8]

Out of the 170 admissions of exacerbation of COPD, for every five admissions in the ward (low-dependency area), there is one admission in high-dependency area or ICU. It is really a cause of concern as every admission in ICU can lead to significant morbidity, mortality, and economic burden to patient and health-care system in developing countries. Admission to wards or high-dependency area does not depend on smoking history, BMI, duration of COPD history, and frequency of previous hospitalizations. Parameters such as respiratory rate, oxygen saturation, raised white blood cell counts with neutrophilia, post-bronchodilator $FEV_1$ done in stable stage, pulmonary artery pressure, blood pH, and level of $PaCO_2$ in blood are more relevant. According to Garcia-Gutierrez *et al*., predictors of appropriate hospitalization were severity of current COPD exacerbation, response to previous treatment, and expected adherence to treatment.[9]

**Table 1: Comparison of various parameters between patients with acute exacerbation of chronic obstructive pulmonary disease admitted to the ward and intensive care unit**

| Parameters | Ward (Group 1), ($n$=141) | ICU (Group 2) ($n$=29) | *P* |
|---|---|---|---|
| Age (years) | 62.36 (9.674) | 64.89 (8.529) | 0.193 |
| BMI kg/m$^2$ | 17.9 (4.13) | 18.46 (5.01) | 0.405 |
| Duration and amount of smoking in pack-years | 36.61 (28.62) | 34.92 (18.06) | 0.766 |
| History of COPD (years) | 6.46 (5.655) | 6.87 (5.913) | 0.725 |
| Length of hospitalization (days) | 3.39 | 7.62 | 0.0001 |
| Cost (Indian rupees) | 6375 | 31286 | 0.0001 |
| Respiratory rate (breaths/min) | 26 (3.04) | 31.56 (6.87) | 0.0001 |
| $SpO_2$ (%) | 93 (4.94) | 88.62 (7.08) | 0.0001 |
| Post-FEV1 (percentage predicted) | 43.98 (17.49) | 29.28 (8.76) | 0.016 |
| FVC (percentage predicted) | 61.54 (23.11) | 48.88 (20.89) | 0.126 |
| $PaCO_2$ (mmHg) | 44.25 (10.11) | 63.24 (27.83) | 0.001 |
| Pulmonary artery pressure(mmHg) | 38.87 (25.27) | 53.74 (24.44) | 0.002 |
| White cell count (cells/mm$^3$) | 12,000 (5388.62) | 16,017 (5369.26) | 0.006 |
| Neutrophils (%) | 78.97 (8.84) | 84.83 (10.34) | 0.005 |
| Exacerbation ≤1 in the last 12 months, *n* (%) | 48 (34) | 8 (28) | 0.956 |
| Exacerbation ≥2 in the last 12 months, *n* (%) | 93 (66) | 21 (72) | 0.956 |

Data are expressed in mean (SD). SD: Standard deviation, BMI: Body mass index, ICU: Intensive care unit, COPD: Chronic obstructive pulmonary disease, $FEV_1$: Forced expiratory volume in 1 s, FVC: Forced vital capacity

ICU admission can lead to significant financial burden with increased morbidity and increased duration of hospital stay with possible nosocomial infections as narrated by Oostenbrink and Rutten-van Mölken.[10] Underweight, history of concomitant diseases, and increased dyspnea are factors that are likely to identify patients who are at increased risk for generating high costs due to hospitalization. Hospitalization accounted for 90% of the total costs of exacerbations. The cost of care in high-dependency area with severe exacerbation was five to six times higher Than that in the ward in the present study.

The best predictor of having frequent exacerbations (two or more per year) was a history of previously treated events as mentioned in the GOLD guidelines, but history of frequent exacerbations did not signify the severity or determine the level of care after hospitalization in this study.[1] Patients with reduced lung function have severe exacerbation requiring admissions in high-dependency ward or ICU, similar to that suggested in the GOLD guidelines.[1]

Infective exacerbations are more common and severe. Viral infections are most common followed by bacterial infections. Bacterial etiology in AECOPD varies, but infections with GNB are more common in COPD due to prior colonization.[3,11,12] In the present study, GNB were more often isolated from the sputum of patients admitted with COPD exacerbation.

Only half of the patients with AECOPD were using inhalers as a part of their routine treatment. Lower use of inhalers is a cause of concern as demonstrated in a study done by Chrystyn *et al*., who mentioned that better compliance for use of inhalers appears to be modestly associated with better health status and less frequent COPD exacerbations.[13] There is a greater need to promote inhaler use among patients which ultimately helps in the better management of COPD.

Nonpharmacological measures are still less utilized for holistic management of COPD in rural areas of developing countries, which again raises questions regarding the implications and effectiveness of pulmonary rehabilitation.

## Conclusion

Exacerbations of COPD in rural area are quite common and severe, which demands high level of health-care facility and resources. Factors determining the severity of exacerbations and level of care in the hospital are poor lung function, higher respiratory rate on presentation, blood pH, blood carbon dioxide level, and PAP. Inhaler bronchodilators are still less utilized as compared to oral bronchodilators. Interventions to promote the use of inhaler devices such as mass media coverage, subsidized rate of inhaler medicines, health education at the level of primary care physician, and discouraging the use of oral bronchodilators may be promoted. Immunization for influenza in COPD patients is very low. Pulmonary rehabilitation which is an integral part of COPD management is less implemented in rural areas.

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### Conflicts of interest

There are no conflicts of interest.

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