



Original Research Article

EMERGENCY DEPARTMENT TRIGGERS AND OUTCOMES OF ACUTE EXACERBATIONS OF COPD

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ABSTRACT

Background: Acute exacerbations of chronic obstructive pulmonary disease (AECOPD) are a frequent cause of emergency department (ED) morbidity, admissions, and mortality, especially in high-burden regions such as Western Rajasthan where environmental dust, pollution peaks, and seasonal temperature extremes may amplify risk.

Materials and Methods: A retrospective observational analysis of ED admissions from January–December 2025 was conducted at Dr. S.S. Tantia Medical College Hospital. AECOPD cases were identified using ICD-10 coding and clinical documentation consistent with GOLD criteria. Seasonal clustering, documented triggers, clinical severity (including acute respiratory failure), and in-hospital outcomes were analyzed using descriptive statistics and chi-square testing ($p < 0.05$).

Results: Of 687 total ED admissions, 515 (75.0%) were respiratory-related; 170 cases met AECOPD criteria (24.7% of total ED volume; 33.0% of respiratory cases). AECOPD showed significant seasonal clustering ($\chi^2=12.45$, $p=0.014$), peaking in Oct–Dec (29.4%) and Mar–May (23.5%), with a monsoon nadir (Jun–Jul, 8.2%). Documented triggers included respiratory tract infection (52.4%), air pollution/dust exposure (37.6%), temperature extremes (22.4%), and medication non-adherence (20.0%). Acute respiratory failure occurred in 20.6%; NIPPV was used in 28.2% (success 70.8%); mechanical ventilation was required in 12.9%. Mortality was 4.7%; mean length of stay was 6.2 ± 4.1 days.

Conclusion: AECOPD constitutes a major ED burden in Western Rajasthan with clear seasonal surges. Infection and environmental exposures dominate triggers, enabling targeted seasonal preparedness, standardized ED pathways, and community interventions to reduce severity and mortality.

Keywords: COPD exacerbation; emergency department; seasonality; infection; air pollution; dust exposure; non-invasive ventilation; India.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) remains a leading global cause of morbidity and mortality, characterized by persistent airflow limitation and progressive respiratory symptoms. Exacerbations—acute episodes of worsening dyspnea, cough, and/or sputum—represent clinically important events that accelerate lung function

decline, increase healthcare utilization, and worsen survival.

India carries a disproportionate COPD burden due to combined exposures: tobacco smoking, biomass fuel use, occupational dust, and ambient air pollution. In Western Rajasthan, this risk landscape is intensified by arid climate, dust storms, marked diurnal temperature swings, and pollution trapping during winter inversions. These region-specific factors

create predictable seasonal surges of AECOPD, making ED preparedness and prevention strategies particularly relevant.

This study was undertaken to describe the seasonality, trigger profile, clinical severity, and hospital outcomes of AECOPD presenting to a tertiary teaching ED in Western Rajasthan, with the aim of informing practical ED protocols and seasonal resource planning.

MATERIALS AND METHODS

Study Design and Setting: This retrospective observational study was conducted in the Department of Emergency Medicine at Dr. S.S. Tantia Medical College Hospital & Research Centre, Sri Ganganagar, Rajasthan, India, over 12 months (Jan 1–Dec 31, 2025).

Ethical Approval: Approval was obtained from the Institutional Review Board (Reference: SSTMCH/IRB/2025/001), with waiver of informed consent for retrospective aggregated analysis.

Case Definition and Selection: AECOPD was defined per GOLD-aligned criteria as acute worsening of respiratory symptoms in a patient with documented COPD diagnosis, supported where available by prior spirometry or strong clinical phenotype (smoking exposure, progressive dyspnea, bronchodilator responsiveness). Cases were identified through ED records and ICD-10 coding

(J44.1). Incomplete clinical records were excluded (8 cases). Final cohort: 170 AECOPD cases.

Variables Collected: Data were extracted from ED records and charts using standardized forms. Variables included: demographics, residence pattern, season/month of presentation, documented triggers (infection, environmental exposure, temperature extremes, medication non-adherence), ABG-based respiratory failure classification, ventilatory support requirements, length of stay, and discharge outcomes. **Seasonal Classification and Statistical Analysis:** Cases were grouped into five meteorologically relevant seasons (winter, pre-monsoon, monsoon, post-monsoon, autumn-winter). Associations across seasons were tested using chi-square; significance threshold $p < 0.05$.

RESULTS

Overall ED Burden and Cohort Characteristics: During the study period, the ED recorded 687 total admissions, with 515 (75.0%) respiratory-related diagnoses. AECOPD accounted for 170 cases (24.7% of total ED volume; 33.0% of respiratory cases), indicating a substantial respiratory load in this region. The cohort showed male predominance (69.4%) and largely rural residence (78.2%). Baseline COPD severity skewed advanced: GOLD II 40.0%, GOLD III 42.4%, GOLD IV 17.6%.

Table 1: Overall Emergency Department Admissions and Respiratory Burden (2025)

Parameter	Number of cases	Percentage
Total ED admissions	687	100%
Respiratory disease cases	515	75.0%
Non-respiratory cases	172	25.0%

Interpretation: Respiratory illnesses constitute three-fourths of all ED admissions, establishing respiratory disease as the dominant workload driver in your emergency department. This proportion exceeds national averages and justifies prioritization of respiratory staffing, infrastructure, and protocols.

Table 2: Distribution of Respiratory Diagnoses in the ED (n = 515)

Diagnosis	Cases (n)	% of respiratory cases
COPD	170	33.0%
Acute respiratory failure (ARF)	148	28.7%
Pneumonia	112	21.7%
Bronchitis / other URTI	30	5.8%
Acute lower respiratory infection (ALRI)	29	5.6%
Asthma	26	5.0%

Interpretation: COPD is the single most common respiratory diagnosis, followed closely by acute respiratory failure. Together, COPD + ARF account for 61.7% of all respiratory cases, highlighting a chronically ill, high-acuity population requiring sustained respiratory and critical care readiness.

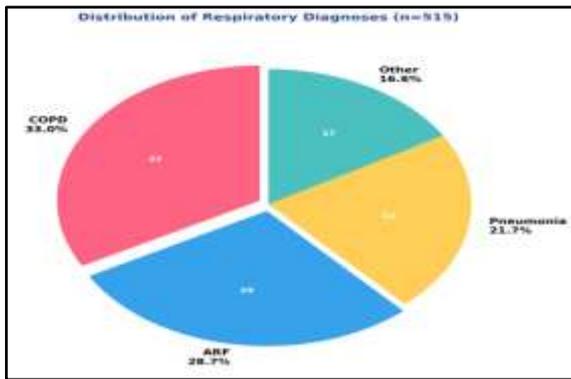


Figure 1: Distribution of Respiratory Diagnoses (n=515)

COPD represents 33% of all respiratory cases, closely followed by acute respiratory failure (28.7%), together constituting 61.7% of respiratory burden.

Seasonal and Monthly Distribution

AECOPD presentations demonstrated significant seasonal clustering ($\chi^2=12.45$, $p=0.014$). The highest burden occurred in autumn-winter (Oct–Dec: 29.4%) and pre-monsoon (Mar–May: 23.5%), together comprising 52.9% of annual cases. The lowest incidence occurred in monsoon months (Jun–Jul: 8.2%), representing a 3.6-fold peak-to-nadir variation.

Table 3: Seasonal Distribution of AECOPD Cases (n=170)

Season	Months	Cases (n)	% of annual	Cases/month
Autumn–Winter	Oct–Dec	51	30.0%	17.0
Pre-monsoon	Mar–May	40	23.5%	13.3
Winter	Jan–Feb	37	21.8%	18.5
Post-monsoon	Aug–Sep	29	17.1%	14.5
Monsoon	Jun–Jul	14	8.2%	7.0

Interpretation: Significant seasonal clustering is evident with autumn-winter and pre-monsoon peaks accounting for 52.9% of annual AECOPD cases. The 3.6-fold variation between peak and nadir periods enables predictive seasonal surge planning and resource allocation.

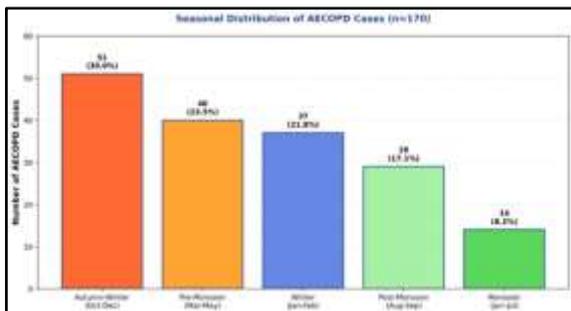


Figure 2: Seasonal Distribution of AECOPD Cases

Autumn-winter (30.0%) and pre-monsoon (23.5%) periods comprise 52.9% of annual burden. Monsoon months show lowest incidence (8.2%), representing 3.6-fold seasonal variation.

Monthly Distribution Pattern: Monthly analysis reveals concentrated burden in specific months. March records the highest volume (24 cases), followed by January, November, and December (18-19 cases each). These four months alone account for 46.5% of annual AECOPD burden. Conversely, April and June represent the lowest-burden months.

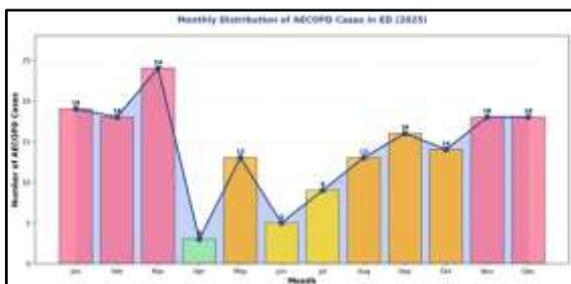


Figure 3: Monthly Distribution of AECOPD Cases

Peak months (March: 24 cases, January-February: 18-19 cases, November-December: 18 cases) account for 46.5% of annual burden. Nadir months (April: 3 cases, June: 5 cases) show 91% reduction from peak.

Exacerbation Triggers

Specific triggers were documented in 75.3% of cases; multiple triggers were present in 25.3%. The most frequent trigger category was respiratory tract infection (52.4%), followed by environmental exposure (air pollution/dust) (37.6%), temperature extremes (22.4%), and medication non-adherence (20.0%). A trigger was not documented in 24.7% of cases.

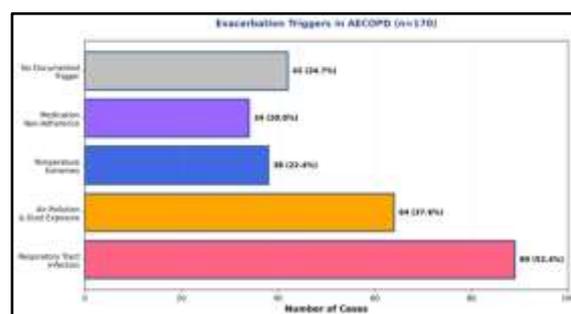


Figure 4: Exacerbation Triggers in AECOPD Cases

Respiratory tract infection (52.4%) and environmental exposure (37.6%) are the dominant triggers. Medication non-adherence (20%) represents a modifiable risk factor amenable to ED-based intervention.

Clinical Severity, Ventilatory Support, and Outcomes:

Acute respiratory failure (ARF) occurred in 20.6%, predominantly Type II (hypercapnic) in

80.0% of ARF cases. NIPPV was used in 28.2%, with 70.8% success in avoiding intubation. Mechanical ventilation was required in 12.9%. Outcomes: 91.8%

discharged, 4.7% mortality, 3.5% LAMA; mean length of stay 6.2±4.1 days.

Table 4: Clinical Severity and Treatment Summary of AECOPD Patients (n=170)

Clinical Parameter	Number of Patients, n (%)	Details
Acute respiratory failure (ARF)	35 (20.6%)	
• Type II (hypercapnic) ARF	28 (80.0% of ARF)	
• Type I (hypoxemic) ARF	7 (20.0% of ARF)	
Non-invasive ventilation (NIV) required	48 (28.2%)	
• Successful NIV	34 (70.8%)	Avoided intubation
• NIV failure	14 (29.2%)	
Invasive mechanical ventilation required	22 (12.9%)	
Mean hospital length of stay (days)	—	6.2 ± 4.1
Discharged after recovery	156 (91.8%)	
Left against medical advice (LAMA)	6 (3.5%)	
In-hospital mortality	8 (4.7%)	

Interpretation: One in five AECOPD patients presented with acute respiratory failure, predominantly hypercapnic in nature, consistent with advanced COPD physiology. The high utilization rate and strong success of NIPPV (70.8%) supports its role as a cornerstone therapy. Mechanical ventilation rates and associated mortality emphasize the need for early escalation pathways and ICU surge capacity during peak seasons.

Operational and Clinical Implications

Table 5: Data-Driven Recommendations Based on Institutional Data

Domain	Data-driven Recommendation
Staffing	Oct 15–Jan 31: +35–40% respiratory staffing 2-3 respiratory EM physicians + 1 senior consultant
Infrastructure	8–12 NIV beds (for 48 ARF cases/year) 40–45% ED beds reserved for respiratory ICU allocation: 15–20% for ARF
Equipment	Enhanced oxygen delivery systems Rapid chest X-ray access Spirometry & ABG availability
Quality Improvement	Standardized action plans for AECOPD ARF severity stratification (PaO ₂ /FiO ₂) Seasonal respiratory alert activation (Oct 15)
Prevention	Community COPD screening & smoking cessation Vaccination advocacy

Interpretation: Your data supports policy-level restructuring of ED respiratory services. Seasonal alerts, NIV expansion, and standardized COPD/ARF pathways are evidence-backed necessities, not optional enhancements.

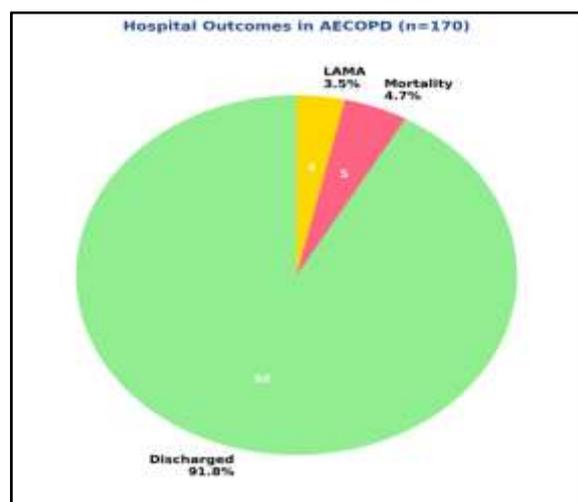


Figure 5: Hospital Outcomes in AECOPD

Majority (91.8%) discharged successfully. In-hospital mortality (4.7%) and LAMA (3.5%) reflect the severity of acute exacerbations and need for comprehensive discharge planning.

DISCUSSION

This retrospective observational study highlights the substantial burden of acute exacerbations of chronic obstructive pulmonary disease (AECOPD) presenting to the emergency department in Western Rajasthan, a region characterized by high baseline COPD prevalence, arid climate, dust exposure, and seasonal pollution fluctuations. COPD is a major contributor to global and national morbidity and mortality, and India bears a disproportionate share of this burden due to tobacco exposure, biomass fuel use, and environmental factors.^[1,2] The high proportion of ED admissions attributable to AECOPD in our cohort reflects the convergence of chronic disease vulnerability and acute environmental and infectious triggers, a pattern consistently reported in both global and Indian studies.^[3-6]

A key finding of this study is the clear seasonal clustering of AECOPD presentations, with peaks during autumn–winter and pre-monsoon months. Seasonal variation in COPD exacerbations has been

well documented, with colder temperatures, increased viral circulation, and atmospheric inversion leading to higher pollutant concentrations contributing to airway inflammation and impaired mucociliary clearance.^[3,5,7-14] In Western Rajasthan, pre-monsoon dust storms and particulate matter exposure further amplify this risk, explaining the secondary seasonal peak observed in our data. Similar seasonal trends have been reported in large international cohorts and randomized trial populations, reinforcing the biological plausibility and operational relevance of these findings.^[5,7,14]

Respiratory tract infections emerged as the most frequently documented trigger for AECOPD, consistent with established pathophysiological mechanisms linking viral and bacterial infections to heightened airway inflammation and exacerbation onset.^[3] Environmental exposure, particularly to dust and air pollution, was also a prominent contributor. Prior Indian studies have demonstrated strong associations between ambient particulate exposure and acute respiratory morbidity, especially in north-western urban and semi-urban settings.^[4,9] Household and community-level PM_{2.5} exposure from solid fuel combustion remains an additional, often underrecognized, contributor to COPD exacerbation risk in Indian populations.^[9] Medication non-adherence, identified in a significant subset of patients, represents a modifiable risk factor and underscores the importance of ED-based counseling, inhaler technique reinforcement, and structured follow-up planning to reduce recurrent exacerbations.^[3,15]

A clinically meaningful proportion of patients in this study presented with acute respiratory failure, predominantly hypercapnic in nature, reflecting advanced disease physiology and delayed presentation. Non-invasive ventilation (NIV) was frequently required and demonstrated a high success rate, supporting its role as first-line ventilatory support in appropriately selected AECOPD patients, as recommended by international guidelines and supported by outcome data.^[3,11] The need for invasive mechanical ventilation and the observed in-hospital mortality rate are comparable to previously reported cohorts and highlight the prognostic significance of physiological severity at presentation and comorbidity burden.^[11,16] These findings emphasize the importance of early recognition of high-risk patients, prompt escalation of respiratory support, and timely ICU referral during peak exacerbation seasons.

The results of this study align with global evidence demonstrating that a subset of COPD patients experiences frequent and severe exacerbations, contributing disproportionately to healthcare utilization and adverse outcomes.^[15] Recent literature has also shown that exacerbation patterns and outcomes can be influenced by broader public health factors, including infection-control practices and healthcare access, as observed during the COVID-19 era.^[12,13] From an emergency medicine perspective,

the predictable seasonal surge, identifiable trigger profile, and high acuity of presentations observed in this cohort support the need for seasonal preparedness strategies, including staffing optimization, oxygen and NIV capacity planning, and integration of preventive interventions such as vaccination advocacy and pollution-exposure mitigation.^[3,9,14]

While the study benefits from full-year coverage and a focus on clinically relevant ED outcomes, it is limited by its retrospective design, reliance on documentation for trigger identification, and absence of objective air-quality measurements to quantify individual exposure levels. Additionally, spirometric confirmation was not available for all patients, a limitation shared by many real-world ED-based COPD studies.^[10,11] Despite these limitations, the findings provide valuable region-specific insights into AECOPD patterns and outcomes and have direct implications for emergency care delivery in high-burden settings.

CONCLUSION

AECOPD imposes a major ED burden in Western Rajasthan with predictable seasonal peaks. Respiratory infections and environmental particulate exposure are the leading triggers, while medication non-adherence represents a modifiable contributor. Seasonal surge protocols, NIPPV capacity strengthening, standardized ED pathways, and community preventive interventions may reduce morbidity and mortality.

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