International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Assessing Sputum Bacteriology, Antibiotic Sensitivity And Resistance Patterns in Patients with Acute Exacerbations of Chronic Obstructive Pulmonary Disease: A Prospective Observational Study at Teritiary Care Hospital

Dr Mohitha Sri M[1], Dr Koppolu Sirisha[2], Dr Aruna Vasireddy[3], Dr P Samar Kumar[4], Dr Kalaiyarasan R[5], Parasa Rashmi[6]

[1]3rd year postgraduate, Department of Pulmonary Medicine, Govt Siddhartha medical college,Vijayawada, Andhra Pradesh, India
[2]Assistant Professor,Department of Pulmonary Medicine, Govt Siddhartha medical college,Vijayawada, Andhra Pradesh, India
[3]Associate Professor,Department of Pulmonary Medicine, Govt Siddhartha medical college,Vijayawada, Andhra Pradesh, India
[4]Assistant Professor,Department of Pulmonary Medicine, Govt Siddhartha medical college,Vijayawada, Andhra Pradesh, India
[5]3rd year postgraduate, Department of Pulmonary Medicine, Govt Siddhartha medical college,Vijayawada, Andhra Pradesh, India
[6]5th year PHARM.D (Doctor of Pharmacy), Vijaya Institute of Pharmaceutical Sciences for Women, Vijayawada, Andhra Pradesh, India

OPEN ACCESS

Corresponding Author:

Dr Mohitha Sri M
3rd year postgraduate, Department of Pulmonary Medicine, Govt Siddhartha medical college, Vijayawada, Andhra Pradesh, India

Received: 02-01-2026
Accepted: 21-01-2026
Available online: 31-01-2026

ABSTRACT

Background: Infective involvement of the lower respiratory tract remains one of the most frequent provoking factors for acute worsening of chronic obstructive pulmonary disease(COPD). The injudicious selection of empirical antibiotics has accelerated the emergence of resistant strains. Understanding local microbial trends and their drug responsiveness is crucial for improving clinical care.

Objectives: To determine the common aerobic bacterial pathogens present in sputum during AECOPD and to analyze their antibiotic sensitivity and resistance characteristics.

Methods: This prospective observational analysis was undertaken for 14 months at a tertiary care hospital. One hundred and fifty adult patients diagnosed with COPD and presenting with acute exacerbation symptoms were included. Collected sputum specimens were examined microscopically and processed for aerobic culture. Antibiotic susceptibility was evaluated using the Kirby–Bauer disc diffusion technique following CLSI standards.

Results: Sixty percent of the samples yielded pathogenic bacterial growth. Among culture-positive cases, Klebsiella pneumoniae was most frequently identified, followed by Pseudomonas aeruginosa and Escherichia coli. Aminoglycosides and carbapenems showed superior effectiveness. Considerable resistance was recorded against third-generation cephalosporins.

Conclusion: Aerobic gram-negative pathogens contribute substantially to AECOPD in this population. Treatment decisions supported by culture reports and regional antibiogram awareness can reduce therapeutic failure and unnecessary broad-spectrum antibiotic exposure.

Keywords*: AECOPD, sputum microbiology, antibiotic sensitivity, antimicrobial resistance. [1-9].*

INTRODUCTION

COPD is a chronic, slowly advancing pulmonary condition associated with irreversible airflow restriction caused by long-term exposure to inhaled toxins such as cigarette smoke, industrial emissions, and biomass fuel fumes. Continuous inflammatory activity leads to progressive airway narrowing and parenchymal injury. AECOPD refers to abrupt symptomatic aggravation beyond routine day-to-day variations, clinically manifested by intensified breathlessness, increased cough frequency, and alteration in sputum quantity or color. These episodes are major determinants of lung function decline, increased hospitalization frequency, and impaired patient well-being. [1-4]

Microbial infection, especially bacterial invasion, plays a dominant role in triggering exacerbations, although viruses and environmental factors also contribute. Differentiating harmless colonization from active infection has been a long-standing clinical challenge. More reliable sampling approaches have shown that bacterial isolation rates rise significantly during acute exacerbations compared with stable disease phases, indicating a causative link rather than incidental presence. [2,4]

Several investigations from India, Nepal, Egypt, and other developing healthcare environments have documented a broad range of bacterial isolates in AECOPD, often highlighting gram-negative organisms as predominant, with regional differences in drug response. [1,3,5-7] Research from South-Asian populations further reinforces the importance of laboratory-driven antibiotic decisions due to shifting pathogen prevalence and increasing resistance pressure. [5,7-9]

Given the fluctuating nature of airway microbiota and the lack of comprehensive regional data from certain Indian centers, localized microbial profiling becomes essential. Unverified empirical antibiotic use increases the risk of ineffective treatment and fosters antimicrobial resistance. [3,5,6] Therefore, the present study focuses on identifying aerobic bacterial triggers and their susceptibility trends to assist clinicians in selecting more effective and rational antibiotics

MATERIALS AND METHODS

This real-time prospective observational study was implemented in the Department of Pulmonary Medicine at Siddhartha Medical College and Government General Hospital, Vijayawada between March 2024 and May 2025. One hundred and fifty patients aged above 18 years with previously confirmed COPD diagnosis and presenting with clinical features of acute exacerbation were enrolled after obtaining informed consent.

Morning expectorated sputum was collected using sterile wide-mouth, sealed containers. Sample adequacy was verified visually prior to processing. Microscopic evaluation was initiated using Gram stain, followed by inoculation onto standard aerobic culture media. Bacterial species were confirmed using accepted biochemical and morphological identification protocols.

Drug susceptibility was analyzed through the Kirby–Bauer disk diffusion method. Zone diameters were interpreted using CLSI recommendations. In addition to laboratory procedures, patient-specific clinical information including age, gender, symptoms, and prior treatment exposure were documented in structured case sheets. All results were categorized for final statistical interpretation.

Inclusion Criteria

- Individuals providing written or verbal consent
- Age above 18 years
- Established COPD diagnosis
- Presentation consistent with acute exacerbation symptoms

Exclusion Criteria

- Refusal to participate
- Age below 18 years
- Pregnant or breastfeeding individuals
- Terminal systemic illness
- Psychiatric disorders interfering with participation

RESULTS

- Majority of the study subjects belong to age group 2 (41-60 years) 50.6% and age group 3 (61-80 years) 40.7% highlighting that middle-aged and older patients are most affected.

TABLE 1- AGE WISE DISTRIBUTION

GROUP	AGE	FREQUENCY	PERCENTAGE
1	18-40	10	6.7
2	41-60	76	50.6
3	61-80	61	40.7
4	81-95	3	2
Total		150	100

TABLE 2-GENDER WISE DISTRIBUTION

GENDER	FREQUENCY	PERCENT
Female	20	13.3
Male	130	86.7
Total	150	100

- In our study of 150 cases, 130 were male (86.7%) and 20 were female (13.3%).
- The predominance of male patients aligns with the well-documented higher prevalence of COPD among men, likely due to higher rates of smoking and occupational exposure to respiratory irritants.
- Culture reports showed that 60% of patients (90 out of 150) had a positive sputum culture, indicating the presence of bacterial infection, while 40% (60 out of 150) had a negative culture, suggesting no significant bacterial growth. The predominance of positive culture results (60%) suggests that bacterial infections play a significant role in Acute Exacerbation of Chronic Obstructive Pulmonary Disease (AECOPD).
- Out of the organisms isolated Klebshiella pneumoniae is more common, followed by Pseudomonas aeruginosa and Escherichia coli.

TABLE 3- ORGANISM ISOLATED

SPECIES	FREQUENCY	PERCENTAGE(%)
Klebshiella pneumoniae	40	26.7
Pseudomonas aeruginosa	22	14.7
Escherichia coli	11	7.3
Citrobacter species	8	5.3
Burkholderia species	4	2.7
Streptococcus pneumoniae	2	1.3
Enterococcus faecalis	2	1.3
Klebshiella oxytosa	1	0.7
Staphylococcus aureus	1	0.7
Proteus mirabilis	1	0.7
Nil	58	38.6
Total	150	100

- Klebsiella pneumoniae

High Sensitivity: Amikacin (23), Gentamicin (24), Piperacillin tazobactum (22)
High Resistance: Ceftriaxone (10), Cefepime (7), Ciprofloxacin (2)

- Pseudomonas aeruginosa

High sensitivity: Gentamicin (12), Cefepime (11), Levofloxacin (13)
Resistance Concern: Piperacillin-tazobactum (7), Ceftriaxone (5)

- E. coli

high sensitivity: Amikacin (9), Gentamicin (8), Meropenem (8)
High Resistance: Levofloxacin (8), Ceftriaxone (8), Cefotaxime (1)

TABLE 4- SENSITIVITY PATTERN

Antibiotics	Pseudomonas	E.Coli	Klebshiella
Gentamicin	12	8	24
Amikacin	10	9	23
Piperacillin-tazobactum	10	5	22
Meropenem	7	8	15
Cefepime	11	5	11
Levofloxacin	13	1	28
Ceftriaxone	6	2	13
Ceftazidime	7	1	3
Cefotaxime	-	0	1
Ciprofloxacin	2	-	0
Colistin	2	-	1

TABLE 5- RESISTANCE PATTERN

Antibiotics	Pseudomonas	E.Coli	Klebshiella
Ceftriaxone	5	8	10
Cefipime	3	5	7
Piperacillin - tazobactum	7	3	2
Levofloxacin	3	8	7
Ciprofloxacin	1	-	2
Cefotaxime	-	1	0
Amikacin	0	0	0
Ceftazidime	1	2	3
Gentamicin	3	1	3
Meropenem	2	1	2
Colistin	0	-	0

DISCUSSION

The study confirms that gram-negative bacteria form the major share of sputum isolates in AECOPD, particularly Klebsiella pneumoniae, Pseudomonas aeruginosa, and E. coli, a pattern consistent with previous observations across India, Nepal, and Egypt. [1,3,5-9]

The recurring identification of P. aeruginosa in patients with repeated hospital visits and prior antibiotic intake supports its known risk association in advanced COPD. [4,6] The maintained susceptibility of P. aeruginosa to levofloxacin, cefepime, gentamicin, and carbapenems reflects continued effectiveness of these drug classes regionally. [1,3,7]

Reduced responsiveness to ceftriaxone and piperacillin-tazobactam indicates growing resistance pressure, likely from frequent unverified empirical antibiotic administration, a challenge similarly noted in Indian and African reports. [3,6,7] The favorable response of E. coli and K. pneumoniae to aminoglycosides and carbapenems also mirrors earlier hospital-based antibiogram trends. [3,5,6,9] The high resistance to third-generation cephalosporins further reflects antibiotic selection pressure due to their widespread unsupervised prescription. [5,7-9]

Evidence of chronic bacterial carriage in COPD airways during stable phases suggests that colonization may predispose individuals to future infective exacerbations, enhancing airway inflammation rather than representing a passive occurrence. [2,4,6]

Overall, these findings emphasize the need for laboratory-supported antibiotic selection and structured antimicrobial stewardship. [1-9]

CONCLUSION

This study reaffirms that bacterial infections constitute a major driver of AECOPD and emphasises the necessity of understanding local microbial patterns for effective treatment. Performing sputum culture and sensitivity testing before initiating therapy helps avoid unnecessary exposure to broad-spectrum antibiotics and reduces the emergence of resistant organisms. Using region-specific resistance patterns to guide management can significantly improve patient outcomes, reduce treatment-related expenses, and limit the spread of multidrug-resistant bacteria. Continuous surveillance of pathogen behaviour and resistance trends will remain essential to improving long-term care strategies for COPD patients.

LIMITATIONS

- The study was conducted in a single tertiary care centre, which may limit the generalizability of the findings to other regions or healthcare settings.
- Only aerobic bacterial pathogens were assessed; viral, fungal, and atypical organisms were not included, which may underestimate the true spectrum of etiological agents in AECOPD.
- Antibiotic usage prior to hospital presentation could not be fully controlled, potentially influencing culture positivity and resistance patterns.
- The study did not evaluate clinical outcomes in relation to specific pathogens or resistance profiles, which could provide additional insight into treatment effectiveness.
- Seasonal variations were not analysed separately, although they may influence infection patterns and exacerbation frequency.

DECLARATION

Conflicts of interest: the authors declare no conflicts of interest.
Author contribution- All authors have equally contributed in the manuscript.
Author funding- Nil.

REFERENCES

1. Sharan, H. (2015). Aerobic bacteriological study of AECOPD. Journal of Clinical and Diagnostic Research. [1]
2. Monso, E., Ruiz, J., et al. (1995). Bacterial role in stable vs exacerbated COPD using protected brush sampling. American Journal of Respiratory and Critical Care Medicine. [2]
3. Chawla, K., Mukhopadhay, C., et al. (2008). Bacteriology and antibiogram of AECOPD: A hospital study. Journal of Clinical and Diagnostic Research. [3]
4. Sethi, S. (2004). Bacterial presence in COPD exacerbation: Active cause or incidental? Proceedings of the American Thoracic Society. [4]
5. Patel, A. (2015). Sputum microbiology and antibiotic response in AECOPD in India. Journal of Pulmonary and Respiratory Medicine. [5]
6. Madhavi, S., Rao, M. V., et al. (2012). Bacterial causes of AECOPD. Journal of Microbiology and Biotechnology Research. [6]
7. Hassan, A. T., Mohamed, S. A., et al. (2016). Antibiotic resistance in COPD exacerbations in Upper Egypt. Egyptian Journal of Bronchology. [7]
8. Arya, S., et al. (2019). Sputum bacteriology of community-acquired pneumonia in tertiary care. World Journal of Pharmaceutical Research. [8]
9. Dahal, A., et al. (2024). AECOPD sputum microbiology and sensitivity profile in Kathmandu. Nepal Health Research Council Journal. [9]