DOI: 10.55522/jmpas.V15I3.7023 ISSN NO. 2320 – 7418

International peer reviewed open access journal

Journal of Medical Pharmaceutical and Allied Sciences

Journal homepage: www.jmpas.com CODEN: JMPACO

Research article

Antimicrobial resistance and disease severity in hospitalized patients with acute exacerbation of bronchiectasis

Venkata Prathigna Kudipudi*, Deva Harshini Korlakunta, Kusuma Lalitha Madhuri Chintala, Swarnakumari Lalam, Mallika Mini

Department of pharmacy practice, Aditya college of pharmacy, Surampalem, Andhra Pradesh, India

Corresponding author: Venkata Prathigna Kudipudi, ✉ venkataprathigna@gmail.com, **Orcid Id**: https://orcid.org/0009-0008-7087-6143

Department of Pharmacy Practice, Aditya College of Pharmacy, Surampalem, Andhra Pradesh, India

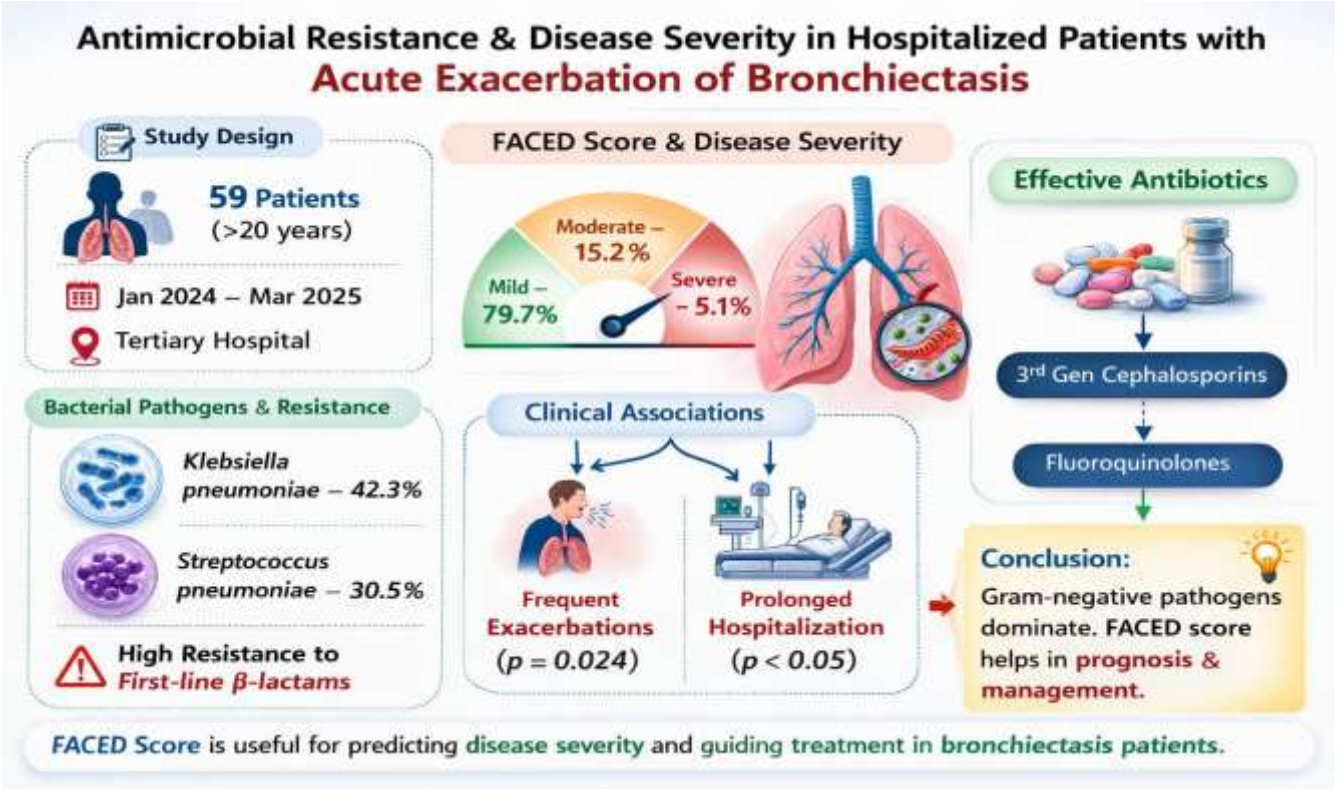
Received - 10-03-2026**, Revised** - 22-03-2026, **Accepted** - 20-05-2026 **(DD-MM-YYYY)**

Refer This Article

Venkata Prathigna Kudipudi, Deva Harshini Korlakunta, Kusuma Lalitha Madhuri Chintala, Swarnakumari Lalam, Mallika Mini, 2026. Antimicrobial resistance and disease severity in hospitalized patients with acute exacerbation of bronchiectasis. Journal of medical pharmaceutical and allied sciences, V 15, I 3, Pages 23 – 28. Doi: https://doi.org/10.55522/jmpas.V15I3.7023.

ABSTRACT

Bronchiectasis is an increasingly recognized chronic lung disease marked by recurrent infections and airway damage. Antimicrobial resistance and the challenge of predicting disease progression necessitate combined microbiological and clinical evaluation. To investigate antimicrobial resistance profiles in acute exacerbations of bronchiectasis and explore the utility of the FACED score in predicting outcomes. A cross-sectional observational study was conducted among 59 patients (>20 years) admitted with acute exacerbations of bronchiectasis at a tertiary care hospital in East Godavari District (January 2024–March 2025).



Demographics, sputum cultures, and antibiotic susceptibility patterns were recorded. Disease severity was graded using the FACED score and correlated with body mass index (BMI), hospitalization, and exacerbation frequency. Statistical analysis was performed using SPSS version 20; one-way ANOVA and non-parametric tests were applied, with $p < 0.05$ considered significant. The cohort had a mean age of 58.4 years, with a female predominance (57.6%). Klebsiella pneumoniae (42.3%) and Streptococcus pneumoniae (30.5%) were the leading pathogens, with high resistance to first-line β-lactams. The FACED score classified the disease as mild in 79.7%, moderate in 15.2%, and severe in 5.1% (mean = 1.34). Higher FACED scores were significantly associated with frequent exacerbations ($p = 0.024$) and prolonged hospitalizations ($p < 0.05$), but not with BMI. Gram-negative pathogens, especially Klebsiella pneumoniae, dominate bronchiectasis exacerbations and show worrying resistance trends. Third-generation cephalosporins and fluoroquinolones remain viable therapeutic options. The FACED score effectively stratifies patients and guides prognosis and management.

Keywords: Bronchiectasis, Antimicrobial resistance, Bacterial infections, Antibacterial agents, Hospitalization, Klebsiella pneumoniae.

INTRODUCTION

Bronchiectasis is a chronic and progressive respiratory disorder characterized by irreversible dilation of the bronchi, impaired mucociliary clearance, and persistent airway inflammation [1]. These structural abnormalities lead to recurrent respiratory infections, chronic productive cough, and progressive decline in lung function. Clinically, bronchiectasis is recognized as a syndrome characterized by chronic cough, daily sputum production, and recurrent pulmonary exacerbations confirmed by radiological evidence of bronchial dilatation on computed tomography (CT) imaging [2]. Recurrent exacerbations significantly contribute to patient morbidity, reduced quality of life, and increased healthcare utilization.

In recent years, the incidence and prevalence of bronchiectasis have increased globally. This trend is largely attributed to improvements in diagnostic imaging techniques such as high-resolution computed tomography (HRCT) and growing clinical awareness of the disease [3]. Consequently, bronchiectasis has evolved from being considered a relatively rare or orphan condition to an increasingly recognized global health problem over the past few decades [4]. The increasing prevalence has also resulted in a substantial socioeconomic burden due to frequent hospitalizations, long-term treatment requirements, and increased healthcare costs. Although bronchiectasis has been studied extensively in developed countries, the global prevalence remains uncertain and varies significantly across different regions and populations [5]. The burden of disease is often greater in economically disadvantaged communities, yet comprehensive epidemiological data describing bronchiectasis in India remain limited.

The pathogenesis of bronchiectasis involves a complex interaction between persistent infection, chronic inflammation, and impaired mucociliary clearance. A common initiating factor in many cases is abnormal mucus clearance caused by structural airway abnormalities, defects in mucociliary function, or alterations in the properties of mucus itself [6]. Impaired clearance facilitates the persistence of microorganisms within the airways, leading to chronic bacterial colonization and continuous inflammatory responses that ultimately damage airway structures. In addition, bronchiectasis may occur as a primary condition or develop secondary to other respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD), further complicating disease management [7].

Acute exacerbations represent a major clinical challenge in the management of bronchiectasis. These exacerbations are defined as the worsening of three or more key symptoms including cough, sputum volume or purulence, dyspnoea, fatigue, or haemoptysis lasting for at least 48 hours and requiring modification of treatment. Bacterial infections are the most common cause of these exacerbations, and antibiotic therapy remains the primary treatment approach. However, repeated and sometimes inappropriate use of antibiotics has contributed to the emergence of antimicrobial resistance (AMR), which poses a major threat to effective disease management. The presence of resistant pathogens may result in treatment failure, prolonged hospital stays, increased healthcare costs, and limited therapeutic options. Furthermore, the distribution of bacterial pathogens and their antimicrobial susceptibility patterns vary widely across geographical regions, emphasizing the need for region-specific microbiological data to guide empirical antibiotic therapy.

Despite the growing recognition of antimicrobial resistance in chronic respiratory diseases, limited data are available regarding the microbial profile and antimicrobial resistance patterns associated with bronchiectasis exacerbations in Indian tertiary care settings. Understanding the local epidemiology of bacterial pathogens and their resistance trends is essential for optimizing antibiotic therapy and supporting antimicrobial stewardship strategies.

Therefore, the present study aims to analyze antimicrobial resistance patterns among patients admitted with acute exacerbations of bronchiectasis in the East Godavari District. The study seeks to identify the predominant bacterial pathogens responsible for these infections and evaluate their susceptibility to commonly used antimicrobial agents. The research also aims to determine the

prevalence of multidrug-resistant organisms among bronchiectasis patients and generate region-specific data that may help guide appropriate antibiotic therapy and improve clinical management in the local healthcare setting [13].

MATERIALS AND METHODS

Study design and setting

A cross-sectional observational study was conducted in the Department of Respiratory Medicine at GSL Medical College and General Hospital, Rajamahendravaram, Andhra Pradesh. The study was carried out from January 2024 to March 2025. The study was approved by the Institutional Ethics Committee of GSL Medical College and General Hospital. All procedures were performed in accordance with the ethical standards of the institutional and national research committee and with the 1975 Helsinki Declaration, as revised in 2013. Written informed consent was obtained from all participants.

Study population

A total of 59 patients aged above 20 years, admitted with acute exacerbation of bronchiectasis, were enrolled. Bronchiectasis was confirmed using high-resolution computed tomography (HRCT).

Inclusion criteria

Patients >20 years of age diagnosed with acute exacerbation of bronchiectasis and Patients who provided informed consent.

Exclusion criteria

Patients with bronchiectasis secondary to malignancy or cardiac failure, and Patients unwilling to participate or with incomplete clinical data.

Data collection

Sputum samples were collected from each participant for bacteriological culture and antibiotic susceptibility testing according to standard microbiological procedures. The age range (21–80 years) was selected to represent the adult population, and both sexes were included to reflect the epidemiological distribution. FACED scores were grouped into mild, moderate, and severe categories using established thresholds. Selection bias was minimized by enrolling consecutive eligible patients, and measurement bias was reduced using standardized microbiological procedures and uniform FACED scoring.

Microbiological analysis

Sputum samples were processed following standard operating procedures. Pathogenic isolates were identified based on colony morphology, Gram staining, and relevant biochemical tests. Antimicrobial susceptibility testing was performed using the Kirby–Bauer disc diffusion method using Mueller–Hinton agar carpet culture, and results were interpreted following Clinical and Laboratory Standards Institute (CLSI) 2023 guidelines. The organisms tested included *Klebsiella pneumoniae*, *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Acinetobacter* species.

Statistical analysis

Data were compiled and analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Comparisons between FACED score categories and clinical variables such as body mass index (BMI), hospitalization duration, and frequency of exacerbations were assessed using one-way Analysis of Variance (ANOVA) and non-parametric tests. A *p*-value of <0.05 was considered statistically significant.

Sponsorship

This research received no external funding.

RESULT

Demographic and clinical characteristics

A total of 59 patients with acute exacerbation of bronchiectasis were included. The cohort had a mean age of 58.4 ± 12.7 years (range: 21–80 years), with the highest proportion in the 61–80-year age group (49.1%), followed by 41–60 years (40.7%). Only 8.5% were aged 21–40 years, and 1.7% were above 80 years. A female predominance (57.6%) was observed compared to males (42.4%). The mean body mass index (BMI) of the study group was 21.34 ± 3.8 kg/m², with most patients falling within the normal range. However, a few exhibited lower BMI values.

The most common presenting symptoms were dyspnoea (94.9%), productive cough (86.4%), and persistent cough (84.7%). Less frequent symptoms included hemoptysis (3.4%), reflecting airway wall damage and intermittent infection-related inflammatory processes.

Table 1: Demographic and clinical characteristics of study population (n = 59)

Parameter	Category	n (%)	Mean ± SD
Age (years)	21–40	5 (8.5)	58.4 ± 12.7
	41–60	24(40.7)	
	61–80	29 (49.1)	
	>80	1(1.7)	
Sex	Male	25 (42.4)	
	Female	34 (57.6)	
Body-mass index (kg/m²)			21.34 ± 3.8
Common symptoms	Dyspnoea	56 (94.9)	
	Productive cough	51 (86.4)	
	Persistent cough	50 (84.7)	
	Haemoptysis	2 (3.4)	
Comorbidities	Hypertension	21 (35.6)	
	Post-tubercular sequelae	19 (32.2)	
	Asthma	13 (22.0)	
	Diabetes mellitus	12 (20.3)	
	COPD	10 (16.9)	
	Pneumonia	7 (11.9)	

Note: COPD = chronic obstructive pulmonary disease; SD = standard deviation.

Regarding comorbid conditions, hypertension (35.6%) and post-tubercular sequelae (32.2%) were the most prevalent, followed by asthma (22.0%), type 2 diabetes mellitus (20.3%), chronic obstructive pulmonary disease (COPD) (16.9%), and pneumonia (11.9%). The coexistence of these comorbidities likely contributes to disease severity and recurrent exacerbations.

Microbiological profile

Sputum cultures from all 59 patients showed 100% microbial growth, including 58 (98.3%) bacterial and 1 (1.7%) fungal (Penicillium) isolate. The consistently high positivity underscores the infectious basis of bronchiectasis exacerbations, reflecting persistent microbial colonization and impaired mucociliary clearance. Among bacterial isolates, Gram-negative bacilli accounted for 51.7% (n = 30), whereas Gram-positive cocci represented 48.3% (n = 28), indicating a near-equal distribution with a slight predominance of Gram-negative species.

Klebsiella pneumoniae was the most frequently isolated organism (25 isolates, 42.37%), especially in post-tubercular and tropical populations. The next most frequent pathogens were Staphylococcus aureus (8 isolates, 13.56%) and Streptococcus pneumoniae (18 isolates, 30.51%). Less frequent isolates included Pseudomonas aeruginosa (2, 3.39%), Acinetobacter species (2, 3.39%), Escherichia coli (1, 1.69%), Enterococcus species (1, 1.69%), Streptococcus pyogenes (1, 1.69%), and the fungal isolate Penicillium species (1, 1.69%). Mixed bacterial infections, involving both Gram-positive and Gram-negative organisms, were detected in approximately 6.8% of patients.

Streptococcus pneumoniae is a key community-acquired respiratory pathogen, while *Staphylococcus aureus*, including both methicillin-sensitive and methicillin-resistant strains, was frequently isolated among patients with prior hospitalization and antibiotic exposure. Although Pseudomonas aeruginosa and Acinetobacter species were less common, their identification remains clinically significant because of their multidrug resistance and potential for chronic airway colonization.

Table 2: Distribution of bacterial isolates from sputum cultures

Bacterial isolate	Frequency (n)	Percentage (%)
Klebsiella pneumoniae	25	42.37
Streptococcus pneumoniae	18	30.51
Staphylococcus aureus	8	13.56
Pseudomonas aeruginosa	2	3.39
Acinetobacter	2	3.39
Escherichia coli	1	1.69
Enterococcus	1	1.69
Streptococcus pyogenes	1	1.69
Penicillium	1	1.69
Total positive cultures	**59**	**100%**

Overall, Gram-negative organisms showed a slight predominance (51.7%), with a notable emergence of resistant Enterobacteriaceae, particularly Klebsiella pneumoniae. This evolving microbial pattern emphasizes the importance of continuous microbiological surveillance, empirical therapy guided by local resistance trends, and rigorous antimicrobial stewardship to optimize the management of bronchiectasis exacerbations in tertiary care settings.

Antimicrobial resistance patterns

Antimicrobial susceptibility testing of the isolated pathogens revealed a diverse resistance profile in chronic respiratory infections. The analysis demonstrated a high degree of resistance to commonly prescribed ampicillin (50.9%) and amoxicillin–clavulanate (47.5%). Trimethoprim-sulfamethoxazole (23.7%), teicoplanin (23.7%), and penicillin (33.9%) all demonstrated significant resistance.

Conversely, third-generation cephalosporins such as ceftriaxone (10.2%) and cefoxitin (11.9%), along with the fluoroquinolone ciprofloxacin (11.9%), linezolid (13.6%), and vancomycin (11.9%), maintained good efficacy against Gram-positive cocci, supporting their continued utility as reserve agents. Macrolides such as erythromycin (22.0%) and azithromycin (11.9%), and lincosamides like clindamycin (18.6%), showed considerable resistance, which would restrict their usage in empirical regimens.

Table 3: Antimicrobial resistance profile of bacterial isolates

Antibiotic tested	No. of resistant isolates (n = 59)	Resistance (%)
Ampicillin	30	50.85
Amoxicillin–clavulanate	28	47.46
Penicillin	20	33.90
Teicoplanin	14	23.73
Cotrimoxazole	14	23.73
Erythromycin	13	22.03
Clindamycin	11	18.64
Optochin	9	15.25
linezolid	8	13.56
vancomycin	7	11.86
Cefoxitin	7	11.86
Ciprofloxacin	7	11.86
Azithromycin	7	11.86
Ceftriaxone	6	11.86
Bacitracin	6	11.86

Note: Interpretation based on Clinical and Laboratory Standards Institute (CLSI) 2023 guidelines.

The predominance of multidrug-resistant (MDR) *Klebsiella pneumoniae* and the detection of resistant *Pseudomonas aeruginosa* and *Acinetobacter* spp. underscore the growing threat of MDR pathogens in bronchiectasis exacerbations. This pattern likely results from prior antibiotic exposure, repeated hospitalizations, and chronic airway colonization, all of which create selective pressure favouring resistant strains.

Overall, the observed susceptibility of isolates to third- and

fourth-generation cephalosporins and fluoroquinolones supports their use as first-line empirical agents in bronchiectasis exacerbations, pending culture results. However, the concurrent presence of high β-lactam resistance, routine resistance surveillance, and judicious antibiotic prescribing is necessary to prevent further escalation of antimicrobial resistance in chronic airway infections.

FACED score assessment and statistical correlation

The FACED score, a validated multidimensional tool for assessing disease severity in bronchiectasis, was applied to all 59 study participants to evaluate the correlation between clinical parameters, exacerbation frequency, and hospitalization outcomes. The score encompasses five key parameters: *Forced Expiratory Volume in 1 second (FEV_1), Age, Chronic colonization, Extent of radiological involvement,* and *Dyspnoea severity*.

The mean FACED score was 1.34 ± 1.21, indicating that most patients had mild bronchiectasis. Stratification revealed that 47 patients (79.7%) were classified as *mild*, 9 patients (15.2%) as *moderate*, and 3 patients (5.1%) as *severe*.

Patients with moderate-to-severe FACED scores demonstrated a higher incidence of frequent exacerbations (≥3 episodes per year), prolonged hospital stay, and higher rates of Gram-negative colonization, particularly by *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. Statistical analysis confirmed a significant positive correlation between FACED score and frequency of exacerbations ($p = 0.024$), indicating that increasing disease severity is associated with more frequent infective episodes.

Similarly, a significant relationship was observed between FACED score and duration of hospitalization ($p < 0.05$), suggesting that patients with higher scores tend to have prolonged recovery and more complex inpatient management needs. However, no statistically significant association was noted between FACED score and body mass index (BMI) ($p > 0.05$), implying that nutritional status did not significantly influence disease severity in this cohort.

Although Pseudomonas aeruginosa demonstrated the highest mean FACED score, one-way ANOVA showed no statistically significant difference in FACED scores across infecting organisms ($F = 0.776$, $p = 0.625$). The effect size was small ($\eta^2 = 0.11$), indicating that organism type explained only about 11% of disease severity, with the remaining variability driven by host and clinical factors. This result was influenced by small and uneven sample sizes across organism groups.

The prevalence of multidrug-resistant (MDR) organisms increased with higher FACED categories, linking disease severity to recurrent infections and progressive airway damage. Overall, these findings demonstrate that the FACED score reflects clinical burden more strongly than pathogen type alone.

Multidrug-resistant (MDR) organisms were more prevalent in moderate-to-severe cases, linking higher FACED scores to recurrent infections and progressive lung function decline.

DISCUSSION

This study analysed the microbiological profile and antimicrobial resistance patterns in patients with acute exacerbations of bronchiectasis and examined their association with disease severity using the FACED score. The findings provide region-specific evidence relevant to bronchiectasis management in the clinical Indian setting.

Klebsiella pneumoniae emerged as the most common isolate, followed by *Streptococcus pneumoniae* and *Staphylococcus aureus*. This distribution differs from Western studies, where *Pseudomonas aeruginosa* and *Haemophilus influenzae* predominate[6,7]. Such variation likely reflects regional epidemiology, antibiotic exposure, and the high burden of post-tubercular bronchiectasis in the Indian population [8].

High resistance to ampicillin and amoxicillin–clavulanate observed in this study aligns with reports from Indian tertiary care centres and suggests widespread β-lactamase–mediated resistance among respiratory pathogens [9, 10] In contrast, third-generation cephalosporins and ciprofloxacin demonstrated relatively better activity, supporting their cautious use as empirical therapy guided by local antibiograms.

The presence of multidrug-resistant *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* highlights the growing challenge of antimicrobial resistance in chronic airway diseases and reinforces the need for structured antimicrobial stewardship programs [11, 12]

FACED score analysis showed a significant association with exacerbation frequency and hospitalization, consistent with prior validation studies [14]. Importantly, although *Pseudomonas aeruginosa* was numerically associated with more severe disease, organism type did not significantly influence FACED score, indicating that host factors, lung damage, and chronic infection burden play a greater role than the infecting pathogen alone. The absence of a BMI–FACED association further supports that disease severity is driven primarily by airway pathology rather than nutritional status [15].

The integration of FACED scoring with microbiological data provides a clinically useful framework for risk stratification and individualized therapy. While limited by its single-centre design and modest sample size, this study highlights the dominance of resistant Gram-negative pathogens and supports FACED-guided clinical decision-making. Larger multicentre studies are needed to validate these findings and better define long-term outcomes.

CONCLUSION

This study highlights antimicrobial resistance (AMR) patterns in bronchiectasis patients in East Godavari District,

emphasizing the need for targeted antibiotic therapy. The most common pathogens were Klebsiella pneumoniae and Streptococcus pneumoniae. High resistance was seen to ampicillin and amoxicillin-clavulanic acid, while cefotaxime and ceftriaxone showed better efficacy.

Exacerbations were significantly associated with higher FACED scores ($p = 0.024$), and their severity also correlated with FACED grading ($p = 0.004$), indicating that severe bronchiectasis leads to frequent exacerbations.

Most patients had mild bronchiectasis with relatively preserved lung function, but many still experienced exacerbations, showing the chronic nature of the disease. The findings highlight the healthcare burden of bronchiectasis and AMR and may help clinicians choose appropriate empirical antibiotics while promoting rational antibiotic use and stewardship.

REFERENCES

1. Barker AF, 2002. Bronchiectasis. New England Journal of Medicine. 346(18), Pages 1383–93. Doi:10.1056/NEJMra012519.

2. Pasteur MC, Bilton D, Hill AT, 2010. British Thoracic Society guideline for non-CF bronchiectasis. Thorax. 65(Suppl 1), Pages i1–58. Doi:10.1136/thx.2010.136119.

3. Chalmers JD, Chang AB, Chotirmall SH, et al, 2018. Bronchiectasis. Nat Rev Dis Primers. 4(1), Page 45. Doi:10.1038/s41572-018-0042-3.

4. Chalmers JD, Aliberti S, Filonenko A, et al, 2018. Characterization of the “Frequent Exacerbator Phenotype” in Bronchiectasis. Am J Respir Crit Care Med. 197(11), Pages 1410–20. Doi:10.1164/rccm.201711-2202OC.

5. Chandrasekaran R, Mac Aogáin M, Chalmers JD, et al, 2018. Geographic variation in the aetiology, epidemiology and microbiology of bronchiectasis. BMC Pulm Med. 18(1), Page 83. Doi:10.1186/s12890-018-0638-0.

6. Pasteur MC, Bilton D, Hill AT, 2010. British Thoracic Society guideline for non-CF bronchiectasis. Thorax. 65(7), Pages 577–577. Doi:10.1136/thx.2010.142778.

7. King PT, Holdsworth SR, Freezer NJ, et al, 2007. Microbiologic follow-up study in adult bronchiectasis. Respir Med. 101(8), Pages 1633–1638. Doi: 10.1016/j.rmed.2007.03.009.

8. Chandrasekaran R, Mac Aogáin M, Chalmers JD, et al, Geographic variation in the aetiology, epidemiology and microbiology of bronchiectasis. BMC Pulm Med. 18(1), Page 83. Doi:10.1186/s12890-018-0638-0.

9. Narimisa N, Keshtkar A, Dadgar-Zankbar L, et al, Prevalence of colistin resistance in clinical isolates of Pseudomonas aeruginosa: a systematic review and meta-analysis. Front Microbiol. 9, Page 15. Doi: 10.3389/fmicb.2024.1477836.

10. Yimer O, Abebaw A, Adugna A, et al, 202. Bacterial profile, antimicrobial susceptibility patterns, and associated factors among lower respiratory tract infection patients attending at Debre Markos comprehensive specialized hospital, Northwest, Ethiopia. BMC Infect Dis. 25(1), Page 266. Doi:10.1186/s12879-025-10633-y.

11. Chang CH, Chang CH, Huang SH, et al, 2024. Epidemiology and outcomes of multidrug-resistant bacterial infection in non-cystic fibrosis bronchiectasis. Ann Clin Microbiol Antimicrob. 23(1), Page 15. Doi:10.1186/s12941-024-00675-6.

12. Inchingolo R, Pierandrei C, Montemurro G, et al, 2021. Antimicrobial Resistance in Common Respiratory Pathogens of Chronic Bronchiectasis Patients: A Literature Review. Antibiotics. 10(3), Page 326. Doi:10.3390/antibiotics10030326.

13. Martínez-García MÁ, de Gracia J, Vendrell Relat M, et al, 2014. Multidimensional approach to non-cystic fibrosis bronchiectasis: the FACED score. European Respiratory Journal. 43(5), Pages 1357–1367. Doi:10.1183/09031936.00026313.

14. Barbosa M, Chalmers JD, 2023. Bronchiectasis. Presse Med. 52(3), Page 104174. Doi: 10.1016/j.lpm.2023.104174.

15. Chalmers JD, Aliberti S, Filonenko A, et al, 2018. Characterisation of the “Frequent Exacerbator Phenotype” in Bronchiectasis. Am J Respir Crit Care Med. 197(11), Pages 1410–20. Doi:10.1164/rccm.201711-2202OC.