Assessment of Antibiotic Therapy in Lower Respiratory Tract Infections (LRTIs) in a Tertiary Care Hospital: A Prospective Observational Study

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Abstract

Background: Lower Respiratory Tract Infections (LRTIs) remain a significant cause of morbidity and hospitalizations. Effective management often involves proper antibiotic therapy. Patterns of antibiotic use vary widely across hospitals due to the lack of standardized protocols. Understanding the common pathogens, evaluating the appropriateness of prescriptions are essential steps toward improving care.

Objective: The objectives of the study is to assess the pattern of antibiotic prescription in LRTI patients, to evaluate the appropriateness of antibiotic prescribing, to analyse the impact of current antibiotic use on patient outcomes, to assess the microbiological patterns and to develop evidence-based antibiotic guidelines for LRTI.

Methods: The study is a prospective, observational, cross-sectional which is conducted at Akash Super Speciality Hospital, Karnataka for a period of 6-months. The study includes patients who are diagnosed with LRTI and also all patients receiving antibiotics. Patients with non-respiratory infections, who are not receiving antibiotics or those who have already been discharged from hospital, and immunocompromised patients are excluded from the study. The sample size of the study was rounded to be 100 patients.

Results: Among 100 patients with LRTI, the majority were above 60 years and highest was male gender (61). Most had clean wounds (47), and 81 did not receive prophylactic antibiotics, with empirical use being most common (77%). AECOPD was the leading diagnosis (41), followed by community-acquired pneumonia (35%). Streptococcus pneumoniae was the most frequently isolated organism (54). Ceftriaxone was the most used antibiotic (69%). Treatment adhered to guidelines in 66% of cases. Treatment effectiveness was significantly higher in females (94.9%) than males (77%) with a p-value of 0.036.

Conclusion: Empirical antibiotic use was common, often without microbiological confirmation. While most prescriptions were appropriate, issues such as spectrum mismatches, unnecessary initiation, and dosing errors were noted. Gender differences in response and frequent isolation of resistant Gram-negative pathogens highlight the need to strengthen antimicrobial stewardship, encourage culture-based prescribing, and adopt a more individualized treatment approach.

Keywords: LRTI, Lower Respiratory Tract Infection, Antibiotic, Ceftriaxone, Streptococcus pneumoniae, Community acquired pneumonia.

INTRODUCTION

Lower Respiratory Tract Infections (LRTI), which are a frequent form of respiratory disease which include Community Acquired Pneumonia (CAP), exacerbations of COPD, Acute Bronchitis (AB) [2] It is a network of disease that affect the tissues, organs and blood vessels of larynx, the bronchi, bronchioles and alveoli. LRTI have reported to be the one of the leading infectious disease causes of death (95%) that include countries with low income. The incidence and related mortality of LRTI can involve various factors such as age, gender, season, type of population which is at risk, distribution of causative agents. In India the factors responsible for LRTI include overcrowding, malnutrition, poor sanitisation, limited access to primary healthcare accesses [4]. The commonest causative agents include Gram-positive bacteria like Staphylococcus aureus and Enterococcus and Gram-negative

bacteria like Pseudomonas, Acinetobacter, Klebsiella pneumonia. The treatment conditions of LRTI can be monitored by WBC and CRP levels which in turn reflect the patient's progression condition and the treatment effect [3]. According to WHO India ranks the highest in antibiotic consumption and irrational use. In paediatric the use of antibiotic usually involves between monotherapy; which involves the use of single antibiotic due to its low risk of side effects and adverse effect and combination therapy; which is frequently used [5]. Antibiotic resistance has been now serious public health concern and it is always advisable to follow proper guidelines when selecting whether and which antibiotics to administer base on the age group and the population [6] Some prescriptions are mishandled due to lack of knowledge and the physician prescribing rates differ in ways that are not justified by patient factors.

METHODOLOGY

The study is a prospective, observational, cross-sectional study which is conducted at Akash Mult speciality Hospital, Devanahalli, Bengaluru, Karnataka for a period of 6-months. The study includes patients (≥18 years) who are diagnosed with LRTI that includes pneumonia, bronchitis, and COPD exacerbations and also all the patients who are receiving antibiotics for the treatment of LRTI in their hospitalization. Patients with non-respiratory infections, who are not receiving antibiotics or those who have already been discharged from hospital, and immunocompromised patients (e.g., those undergoing chemotherapy, organ transplant, etc.) are excluded from the study. The sample size of the study was calculated using 95% confidence interval, margin of error of 10% and estimated proportion of 50%, which result in a sample size of about 96, which was rounded to be 100 patients.

RESULTS

Table 01: Patient demographic details

Variable	Category/Value	Number of Patients (n) / Frequency	Mean ± SD
Age (years)	>60	60	0.60 ± 0.49
	41-60	34	0.34 ± 0.47
	19-40	6	0.06 ± 0.24
Gender	Male	61	0.61 ± 0.49
	Female	39	0.39 ± 0.49
Number of days in hospital stay (valid only)	Valid (90)	65	29.05 ± 40.14
	Invalid (10)	-	
Prophylactic Antibiotic Used	Yes	19	0.19 ± 0.39
	No	81	0.81 ± 0.39
Reason for Antibiotic Use	Empirical	77	0.77 ± 0.42
	Targeted	14	0.14 ± 0.35
	Prophylactic	9	0.09 ± 0.29

In our study majority of patients (60%) were aged above 60 years (Mean ± SD: 0.60 ± 0.49), indicating that elderly individuals formed the predominant age group affected by LRTIs. Predominantly males were slightly more affected (61%) than females (39%). And the valid data acquired from the hospital stays for 90 patients showed a wide variation in the length of stay, with a mean of 29.05 ± 40.14 days. Antibiotics uses also seen where only 19% of patients received prophylactic antibiotics and the primary reason for antibiotic use was empirical therapy (77%), followed by targeted (14%) and prophylactic (9%) therapy, suggesting limited reliance on culture sensitivity.

Table 02: Distribution of Primary Diagnosis among LRTI Patients (n = 100)

Primary Diagnosis	Frequency	Percentage (%)	Mean ± SD
AECOPD	41	41.0	0.41 ± 0.49
Community Acquired Pneumonia	35	35.0	0.35 ± 0.48
Bronchitis	17	17.0	0.17 ± 0.38
Hospital Acquired Pneumonia	3	3.0	0.03 ± 0.17
Bronchiolitis	3	3.0	0.03 ± 0.17
Ventilator Associated Pneumonia	1	1.0	0.01 ± 0.10

The most common diagnosis among patient were AECOPD (41%) and Community Acquired Pneumonia (35%), followed by Bronchitis (17%). Less frequent diagnoses included Hospital Acquired Pneumonia (3%), Bronchiolitis (3%), and Ventilator Associated Pneumonia (1%). The mean ± SD values reflect the prevalence, with AECOPD (0.41 ± 0.49) being the highest.

Table 03: Summary of Isolated Organisms causing LRTIs

Sl. No.	Organism	Count
01.	Streptococcus pneumoniae	54
02.	Escherichia coli (E. coli)	20
03.	Klebsiella pneumoniae	13
04.	Pseudomonas aeruginosa	11
05.	Haemophilus influenzae	7
06.	Mycoplasma pneumoniae	7
07.	Staphylococcus aureus (MSSA)	4
08.	Staphylococcus aureus (MRSA)	2
09.	Cocci	1
	Mean ± SD	**13.22 ± 16.13**

Microbiological Profile Streptococcus pneumoniae was the most common pathogen affecting 54% of the patients, followed by E. coli (20%) and Klebsiella pneumoniae (13%). Other notable organisms included *Pseudomonas aeruginosa* (11), *Haemophilus influenzae* (7%), *Mycoplasma pneumoniae* (7%), and both MSSA (4%) and MRSA (2%) strains of *Staphylococcus aureus*. The mean organism count was 13.22 ± 16.13, indicating a skewed distribution with some organisms being more predominant.

Table 04: Frequency and Proportion of Antibiotic Usage in LRTI Management (n = 100)

Antibiotic	Frequency	Percentage (%)	Mean ± SD

Ceftriaxone	69	69.0	0.69 ± 0.46
Azithromycin	30	30.0	0.30 ± 0.46
Piperacillin-Tazobactam	27	27.0	0.27 ± 0.44
Clarithromycin	27	27.0	0.27 ± 0.44
Doxycycline	16	16.0	0.16 ± 0.37
Meropenem	10	10.0	0.10 ± 0.30
Metronidazole	6	6.0	0.06 ± 0.24
Ciprofloxacin	3	3.0	0.03 ± 0.17

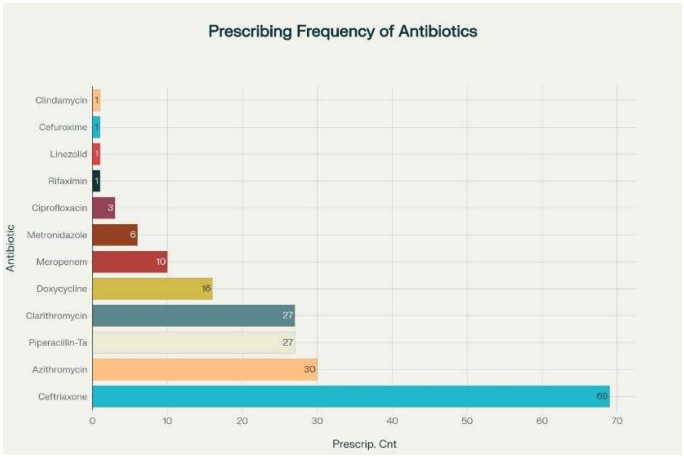

Figure 01: Prescribing Frequency of Antibiotics Therapy For the treatment of LRTIs

Antibiotic Usage of Ceftriaxone was the most frequently used antibiotic (69%), followed by Azithromycin (30%), Piperacillin-Tazobactam (27%), and Clarithromycin (27%). Broad-spectrum and higher-line antibiotics such as Meropenem (10%) and Linezolid (1%) were used in a minority of cases. The therapy was used both as monotherapy or in the combination therapy. The lower use of reserve antibiotics suggests an attempt at rational prescribing, though empirical use remains high (as shown in Table 1). 66% of cases adhered to standard antibiotic guidelines, whereas 34% did not.

Table 05: Categorical Variables vs. Treatment Effectiveness

Variable	Category	Effective: No	Effective: Yes	p-value
Age Group	19-40	0	6	0.144
	41-60	3	31	
	>60	13	47	
Gender	Female	2	37	0.036
	Male	14	47	
Primary Diagnosis	AECOPD	7	34	0.672
	Bronchiolitis	0	3	
	Bronchitis	1	16	
	CAP	7	28	

	HAP	1	2	
	VAP	0	1	

Table 06: Categorical variables vs appropriateness of the therapy

Variable	Category	Adherent (n)	Non-Adherent (n)	Total (n)	Adherent (%)	Non-Adherent (%)	p-value
Gender	Male	37	24	61	60.7	39.3	0.686
	Female	24	15	39	61.5	38.5	
Age Group	19–40	4	2	6	66.7	33.3	0.978
	41–60	20	14	34	58.8	41.2	
	>60	37	23	60	61.7	38.3	
Main Diagnosis	AECOPD	26	15	41	63.4	36.6	0.988
	CAP	21	14	35	60.0	40.0	
	Bronchitis	9	8	17	52.9	47.1	
	Bronchiolitis	2	1	3	66.7	33.3	
	HAP	2	1	3	66.7	33.3	
	VAP	1	0	1	100.0	0.0	

The mean adherence rate was 0.66 ± 0.47, highlighting room for improvement in antimicrobial stewardship. There was no statistically significant association between age and treatment effectiveness ($p = 0.144$) but a statistically significant association was observed between gender and treatment effectiveness ($p = 0.036$), with females showing slightly better outcomes. Primary Diagnosis also reveals no statistically significant association was found between diagnosis type and treatment effectiveness ($p = 0.672$). Appropriateness of Therapy describes Gender has no significant difference in guideline adherence between males and females ($p = 0.686$). Also, there's no statistically significant difference across age groups ($p = 0.978$). The appropriateness of therapy did not significantly differ across diagnostic categories ($p = 0.988$).

DISCUSSION

The demographic and clinical characteristics observed in this study of patients with lower respiratory tract infections (LRTIs) offer valuable insights into current antibiotic prescribing practices and their alignment with evidence-based standards. The majority of patients were elderly, which is consistent with the known increased susceptibility to respiratory infections among individuals over 60 due to immune suppressant and associated comorbidities. This age-related vulnerability has been widely documented and often necessitates hospitalization, as reflected in our data showing varied durations of hospital stay. Gender distribution showed a male predominance, which could be linked to lifestyle-related exposure risks. Similarly, *Kalita et al.* reported high rates of resistance among pathogens in community-acquired pneumonia, supporting the importance of microbiological testing to guide therapy [2]. The findings of our study underscore an urgent need to improve diagnostic access, promote targeted antibiotic use, and incorporate structured stewardship interventions, especially for the elderly, to ensure optimal clinical outcomes and reduce antimicrobial resistance. This study on LRTI patients highlights key trends in diagnosis and antibiotic use. Most patients were elderly males, consistent with known risk factors for LRTIs, and experienced variable hospital stays. Although wound class isn't typically central to LRTIs, clean and clean-contaminated categories suggest comorbid surgical conditions. Prophylactic antibiotic use was low, while empirical treatment dominated, with targeted therapy notably underused. The most common diagnoses were AECOPD and community-acquired pneumonia, followed by bronchitis and nosocomial pneumonias. *Kumar et al.* reported that empirical antibiotic therapy was initially effective in most LRTI cases but required adjustment in about 24% based on culture results, underscoring the need for diagnostic support [1]. Similarly, *Yimer et al.* found

that nearly half of LRTI pathogens in hospitalized patients were multidrug-resistant, emphasizing the risks of empirical overuse [2] The microbial etiology of lower respiratory tract infections (LRTIs) in our cohort was dominated by *Streptococcus pneumoniae*, followed by *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*, with lesser prevalence of *Haemophilus influenzae*, *Mycoplasma pneumoniae*, MSSA, and MRSA. This spectrum reflects a mix of community-acquired and hospital-associated pathogens, raising concerns about empirical antibiotic effectiveness, especially against resistant Gram-negatives. *Sharma et al.* evaluated 68 *S. pneumoniae* isolates in India and found high resistance rates to cotrimoxazole, tetracycline, and erythromycin, illustrating the diminishing utility of common empirical regimens [1] Similarly, *Rangineni et al.* in a tertiary care hospital in South India documented a high burden of multidrug-resistant Gram-negative bacilli—*E. coli*, *Klebsiella*, and *Pseudomonas*—with over 60% resistance to most antibiotics tested, underscoring the challenges of treating non-pneumococcal LRTIs [2] In our LRTI cohort, antibiotic utilization was dominated by ceftriaxone (69%), followed by azithromycin (30%), clarithromycin (27%), and piperacillin-tazobactam (27%), with lesser use of doxycycline, meropenem, metronidazole, and others. The high reliance on broad-spectrum agents—particularly third-generation cephalosporins and macrolides—reflects empirical decision-making, often without culture guidance, as seen in many similar settings. *Naik et al.* conducted a drug utilization study in Maharashtra and identified ceftriaxone and azithromycin as the most commonly prescribed antibiotics for LRTIs, with frequent polypharmacy and widespread empirical use [1] This analysis examined how age, gender, and primary diagnosis categories relate to treatment success in LRTI patients. Notably, gender showed a significant association: females responded better to therapy than males, while age group and type of LRTI (such as AECOPD, CAP, or bronchitis) did not significantly influence effectiveness. These findings suggest that despite broad empirical use of antibiotics, intrinsic factors—especially gender—may impact outcomes more than age or specific diagnosis. *Jambo et al.* evaluated pneumonia treatment outcomes in Ethiopia and identified male sex as a predictor of treatment failure, suggesting gender-related biological or access disparities could underlie poorer response in men. [1] In this study, we evaluated the appropriateness of antibiotic prescriptions in patients with respiratory tract infections and found that 61% of prescriptions were appropriate, while 39% were not. While bronchitis had the lowest rate (52.9%), reflecting a common trend of unnecessary antibiotic use in likely viral conditions. The major reasons for inappropriate prescriptions included the use of antibiotics with either broader or narrower spectrums than necessary, incorrect dosages, unnecessary initiation, improper routes, treatment delays, and selection of costlier alternatives without added benefit. These findings are consistent with international patterns, such as a multicentre study by *Bel haj ali et al.*,[1] Our findings underscore the need for focused antimicrobial stewardship interventions aimed at improving diagnostic accuracy, promoting evidence-based prescription practices, and reducing inappropriate antibiotic use to combat rising antimicrobial resistance.

CONCLUSION

This study offers important insights into the real-world management of lower respiratory tract infections. The high rate of empirical antibiotic use—often without microbiological confirmation—highlights the need for better diagnostic access and utilization. While most prescriptions were appropriate, issues like spectrum mismatch, unnecessary initiation, and dosing errors were noted. Gender appeared to influence treatment response, and resistant pathogens were common, especially among Gram-negative isolates. These findings underscore the value of strengthening antimicrobial stewardship, encouraging culture-based prescribing, and adopting a more personalized approach to improve clinical outcomes and reduce resistance.

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