

Antibiogram Pattern of Common Pathogens Isolated in Patients of Community Acquired Pneumonia

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Abstract

Background: Community-acquired pneumonia (CAP) is acute parenchymal lung infection with constantly evolving bacteriological profile. For efficient treatment planning; clinical, laboratory and radiological findings are assessed. Bacteriological profile and pattern of antibiotic sensitivity needs to be thoroughly evaluated. Thus the present research was done assessing bacterial profile of cases diagnosed with CAP/ community acquired pneumonia in tertiary care center. **Material and Methods:** Present cross sectional study was done on 110 CAP patients, aged >18years. A thorough case history, complete clinical, laboratory and radiographical examination was done. Culture sensitivity test was done using sputum and blood sample. Antibiotic susceptibility was also assessed for all patients. Data was collected and evaluated using statistical analysis with SPSS version 20.0 software at $p < 0.05$. **Results:** Maximum cases revealed Gram +ve cocci arranged in pair, and pseudomonas species. Staph Aureus and Enterococcus showed maximum resistance against Fluoroquinolones; Enterobacter, Klebsiella and Pseudomonas against β -Lactum antibiotic; Acinetobacter and E.Coli against Cephalosporins; Staph Hominis against macrolide, Sulfonamide, Fluoroquinolone. **Conclusion:** Research involving various patient demographics, geographical locations, and practice environments is necessary, taking into account the ever-evolving microbiological profile throughout time as well as the emergence of novel diagnostic and treatment approaches.

Keywords: Community-acquired pneumonia; Bacteria; Antibiotic; Resistance; Sensitivity.

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INTRODUCTION

Community-acquired pneumonia (CAP) is an acute non-nosocomially acquired parenchymal lung infection with high mortality and morbidity rate. Presentation of disease ranges from mild sickness to severe disease.^[1] Various organisms like viruses, bacteria, fungi, leads to CAP. Gram +ve agents include Staphylococcus aureus, Group A streptococci, Streptococcus pneumoniae, and streptococci; Gram -ve agents: Moraxella catarrhalis, Haemophilus influenzae, Enterobacteriaceae; & atypical agents: Mycoplasma, Legionella, Chlamydia pneumonia & Psittaci. Viruses like rhinovirus, influenza, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), and respiratory viruses (parainfluenza, human metapneumovirus, etc) are increasingly discovered as pathogens based on molecular detection technologies.^[2] Bacteriological profile in CAP is constantly evolving, thus introducing better methods of diagnosis, availability of recent vaccines and antibiotics.^[3] Overall prevalence of CAP ranges 1.5-14 every 1000 persons per year, depending on factors such as geographic location, season, and demographics.^[4] Pathogens infiltrate the lower respiratory system through micro-aspiration after initially colonizing the throat and can spread through

hematogenous route and macroaspiration.^[5] Signs and symptoms include cough, fever $>38^{\circ}\text{C}$, mucopurulent sputum, dyspnea, discomfort in pleuritic chest, and bronchial breathing. Chest radiography helps to confirm diagnosis and also evaluate the treatment outcomes. In outpatient setting, mortality rate for pneumonia is low (1-5%), while in ICU patients, it approaches to 25%.^[6] For achieving logical therapeutic judgments one require trustworthy data on relative occurrence of various etiologic agents in cases "area of residence," additional to clinical, laboratory, and radiological finding.^[7-8]

The antimicrobials misuse, in inpatient and outpatient settings, leads to rise in resistance to commonly prescribed antimicrobials like fluoroquinolones, macrolides, and

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cephalosporins etc.^[9] Studying the bacteriological profile and pattern of antibiotic sensitivity in cases with CAP who are admitted to an Indian tertiary care hospital is therefore worthwhile. Thus the present research was done assessing bacterial profile of cases diagnosed with CAP/ community acquired pneumonia in tertiary care center.

MATERIALS AND METHODS

The present observational cross sectional study was conducted in the Department of Pharmacology from June 2023 to May 2026. A total of 110 patients, aged more than 18years, diagnosed clinically, radiologically and bacteriologically as community acquired pneumonia were included in the study. Patients who suffered from pneumonia due to any other cause (like fungal, viral) than bacterial; those suffering with active tuberculosis; having hospital acquired pneumonia; with history of hospital admission >2 days in last 90 days were excluded from the study. All included patients were explained about the study and a written informed consent was taken. The research was conducted after taking clearance from Institutional Ethical Committee (IEC.....). All patients (n=110) were selected using purposive sampling technique.

A thorough case history was taken, along with complete clinical examination. Sample collection was done within 48 hours of admission. The extent and distribution of lesion was observed on chest X-ray. Respiratory sample was collected and subjected to AFB A/B; CBNAAT; Gram stain and KOH. Culture sensitivity test was done using sputum and blood sample. Antibiotic susceptibility was also assessed for all patients.

Statistical analysis: All quantitative variables were recorded as mean standard deviation and qualitative variables as frequency and percentage. Data was evaluated using statistical analysis with SPSS version 20.0 software (IBM Chicago).

RESULTS

In our study in ET/BAL/ Gram stain, maximum 56.4% cases revealed Gram +ve cocci arranged in pair, and according to ET secretion/ sputum/BAL assessment, maximum 19.09% cases revealed pseudomonas, 17.3% were Klebsiella Pneumoniae, and 22.7% cases showed no bacteria. [Table 1] According to blood culture, maximum 19.0% were Pseudomonas, and minimum 0.9% was E.coli and Enterococcus species. 61.8% cases showed no bacteria. [Table 2]

According to ET secretion/ sputum/BAL, susceptibility and resistance pattern of each organism was observed with different antibiotics. Acinetobacter showed high susceptibility to Minocycline, Polymyxin b, Colistin and moderate to Tobramycin. C. Freundii showed mild susceptibility to gentamicin, Piperacillin/tazobactam, Imipenem, Meropenem, Ticarcillin+ clavulanic acid, Tobramycin, Polymyxin b and Colistin. E.Coli showed high susceptibility to Amikacin, Imipenem, Meropenem, Polymyxin b, Colistin, Ertapenem; and moderate to Ampicillin/sulbactam, Gentamicin, Cefepime,

Chloramphenicol, Co-trimoxazole, Piperacillin/tazobactam, Ticarcillin+ clavulanic acid. Enterobacter showed mild susceptibility to Gentamicin, Amikacin, Chloramphenicol, Co-trimoxazole, Clarithromycin, Penicillin, Piperacillin/tazobactam, Imipenem, Meropenem, Doripenem, Minocycline, Tetracyclin, Tigecycline, Polymyxin b, Colistin, Linezolid, Vancomycin, Ertapenem, Teicoplanin, Netilmicin. Klebsiella showed high susceptibility to Ampicillin/sulbactam, Gentamicin, Amikacin, Amoxicillin/ clavulanic acid, Cefepime, Chloramphenicol, Ceftazidime, Cefotaxime, Ceftriaxone, Ciprofloxacin, Levofloxacin, Imipenem, Piperacillin/tazobactam, Meropenem, Aztreonam, Minocycline, Tetracyclin, Ticarcillin+ clavulanic acid, Tobramycin, Polymyxin b, Colistin. Pseudomonas showed high susceptibility to Gentamicin, Amikacin, Cefepime, Ceftazidime, Ciprofloxacin, Piperacillin, Piperacillin/tazobactam, Levofloxacin, Imipenem, Meropenem, Aztreonam, Ticarcillin+ clavulanic acid, Polymyxin b, Colistin, Netilmicin. Serratia M. showed mild susceptibility to Amikacin, Co-trimoxazole, Ceftazidime-avibactam, Meropenem, Doripenem, Tetracyclin. Staph Aureus showed mild susceptibility to Gentamicin, Cefoxitin, Co-trimoxazole, Doxycycline, Minocycline, Tetracyclin, Linezolid, Vancomycin, Teicoplanin. Streptococcus showed high susceptibility to Azithromycin, Clarithromycin, Erythromycin, Tetracyclin. [Table 3]

According to blood culture, susceptibility and resistance pattern of each organism was observed with different antibiotics. Acinetobacter showed maximum resistance against Amikacin, Cefotaxime, ciprofloxacin, Levofloxacin, Ticarcillin+ clavulanic acid. It was sensitive to gentamicin, cefepime, Co-trimoxazole, Ceftazidime, ciprofloxacin, Piperacillin/tazobactam, Imipenem, Meropenem, Polymyxin b, tobramycin and Colistin mainly.

C neg. Staph showed maximum resistance against gentamicin, azithromycin, Co-trimoxazole, ciprofloxacin, erythromycin, levofloxacin and ofloxacin; and sensitivity to Linezolid, Vancomycin, teicoplanin mainly. E.Coli showed maximum resistance against ampicillin, amikacin, gentamycin, Cefuroxime, Cefepime, Cefoxitin, cefuroxime, Ceftriaxone, Ciprofloxacin, cotrimazole, ampicillin and tobramycin; whereas it was sensitive to minocycline, chloramphenicol, Polymyxin b and Colistin. Enterococcus showed maximum resistance against azithromycin, Ciprofloxacin, clarithromycin, erythromycin, levofloxacin, ofloxacin and tetracycline; whereas it was sensitive to Linezolid, chloramphenicol, Vancomycin, teicoplanin mainly.

Pseudomonas showed maximum resistance against ampicillin, cefazoline and was sensitive to Gentamicin, Amikacin, Cefepime, Ceftazidime, ciprofloxacin, Piperacillin, Piperacillin/tazobactam, Levofloxacin, Imipenem, Meropenem, Aztreonam, Polymyxin b and Colistin. Staph Aureus showed maximum resistance against co-trimazole; whereas sensitive to gentamycin, cefoxitin, ciprofloxacin, clindamycin, Doxycycline, ofloxacin, Tetracyclin, Linezolid, and Vancomycin. Staph Hominis showed maximum resistance against azithromycin, co-trimazole, ciprofloxacin, erythromycin, levofloxacin; whereas sensitive to gentamycin, clindamycin, doxycycline, tetracycline, Linezolid, Rifampicin, Teicoplanin, Daptomycin and Vancomycin. S Maltophilia showed maximum resistance against ampicillin, amikacin,

cefipime, cefexidime, ciprofloxacin, Ticarcillin+ cluvlanic acid; whereas sensitive to ceftazidime, co-trimazole, gentamycin, Piperacillin, Piperacillin/tazobactam, Imipenem, Meropenem, Aztreonam, Polymyxin b and Colistin. [Table 4]

Table 1: Baseline Characteristics of the Study Population (N=60)

ET secretion/ sputum/BAL organism isolated	Frequency (n)	Percentage (%)
Acinetobacter Species	16	14.545
Citrobacter Freundii	1	0.909
Escherichia Coli	15	13.636
Enterobacter Species	5	4.545
Klebsiella Pneumoniae	19	17.272
Pseudomonas Species	21	19.090
Serratia Marcescens	1	0.909
Staphylococcus Aureus	3	2.727
Streptococcus Pneumonia	4	3.636
No Pathogenic Organism	25	22.727

Table 2: Distribution of study subjects according to blood culture

Blood culture organism isolated	Frequency (n)	Percentage (%)
Acinetobacter species	4	3.6
Coagulase negative staphylococcus	6	5.5
E.coli	1	.9
Enterococcus species	1	.9
Pseudomonas species	21	19.0
Staphylococcus aureus	2	1.8
Staphylococcus hominis	1	.9
Stenotrophomonas maltophilia	9	8.2
No pathogenic organism	68	61.8
Total	110	100.0

Table 3: Organism (ET secretion/ sputum/BAL) and susceptibility pattern

Organism (ET secretion/ sputum/BAL)	Mild susceptible	Moderate susceptible	Highly susceptible	Resistant
Acinetobacter	Ampicillin/sulbactam, Gentamicin, Amikacin, Amoxicillin/ clavulanic acid, Cefepime, Co-trimoxazole, Ceftazidime, Cefoparazone/sulbactam, Ciprofloxacin, Piperacillin/tazobactam, Levofloxacin, Ofloxacin, Imipenem, Meropenem, Ticarcillin+ cluvlanic acid, Trimethoprm/sulfamethoxazole	Tobramycin	Minocycline, Polymyxin b, Colistin	Amoxicillin, Ampicillin/sulbactam, Gentamicin, Amikacin, Amoxicillin/ clavulanic acid, Cefepime, Co-trimoxazole, Ceftazidime, Cefuroxime, Cefotaxime, Ceftriaxone, Piperacillin/tazobactam, Ciprofloxacin, Levofloxacin, Ofloxacin, Imipenem, Meropenem, Aztreonam, Minocycline, Tetracyclin, Ticarcillin, Ticarcillin+ cluvlanic acid, Tobramycin, Netilmicin
C. Freundii	Gentamicin, Piperacillin/tazobactam, Imipenem, Meropenem, Ticarcillin+ cluvlanic acid, Tobramycin, Polymyxin b, Colistin,			Cefazoline, Amikacin, Amoxicillin/ clavulanic acid, Cefepime, Cefoxitin, Co-trimoxazole, Cefotaxime, Ceftriaxone, Ciprofloxacin, Levofloxacin, Aztreonam, Doxycycline, Tetracyclin, Ampicillin
E.Coli	Amoxicillin/ clavulanic acid, Ceftazidime, Cefoparazone/sulbactam, Doripenem, Fosfomycin, Doxycycline, Minocycline, Tetracyclin, Tigecycline, Tobramycin, Netilmicin	Ampicillin /sulbactam, Gentamicin, Cefepime, Chloramphenicol, Co-trimoxazole, Piperacillin/tazobactam, Ticarcillin + cluvlanic acid ,	Amikacin, Imipenem, Meropenem, Polymyxin b, Colistin, Ertapenem,	Ampicillin/sulbactam, Cefazoline, Gentamicin, Amikacin, Amoxicillin, Amoxicillin/ clavulanic acid, Cefuroxime axetil, Cefuroxime, Cefepime, Cefoxitin, Chloramphenicol, Co-trimoxazole, Ceftazidime, Cefotaxime, Cefoperazone, Cefoparazone/sulbactam, Ceftriaxone, Ciprofloxacin, Piperacillin/tazobactam, Levofloxacin, Ofloxacin, Imipenem, Meropenem, Aztreonam, Doxycycline, Tetracyclin, Ticarcillin, Ticarcillin+ cluvlanic acid , Trimethoprm/sulfamethoxazole, Ampicillin,
Enterobacter	Gentamicin, Amikacin, Chloramphenicol, Co-			Ampicillin/sulbactam, Cefazoline, Gentamicin, Amikacin, Amoxicillin/ clavulanic acid, Azithromycin, Cefuroxime,

	trimoxazole, Clarithromycin, Penicillin, Piperacillin/tazobactam, Imipenem, Meropenem, Doripenem, Minocycline, Tetracyclin, Tigecycline, Polymyxin b, Colistin, Linezolid, Vancomycin, Ertapenem, Teicoplanin, Netilmicin			Cefepime, Cefoxitine, Chloramphenicol, Co-trimoxazole, Ceftazidime, Cefotaxime, Cefoparazone/sulbactam, Ceftriaxone, Ciprofloxacin, Clarithromycin, Erythromycin, Piperacillin/tazobactam, Levofloxacin, Colistin, Imipenem, Meropenem, Aztreonam, Tetracyclin, Tobramycin, Ampicillin, Linezolid, Ertapenem,
Klebsiella	Cefazoline, Cefuroxime, Ofloxacin, Fosfomycin, Ticarcillin, Tigecycline, Trimethoprm/sulfamethoxazole, Ampicillin, Ertapenem	Cefoxitine, Co-trimoxazole, Doxycycline, Ticarcillin + cluvlanic acid	Ampicillin/sulbactam, Gentamicin, Amikacin, Amoxicillin/clavulanic acid, Cefepime, Chloramphenicol, Ceftazidime, Cefotaxime, Ceftriaxone, Ciprofloxacin, Levofloxacin, Imipenem, Piperacillin/tazobactam, Meropenem, Aztreonam, Minocycline, Tetracyclin, Ticarcillin+ cluvlanic acid, Tobramycin, Polymyxin b, Colistin,	Ampicillin/sulbactam, Cefazoline, Gentamicin, Amikacin, Amoxicillin/ clavulanic acid, Azithromycin, Cefuroxime axetil, Cefuroxime, Cefepime, Cefoxitine, Co-trimoxazole, Ceftazidime, Cefotaxime, Ceftriaxone, Ciprofloxacin, Piperacillin/tazobactam, Levofloxacin, Ofloxacin, Imipenem, Meropenem, Aztreonam, Doxycycline, Tetracyclin, Ticarcillin, Tobramycin, Ampicillin, Ertapenem, Netilmicin
Pseudomonas	Ampicillin/sulbactam, Amoxicillin/ clavulanic acid, Azithromycin, Cefuroxime, Cefepime, Cefoxitine, Cefotaxime/clavulanic acid, Chloramphenicol, Ceftazidime/clavulanic acid, Cefoparazone/sulbactam, Penicillin, Doripenem, Doxycycline, Tigecycline, Ampicillin,		Gentamicin, Amikacin, Cefepime, Ceftazidime, Ciprofloxacin, Piperacillin, Piperacillin/tazobactam, Levofloxacin, Imipenem, Meropenem, Aztreonam, Ticarcillin+ cluvlanic acid, Polymyxin b, Colistin, Netilmicin	Ampicillin/sulbactam, Cefazoline, Amoxicillin, Amoxicillin/ clavulanic acid, Azithromycin, Cefuroxime, Cefoxitine, Chloramphenicol, Co-trimoxazole, Ceftazidime, Cefotaxime, Ceftazidime/clavulanic acid, Cefotaxime/clavulanic acid, Ceftriaxone, Ciprofloxacin, Penicillin, Piperacillin/tazobactam, Levofloxacin, Imipenem, Meropenem, Aztreonam, Doxycycline, Ticarcillin+ cluvlanic acid, Ampicillin, Netilmicin
Serratia M.	Amikacin, Co-trimoxazole, Ceftazidime-avibactam, Meropenem, Doripenem, Tetracyclin			Ampicillin/sulbactam, Gentamicin, Amoxicillin/ clavulanic acid, Cefuroxime, Cefepime, Ceftazidime, Cefotaxime, Ciprofloxacin, Levofloxacin, Doxycycline, Colistin, Ampicillin, Linezolid
Staph Aureus	Gentamicin, Cefoxitine, Co-trimoxazole, Doxycycline, Minocycline, Tetracyclin, Linezolid, Vancomycin, Teicoplanin			Azithromycin, Cefoxitine, Ciprofloxacin, Clarithromycin, Erythromycin, Levofloxacin, Ofloxacin,
Streptococcus	Cefoparazone/sulbactam, Penicillin,	Chloramphenicol, Levofloxacin, Linezolid	Azithromycin, Clarithromycin, Erythromycin, Tetracyclin	Cefoparazone/sulbactam, Penicillin,

Table 4: Organism (Blood culture) and susceptibility pattern

Organism (Blood culture)	Mild susceptible	Moderate susceptible	Highly susceptible	Resistant
Acinetobact	Ampicillin/sulbactam, Gentamicin,	Imipenem,		Ampicillin/sulbactam, Gentamicin, Amikacin,

er	Amikacin, Cefuroxime, Cefepime, Chloramphenicol, Co-trimoxazole, Ceftazidime, Cefotaxime, Ceftriaxone, Ciprofloxacin, Piperacillin/tazobactam, Levofloxacin, Ticarcillin+ clulvanic acid , Minocyclin, Polymyxin b, Colistin, Tobramycin	Meropenem, Aztreonam, Ofloxacin, Ticarcillin,		Co-trimoxazole, Ceftazidime, Cefotaxime, Ceftriaxone, Ciprofloxacin, Piperacillin/tazobactam, Levofloxacin, Ticarcillin+ clulvanic acid , Minocyclin, Tobramycin
C neg. Staph	Gentamicin, Azithromycin, Cefoxitine, Co-trimoxazole, Clindamycin, Erythromycin, Doxycycline, Tetracyclin, Minocyclin, Rifampicin, Teicoplanin, Daptomycin	Linezolid, Vancomycin,		Gentamicin, Azithromycin, Cefoxitine, Co-trimoxazole, Ciprofloxacin, Clarithromycin, Clindamycin, Erythromycin, Levofloxacin, Doxycycline, Ofloxacin, Tetracyclin,
E.Coli	Chloramphenicol, Minocyclin, Polymyxin b, Colistin			Ampicillin/sulbactam, Gentamicin, Amikacin, Amoxicillin/ clavulanic acid, Cefuroxime, Cefepime, Cefoxitine, Co-trimoxazole, Ceftazidime, Cefotaxime, Ceftriaxone, Ciprofloxacin, Ertapenem, Piperacillin/tazobactam, Levofloxacin, Imipenem, Meropenem, Aztreonam, Tetracyclin, Ampicillin, Tobramycin
Enterococcus	Chloramphenicol, Linezolid, Vancomycin, Teicoplanin			Azithromycin, Ciprofloxacin, Clarithromycin, Erythromycin, Levofloxacin, Ofloxacin, Tetracyclin,
Pseudomonas	Ampicillin/sulbactam, Azithromycin, Cefuroxime, Chloramphenicol, Co-trimoxazole, Ticarcillin+ clulvanic acid, Cefotaxime/clavulanic acid, Ceftazidime/clavulanic acid, Cefotaxime, Doxycycline, Tigecycline, Ampicillin		Gentamicin, Amikacin, Cefepime, Ceftazidime, Ciprofloxacin, Piperacillin, Piperacillin/tazobactam, Imipenem, Meropenem, Aztreonam, Polymyxin b, Netilmicin	Ampicillin/sulbactam, Cefazoline, Imipenem, Cefuroxime, Ciprofloxacin, Cefoxitine, Chloramphenicol, Co-trimoxazole, Cefotaxime/clavulanic acid, Ceftazidime, Ceftazidime/clavulanic acid, Cefotaxime, Ertapenem, Piperacillin/tazobactam, Aztreonam, Ticarcillin, Ticarcillin+ clulvanic acid , Ampicillin,
Staph Aureus	Gentamicin, Cefoxitine, Ciprofloxacin, Clindamycin, Levofloxacin, Doxycycline, Ofloxacin, Tetracyclin, Minocyclin, Linezolid, Vancomycin, Rifampicin, Teicoplanin, Daptomycin			Gentamicin, Azithromycin, Cefoxitine, Co-trimoxazole, Ciprofloxacin, Clarithromycin, Clindamycin, Erythromycin, Levofloxacin, Doxycycline, Ofloxacin, Tetracyclin, Minocyclin, Linezolid,
Staph Hominis	Gentamicin, Clindamycin, Doxycycline, Tetracyclin, Linezolid, Vancomycin, Rifampicin, Teicoplanin, Daptomycin			Azithromycin, Cefoxitine, Co-trimoxazole, Ciprofloxacin, Erythromycin, Levofloxacin, Ofloxacin,
S. Maltophilia	Ampicillin/sulbactam, Aztreonam,	Gentamicin, Amikacin, Cefepime, Co-trimoxazole, Ceftazidime, Ciprofloxacin, Piperacillin, Piperacillin/tazobactam, Imipenem, Meropenem, Ticarcillin+ clulvanic acid , Polymyxin b, Minocyclin, Colistin, Netilmicin	Levofloxacin	Ampicillin/sulbactam, Gentamicin, Amikacin, Cefepime, Ceftazidime, Ciprofloxacin, Piperacillin, Piperacillin/tazobactam, Imipenem, Meropenem, Aztreonam, Tetracyclin, Ticarcillin+ clulvanic acid, Polymyxin b, Colistin, Netilmicin

DISCUSSION

This prospective research was carried to assess the bacterial profile profile of cases diagnosed with CAP in tertiary care center. Overall incidence of CAP and pneumonia is significantly influenced by age and gender. In our study, mean age was 56.55±13.89yrs, with male predominance (61.8%). In accordance with our study, Hati B et al,^[3] also found that most common age group being affected with CAP was 40-50yrs, with mean age being 47.61yrs; showing

male predominance (63%). Similarly, in studies by Mahendra M et al,^[10] and Gutiérrez F et al.^[11] it was found that rate of incidence of CAP is considerably affected by age and gender. They observed that chances of CAP increased in older subjects and males were affected with CAP more often than females. Among the predisposing risk factors, we observed that more than 40% cases had history of smoking and TB, more than 20% suffered from diabetes and hypertension. In accordance with our study, Hati B et al,^[3] found that maximum cases were

smokers (33%), followed by diabetes & hypertension (27% & 19% respectively) as co-morbidities. In our study, maximum cases had dyspnea and cough, followed by fever and chest pain. Jain SK et al,^[5] observed that more than 90% cases had fever and cough; and 60% had dyspnea. In our study, right side was highly affected, followed by left and bilateral involvement. Maximum cases showed involvement of lower zone, followed by middle and upper zone. In accordance with our study, Jain SK et al,^[5] observed that right lower lobe (48.3%) was most commonly affected, followed by left lower (15.8%) and bilateral involvement (12%). In a study by Kelli SBR et al,^[12] it was found that maximum 21.12% had bilateral consolidation, followed by right (12.12%) and left side (9%).

In ET/BAL/ Gram stain, maximum cases revealed Gram +ve cocci arranged in pair, followed by Gram -ve bacilli, and Gram +ve cocci in chains. Similar to our study, Kelli SBR et al,^[12] found that 42.3% and 30% of sputum samples revealed gram +ve cocci and gram -ve bacteria respectively. Shah BA et al,^[13] and Pushpa Kumari RS et al,^[14] reported that the most prevalent CAP reason was gram-negative bacteria. In the treatment of CAP, the choice of empirical antibiotic is critical and may subsequently be changed based on the culture report and the patient's reaction to the first antibiotic given.

According to research from throughout the world, vaccination practices in various regions also play a role in the differences in microbiological patterns.^[3] Our study revealed that rate of isolation of organisms in blood culture was lower (38.2%) as compared to sputum culture (77.3%). In a study by Kelli SBR et al,^[12] 30% of CAP patients were positive in blood cultures. Similarly, other Indian studies by Kulpati DDS et al,^[15] and Sharma BK et al,^[16] showed that rate of positivity of sputum culture range from 10 to 33%. Previous antibiotic use, improper sputum generation, and unproductive coughing can all contribute to decreased sputum positivity. In accordance with our study, in a study by Kelli SBR et al,^[12] *Pseudomonas* (9.09%), *Staphylococcus* (15.15%), and *Streptococcus* (24.24%) were the most frequently isolated organisms among CAP patients. In contrast to our study, Hati B et al,^[3] found that 26% *S. pneumoniae* was most common, followed by 12% *Klebsiella pneumoniae*.

In accordance with our study, Sunda P et al,^[17] found that Colistin (97%) and meropenem (91%) were highly effectual antibiotics against Gram -ve isolates, whereas ceftriaxone (58%) was the least effective. The trend of antibiotic resistance among isolates of *Acinetobacter* spp., *P. aeruginosa*, *E. coli*, *K. pneumonia* found in this investigation is in line with findings from other developing nations by Abdelaziz S et al.¹⁸, and Bajpai T et al,^[19]. Bajpai T et al,^[19] found that all of Gram -ve bacteria showed more cephalosporin resistance (75.38%). *S. aureus* (100%) and *Streptococcus* species (76%) was susceptible to both vancomycin and linezolid.

According to our research, carbapenem should be given sparingly in ventilated patients in order to stop resistance from growing. Gonlugur U et al,^[20] stated that many hospitals have acknowledged that some gram negative

bacteria are more resistant to gentamicin than amikacin when it comes to aminoglycosides. Careful & limited antibiotics use is desperately required because of higher amikacin resistance advancement. At locations where drug penetration is weak, aminoglycoside-resistant strains are more prevalent. Monitoring antimicrobials resistance aids in antimicrobial therapy optimization & is particularly crucial in intensive care units (ICUs) due to the much increased rates of infection and antibiotic usage.^[21]

In accordance with our study, Saritha Y et al,^[21] observed that *Acinetobacter baumannii*, *Escherichia coli* and *Pseudomonas* was most susceptible to Polymyxin B. Sunda P et al.^[17] found that vancomycin shown the highest activity (100%) against Gram-positive isolates, followed by linezolid (92%) and gentamicin (79%). Ahmad H, et al,^[22] and Rathod VS et al,^[23] found that Gram-positive bacteria, like *Staph Aureus*, and *Streptococcus* spp., were 100% linezolid & vancomycin susceptible; followed by co-trimoxazole & tetracycline (64.3%), 42.85% (clindamycin), 35.71% gentamicin; amoxyclav, oxacillin, cephalothin, ceftriaxone, (28.6%); ciprofloxacin, erythromycin (21.43%), & penicillin (14.3%).

In order to effectively treat pneumonia, ultimate bacterial diagnosis & testing of susceptibility are needed due to the increasing antibiotic resistance in respiratory infections, which has reduced the efficacy of empirical treatment with conventional drugs. Antimicrobial resistance monitoring is essential for therapy optimization, particularly in ICU (intensive care units) where use of antibiotic and rates of infection are higher. Therefore, to address the worldwide problem of antibiotic resistance in pneumonia treatment, a locally designed antibiogram is crucial, coupled with bacteriological diagnosis and susceptibility testing.

Limitations of study:

1. Study was carried on smaller sample, thus further researches are needed to be done on elaborated sample.
2. Research is based on outcomes from one centre, so results cannot be applicable to complete population of India. Further prospective researches & clinical trials comprising complete Indian population, generalising results of study.
3. Since we only included hospitalized CAP patients in the study, we needed healthy individuals as controls to evaluate the risk factors of CAP.
4. Although they were not included in the study, viruses, atypical bacteria & fungus are a significant microbiological cause of CAP.
5. The prospective observational study's shortcomings include the inability to determine overall mortality due to the lack of follow-up.

CONCLUSION

The management of CAP is greatly aided by empirical antibiotic therapy, and the constantly shifting microbiological pattern frequently presents significant challenges. Therefore, it is necessary to periodically investigate the microbiological pattern of CAP in various patient demographics, geographical locations, and practice settings, such as community clinics or secondary or tertiary care facilities.

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Conflicts of interest

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