Journal of Advances in Medicine and Medical Research

Volume 36, Issue 7, Page 86-103, 2024; Article no.JAMMR.118990
ISSN: 2456-8899, NLM ID: 101711724
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

Study of Clinical Profile and Microbiology of Community- Acquired Pneumonia

Rushita D. Nakarani [a++*], R.K. Chopra [a#] and Rupali Suryawanshi [b†]

[a] Department of Pulmonary Medicine, Ruby Hall Clinic, 40, Sasoon Road, Pune, Maharashtra, India.
[b] Department of Microbiology, Ruby Hall Clinic, 40, Sasoon Road, Pune, Maharashtra, India.

Authors' contributions

This work was carried out in collaboration among all authors. Author RDN collected data, performed analysis, and drafted the initial manuscript. Authors RKC and RS summarized the clinical data, provided guidance and corrections, and contributed to writing and revising the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/jammr/2024/v36i75488

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/118990

Original Research Article

Received: 14/04/2024
Accepted: 17/06/2024
Published: 21/06/2024

ABSTRACT

Aim: This study aimed to investigate the patterns of etiological agents, predisposing factors, radiological presentations, and bacteriological etiologies of Community- Acquired Pneumonia (CAP). The primary objective was to study the prevalence of CAP, while the secondary objective was to explore its association with age, sex, comorbidities, risk factors and causative organisms.
Study Design: Prospective observational study.
Place and Duration of Study: The study was conducted at Ruby Hall Clinic, Pune, from December 1, 2022, to November 30, 2023.
Background: Community-acquired pneumonia (CAP) Considered as one of the main causes of

[++] [D]Dnb Resident;
[#] Md General Medicine And Md Pulmonary Medicine, Senior Consultant;
[†] MD Microbiologist, HOD HIC;
**Corresponding author: E-mail: rushitanakrani@gmail.com;*

Cite as: Nakarani , Rushita D., R.K. Chopra, and Rupali Suryawanshi. 2024. "Study of Clinical Profile and Microbiology of Community- Acquired Pneumonia". Journal of Advances in Medicine and Medical Research 36 (7):86-103. https://doi.org/10.9734/jammr/2024/v36i75488.

morbidity and mortality, particularly in the elderly. Diagnosis relies on clinical, radiological, and microbiological assessments. The study aims to provide insight into the clinical and microbiological profiles of CAP in a developing country setting.

Methodology: 72 patients aged over 12 years, presenting with clinical and radiological evidence of CAP, were enrolled. Standard investigations included complete blood count, biochemistry, sputum Gram stain and culture, blood culture, BioFire FilmArray Pneumonia Panel, chest X-ray, and CT scan. The BioFire Panel was used selectively due to cost considerations. Data analysis employed statistical methods such as the Chi-Square test, Mean, Standard Deviation, Fischer Exact test, and Odds Ratio.

Results: The mean age of the patients was 59.93 years, with a male predominance (61%). Fever, dyspnea, and cough were the predominant symptoms. Common comorbidities included hypertension, diabetes, and chronic lung diseases. Microbiological analysis revealed diverse pathogens, with gram-positive cocci in 17% and gram-negative bacilli in 11% of cases. Sputum culture and BioFire Panel identified various bacterial and viral pathogens. Prior antibiotic use significantly affected sputumculture results but not BioFire test outcomes.

Conclusion: CAP in the studied cohort presented with diverse clinical and microbiological profiles. The BioFire Panel demonstrated higher sensitivity and a broader pathogen detection range compared to conventional methods. The findings emphasize the need for precise diagnostic tools and tailored treatment strategies to manage CAP effectively.

Keywords: Community-Acquired Pneumonia (CAP); microbiologic tests; bio fire film array pneumonia panel.

1. INTRODUCTION

Community-acquired pneumonia (CAP) Is an acute non-nosocomially aquired infection of the pulmonary parenchyma [1]. Diagnosis is based on signs and symptoms Which include fever >38ºC (>100ºF), cough, mucopurulent sputum, pleuritic chest pain, dyspnea and signs like crackles or bronchial breathing [1].

CAP incidence ranges from 1.3 to 11.6 cases per 1000 individuals annually, with higher rates among elderly adults, reaching 13 to 15 cases per 1000 annually [2-4]. Additionally, in developed countries, almost half of all pneumonia hospitalizations occur in patients over 65, Making this infection the main cause of increasing mortality rate in this age group [5].

According to the American Thoracic Society/Infectious Disease Society of America chest imaging is the gold standard for diagnosis [6]. CT scanning Have a main role in identifying complications and provides a more accurate picture of pneumonia.

Microbiologic tests are crucial for determining local epidemiology and guiding treatment. Gram-positive bacteria, such as Streptococcus pneumoniae (Pneumococcus), Staphylococcus aureus, Streptococcus pyogenes (Group A Streptococcus), and Group B Streptococcus (GBS), are major CAP pathogens. Streptococcus pneumoniae and respiratory viruses are the most frequently identified pathogens in individuals with CAP [7-10]. While some studies found that gram-negative organisms are commonly involved [11-14] common Gram- negative bacteria in CAP include Pseudomonas aeruginosa, Klebsiella pneumoniae, Haemophilus influenzae, *Escherichia coli*, and Acinetobacter baumannii.

In the majority of moderate CAP cases admitted to the general ward, we obtain a sputum Gram stain and culture, blood culture, complete blood count, chest x-ray, and CT scan. During virus season, testing for respiratory viruses using PCR is preferred, especially for influenza. Additionally, multiplex molecular assays such as the BioFire FilmArray Pneumonia Panel (PN panel) and Pneumonia Plus Panel (PNplus panel) are employed to detect multiple respiratory pathogens from a single sample [15]. Bronchoscopy, including bronchoalveolar lavage (BAL) Gram stain and culture or BAL BioFire FilmArray Pneumonia Panel, is performed in selected cases when clinically indicated [16].

The main sources of CAP are:

1.1 Typical Bacteria [17]:

- Streptococcus pneumoniae
- Haemophilus influenzae
- Moraxella catarrhalis
- Staphylococcus aureus
- Group A streptococci
- Aerobic gram-negative bacteria (e.g., Enterobacteriaceae like Klebsiella spp or

Escherichia coli)
- Microaerophilic bacteria and anaerobes (associated with aspiration)

1.2 Atypical Bacteria [17]:

- *Legionella* spp
- Mycoplasma pneumoniae
- Chlamydia pneumoniae
- Chlamydia psittaci
- Coxiella burnetii

1.3 Respiratory Viruses [17]:

- Influenza A and B viruses
- Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)
- Other coronaviruses
- Rhinoviruses
- Parainfluenza viruses
- Adenoviruses
- Respiratory syncytial virus
- Human metapneumovirus
- Human bocaviruses

BioFire Pneumonia Panel is a multiplex molecular assay that That is capable of identifying 33 pathogens, including bacteria, viruses, and resistance markers (carbapenemases: IMP, KPC, NDM, OXA-48-like, and VIM; ESBLs: CTX-M; methicillin resistance: mecA/C and MREJ) from lower respiratory specimens in about one hour. It aids faster pneumonia diagnosis and appropriate antibiotic prescription [18].

The limited data on CAP microbiological causes in developing nations like India complicates understanding. Therefore, this study aims to investigate the clinical profile and microbiology of CAP through a prospective observational study with a sample size of 72, conducted from 1st December 2022 to 30th November 2023 at Ruby Hall Clinic,Pune.

2. MATERIALS AND METHODS

2.1 Study Design

- Prospective observational study

2.1.1 Inclusion criteria

1. Age > 12yrs, irrespective of sex.
2. Clinical symptoms like fever, cough with or without expectoration, pleuritic chest pain, dyspnea and altered sensorium.
3. Clinical Signs like tachypnea, reduced chest movements, dull percussion notes, bronchial breath sounds, increased vocal fremitus and vocal resonance and crepitations.
4. Radiological evidence of pneumonia without any clinical evidence of pneumonia willalso be included.

2.1.2 Exclusion criteria

1. Active pulmonary tuberculosis
2. Hospital Acquired Pneumonia
3. Parapneumonic Effusion
4. Ventilator-Associated Pneumonia

Study Period: 12 months [01/12/22 to 30/11/23]

The study Have been conducted at the Department of Pulmonary Medicine at Ruby Hall Clinic, was a prospective observational study on Community-Acquired Pneumonia cases in patients aged over 12 years from December 1, 2022, to November 30, 2023. Patients were interviewed, underwent clinical examination, and had their laboratory findings analyzed according to a predetermined protocol.

Data were collected from outpatient (OPD) and inpatient wards (IPD) at Ruby Hall Clinic, Pune, confirming CAP cases based on etiology, clinical history, and radiological findings. At least 72 cases were evaluated with written consent. Data collection followed the study proforma. Patients meeting inclusion criteria underwent standard investigations: complete blood count, standard biochemistry (RFT, LFT, Electrolyte), sputum Gram stain, culture, blood culture, BioFire FilmArray Pneumonia Panel, chest X-ray, and CT scan.

BioFire FilmArray Pneumonia Panel, a rapid PCR system, was selectively used due to cost. The disposable pouch contains all reagents for nucleic acid extraction, purification, reverse transcription, and PCR. It detects multiple pathogens simultaneously in sputum and bronchoalveolar lavage samples, offering quick results in about an hour, facilitating prompt therapy initiation.

Participants were recruited from Ruby Hall Clinic, Pune. Detailed clinical histories and factors contributing to CAP were documented. Data collected underwent analysis and comparison with previous studies. Statistical methods, including the Chi-Square test, Mean, Standard Deviation,

Fischer Exact test, and Odds Ratio, were employed for analysis.

2.3 Sample Size Calculation and Justification

Sample Size was determined by using the proportion from a previously published study (Ranjith Kumar GK, Eshwarappa P, Rashmi GK, Nagabhushana S).

A sample Size 72 is to be enrolled for this study with the help of the following formula: Where, n = Desired Sample Size

P = Proportion of community-acquired pneumonia= 40 %d = effect size =0.10

Z = Zα/2 (Z statistics for the level of confidence) =1.645

n = (1.645/0.10)2 *(0.40)* (0.60)
n = 64.94
n˚72 (With 10% dropout rate)

So, the minimum sample size of 72 patients included in this study.

Statistical Analysis Data will be collected in a predesigned Performa and tabulated in Microsoft Excel. Categorical data will be shown as n (% of cases), and numerical data as mean ± std. dev. Statistical analysis will be done using IBM SPSS Statistics 20. The Chi-square test or Fisher exact test will be used as appropriate, with other tests applied as needed. P < 0.05 will be considered significant.

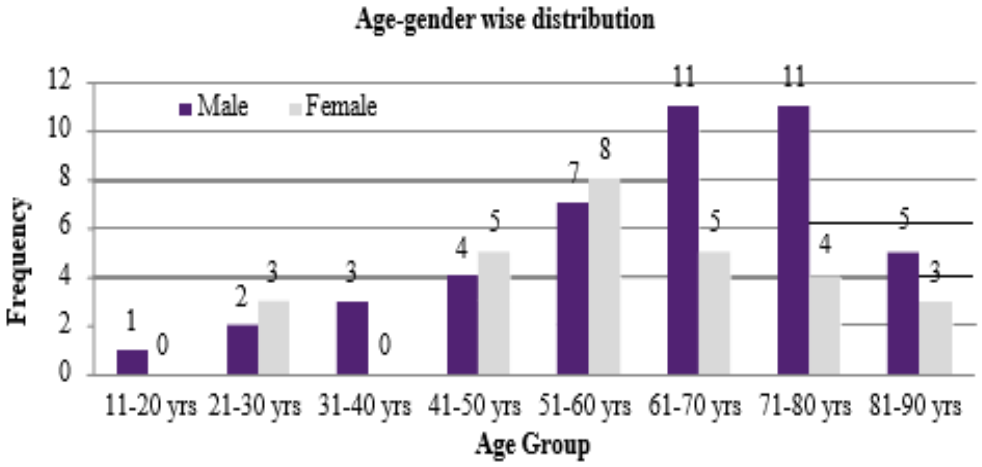
3. RESULTS

The mean age of the 72 samples was 59.93 years (SD 17.41), ranging from 20 to 88 years. There were 44 (61%) males and 28 (39%) females. Sixteen (22.22%) samples were from the 61-70 age group, followed by 15 (20.83%) from the 51-60 age group.

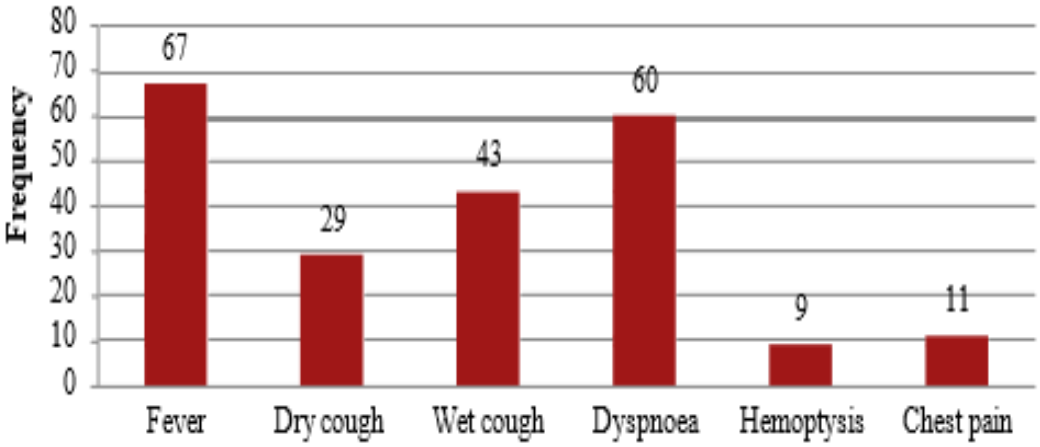
In 72 CAP patients, 67 (93.1%) had fever, 29 (40.3%) dry cough, and 43 (59.7%) wet cough. Dyspnea affected 60 (83.3%), hemoptysis 9 (12.5%), and chest pain 11 (15.3%). Fever, dyspnea, and cough were predominant CAP symptoms.

27.8% reported yellow sputum, suggestive of respiratory infection. White sputum appeared in 15.3%, possibly benign or viral. Greenish sputum occurred in 5.6%, indicating bacterial infection. Additionally, 4.2% had blood-tinged, 4.2% rusty, and 2.8% brown sputum, suggesting lung tissue damage or blood in secretions.

In the 72 CAP patients, common comorbidities included hypertension and diabetes mellitus, affecting 63.89%. Chronic kidney disease was noted in 11.11%, emphasizing its respiratory impact. Lung diseases (COPD, asthma, ILD, bronchiectasis etc) were present in 29.17%, highlighting vulnerability. Malignancy and heart disease affected 11.11% and 9.72%, respectively, possibly increasing CAP risk.



Graph 1. Bar diagram showing age and gender-wise distribution & BMI of thestudy sample



Graph 2. Bar diagram showing chief complaint among CAP subjects

COPD affected 15.28% of patients, emphasizing its relevance in CAP management. Asthma was present in 6.94%, highlighting vulnerability. Bronchiectasis and interstitial lung disease (ILD) were less common, at 4.17% and 1.39%, respectively.

Malignancies included breast, prostate, tongue cancer, CML, NHL, and AML, each at 1.39%. Two patients (2.78%) had a history of lung cancer.

4. ADDICTION AMONG CAP SUBJECTS

Smoking was reported by 29.17% of patients, and tobacco use accounted for 19.44% of cases. Alcohol addiction was identified in 8.33% of patients, suggesting a link between addiction and susceptibility to respiratory infections.

5. HISTORY OF TRAVELLING AMONG CAP SUBJECTS

Among the 72 community-acquired pneumonia (CAP) patients, a small proportion (13%) had a history of travelling, while the majority (87%) did not report any recent travel.

Among 72 CAP patients, 61% [19] had a history of antibiotic use, while 39% [20] did not. This highlights the prevalence of prior antibiotic exposure and its implications for treatment and antibiotic resistance.

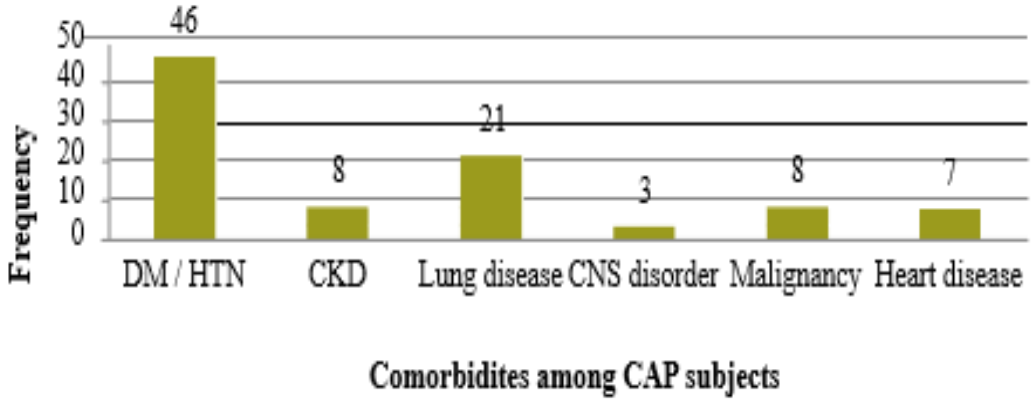
Prior antibiotic use in respiratory infections can reduce bacterial load, alter flora, and lead to false-negative culture results. It creates selection pressure favoring resistant bacteria, potentially delaying pathogen identification and complicating culture interpretation with mixed infections. Antibiotics also influence resistance patterns and may affect sample quality, impacting diagnostic reliability.

6. GENERAL, SYSTEMIC & RADIOLOGICAL EXAMINATION FINDINGS AMONG CAP SUBJECTS

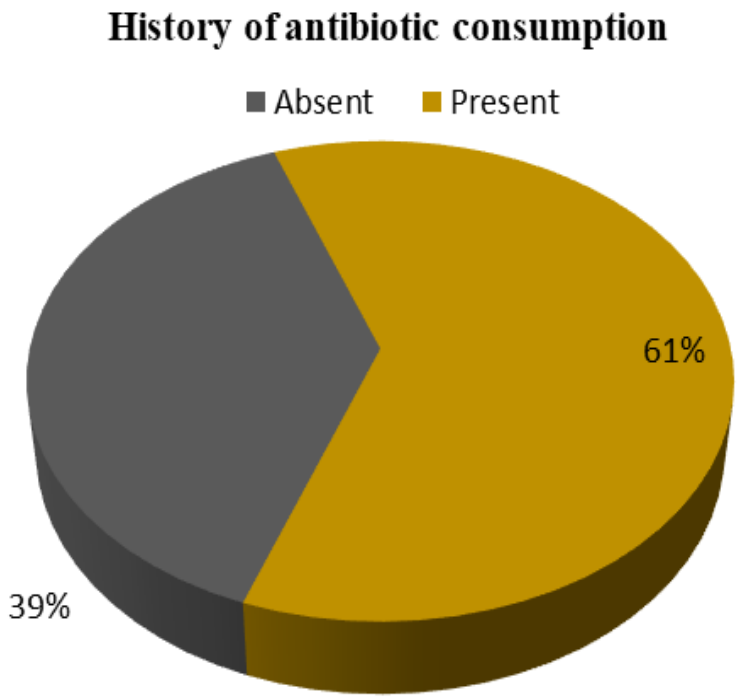
Among CAP patients, the average SBP was 114.72 mmHg (SD = 13.144), DBP was 74.36 mmHg (SD = 10.837), and RR was 25.85 breaths per minute (SD = 3.559).

Crepitations were present in 69 cases (95.83%), bronchial breathing in 48 cases (66.67%), dullness on percussion in 57 cases (79.17%), and pleural effusion in 3 cases (4.17%). Altered sensorium and Type I respiratory failure on ABF were each observedin 7 cases (9.72%).

- 38 patients out of 72- have the involvement of bilateral or multiple lobes.
- The pictogram illustrates lung consolidation in 72 CAP patients. Right upper lobe involvement was seen in 6 cases, left upper in 2, and right middle in 13. Lower lobes were notably affected, with 43 cases on the right and 35 on the left. Thirty- eight patients showed bilateral or multiple lobe involvement.



Graph 3. Bar diagram showing comorbidities among CAP subjects



Graph 4. Pie chart showing the history of antibiotic consumption among CAP subjects

7. MICROBIOLOGICAL EXAMINATION FINDINGS AMONG CAP SUBJECTS

In the cohort of 72 CAP patients, Gram staining analysis revealed diverse bacterial characteristics. Gram-positive cocci were found in 17% (12 cases), and Gram- negative bacilli in 11% (8 cases). Intriguingly, a subset showed a combination of both, accounting for 5% (4 cases). A significant portion, 67% (48 cases), displayed no bacterial organism. These findings highlight the varied bacterial profiles in CAP cases, emphasizing the need for precise identification and tailored treatment strategies.

Sputum culture analysis on CAP patients revealed diverse bacterial isolates, including Pseudomonas aeruginosa, Acinetobacter baumannii, *Escherichia coli*, Klebsiella pneumoniae, Staphylococcus aureus, Staphylococcus epidermidis, and Streptococcus pneumoniae (4.17%, 1.39%, 2.78%, 6.94%, 5.56%, 2.78%, and 6.94% respectively), indicating mixed microbial infections. Furthermore, 69.44% of cases showed no bacterial growth. Sputum Gram Stain:

- Organisms detected in 24 cases.
- No organism detected in 48 cases. Sputum Culture:
- Organisms detected in 22 cases.
- No organism growth in 50 cases. Comparing the organism detection rates:
- Gram Stain: 33.33%
- Sputum Culture: 30.56%

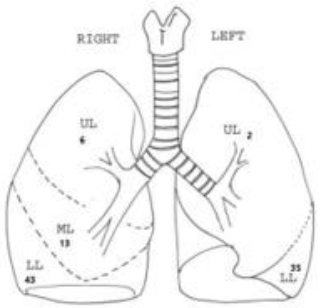
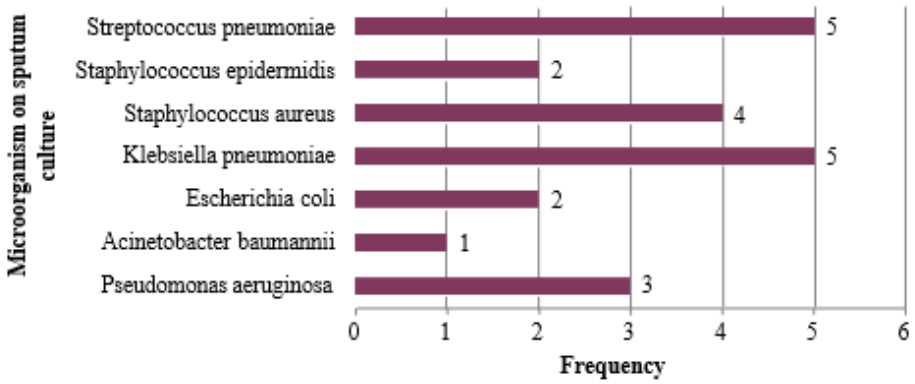


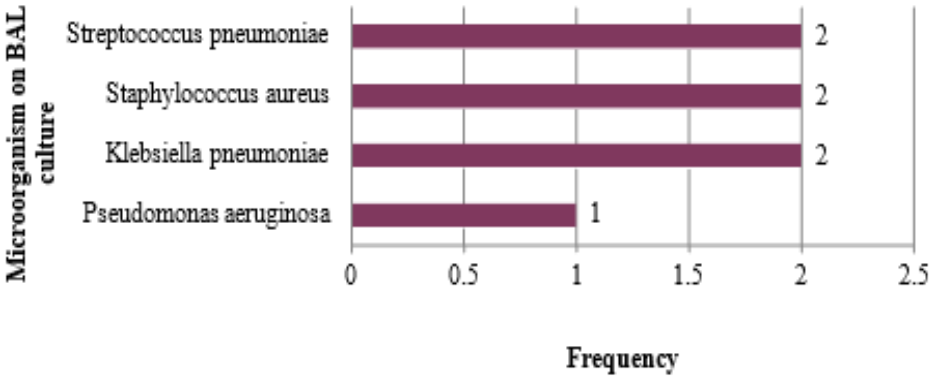
Fig. 1. Pictogram of lung

Blood culture results from suspected infections show varied findings. Out of 72 individuals, 51.39% (37 cases) had no growth, and in 30.56% (22 cases), cultures were not done. Bacterial isolates identified include Pseudomonas aeruginosa (4.17%), Acinetobacter baumannii (1.39%), Escherichia coli (2.78%), Klebsiella pneumoniae (2.78%), Staphylococcus aureus (1.39%), Staphylococcus epidermidis (1.39%), Streptococcus pneumoniae (2.78%), and Streptococcus pyogenes (1.39%).

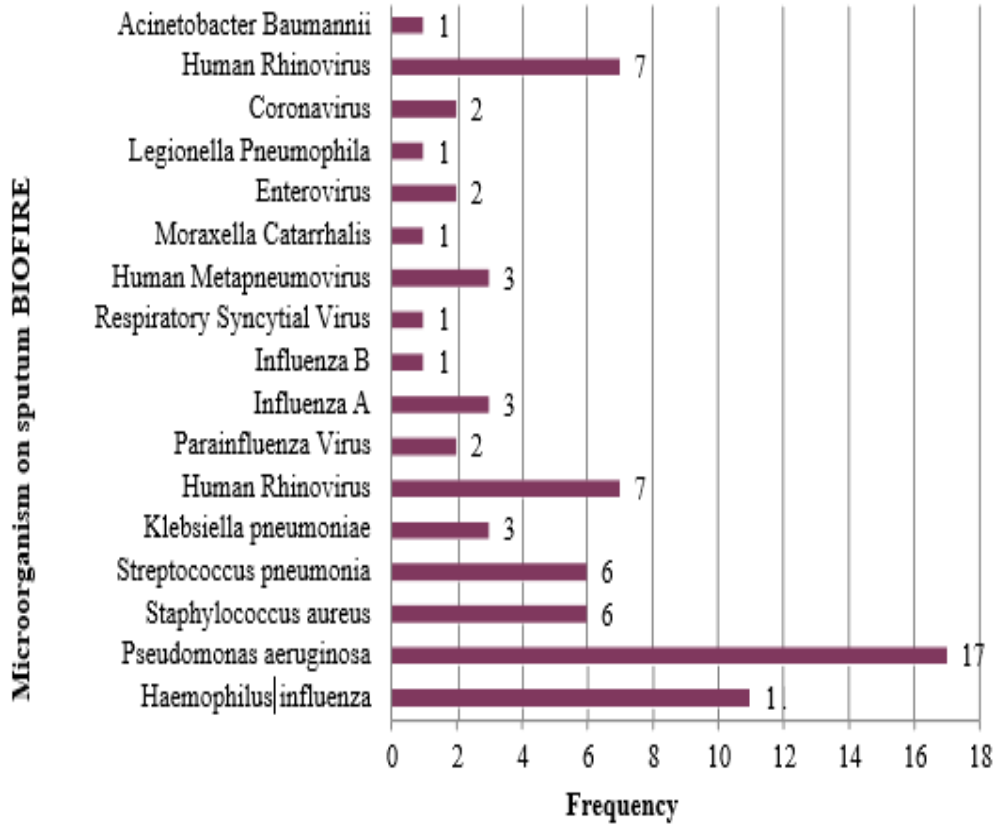
BAL culture findings in 72 CAP patients showed diverse results. Notably, 86.11% (62 patients) had no BAL cultures performed, and 4.17% (3 patients) showed no growth. Positive cultures included Klebsiella pneumoniae, Staphylococcus aureus, and Streptococcus pneumoniae (2.78% each), and Pseudomonas aeruginosa (1.39%). These results highlight potential CAP pathogens and the need for thorough diagnostic and treatment strategies



Graph 5. Microbiological examination findings among CAP subjects



Graph 6. Microorganism on BAL culture



Graph 7. Microbiological examination of BIOFIRE test findings among CAP subjects

The SPUTUM BIOFIRE PNEUMONIA PANEL results from 72 CAP subjects showed varied infections. Haemophilus influenza was found in 11 cases, Pseudomonas aeruginosa in 17, Staphylococcus aureus in 6, Streptococcus pneumoniae in 6, and Human Rhinovirus in 7 cases. Other pathogens detected included Klebsiella pneumoniae [6], Parainfluenza virus [5], Influenza A [6], Influenza B [1], Human Metapneumovirus [5], Moraxella catarrhalis (1), Enterovirus [4], and others. Some patients had multiple infections. This diversity highlights the complexity of CAP infections and the need for accurate diagnostics and tailored treatments.

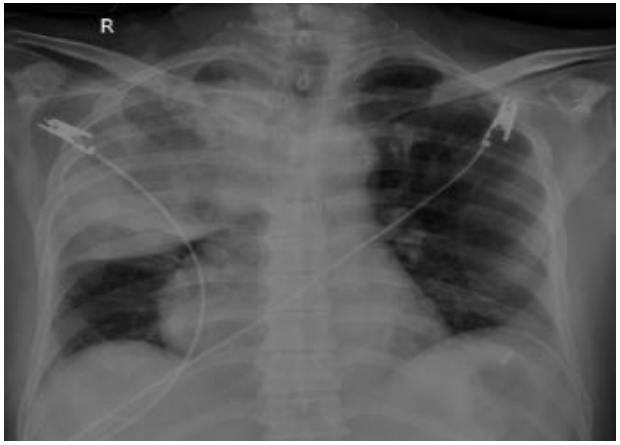
The BIOFIRE test on sputum samples revealed various gene resistance patterns. CTX-M was found in 2.78% of cases, CTX-M and NDM in 5.56%, and CTX-M, NDM, OXA-48, and VIM in 1.39%. NDM and VIM together appeared in 2.78% of cases, and MEC A/C + MREJ in 4.17%. Notably, 31.94% of cases showed no resistance, while 48.61% were not tested with BIOFIRE.

The BAL BIOFIRE analysis showed various organisms: Haemophilus influenzae, Streptococcus pneumoniae, and Klebsiella pneumoniae in 2 cases each; Influenza A in 2 cases; Influenza B, Respiratory Syncytial Virus, and Adenovirus in 1 case each. Staphylococcus aureus, Pseudomonas aeruginosa, and Acinetobacter baumannii were each found once. One case showed no growth, and 62 cases were not tested.

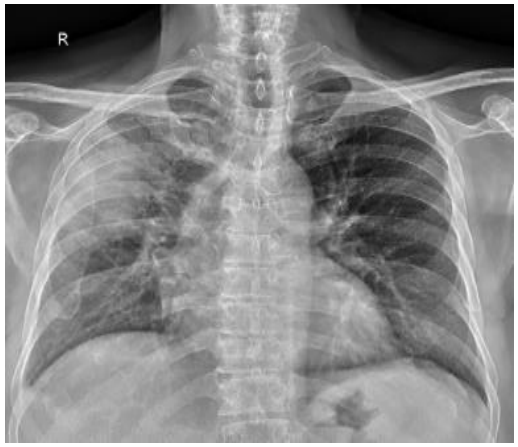
The BAL BIOFIRE analysis revealed gene resistance patterns. CTX-M resistance was detected in 1.4% of cases, CTX-M and NDM in 2.8%, and MEC A/C +

MREJ in 1.4%. No gene resistance was found in 8.3% of cases. The BIOFIRE test was not performed in 86.1% of cases.

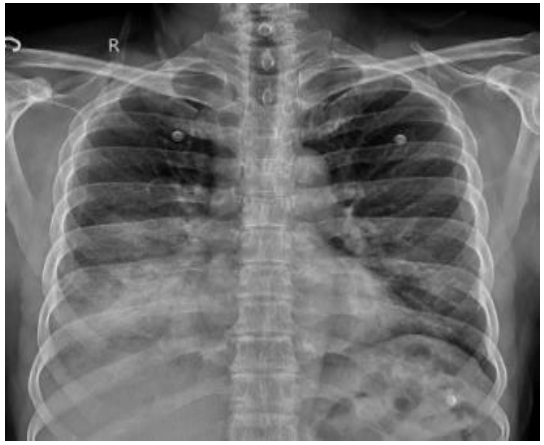
The throat swab test revealed several viral pathogens. Human Rhinovirus was detected in 1 case, Parainfluenza Virus in 3, Influenza A in 3, Influenza B and Adenovirus in 4 each, and Coronavirus in 2 cases. Six cases tested negative, and 55 cases did not undergo the BIOFIRE test.



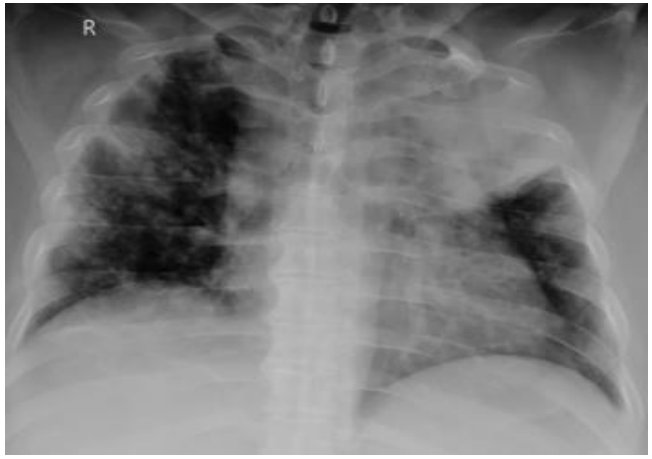
2a. Right Upper Lobe



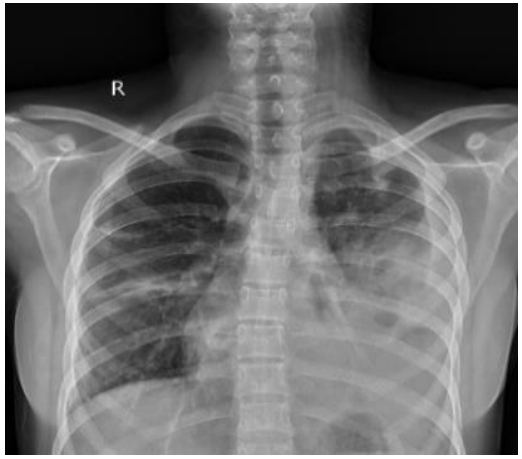
2b. Right Upper & Middle Lobe



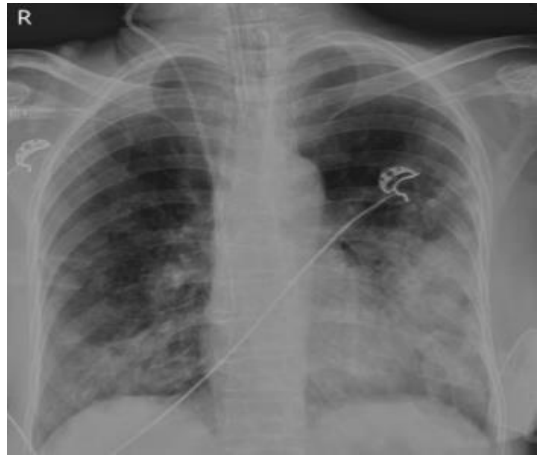
2c. Right Middle & Lower Lobe



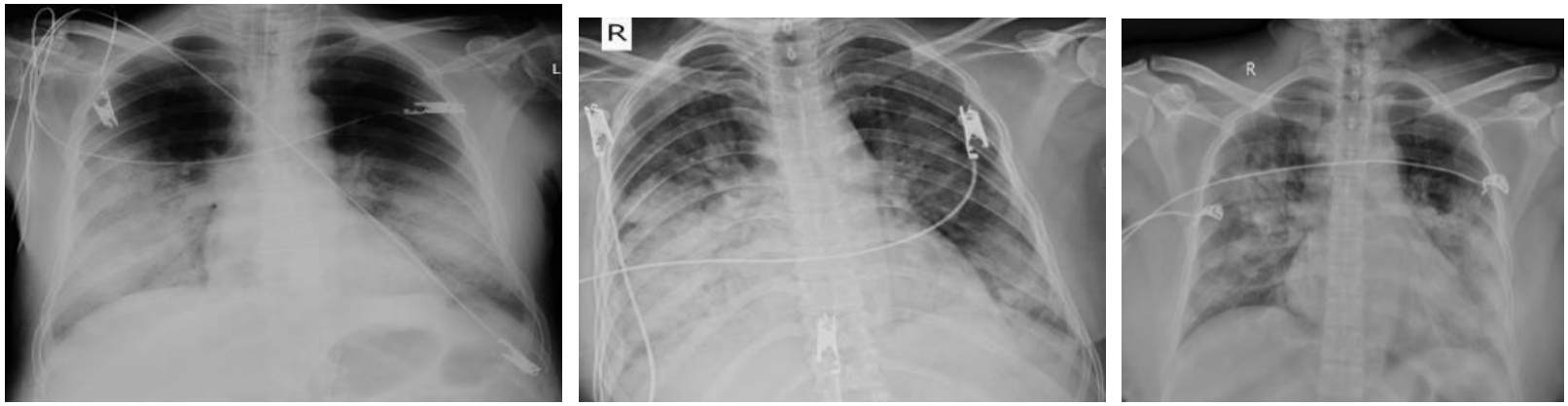
2d. Left Upper Lobe



2e. Left Lingual & LL Lobe

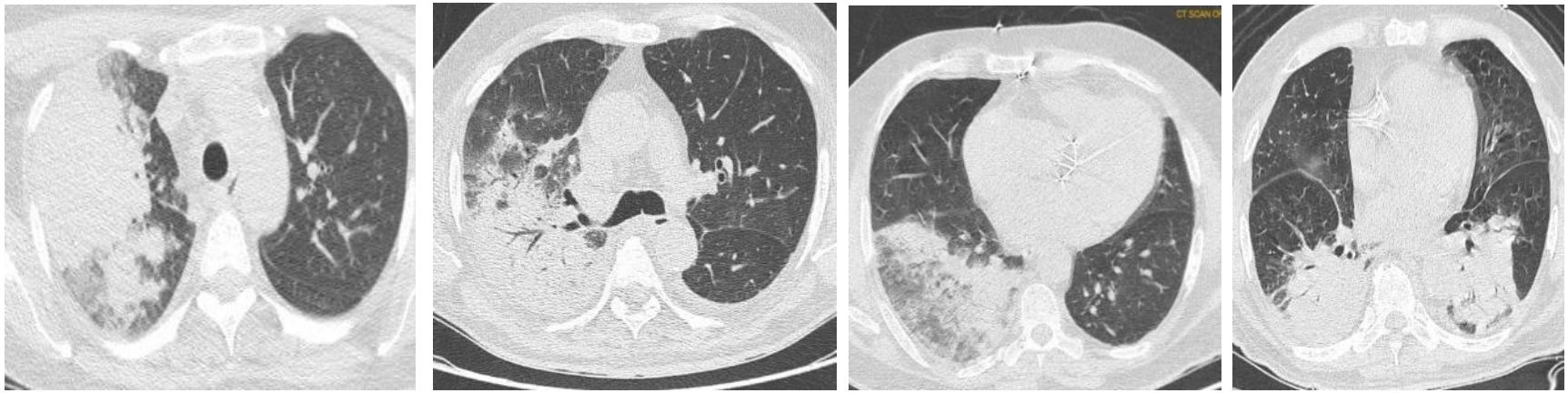


2f. Left Lower Lobe



2g. Bilateral or Multiple Lobes involvement

Fig. 2. Chest X-ray of community-acquired pneumonia



3a. Right Upper Lobe **3b. Right ML & LL** **3c. Right Lower Lobe** **3d.Bilateral LL**

Fig. 3. HRCT Scan of Community-Acquired Pneumonia

There was no significant association between growth on the BIOFIRE test and history of consumption of antibiotics (The chi-square statistic is 0.0407. The p-value is .840205. Not significant at $p < .05$)

The study finds a significant association ($p < 0.00001$) between past antibiotic use and sputum culture growth, indicating that antibiotic history affects culture results. In contrast, the BIOFIRE test shows no significant association ($p = 0.840$) with past antibiotic use, suggesting test outcomes are independent of such history. These findings imply that while antibiotic history impacts sputum culture results, it does not affect BIOFIRE test results.

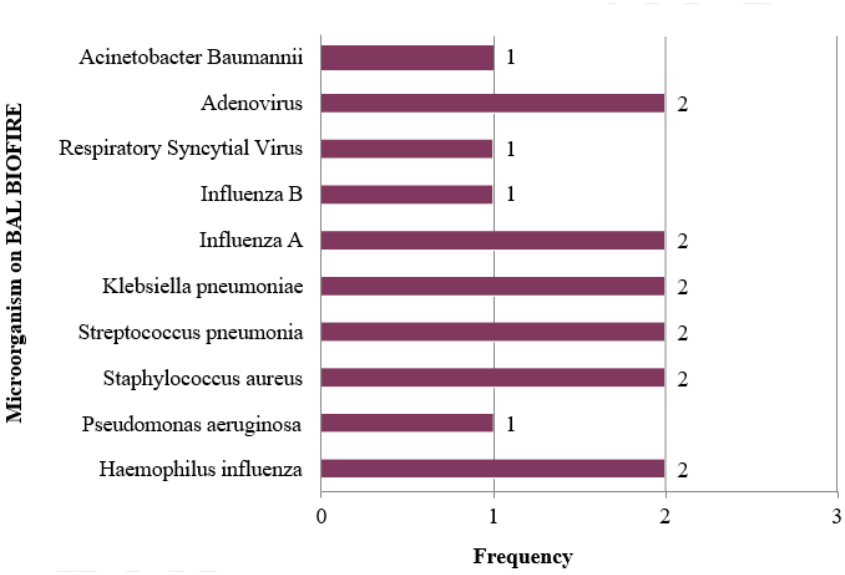
The BioFire Panel was significantly more sensitive in detecting pathogens in CAP patients. The Sputum BioFire Panel had a higher positive rate (91.66%) compared to sputum culture (30%), and the BAL BioFire Panel showed 90% positivity versus 70% for BAL culture. This indicates a substantial improvement in microbial detection. The BioFire Panel also identified a broader range of pathogens, including viruses, and revealed greater microbial diversity. These findings highlighted the enhanced diagnostic capability of the BioFire Panel, crucial for guiding treatment and management in CAP.

The BAL BioFire test seems to be more sensitive and capable of detecting a broader spectrum of microorganisms compared to the traditional BAL culture method. It can identify a variety of bacterial and viral pathogens, potentially providing more comprehensive diagnostic information.

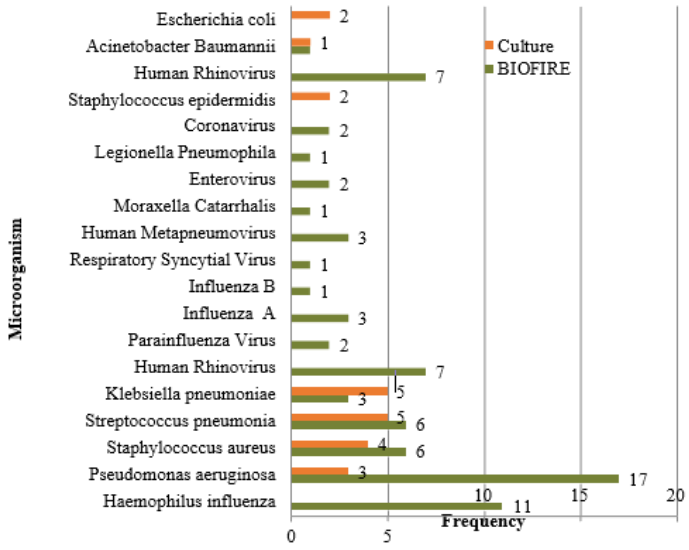
Table 1. Comparison of sputum culture & BIOFIRE test with history ofantibiotic consumption

Variables		Growth in sputum culture		P value
		Present	**Absent**	
History of antibiotics Variables	Present	2	42	**<0.00001**
	Absent	20	8	
		Growth on BIOFIRE		**P value**
		Present	**Absent**	
History of antibiotics	Present	42	2	**0.840**
	Absent	27	1	

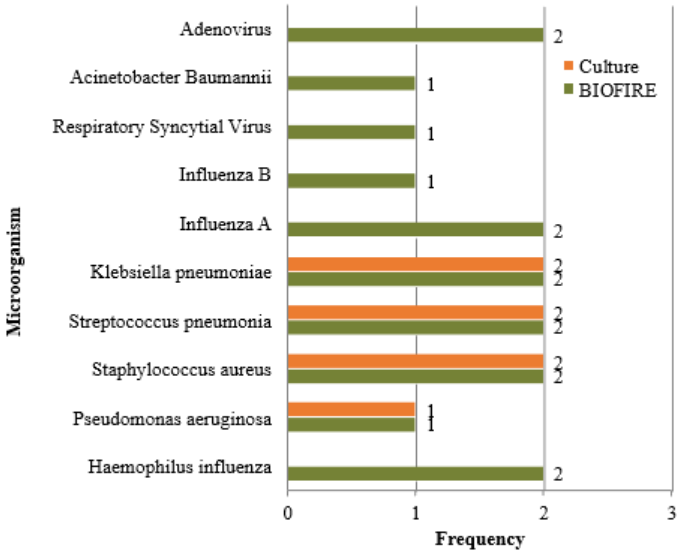
20 out of 28 subjects without a history of antibiotic use showed growth on sputum culture. The chi-square test indicates a significant association between antibiotic history and sputum culture growth (chi-square = 36.0731, p < 0.00001, significant at p< .05)



Graph 8. Microorganism on Bal Biofire



Graph 9. Comparison of sputum culture with sputum BIOFIRE test finding



Graph 10. Comparison of BAL culture with BAL BIOFIRE test finding

8. DISCUSSION

72 Patients with Community-Acquired Pneumonia treated at the Department of Respiratory Medicine, Ruby Hall Clinic, Pune were enrolled for this study.

- **Incidence of sex & age**

this study comprised 61%of male participants and 39%of female participation indicating a notable male predominance. Bansal et al. found similar results in a study conducted in Himachal Pradesh [21]. Similarly, in Iraq, a study with 52 participants also noted a majority of males [22]. Research from Ludhiana yielded comparable results [10,23,9].

The majority of participants were >60 years old. Oberoi et al study in Ludhiana similarly found most participants were over 60 years old [10]. In Iraq, Ghizawi et al study revealed most subjects were under 15 years old [22]. Another study reported participant ages between 65 and 80 years [24]. One study noted a mean age of 63 years [25], while another reported 56 years [23].

- **Incidence of Signs and Symptoms**

Among 72 CAP patients, fever was the most common complaint, reported by 67 (93.1%) patients. Dry cough occurred in 29 (40.3%)

cases, while wet cough was observed in 43 (59.7%). Dyspnea, indicating breathing difficulties, was prevalent in 60 (83.3%) patients. Hemoptysis, characterized by coughing up blood, was noted in 9 (12.5%) cases, and pleuritic chest pain was reported by 11 (15.3%) patients. Crepitation and Bronchial Breath sounds were found in 95.83% and 66.67% of patients respectively. Angela & Shah et al identified cough and fever as the most common signs and symptoms [10,25,11].

- **Predisposing risk factors in patients with CAP**

Among the 72 CAP patients, various comorbidities were identified. Diabetes mellitus (DM) was the most prevalent, present in 63.89% of patients, emphasizing the significance of underlying conditions in CAP cases. Chronic kidney disease (CKD) was observed in 11.11% of patients, highlighting the potential impact of renal impairment on respiratory health. Lung disease, including chronic obstructive pulmonary disease (COPD) and asthma, was present in 29.17% of cases, underscoring the heightened vulnerability of individuals with pre-existing respiratory conditions to CAP.jain & shah et al showed underlying lung disease associated with CAP in 35.8% & 57% [11,26]. Malignancy and heart disease were also notable, each found in 11.11% and 9.72% of patients, respectively, suggesting a potential association with increased CAPrisk.

- **Role of Travel History in Community-Acquired Pneumonia (CAP)**

Among the 72 individuals with CAP, 13% had a documented travel history, and 87% had none. The New England Journal of Medicine has published an article discussing CAP aetiology in adults, recommending consideration of uncommon causes like travel or animal exposure [27].

- **Lobar distribution of consolidation**

The study found that 26% of had right lower lobes involvement, 21% in the left lower lobes, 24% in bilateral lobes, 18% in the right middle lobes, and 3% in the left upper lobes involvement. Overall, the right lower lobe was most commonly involved, and the least common was the left upper lobe. This can be attributed to its dependent position, making it more susceptible to aspiration [28]. Similar findings of 24% in the right lower lobe were reported by Lamb et al. [29] and 48.3% by Jain et al.[26].

The radiological data in our study showed a predominance of lobar pneumonia in 66 (91.66%) patients followed by bronchopneumonia in 4 (5.5%) and interstitial pneumonia in 2 (2.7%) patients. Radiological data ($P < 0.0001$) of our study

- **Gram staining analysis**

In our study, Gram-positive cocci were detected in 17% (12 cases), while Gram-negative bacilli were identified in 11% (8 cases). Intriguingly, a subset of patients exhibited a combination of Gram-negative bacilli along with Gram-positive cocci, accounting for 5% (4 cases). A significant portion, representing 67% (48 cases), displayed no bacterial organism.

- **Pattern of micro-organism isolation from sputum culture in patients with CAP**

The study found 69.44% cases had no identifiable cause. Staphylococcus was common in sputum culture, followed by streptococcus, Klebsiella, Pseudomonas, E. coli, and Acinetobacter. White at el study noted Streptococcus pneumoniae as common, followed by Staphylococcus aureus, Hemophilus influenzae, Klebsiella, Legionella pneumophila, and Viridans streptococcus, with 52% cases unidentified [8]. In another, Streptococcus pneumoniae and Legionella pneumophila were frequent [9]. Yet another oberoiat el study found Streptococcus pneumoniae and Pseudomonas aeruginosa common, with 72% unidentified [10], and another shah et al highlighted Pseudomonas aeruginosa, with 71% unidentified [11]. Sputum culture aids empirical antibiotic selection. While valuable, culturing has limitations, including time-consuming procedures, potential growth issues, antibiotic interference, and sampling errors. Graham Rogers et al. address factors contributing to discrepancies, including contamination, inadequate samples, lab conditions, non-culturable bacteria, antibiotics, and delays, stressing clinical context and multiple diagnostics for accurate diagnosis and treatment [30,31].

- **Incidence of Blood culture growth**

This study detected mostly negative blood culture growth, with only 18% positive cases.

Another study noted blood culture growth in 8.5% [32] and 6% [11] of patients respectively. Positive blood culture, bilateral/multiple lobe involvement, high WBC count, and decreased saturation suggest severe community-acquired pneumonia. Streptococcus pneumoniae and Pseudomonas aeruginosa, common pathogens, require targeted treatment forgaining optimal outcomes.

Limited BioFire Panel testing due to cost; only 36 of 72 CAP cases tested. BioFire Panel showed higher sensitivity in CAP pathogen detection. Sputum BioFire Panel: 91.66% vs. 30% for culture; BAL BioFire Panel: 90% vs. 70%. Another study-Human p , Kosai k & Endicott y et al showed detection rate by BioFire Panels (87.5%, 75%, and 70% respectively) vs. culture (37.5%, 25%, and 20% respectively). Broader pathogen detection enhances CAP diagnosis and management.

Our study found BioFire Panel's superior sensitivity in CAP pathogen detection. Sputum and BAL BioFire Panels showed higher positivity rates (91.66% vs. 30% and 90% vs. 70%), improving microbiological isolation. Kosai et al. examined BioFire FilmArray Pneumonia Panel's utility, detecting 97 targets (84 bacteria, four viruses, and nine resistance markers) in lower respiratory specimens. PN panel outperformed bacterial culture in pathogen and resistance marker detection, with 100.0% and 92.9% positive and negative agreements [33].

In our study, common gene resistances in sputum BioFire included CTX-M (2.78%), CTX-M + NDM (5.56%), and more complex profiles (1.39%). Notably, 31.94% showed no gene resistance, and 48.61% were untested. BAL BioFire revealed CTX-M (1.4%) and CTX-M + NDM (2.8%). These resistance genes suggest potential antibiotic resistance, emphasizing tailored treatment [34].

Resistance gene implications:

- CTX-M: Resistant to various beta-lactam antibiotics [35].
- NDM: Resistant to carbapenems [35].
- OXA-48: Renders carbapenems ineffective [68].
- VIM: Carbapenem resistance [35].
- MEC-A/C: Methicillin resistance, including MRSA [35].
- **MREJ: Linked to methicillin resistance in Staphylococcus species, including MRSA [35].**

The study showed Antibiotic use related to sputum culture results ($p < 0.00001$), but not BIOFIRE ($p = 0.840$), suggesting prior antibiotics don't affect it [36]. García- Vázquez E & Manatrey-Lancaster JJ et al observed that BioFire FilmArray Respiratory Panel doesn't change antibiotic therapy duration in hospitalized patients [36,37].

- **Throat swab PCR test for respiratory viruses (N=17)**

Among the 17 participants, 64% [13] tested positive for respiratory viruses. Influenza B was the most prevalent (4 cases), followed by Influenza A [6], Adenovirus [6], Parainfluenza Virus [6], Coronavirus [5], and Human Rhinovirus [1]. This highlights the diversity of respiratory viruses in the population and the importance of thorough testing.

Burk M et al.'s systematic review and meta-analysis in the European Respiratory Society found a significant viral infection rate (24.5%) in CAP patients, rising to 44.2% when lower respiratory samples were tested. Viral infection prevalence might be underestimated due to swab PCR tests, emphasizing the need for comprehensive diagnostic strategies to enhance patient outcomes and treatment [38].

Table 2. Comparison of culture & BIOFIRE test with history of antibiotic consumption

	Test	
	Sputum culture (N=72)	**Sputum BioFireFilmArray Pneumonia Panel(N=36)**
Positive	22 cases	33 cases
Negative	50 cases	3 cases
Total Microbiological Isolation	30%	91.66%
	BAL culture (N=10)	**BAL BioFire FilmArray Pneumonia Panel**

	Test	
	Sputum culture (N=72)	**Sputum BioFireFilmArray Pneumonia Panel(N=36) (N=10)**
Positive	7	9
Negative	3	1
Total Microbiological Isolation	70%	90%

9. CONCLUSION

- Males (61%) had a higher CAP incidence than females (39%).
- CAP was most common in the >60 years age group (54.16%).
- Common CAP symptoms included cough (100%), fever (93.1%), dyspnea (83.3%), and expectoration (59.7%). Pleuritic chest pain (15.3%) and hemoptysis (12.5%) were less common.
- Crepitations (95.83%) and bronchial breath sounds (66.67%) predominated in respiratory examinations.
- Diabetes (63.89%) was the most prevalent comorbidity, followed by smoking and underlying lung disease (29.7%).
- Right lower lobe (26%) and bilateral involvement (24%) were most affected on chestX-ray.
- Staphylococcus (8.34%) was the most common sputum culture pathogen, followed by Streptococcus (6.94%), Klebsiella (6.94%), Pseudomonas (4.17%), *Escherichia coli* (2.78%), and Acinetobacter (1.39%). In 69.44% of cases, sputum culture yielded no etiological cause.
- Blood culture growth was absent in most patients (82%).
- BioFire FilmArray Pneumonia Panel showed higher sensitivity (91.66%) than sputum culture (30%) in pathogen identification, detecting a broader range of pathogens, including viruses. Resistance gene analysis emphasized antibiotic treatment customization.
- Past antibiotic use significantly influenced sputum culture outcomes, while BioFire test remained reliable.
- Throat swab PCR for respiratory viruses had a 64% isolation rate, stressing viral pathogen recognition in CAP.
- This study offers insights into CAP demographics, clinical features, risk factors, and diagnostics, underscoring the BioFire Panel's role in enhancing diagnostic accuracy and guiding treatment.

10. LIMITATIONS

- Single-center setting may not generalize to other regions [36].
- Sputum culture's low detection rate (30%) and frequent absence of growth poselimitations [36].
- Challenges with sputum culture include potential contamination, sample quality issues, and result delays [36].
- Limited availability of BioFire test in many centers due to high cost [36].

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

CONSENT

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Community-acquired pneumonia - Pulmonary disorders - MSD manual professional edition.

Available:https://www.msdmanuals.com/en in/professional/pulmonarydisorders/pneum onia/community-acquired-pneumonia [Accessed On:2023 Apr 4].

2. García-Vázquez E, Marcos MA, Mensa J. Assessment of the usefulness of sputum culture for diagnosis of community-acquired pneumonia using the port predictive scoring system. Arch Intern Med. 2004;164(16):1807–1811. DOI: 10.1001/archinte.164.16.1807
3. Manatrey-Lancaster JJ, Bushman AM, Caligiuri ME, Rosa R. Impact of BioFire FilmArray respiratory panel results on antibiotic days of therapy in different clinical settings. Antimicrobial Stewardship & Healthcare Epidemiology. Cambridge University Press. 2021;1(1):e4.
4. Burk M, El-Kersh K, Saad M, Wiemken T, Ramirez J, Cavallazzi R. Viral infection in community-acquired pneumonia: A systematic review and meta-analysis. Available:http://ow.ly/X03pK [Accessed On:2023 Oct 28];
5. Cillóniz C, Cardozo C, García-Vidal C. Epidemiology, pathophysiology, and microbiology of community-acquired pneumonia. Ann Res Hosp. 2018;2(1):1–1. [Accessed On:2023 May 13] Available:https://arh.amegroups.com/articl e/view/3921/html
6. Metlay JP, Waterer GW, Long AC. Diagnosis and treatment of adults with community-acquired pneumonia. An Official Clinical Practice Guideline of the American Thoracic Society and Infectious Diseases Society of America. Am J Respir Crit Care Med. 2019; 200:e45.
7. Holm A, Nexoe J, Bistrup LA. Aetiology and prediction of pneumonia in lower respiratory tract infection in primary care. Br J Gen Pract. 2007; 57:547.
8. White RJ, Blainey AD, Harrison KJ, Clarke SK. Causes of pneumonia presenting to a district general hospital. Thorax. 1981;36 (8):566-70.
9. Torres A, Serra-Batlles J, Ferrer A, Jimenez P, Celis R, Cobo E. Severe community-acquired pneumonia. Epidemiology and prognostic factors. Am Rev Respir Dis. 1991;144(2):312–8. [Accessed On:2023 Mar 24] Available:https://pubmed.ncbi.nlm.nih.gov/ 1859053/
10. Oberoi A, Aggarwal A. Bacteriological Profile, Serology and Antibiotic Sensitivity Pattern of Micro-organisms from Community-Acquired Pneumonia.
11. Shah BA, Singh G, Naik MA, Dhobi GN. Bacteriological and clinical profile of Community-acquired pneumonia in hospitalized patients. Lung India. 2010;27(2):54–7. [Accessed On:2023 Apr 4] Available:https://pubmed.ncbi.nlm.nih.gov/ 20616935/
12. Assefa M. Multi-drug resistant gram-negative bacterial pneumonia: aetiology, risk factors, and drug resistance patterns. Pneumonia.2022;14(1):1–12. Accessed On:2023 Dec 5] Available:https://pneumonia.biomedcentral. com/articles/10.1186/s41479-022-00096-z
13. Cillóniz C, Dominedò C, Torres A. Multidrug-Resistant Gram-Negative Bacteria in Community-Acquired Pneumonia. Crit Care. 2019;23(1):1–9. [Accessed on:2023 Dec 5] Available:https://ccforum.biomedcentral.co m/articles/10.1186/s13054-019-2371-3
14. Arancibia F, Bauer TT, Ewig S, Mensa J, Gonzalez J, Niederman MS. Community-Acquired Pneumonia Due to Gram-Negative Bacteria and Pseudomonas aeruginosa: Incidence, Risk, and Prognosis. Arch Intern Med. 2000;162 (16):1849–58. Available:https://jamanetwork.com/journals /jamainternalmedicine/fullarticle/212617 [Accessed On:2023 Dec5]
15. Risk factors and prevention of hospital-acquired and ventilator-associated pneumonia iadults UpTo Date [Accessed On: 2023 Mar 25]. Available:https://sso.uptodate.com/content s/risk-factors-and-prevention-of-hospital-acquired- and-ventilator-associated-pneumonia-in-adults?source=related_link
16. Inamdar DP, Anuradha B, Inamdar P, Patti PS. Microbiota of bronchoalveolar lavage samples from patients of lower respiratory tract infection - A changing trend. J Pure Appl Microbiol. 2021;15(3):1508–16.
17. Overview of community-acquired pneumonia in adults – UpToDate. [Accessed On:2023 Nov 5]. Available:https://www.uptodate.com/conten ts/overview-of- community-acquired-pneumonia-in-adults/print?search=defination%20of%20C AP&source=search_result&selectedTitle= 1~150&usage_type=default&display_rank= 1

18. The BioFire® FilmArray® Pneumonia Panel | BioFire Diagnostics. [Accessed On:2023 Nov 5]. Available:https://www.biofiredx.com/products/the-filmarraypanels/filmarraypneumonia/
19. Kumar RG, Professor A. Clinical profile and prognosis of community-acquired pneumonia. Int J Cur Res Rev; 2021 [Accessed On:2023 Jul 29];13. Available:http://dx.doi.org/10.31782/IJCRR.2021.131425
20. Mandell LA, Marrie TJ, Grossman RF, Chow AW, Hyland RH. Canadian guidelines for the initial management of community-acquired pneumonia: An evidence-based update by the Canadian Infectious Diseases Society and the Canadian Thoracic Society. The Canadian Community-Acquired Pneumonia Working Group. Clin Infect Dis. 2000; ;31(2):383–421. [Accessed On: 2023 May 22]. Available:https://pubmed.ncbi.nlm.nih.gov/10987698/
21. Thomas M. File Jr, Ramirez JA. Community-Acquired Pneumonia. O'Malley PG, editor. Available:https://doi.org/101056/NEJMcp2303286 2023;389(7):632–41. [Accessed On:2023 Oct 28] Available:https://www.nejm.org/doi/pdf/10.1056/NEJMcp2303286
22. The BioFire® FilmArray® Pneumonia Panel | BioFire Diagnostics. [Accessed on;2023 Dec 7]. Available:https://www.biofiredx.com/products/the-filmarray-panels/filmarraypneumonia/
23. Kabeerdoss J, Sankaran V, Pugazhendhi S, Ramakrishna BS. Clostridium leptum group bacteria abundance and diversity in the faecal microbiota of patients with inflammatory bowel disease: a case–control study in India. BMC Gastroenterology. 2013;13(1):1-8.
24. Macfarlane J. Community-acquired pneumonia. British Journal of Diseases of the Chest. 1987;81:116-27. .
25. Pachon J, Prados MD, Capote F, Cuello JA, Garnacho J, Verano A. Severe community-acquired pneumonia. Am Rev Respir Dis. 1990;142:369-73. .
26. Marrie TJ, Durant H, Yates L. Community-acquired pneumonia requiring hospitalization: 5-year prospective study. Reviews of infectious diseases. 1989;11 (4):586-99.
27. Costa MI, Cipriano A, Santos FV., Valdoleiros SR, Furtado I, Machado A, et al. Clinical profile and microbiological aetiology diagnosis in adult patients hospitalized with community-acquired pneumonia. Pulmonology. 2022;28(5):358–67.
28. Jain. Study of Clinical, Radiological, and bacteriological profile of community-acquired pneumonia in hospitalized patients. Available:http://www.ijsssn.com/uploads/2/0/1/5/20153321/ijss_sep_oa22.pdf.
29. Antela A, Guerrero A, Meseguer M, González-Sainz J, Escudero R, Pérez Elías MJ, Quereda C, Hermida JM, Cobo J, Montilla P. Community-acquired pneumonia: A prospective study of 101 adult, immunocompetent patients for 1 year. Enfermedades Infecciosas Y Microbiologia Clinica. 1993;11(10):525-30.
30. Pneumonia in right lower Lobe: Symptoms, causes, and treatment | nao medical. [Accessed on:2023 Dec 7]. Available:https://naomedical.com/blog/pneumonia- right-lower-lobe-nao-medical
31. Bansal S, Kashyap S, Pal LS, Goel A. Clinical and bacteriological profile of community- acquired pneumonia in Shimla, Himachal Pradesh. Indian J Chest Dis Allied Sci. 2004;46:17-22.
32. Culture and Sensitivity, (C and S, C/S), and Antibiotics. [Accessed On:2023 Oct 28]. Available: https://labpedia.net/culture-and-sensitivity-c-and-s-c-s-and-antibiotics/
33. Kosai K, Akamatsu N, Ota K, Mitsumoto-Kaseida F, Sakamoto K, Hasegawa H. BioFire film array pneumonia panel enhances the detection of pathogens and antimicrobial resistance in lower respiratory tract specimens. Ann Clin Microbiol Antimicrob; 2022. [Accessed on:2023 Dec 7];21(1). Available:https://pubmed.ncbi.nlm.nih.gov/35659683/
34. Endicott-Yazdani TR, Baylor; TP093 new developments in diagnostics and treatments of pneumonia / thematic poster session concordance of biofire pneumonia panel with traditional respiratory bacterial culture results. [Accessed on:2023 Dec 7] Available from: www.atsjournals.org

35. Kosai, K., Akamatsu, N., Ota, K. et al. BioFire FilmArray Pneumonia Panel enhances the detection of pathogens and antimicrobial resistance in lower respiratory tract specimens. Ann Clin Microbiol Antimicrob. 2022;21:24. Available:https://doi.org/10.1186/s12941-022-00512-8.
36. Roth K, Roth SKM. Chief bacterial multiplex and medical counter measures branch division of microbiology devices OHT7: Office of *In vitro* diagnostics and radiological health office of product evaluation and quality center for devices and radiological health enclosure. [Accessed On:2023 Oct 28] Available: https://www.fda.gov/medical-
37. Mahmoud NE, Altayb HN, Gurashi RM. Detection of carbapenem-resistant genes in *Escherichia coli* isolated from drinking Water in Khartoum, Sudan. J Environ Public Health. 2020;2020.
38. Waterer GW, Kessler LA, Wunderink RG. Delayed administration of antibiotics and atypical presentation in community-acquired pneumonia. Chest 2006 ;130:11.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/118990