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A STUDY ON PRESCRIPTION PATTERN OF PNEUMONIA PATIENTS WITH OR WITHOUT COMORBIDITIES AND IMPORTANCE OF MEDICATION ADHERENCE AT A TERTIARY CARE TEACHING HOSPITAL

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ABSTRACT

Background: Pneumonia, an infection causing alveolar inflammation and frequent consolidation, remains a leading cause of morbidity and mortality—especially among older adults, immunocompromised patients, and those with comorbidities such as diabetes, COPD, and cardiac disease. Effective management requires early diagnosis, rational prescribing, adherence monitoring, patient education, and preventive measures to reduce disease burden and antimicrobial resistance. **Objective:** To evaluate prescription patterns in pneumonia patients and assess the importance of medication adherence. **Methodology:** A six-month prospective observational study in a tertiary-care hospital enrolled 140 admitted pneumonia patients. Prescriptions were analysed for drug utilization, antimicrobial rationality, and guideline adherence. The Medication Adherence Rating Scale (MARS) and Pneumonia Severity Index (PSI) assessed adherence and severity. Data were analysed using Microsoft Excel and statistical software. **Results:** Participants were predominantly male (107/140; 76.4%). Age distribution: 18–40 years, 35.7%; 41–60 years, 40.0%; 61–75 years, 21.4%; >75 years, 2.9%. Adherence was poor in 57.1% (80/140) and good in 42.9% (60/140). Cephalosporins were most prescribed (45.98%), followed by macrolides (14.96%),

tetracyclines (14.59%), and penicillin–beta-lactamase inhibitors (10.21%); other classes formed smaller proportions. **Conclusion:** This study was undertaken to analyse the prescribing trends in pneumonia patients and to determine the importance of medication adherence.

KEYWORDS: Pneumonia, Prescription Pattern, Antibiotic Utilization, Medication Adherence, Antimicrobial Resistance (AMR).

1. INTRODUCTION

The lungs are the key organs of the respiratory system responsible for gas exchange. Adult lung size is typically between 375 and 560gms with an average weight of 450gms. The right lung has divided into three lobes; upper, middle and lower lobe. The left lung is divided into upper and lower lobes. The primary function of the lungs are to supply blood with oxygen and remove carbon dioxide from the body.[1]

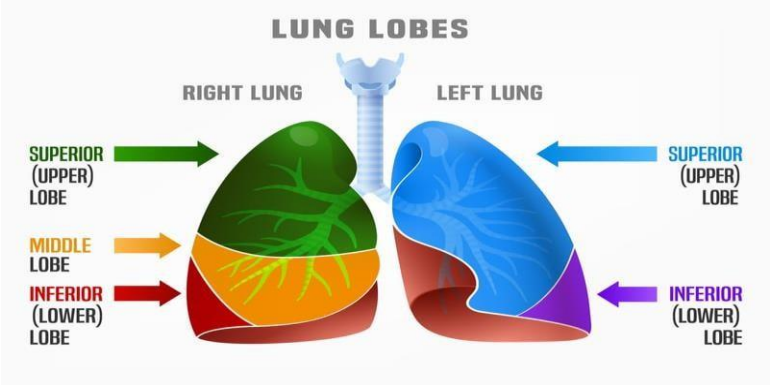

Figure 01: Lobes of Lungs.[1]

Pneumonia is defined as significant inflammation of lung parenchyma, mostly due to the infections, involving alveoli leading to consolidation.[2] It is an acute infection, characterized by symptoms such as cough, fever, pleuritic chest pain, and dyspnea, along with radiographic evidence of infiltrates.[3] [4]

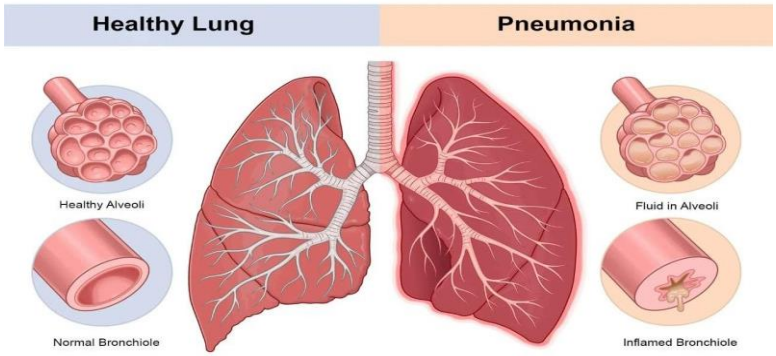

Figure 02: Comparison between healthy lung and pneumonia.[2]

1.1. EPIDEMIOLOGY[3],[4]

About one million adults receive hospital care due to pneumonia each year, resulting in approximately 50,000 deaths annually. In 2019, the population with the highest number of pneumonia deaths was estimated to be those aged 70 and above. Between 1990 and 2019, there was an increase in the number of deaths among those aged 70 and above from roughly 600,000 to more than 1 million. India contributes about 23% of global pneumonia burden.

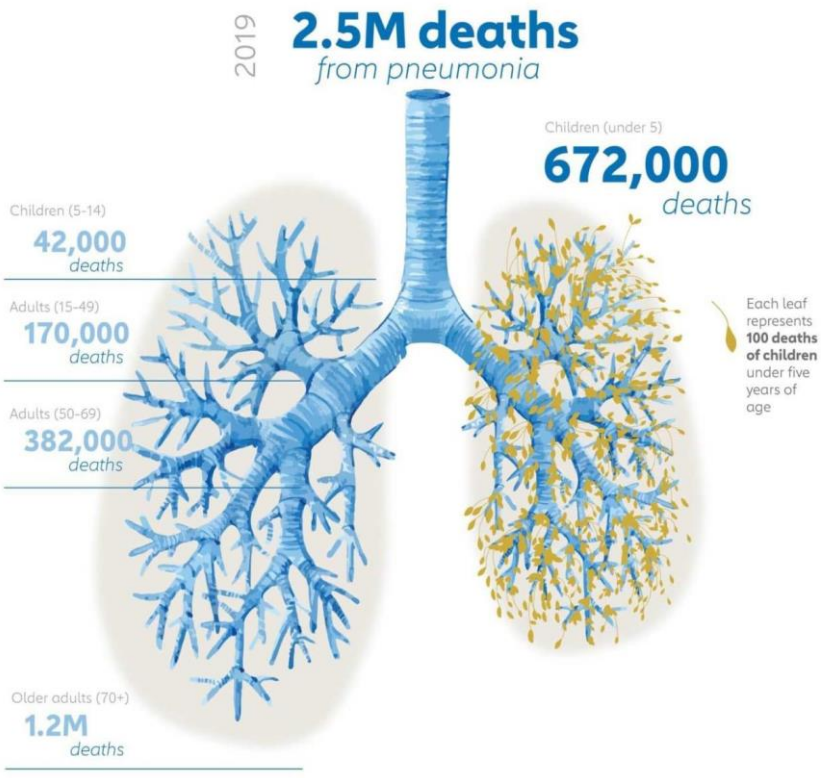

Figure 03: Epidemiology of Pneumonia (2019).[5]

COUNSELLING[8]

Providing information to patients and their representatives regarding disease, drug therapy,

and duration of therapy, side effects and life style modifications.

Effective patient counselling is crucial in pneumonia management to improve adherence, prevent complications, and ensure a successful recovery.[30]

1.2 LIFE STYLE MODIFICATION[31],[32],[33],[34]

- Get vaccinated against pneumococcal infections, influenza, and COVID-19.
- Avoid smoking and excessive alcohol, as they weaken the lungs and immune system.
- Maintain good hygiene, including frequent handwashing and proper oral care.
- Eat a balanced diet rich in vitamins and nutrients to strengthen immunity.
- Exercise regularly to boost lung health and overall wellness.
- Manage chronic illnesses like diabetes, asthma, or heart disease effectively.
- Limit exposure to sick individuals and practice cough/sneeze etiquette.
- Rest adequately to help the body recover.
- Stay well-hydrated to loosen mucus and support lung function.
- Eat nutritious, light meals to maintain strength.
- Avoid smoking and alcohol during recovery.
- Do deep breathing exercises to improve lung expansion.
- Follow prescribed medications and complete the full treatment course.
- Resume activities gradually, without overexertion.
- Avoid environmental pollutants and allergens.
- Attend follow-up check-ups to monitor lung function.
- Seek support if needed, as recovery can sometimes affect mental well-being**.**

1.3 PRESCRIPTION PATTERN EVALUATION

Prescription auditing is an important tool that brings valuable information about drug status to medical profession, public health administration and society. Prescription order is an important transaction between the physician and patient. Prescribing patterns study of drugs are helpful in exploring the commonly used groups of drugs in each group, drugs prescribed by generic or brand names by the physician.[35] In high-income nations, the trend has shifted toward excessive use of antibiotics, while in low- and middle-income countries, rising morbidity and mortality are observed due to the limited availability of second-line therapies and the reduced effectiveness of first-line drugs. Treating patients who initially receive inappropriate medications is not only more costly but also associated with a higher risk of

death. Furthermore, irrational prescribing practices contribute to an increased incidence of adverse drug events. Therefore, the judicious use of antibiotics has become a critical factor in minimizing bacterial resistance, adverse outcomes, and treatment expenses worldwide.[42]

The inappropriate use of medicines whether through overuse, underuse, or misuse leads to wasted resources and significant health risks. According to the WHO (1985), the rational use of medicines (RUM) means that patients should receive drugs suitable for their clinical condition, in the correct dosage tailored to their individual needs, for an adequate duration, and at the lowest possible cost to both them and the community.[43]

Irrational use of drugs is a major concern in modern clinical practice, more than half of all the medicines are prescribed, dispensed or sold inappropriately and that half of all patients fail to take them correctly. Thus the concept of "Rational use of drugs" has been introduced which is defined by WHO as " Patients receive medication according to their clinical needs, in doses that meet their own individual requirements, for an adequate period of time, and at the lowest possible cost to them and their community". Drug utilization studies can provide the insights into a pattern, quality, determinants and outcomes of drug use.[36]

1.4 MEDICATION ADHERENCE[37],[38],[45]

Medication adherence is defined by the World Health Organization as "the degree to which the persons behavior corresponds with the agreed recommendation from a health care provider.

1.5 A. IMPORTANCE OF MEDICATION ADHERENCE:

- Ensures complete eradication of infection.
- Reduces the risk of antibiotic resistance.
- Prevents recurrence and complication.
- Shortens the duration of illness and hospitalization.

1.6 MEDICATION ADHERENCE RATING SCALE

The Medication Adherence Rating Scale (MARS) is a self-reported tool designed to evaluate medication adherence, particularly among patients with psychotic disorders, though it has been adapted for use in various chronic conditions. The scale includes 10 yes/no questions that assess three key factors: the actual behavior of taking medications, attitudes toward the medication, and the influence of side effects on adherence. The total score, ranging from 0 to

10, is calculated by summing the responses, with higher scores indicating better adherence. MARS is a simple, quick, and cost-effective instrument that provides not only a measure of whether medications are being taken but also insight into patients' beliefs and concerns that may affect adherence, such as side effect fears or medication distrust. This makes it particularly useful in clinical settings for identifying at-risk patients and informing personalized adherence strategies. Additionally, it facilitates improved communication between healthcare providers and patients, ultimately contributing to better treatment outcomes.[39]

PNEUMONIA SEVERITY INDEX (PSI)

The Pneumonia Severity Index (PSI) is a clinical tool used to assess the severity of pneumonia and guide the decision-making process regarding the management of patients with community-acquired pneumonia (CAP). It incorporates various factors, such as demographics, comorbidities, physical examination findings, laboratory results, and radiological data, to classify patients into risk categories for mortality and complications. The PSI is calculated using a point-based scoring system, with higher scores indicating an increased risk of poor outcomes. The index stratifies patients into five risk classes (I to V), with class I representing the lowest risk and class V indicating the highest risk, including the need for intensive care or hospitalization. This scoring system helps clinicians determine whether outpatient care is appropriate or if hospitalization or even intensive care is required. It also assists in making more informed decisions regarding antibiotic therapy and clinical monitoring. The PSI is a widely accepted tool for assessing pneumonia severity and has been validated in numerous clinical settings, offering a reliable means of predicting outcomes and guiding treatment strategies.[40],[44]

2. MATERIALS AND METHODS

Study Design: A Prospective Observational study

Study Site: The study was carried out in the Department of General Medicine, BMC&RC, Ballari District, Karnataka.

Duration of Study: The study was conducted for a period of six months (From March 2025-August 2025)

Study Sample Size: The study sample size was calculated by using the formula, $n = Z^2pq /d^2$

$n = (1.96)^2 *0.9*0.1/ (0.05)^2$

n = 138

n- Required sample size, Z- Reliability coefficient, p- Estimated proportion, d- Margin of error.

The required minimum sample size was 138 patients. 140 patients was the achieved sample size.

Source of Data: Data was collected from the patient case sheets and through direct interaction with patients.

Study criteria: The study was carried out by considering the following inclusion and exclusion criteria.

Inclusion criteria

- Patient aged above 18 years.
- Patients willing to participate in the study.
- Patients of either sex in general medicine ward.
- Patients diagnosed with pneumonia.
- Patients with or without comorbidities.

Exclusion criteria

- Patients who are not willing to give informed consent.
- Patients who are treated from outpatient department.
- Patients age less than 18years.
- Special population include pregnant women and psychiatric patients.
- Patients admitted in emergency ward.
- Prescription with insufficient and incomplete data.

Materials Used: Patient Information Sheet, Informed Consent Form, Data Collection Form, Medication Adherence Rating Scale, Pneumonia Severity Index, Patient Counselling Documentation Form, Patient Information Leaflet, MS Excel Sheet**.**

Study Procedure: Regarding this project pilot study was done. Various articles were collected and reviewed pertaining to the project. A study protocol, including study design and design of Performa was prepared. The ethical consent prior to study was obtained. Patients were enrolled according to the inclusion and exclusion criteria. The Patient's details were collected from the case sheet and were evaluated for various antibiotics usage from patient treatment chart. The obtained information was represented in the form of graphs and tables by using MS Excel sheets, and the report was submitted.

3. RESULTS

3.1 GENDER WISE DISTRIBUTION OF PATIENTS

A total of 140 samples were analysed among 107 (76.42%) were males and 33 (23.57%) were females. Here males were more predominant than females.

Table 01: Gender wise distribution of patients.

SL.NO	GENDER	TOTAL NUMBER (n = 140)	PERCENTAGE
01.	MALES	107	76.42%
02.	FEMALES	33	23.57%

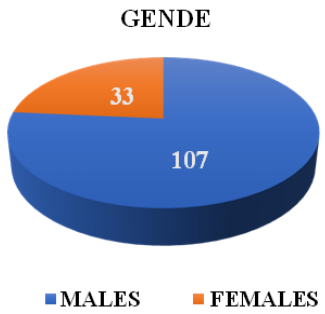

Figure 04: Gender wise distribution of patients.

3.2 AGE WISE DISTRIBUTION OF PATIENTS

A total of 140 samples were analysed with 50 (35.71%) patients aged 18-40 years, 56 (40%) patients aged 41-60 years, 30 (21.42%) patients aged 61-75 years and 4 (2.85%) patients aged over 75 years.

3.3 DISTRIBUTION OF PNEUMONIA PATIENTS ACCORDING TO SOCIAL

Table 02: Age wise distribution of patient.

SL.NO	AGE (IN YEARS)	TOTAL NUMBER (n = 140)	PERCENTAGE
01.	18-40	50	35.71%
02.	41-60	56	40%
03.	61-75	30	21.42%

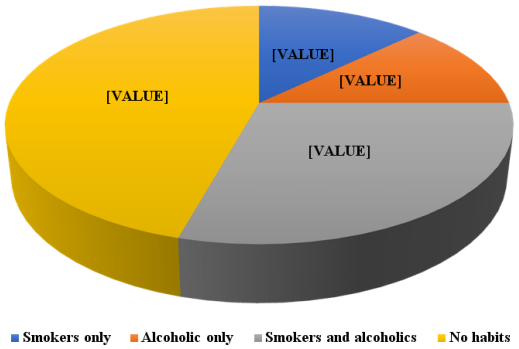

Figure 05: Age wise distribution of patient.

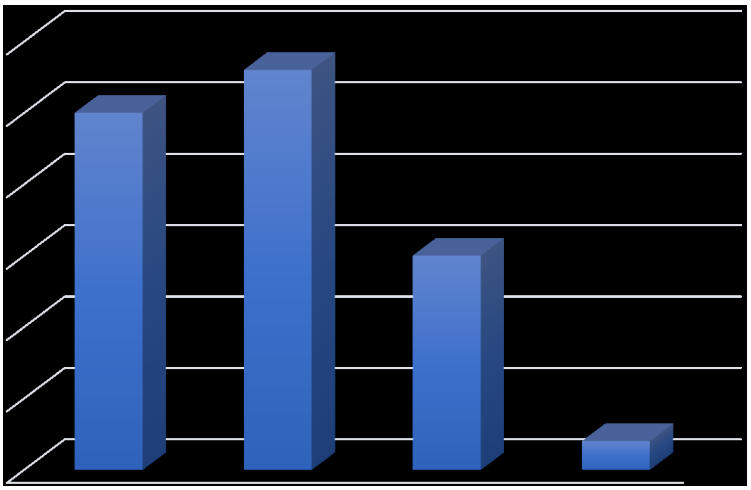

Figure 06: Distribution of pneumonia patients according to social habits.

HABITS

total of 140 patient s were in clude din the study. Among them, 64 patients (45.71%) reported having no history of social habits, while 41 patients (29.28%) were alcoholic and smoking, 17 patients (12.14%) were identified as alcoholics only and 18 patients (12.85%) were reported as smokers only. This indicates that the majority of the patients in the study were patients with no social habits.

Table 03: Distribution of pneumonia patients according to social habits.

SL. NO.	SOCIAL HABITS	TOTAL NUMBER	PERCENTAGE
1	Smokers only	18	12.85%
2	Alcoholic only	17	12.14%
3	Smokers and alcoholics	41	29.28%
4	No habits	64	45.71%

3.4 DISTRIBUTION OF LOBAR INVOLVEMENT BASED ON CHEST X-RAY

In total of 140 patients, 55 patients (39.28%) are of right lower lobe pneumonia, 9 patients (6.42%) were right upper lobe, 16 patients (11.42%) were right middle lobe, 7 patients (5%)

were left upper lobe, 29 patients (20.71%) were left lower lobe and 31 patients (22.14%) were bilateral. This indicates that, majority of the patients shows right lower lobe involvement.

Table 04: Distribution of lobar involvement based on chest x-ray.

SL.NO	TYPES OF PNEUMONIA (ANATOMICAL)	TOTAL UMBER	PERCENTAGE
01.	RIGHT UPPER LOBE	9	6.42%
02.	RIGHT MIDDLE LOBE	16	11.42%
03.	RIGHT LOWER LOBE	55	39.28%
04.	LEFT UPPER LOBE	7	5%
05.	LEFT LOWER LOBE	29	20.71%
06.	BILATERAL	31	22.14%

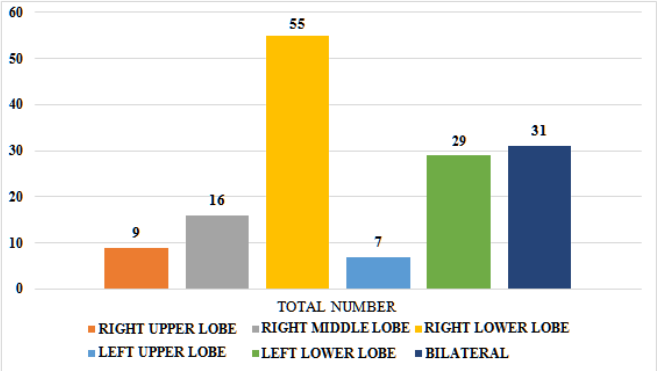

Figure 07: Distributi on oflobar.

3.5 DISTRIBUTION OF PNEUMONIA PATIENTS ACCORDING TO CLINICAL PRESENTATIONS

Among 140 patients, cough was most common clinical presentations, shown in 114 patients (31.4%), breathlessness occurred in 85 patients (23.2%) and bilateral lower limb swelling were observed in 15 patients (4%). Fever was reported in 93 patients (25.4%) and headache was seen in 4 patients (1%). Chest pain was reported in 25 patients (6.8%) and symptoms like cold, backpain, loss of appetite, loose stools, each affected 2 patients (0.5%). Abdominal pain and vomiting, was observed in 4 patients each (1%).

Table 05: Distribution ofpneumonia patients based on clinical presentation.

SL.NO	CLINICAL PRESENTATION	PATIENTS OF NO.	PERCENTAGE
1	Cough	114	31.4%
2	fever	93	25.4%
3	Breathlessness	85	23.2%
4	Chest pain	25	6.8%
5	B/L Lower limb swelling	15	4%
6	vomiting	9	2.4%

7	Headache	4	1%
8	Abdominal pain	4	1%
9	Weakness	4	1%
10	cold	2	0.5%
11	Back pain	2	0.5%
12	Loss of appetite	2	0.5%
13	Loose stool	2	0.5%
14	Facial puffiness	1	0.2%
15	Generalized body ache	1	0.2%
16	Giddiness	1	0.2%
17	Convulsion	1	0.2%
18	Altered sensorium	1	0.2%
	TOTAL	**366**	

Other symptoms like facial puffiness, generalised body ache, giddiness, convulsions, altered sensorium were reported 1 in each patient (0.2%).

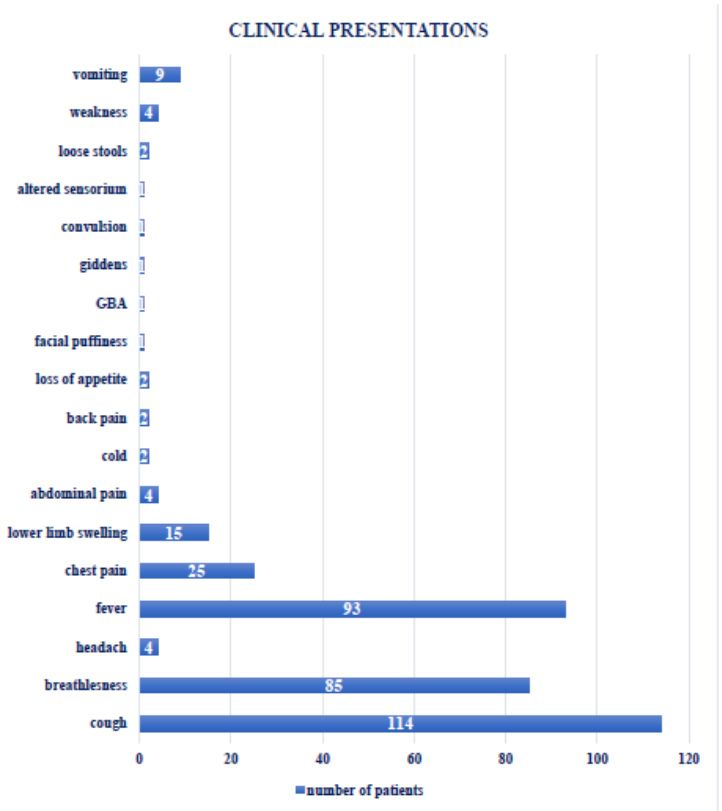

Figure 08: Distributi on ofpneuonia patients based on clinical presentations.

3.6 DISTRIBUTION OF PNEUMONIA PATIENTS BASED ON COMORBIDITIES

Among 140 pneumonia patients, pulmonary tuberculosis was the most common comorbidity, affecting 24 patients (17.14%). Systemic hypertension followed, impacting 17 patients (12.14%), and diabetes mellitus was observed in 14 patients (10%). Sepsis was found in 7 patients (5%) and 6 patients (4.28%) were chronic kidney disease. Other notable condition

included immune deficiency virus and COPD, affecting 5 patients each (3.57%), while anaemia and ischemic heart disease were present in 4 patients each (2.5%). Other conditions like pleural effusion and chronic liver disease seen in 3 patients each (2.14%). Diseases like psychiatric disease, NSTEMI, epilepsy, acute pulmonary oedema and acute chest syndrome was observed in 2 patients each (1.42%).

Table 06: Distribution of pneumonia patients based on comorbidities.

SL.NO	DISEASE	NUMBER OF PATIENT	PERCENTAGE
1	Pulmonary tuberculosis	24	17.14%
2	Systemic hypertension	17	12.14%
3	Diabetes mellitus	14	10%
4	Sepsis	07	5%
5	Chronic kidney disease	06	4.28%
6	Immuno deficiency virus	05	3.57%
7	Chronicobstructive pulmonary disease	05	3.57%
8	Anaemia	04	2.5%
9	Ischemic heart disease	04	2.5%
10	Pleural effusion	03	2.14%
11	Chronic liver disease	03	2.14%
12	Acute pulmonary oedema	02	1.42%
13	Acute chest syndrome	02	1.42%
14	Psychiatric disease	02	1.42%
15	Epilepsy	02	1.42%
16	Non-st elevation myocardial infraction	02	1.42%
17	Psychosis	01	0.71%
18	Deep venous thrombosis	01	0.71%
19	Cerebral venous thrombosis	01	0.71%
20	Neuro infection	01	0.71%
21	Hypokalaemia	01	0.71%
22	Acute febrile illness	01	0.71%

Other conditions like psychosis, deep vein thrombosis, cerebral venous thrombosis, neuro-infection, hypokalaemia and acute febrile illness were seen only 1 patient each (0.71%). This range of comorbidities highlights the complexity of health issues faced by pneumonia patients.

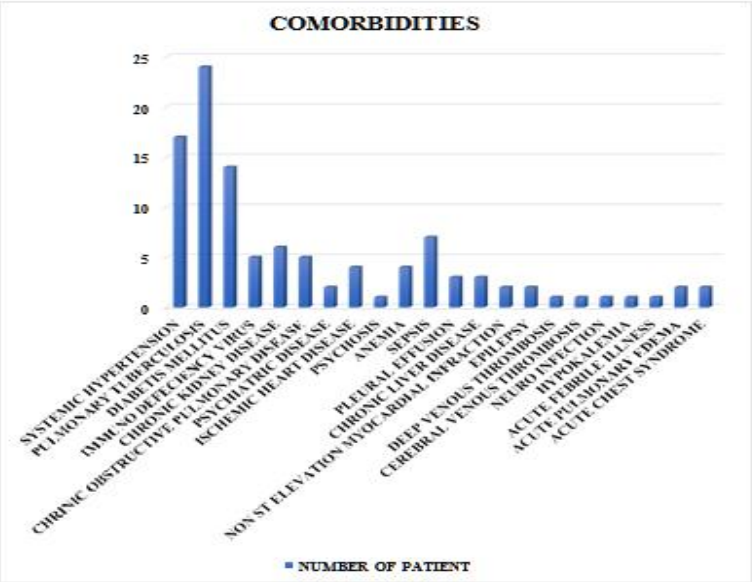

Figure 09: Distribution of pneumonia patients based on comorbidities.

3.7 DISTRIBUTION OF PATIENTS ACCORDING TO ASSESSEMENT OF MEDICATION ADHERENCE

Among 140 patients, 60 (42.85%) patients had good medication adherence and 80 (57.14%) patients had poor medication adherence; It is assessed as patients suffering with pneumonia have a poor medication adherence overall (poor antibiotic compliance).

Table 07: Distribution of patients according to assessment of medication adherence.

SL.NO	MEDICATION ADHERENCE	TOTAL NUMBER (n = 140)	PERCENTAGE
01.	GOOD ADHERENCE	60	42.85%
02.	POOR ADHERENCE	80	57.14 %

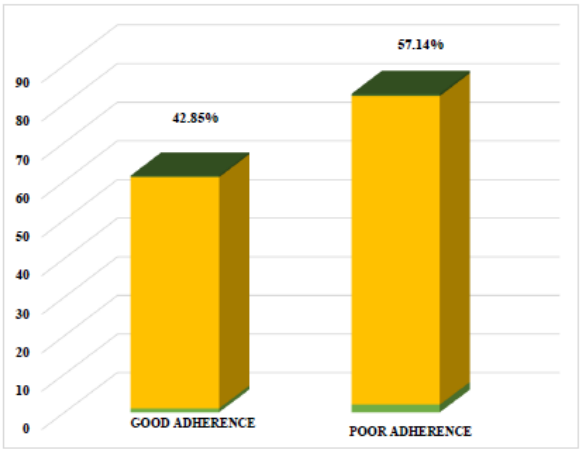

Figure 10: Distribution of patients according to assessment of medication adherence.

3.8 PRESCRIPTION PATTERN OF PNEUMONIA PATIENTS WITH COMORBIDITIES

In this study consist of 140 pneumonia patients, a total of 1062 drugs were prescribed among the study population. Out of which 625 drugs were prescribed to treat pneumonia patients with comorbid conditions. Among them antibiotics were the most frequently prescribed, with 136 drugs (21.76%) and bronchodilators accounted for 77 drugs (12.32%). Proton pump inhibitors comprised 74 drugs (11.84%), while nutritional supplements made up 69 drugs (11.04%). Analgesics represented with 58 drugs (9.28%), followed by mucolytic agents with 46 drugs (7.36%) and anti-hypertensives with 37 drugs (5.92%). Anti-emetics account for 35 drugs (5.6%), statins for 16 drugs (2.56%), NSAIDs and anti-diabetics for 15 each drug (2.4%), and antiplatelet agent for 11 drugs (1.76%). Sympathomimetic agents comprised of 10 drugs (1.6%), followed by corticosteroids account for 5 drugs (0.8%), antivirals and anti-fibrinolytic agents for 4 drugs each (0.64%), anticoagulant and probiotic for 3 drugs each (0.48%), laxative and anti-metabolite for 2 drugs each (0.32%). Antiepileptics, anti-cholinergic and osmotic diuretics accounts for 1 drug each (0.16%).

Table 08: Prescription pattern of pneumonia patients with comorbidities.

SL.NO	CLASS OF DRUGS	AGENTS WITH NO. OFDRUGS RESCRIBED	TOTAL NUMBER OF DRUGS	PERCENTAGE
1	ANTIBIOTICS	Ceftriaxone (71) Azithromycin (22) Piperacillin + Tazobactam (14) Metronidazole (10) Ciprofloxacin (4) ATT (4) Doxycycline (3) Amikacin (2) Meropenem (1) Levofloxacin (1) Clindamycin (1) Linezolid (1) Cotrimoxazole (1)	136	21.76
2	BRONCHODILATORS	Ipratropium bromide (27) Ipratropium bromide + Levo salbutamol (18) Budesonide (12) Salbutamol (15) Albuterol (4) Ipratropium bromide + Levo salbutamol (1)	77	12.32%

3	PROTON PUMP INHIBITORS	Pantoprazole (74)	74	11.84%
4	NUTRITIONAL SUPPLEMENTS	IV fluid (22) IFA (11) T. Calcium (11) Thiamine (9) Folic Acid (7) B Complex (4) Sodium bicarbonate (4) Calcium glutamate (1)	69	11.04%
5	ANALGESICS	Acetaminophen (50) Tramadol (8)	58	9.28%
6	MUCOLYTIC AGENTS	Ambroxol (44) N-Acetyl cysteine (2)	46	7.36%
7	ANTI HYPERTENSIVES	Furosemide (19) Amlodipine (16) Telmisartan (2)	37	5.92%
8	ANTIEMETICS	Ondansetron (35)	35	5.6%
9	STATINS	Atorvastatin (16)	16	2.56%
10	NSAIDS	Aspirin (15)	15	2.4%
11	ANTIDIABETICS	Insulin-R (12) Insulin-N (3)	15	2.4%
12	ANTIPLATELET	Clopidogrel (11)	11	1.76%
13	SYMPATHOMIMETIC DRUG	Noradrenaline (10)	10	1.6%
14	CORTICO-STEROID	Hydrocortisone (3) Dexamethasone (2)	5	0.8%
15	ANTIVIRAL	ART regimen (3) Oseltamivir (1)	4	0.64%
16	ANTI-FIBRINOLYTICS	Tranexamic acid (4)	4	0.64%
17	ANTI-COAGULENT	Heparin (3)	3	0.48%
18	PROBIOTIC	Sporlac (3)	3	0.48%
19	LAXATIVE	Lactulose (2)	2	0.32%
20	ANTI-METABOLITE	Hydroxyurea (2)	2	0.32%
21	ANTI-EPILEPTIC	Levetiracetam (1)	1	0.16%
22	ANTI-CHOLINERGIC	Trihexyphenidyl (1)	1	0.16%
23	OSMOTIC DIURETICS	Mannitol (1)	1	0.16%
	TOTAL		625	100%

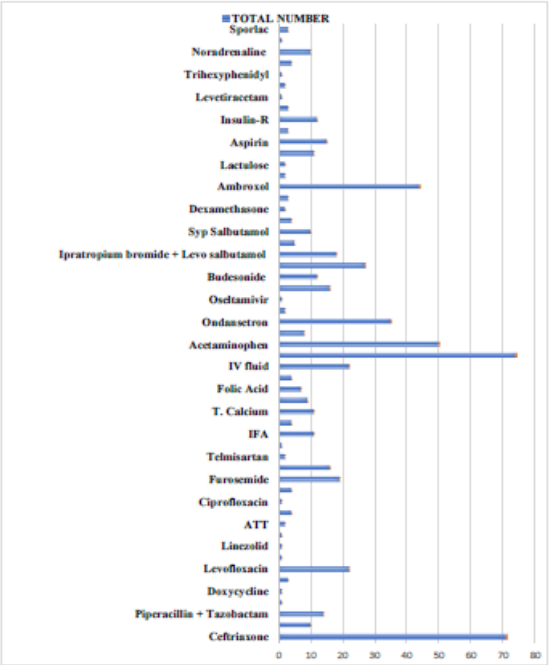

Figure 11: Prescription pattern of pneumonia patients with comorbidities.

3.9 PRESCRIPTION PATTERN OF PNEUMONIA PATIENTS WITHOUT COMORBIDITIES: In this study consist of 140 pneumonia patients, a total of 1062 drugs were prescribed among the study population. Out of which 439 drugs were prescribed to treat pneumonia patients with comorbid conditions. Among them antibiotics were the most frequently prescribed, with 138 drugs (31.43%) and bronchodilators accounted for 78 drugs (17.66%). Proton pump inhibitors comprised 60 drugs (13.66%), while supportive supplements made up 25 drugs (5.69%). Analgesics represented with 51 drugs (11.61 %), followed by mucolytic agents with 42 drugs (9.56%). Anti-emetics account for 19 drugs (4.32%) and anti-hypertensives were 13 (2.96%). Anti-vials, antihistamines, corticosteroids, antifibrinolytics and sympathomimetic drugs were 2 each (0.45%) were prescribed. Other drugs such as antiepileptics, anticonvulsants and probiotics were 1 each (0.22%) were prescribed.

Table 09: Prescription pattern of pneumonia patients without comorbidities.

SL.NO	CLASS OF DRUGS	AGENTS WITH NO. OF DRUGS PRESCRIBED	TOTAL NUMBER OF DRUGS (n=439)	PERCENTAGE
1	ANTIBIOTICS	Ceftriaxone (55) Doxycycline (37) Piperacillin, Tazobactam (14)	138	31.43%

		Azithromycin (18) Metronidazole (8) Meropenem (2) Ciprofloxacin (2) Amoxiclav (1) Levofloxacin (1)		
2	BRONCHODILATORS	Budesonide (14) Ipratropium bromide (23) Ipratropium bromide + Levo salbutamol (15) Salbutamol (13) Syp Salbutamol (7) Salbutamol + pratropium bromide (4) Albuterol (2)	78	17.66%
3	PROTON PUMP INHIBITORS	Pantoprazole (60)	60	13.66%
4	ANALGESICS	Acetaminophen (40) Tramadol (11)	51	11.61%
5	MUCOLYTIC AGENTS	Ambroxol (40) N-Acetyl cysteine (2)	42	9.56%
6	SUPPORTIVE SUPPLIMENTS	IV fluid (24) Sodium bicarbonate (1)	25	5.69%
7	ANTIEMETICS	Ondansetron (19)	19	4.32%
8	ANTI HYPERTENSIVES	Furosemide (9) Amlodipine (4)	13	2.96%
9	ANTIVIRAL	Oseltamivir (2)	2	0.45%
10	ANTIHISTAMINE	Cetirizine (2)	2	0.45%
11	CORTICOSTEROIDS	Hydrocortisone (2)	2	0.45%
12	ANTI-FIBRINOLYTICS	Tranexamic acid (2)	2	0.45%
13	SYMPATHOMIMETIC DRUG	Noradrenaline (2)	2	0.45%
14	ANTI-EPILEPTIC	Levetiracetam (1)	1	0.22%
15	ANTI-CONVULSANTS	Phenytoin (1)	1	0.22%
16	PROBIOTIC	Sporlac (1)	1	0.22%

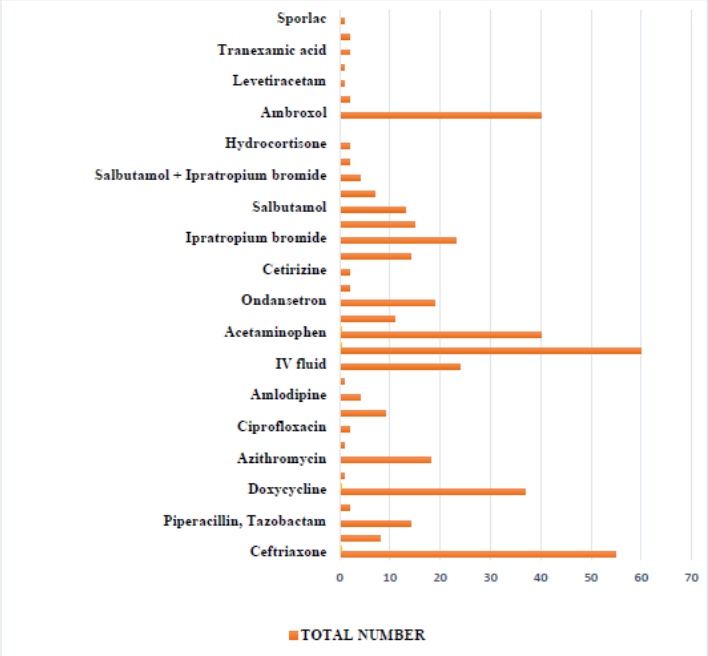

Figure 12: Prescription pattern of pneumonia patients without comorbidities.

3.10 DISTRIBUTION OF ANTIBIOTICS USED IN PNEUMONIA PATIENTS

In this study consist of 140 pneumonia patients, a total of 1062 drugs were prescribed among the study population. Out of which total antibiotics were 274. Among them most frequently prescribed antibiotics was cephalosporins (45.98%) followed by macrolides (14.96%) and tetracyclines (14.59%). Penicillin and beta-lactamase inhibitors were 10.21% and nitroimidazole account for 6.53%.

Table 10: list of antibiotics used in pneumonia patients.

SL.NO	CLASS OF ANTIBIOTICS	NAME OF DRUGS	TOTAL NUMBER OF DRUGS (n=274)	PERCENTAGE %
1	CEPHALOSPORINS	Ceftriaxone	126	45.98%
2	TETRACYCLINES	Doxycycline	40	14.59%
3	MACROLIDES	Azithromycin (40) Clindamycin (1)	41	14.96%
4	PENICILLINS AND BETA-LACTAMASE INHIBITORS	Piperacillin and tazobactam	28	10.21%
5	NITROIMIDAZOLE	Metronidazole	18	6.56%
6	FLUOROQUINOLONES	Ciprofloxacin (6) Levofloxacin (2)	8	2.91%
7	ANTITUBERCULAR AGENT	Rifampicin Isoniazid Pyrazinamide	4	1.45%

		Ethambutol		
8	CARBAPENEM	Meropenem	3	1.09%
9	PENICILLINS	Amoxicillin and clavulanic acid	2	0.72%
10	AMINOGLYCOSIDE	Amikacin	2	0.72%
11	OXAZOLIDINONES	Linezolid	1	0.36%
12	SULFONAMIDES	Sulfamethoxazole	1	0.36%

2.91% of fluoroquinolones and 1.45 % of ATT's were prescribed, followed by carbapenem (1.09%) and 0.72% of penicillin and aminoglycosides were prescribed accordingly, 0.36% of oxazolidinones and sulphonamides were given. This study highlights that, cephalosporins were most frequently prescribed antibiotics.

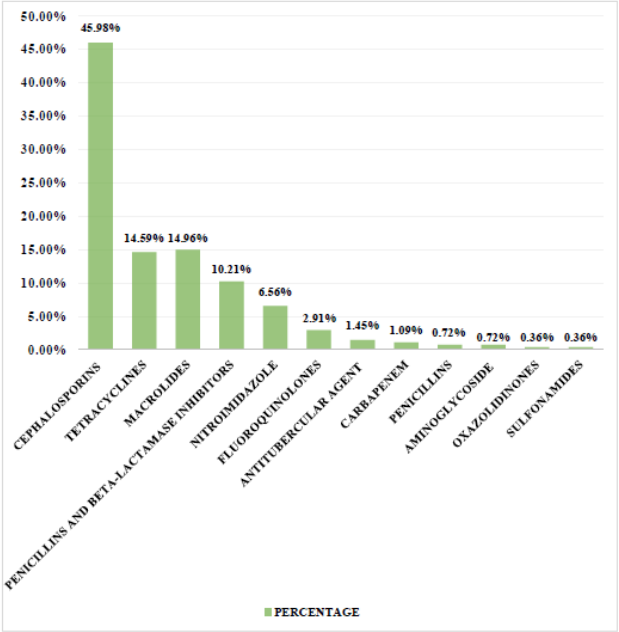

Figure 13: List of antibiotics used in pneumonia patients.

3.11 DISTRIBUTION OF PNEUMONIA PATIENTS WITH COMORBIDITIES ACCORDING TO PNEUMONIA SEVERITY INDEX

In a study of 140 patients, Pneumonia severity index score was assessed to evaluate the risk severity of pneumonia. The majority of patients, 32 individuals (22.85%), were having class II risk severity. A further 18 patients each (12.85%) were categorized as having class I and class III risk severity, followed by 11 patients (7.85%) were categorized ad class IV and 5 individuals (3.57%) were having class V risk severity. This distribution indicates that the largest portion of pneumonia patients with comorbidities shows class II risk severity, as reflected by the higher percentage shown in the PSI score.

Table 11: Distribution of patients with comorbidities based on pneumonia severity index.

SL.NO	SEVERITIY CLASS	TOTAL NUMBER OF PATIENTS	PERCENTAGE
01.	CLASS I (<50)	18	12.85%
02.	CLASS II (51-70)	32	22.85%
03.	CLASS III (71-90)	18	12.85%
04.	CLASS IV (91-130)	11	7.85%
05.	CLASS V (>130)	5	3.57%

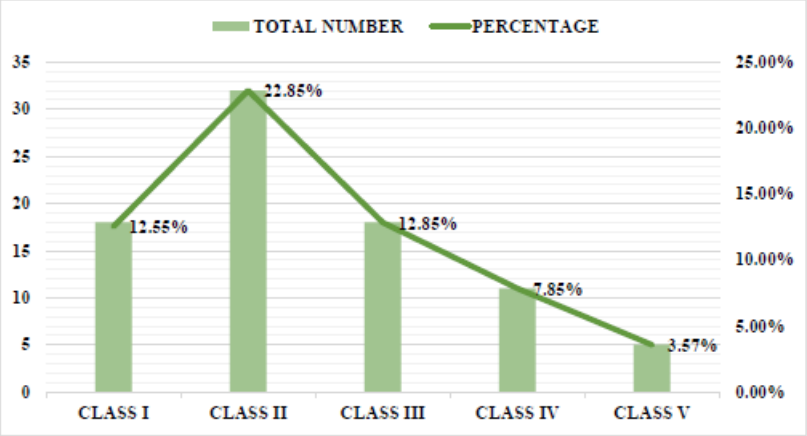

Figure 14: Distribution of patients with comorbidities based on pneumonia severity index.

3.12 DISTRIBUTION OF PNEUMONIA PATIENTS WITHOUT COMORBIDITIES ACCORDING TO PNEUMONIA SEVERITY INDEX

In a study of 140 patients, Pneumonia severity index score was assessed to evaluate the risk severity of pneumonia. The majority of patients, 32 individuals (22.85%), were having class I risk severity. A further 18 patients (12.85%) were categorized as having class I risk severity, followed by 4 patients (2.85%) were categorized as class III and 2 individuals (1.42%) were having class IV risk severity. This distribution indicates that the largest portion of pneumonia patients with comorbidities shows class I risk severity, as reflected by the higher percentage shown in the PSI score.

Table 12: Distribution of patients without comorbidities based on pneumonia severity index.

SL.NO	*SEVERITIY*	*TOTAL NUMBER OF PATIENTS*	*PERCENTAGE*
01	*CLASSI (<50)*	*32*	*22.85%*
02	*CLASSI (51-70)*	*18*	*12.85%*
03	*CLASSI (71-90)*	*4*	*2.85%*
04	*CLASSI (91-130)*	*2*	*1.42%*

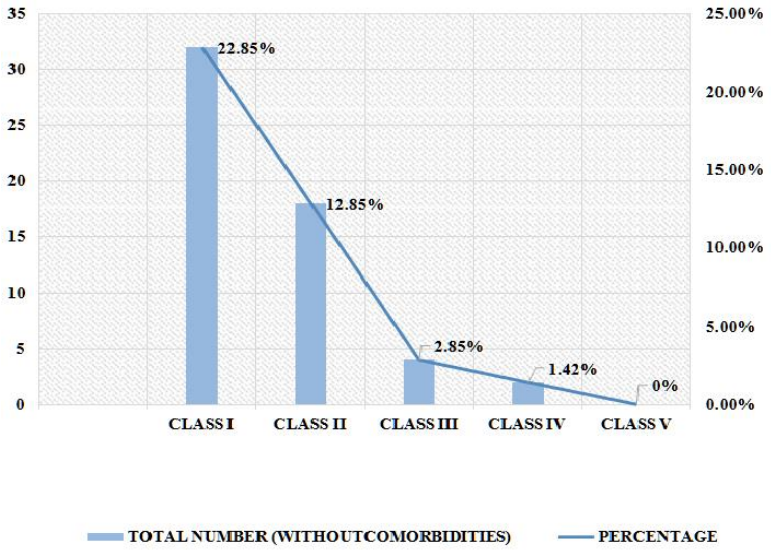

Figure 15: Distribution of patients without comorbidities based on pneumonia severity index.

3.14 DISTRIBUTION OF PNEUMONIA PATIENTS BASED ON TYPE OF DRUG INTERACTIONS

In this study out of 140 patients, 67 drug-drug interactions were identified with 60 major and 7 moderate interactions.

Table 14: Distribution of pneumonia patients based on type of drug interactions.

SL. NO	TYPE OF INTERACTIONS	OUTCOME OF INTERACT1IONS	NUMBER OF INTERACTION	RANGE
1	Doxycycline + Piperacillin tazobactam	Concurrent use of doxycycline and Piperacillin tazobactam may result in Decreased antibacterial effectiveness	11	Major
2	Furosemide + Aspirin	Concurrent use may result in increased risk of salicylate toxicity, reduced diuretic effectiveness, possible nephrotoxicity	7	Major
3	Azithromycin + Ondansetron	Concurrent use of azithromycin and ondansetron may result in an increased risk of qt interval rolongation.	6	Major
4	Aspirin+ Clopidogrel	Concurrent use of aspirin and Clopidogrel may result in Increased risk of bleeding	4	Major
5	Ipratropium bromide + Tramadol	Concurrent use of may result in Increased risk of urinary retention or severe constipation leading to paralytic ileus	4	Major
6	Ondansetron + Tramadol	Concurrent use may result in Increased risk of serotonin syndrome	4	Major
7	Furosemide +	Concurrent use of furosemide and	2	Major

	Telmisartan	angiotensin receptor blockers may result in severe hypotension and deterioration in renal function, including renal failure.		
8	Furosemide + Insulin R	Concurrent use of antidiabetic agents and furosemide may result in an increased risk of hyperglycaemia and an increased insulin requirement.	2	Major
9	Azithromycin + Metronidazole	Increased risk of QT interval prolongation	2	Major
10	Ciprofloxacin + Metronidazole	Concurrent use of metronidazole and QT interval prolonging drugs may result in an increased risk of qt interval prolongation.	2	Major
11	Isoniazid + Theophylline	Concurrent use of isoniazid and theophylline may result in an increased risk of theophylline toxicity (nausea, vomiting, palpitations, zeizures)	1	Major
12	Ipratropium bromide + Tramadol	Concurrent use of tramadol and anticholinergics may result in increased risk of urinary retention and/or severe constipationleading to paralytic ileus.	1	Major
13	Calcium gluconate + Ceftriaxone	Concurrent use of ceftriaxone and selected iv calcium salts may result in formation of ceftriaxone-calcium precipitates and is contraindicated in neonates.	1	Major
14	Salbutamol + Ipratropium bromide + Tramadol	Concurrent use of tramadol and anticholinergics may result in increased risk of urinary retention and/or severe constipation leading to paralytic ileus.	1	Major
15	Linezolid + Tramadol	Concurrent use of tramadol and monoamine oxidase inhibitors may result in increased risk of serotonin syndrome or opioid toxicity and an increased risk of seizures.	1	Major
16	Levofloxacin + Ondansetron	Concurrent use of ondansetron and QT-interval prolonging drugs may result in an increased risk of qt interval prolongation.	1	Major
17	Linezolid + Ondansetron	Concurrent use of ondansetron and serotonergic agents may result in increased risk of serotonin syndrome.	1	Major
18	Aspirin + Budesonide	Increased risk of salicylism subsequent to withdrawal of corticosteroids.	1	Major
19	Hydrocortisone + Aspirin	Concurrent use may result in Increased risk of salicylism subsequent to withdrawal of corticosteroids	1	Major
20	Dolutegravir/lamivud	Concurrent use may result in Reduced	1	Major

	ine + Isoniazid/Rifampicin/ Ethambutol	dolutegravir exposure and reduced efficacy of dolutegravir		
21	Isoniazid/Rifampicin/ Ethambutol + Doxycycline	Concurrent use may result in reduced doxycycline exposure and potential loss of doxycycline efficacy.	1	Major
22	Isoniazid/Rifampicin/ Ethambutol + Acetaminophen	Concurrent use may result in an increased risk of hepatotoxicity.	1	Major
23	Isoniazid/Rifampicin/ Ethambutol + Septran DS	Concurrent use of rifampicin and cotrimoxazole may result in increased rifampicin exposure and an increased risk of rifampicin- related adverse reactions.	1	Major
24	Doxycycline + Phenytoin	Concurrent use of doxycycline and phenytoin may result in Reduced doxycycline exposure	1	Major
25	Aspirin + Heparin	Concurrent use of may result in Increased risk of bleeding	1	Major
26	Ondansetron + Metronidazole	Concurrent use may result a Increased risk of QT interval prolongation	1	Major
27	Atorvastatin + Clopidogrel	Concurrent use of clopidogrel and cyp3a4 metabolized statins may result in decreased formation of clopidogrel active metabolite resulting in high on-treatment platelet reactivity.	2	Moderate
28	Doxycycline + Levofloxacin	Concurrent use of levofloxacin and nonsteroidal anti-inflammatory agents may result in an increased risk of seizures.	1	Moderate
29	Aspirin + Insulin	Concurrent use of insulin or pramlintide and salicylates may result in increased risk of hypoglycaemia.	1	Moderate
30	Budesonide + Insulin	Concurrent use of insulin and corticosteroids may result in reduced blood glucose lowering effect of insulin.	1	Moderate
31	Hydrocortisone + Insulin	Concurrent use of insulin and corticosteroids may result in reduced blood glucose lowering effect of insulin.	1	Moderate
32	Furosemide + Hydrocortisone	Concurrent use of furosemide and hydrocortisone may result in hypokalaemia.	1	Moderate

Figure 16: Distribution of pneumonia patients based on range of drug interactions Figure.

17: Distribution of pneumonia patients based on type of drug interactions

3.15 PRESCRIPTION PATTERN ANALYSIS

Table 15: Prescription pattern analysis.

SL.NO	PRESCRIPTION CATALOG	RESULTS
1	Total number of prescriptions analysed	140
2	Total number of medications prescribed	1062
3	Average number of medications per prescription	9.5 (1-10)
4	Percentage of medication prescribed by brand name	104 (9.78%)
5	Percentage of medication prescribed by generic name	959 (90.21%)
6	Percentage of medication prescribed by solid dosage form	266/1062 (25.04%)
7	Percentage of medication prescribed by parenteral	583/1062 (54.89%)
8	Percentage of medication prescribed by nebulization	110/1062 (10.35%)
9	Percentage of medication prescribed by syrups	103/1062 (9.69%)

Table 17 shows that overall, 140 prescriptions were analysed, in which 1062 medicines were prescribed. Thus, the average number of drugs per prescription was 9.5 and total number of drugs prescribed by generic name was 959 (90.21%), total number of drugs prescribed by brand name was 104 (9.78%) and the highest prescribed formulation was parenteral form was 583 (54.89%), followed by solid dosage form 266 (25.04%) which includes both tablets and capsules, syrups 103 (9.69%), nebulizers 110 (10.35%) were prescribed.

4. DISCUSSION

- A Prospective observational study was conducted to determine the prescription pattern, medication adherence, risk factors, severity, and clinical outcomes of pneumonia patients with or without co-morbid conditions. This was carried out in a population considering age, gender, and other associated risk factors.
- Patient data was collected through case sheets and direct interactions.
- Information recorded included demographics, diagnosis, prescriptions, and adherence.
- Counselling enhanced patient quality of life by improving disease awareness, adherence to therapy, and lifestyle practices.
- Pneumonia continues to be a major cause of illness and death worldwide, particularly among older adults and those with underlying conditions such as diabetes, COPD, hypertension, kidney disorders, or weakened immune systems.
- Key risk factors identified were extremes of age, chronic illnesses, smoking, alcohol intake, poor nutrition, inadequate hygiene, and prolonged hospitalization or ventilation.
- In our study, prescription pattern evaluation revealed frequent use of cephalosporins, macrolides, and fluoroquinolones, consistent with findings from other observational studies.
- While this prescribing pattern mirrored findings from earlier observational studies, it also raised concerns about inappropriate use, which may foster antimicrobial resistance if not closely regulated.
- In our study, out of 140 patients enrolled in study, 107 (76.42%) were male and 33 (23.57%) were female, indicating a higher prevalence in males compared to females. this was compared with study conducted by **Dr. Mudasir Maqbool *et al,*** indicating a higher representation of males in the study population.
- Study included participants aged **18** to above 75 years, with a higher proportion of cases in those between 41–60 years; these findings align closely with **Mamta Yadav *et al***, where the age group with the highest number of pneumonia patients is the 41–60 years group.
- This study included pneumonia patients with comorbidities, among whom a total of 625 drugs were prescribed. Of these, 136 prescriptions were antibiotics, 77 were bronchodilators, 74 were proton pump inhibitors, 69 were nutritional supplements, 58 were analgesics, and 46 were mucolytic agents. In addition, 37 prescriptions were for antihypertensives, 35 for antiemetics, 16 for statins, 15 each for NSAIDs and

antidiabetics, and 11 for antiplatelet agents., This was compared to a study conducted by ***Dr. Shinu C et al,*** where a total of 131 antibiotic prescriptions were issued for 92 pneumonia patients, averaging 1.42 antibiotics per patient, with cephalosporins being the most commonly prescribed (41.2%), followed by penicillin, alongside frequent use of bronchodilators.

- In this study, the Pneumonia Severity Index (PSI) showed that patients with comorbidities tended to have more severe disease, with the highest proportion in Class II (22.85%), and additional cases extending into Class III (12.85%), Class IV (7.85%), and even Class V(3.57%), patients without comorbidities were largely concentrated in the low-risk categories, most commonly in Class I (22.85%) and Class II (12.85%), with only a small minority advancing to Class III (2.85%) and Class IV (1.42%), and none reaching Class V, This was compared to a study conducted by **Ravindranath M *et al*** where The study revealed that the Pneumonia Severity Index (PSI) demonstrates strong sensitivity in forecasting mortality for patients with community - acquired pneumonia (CAP), This means PSI is effective at identifying high risk patients (sensitivity).

- The study on medication adherence among 140 pneumonia patients revealed that a majority of them, 80 patients (57.14%), had poor medication adherence. Conversely, only 60 patients (42.85%) had good medication adherence, this was compared to study conducted by **Urs Victoria *et al*,** where The study concluded that the level of medication adherence among patients with community - acquired pneumonia (CAP) in primary care was “medium” in 51.1% of cases**,** It showed that an increased number of medications and frequent daily use of medications negatively affected adherence, while higher level of education led to better treatment compliance.

5. CONCLUSION

- Pneumonia is a significant infection of the lung parenchyma and remains a major health issue in India and worldwide. It is a common condition with increasing risks in elderly patients, immunocompromised individuals and those with chronic comorbidities.
- A total of 140 pneumonia patients with or without comorbidities were studied and the average prescription contained about 9-10 drugs indicating a high level of polypharmacy.
- Most medications (90.21%) were prescribed by their generic name, which helps to reduce cost and errors and most of them were administered in parenteral formulation (54.89%).

- In our study we observed that most of the patients developed pneumonia were due to the exposure towards environmental factors.
- Cephalosporin antibiotics, especially ceftriaxone were the most frequently prescribed, followed by macrolides and tetracyclines.
- Despite rational antibiotic use, the high number of medications is raised concerns about potential adverse drug interactions and reduced medication adherence, hence the study highlighting the need for careful prescription review.
- Therefore, this study is rational, as it thoroughly evaluates pneumonia prescription pattern in accordance with established clinical guidelines (IDSA&ATS), balancing appropriate antibiotics use and patient specific needs for improving like polypharmacy and medication adherence.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as large language Models (ChatGPT, COPILOT, etc.) and text- to-image generators have been used during the writing or editing of this manuscript.

ETHICAL APPROVAL AND CONSENT

This study was conducted after obtaining approval from institutional ethics committee of T.V.M college of Pharmacy Ballari (Ref.no: TVMCP/IEC/VPD/2024-25/01) and Informed consent form (ICF) was obtained from the guardians of the study subjects.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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