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Drug Utilization Evaluation of Antibiotics in Patients with Respiratory Tract Infection in a Tertiary Care Hospital: A Prospective Observational Study

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ABSTRACT:
Background: Inappropriate antibiotic use in respiratory tract infections (RTIs) is a growing concern, contributing to antibiotic resistance and increased healthcare costs. Drug Utilization Evaluations (DUEs) offer valuable insights into prescribing patterns and guide optimization strategies.
Objectives: This prospective observational study aims to evaluate antibiotic use in adult patients (≥18 years) diagnosed with RTIs at a tertiary care hospital.
Method: We will recruit 120 patients over six months. Data will be collected on demographics, diagnoses, prescribed antibiotics, adherence to national guidelines, and clinical outcomes. The Anatomical Therapeutic Chemical Classification System/Defined Daily Dose (ATC/DDD) methodology will assess antibiotic consumption. Additionally, we will evaluate the therapy's rationality using the World Health Organization (WHO) core prescribing guidelines.
Results: This study looked at antibiotic utilization patterns at a tertiary care hospital for patients with respiratory tract infections (RTIs). Analysis of patient demographics revealed a trend towards older patients, with COPD emerging as the most prevalent diagnosis (41%), followed by pneumonia (29%). The high prevalence of COPD aligns with its characteristic symptoms of shortness of breath and cough. Concordance with ICMR guidelines for antibiotic selection was observed for most RTIs, suggesting successful stewardship programs. The finding that 75% of patients stayed for 4-7 days potentially reflects the effectiveness of the antibiotic regimens employed. Azithromycin dominated prescribed antibiotics, and further exploration of its specific use is recommended. While 73% of prescriptions adhered to ATC/DDD guidelines. The high cost of Zavicefta necessitates exploring alternative options. These findings suggest potential areas for improvement in antibiotic use optimization within the hospital setting.
Significance: This study will help establish evidence-based strategies to support effective antibiotic usage in RTIs within a hospital context by identifying areas that require improvement. This will ultimately benefit patient care by reducing the risk of antibiotic resistance and associated healthcare costs.
KEYWORDS: Antibiotic utilization, Respiratory tract infections (RTIs), Antibiotic resistance, Drug utilization evaluation (DUE), ATC/DDD methodology, Pharmacoeconomics, Tertiary care hospital, National guidelines, Optimal antibiotic use.

I. INTRODUCTION

Throughout the world, respiratory tract infections (RTIs) are the primary cause of morbidity and account for a large amount of the usage of healthcare resources. To encourage the best possible use of antibiotics and reduce antibiotic resistance, it is essential to understand hospital prescription practices. URTIs include infections that spread from the nasal cavity to the trachea. LRTI encompasses infection of the bronchus, bronchiole, and lung parenchyma [(1)].

Tertiary care hospitals manage complex patient populations with a high prevalence of RTIs. These settings often witness a broader spectrum of bacterial pathogens and increased use of broad-spectrum antibiotics compared to primary care settings.

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There are two types of respiratory tract infections: upper and lower respiratory tract infections.

- The upper respiratory tract includes the middle ear, paranasal sinuses, and airways that extend from the nostrils to the voice cords in the larynx.
- The common cold, laryngitis, pharyngitis, tonsillitis, acute rhinitis, and acute otitis are all considered upper respiratory tract infections or URTIs[2].
- The airways that extend from the trachea and bronchi to the bronchioles and alveoli make up the lower respiratory tract.
- Acute bronchitis, bronchiolitis, and pneumonia are all types of lower respiratory tract infections (LRTI)[3].
- Fever, runny nose (rhinorrhoea), cough, sore throat, earache, and exhaustion are typical signs of RTIs. The majority of treatment guidelines for RTIs are based on the cause, while empirical therapy is typically used in developing countries including India.
- Pneumococcal pneumonia is the most common cause of mortality from lower respiratory infections. Worldwide, pneumonia is a leading cause of death[4].

Classification:

UPPER RESPIRATORY INFECTIONS:

1)Common Cold:

Aetiology: Of all respiratory diseases, common colds are the most common and the main reason patients contact their doctor, miss work and school and take sick days. Viruses are the main cause of colds. More than 100 different serotypes of rhinoviruses are the most prevalent infections, accounting for at least 25% of adult colds. It's possible that coronaviruses cause over 10% of cases. The common cold syndrome has been associated with parainfluenza viruses, influenza viruses, adenoviruses, and respiratory syncytial viruses. The incidence of each of them varies with the season. Between thirty and forty percent of cold syndromes have an unidentified origin[5].

The treatment of the uncomplicated common cold is mostly symptomatic. Usually, bed rest, water, antipyretics, and decongestants are enough. The best ways to stop the disease from spreading include limiting your activity to prevent spreading the infection to others and washing your hands thoroughly. For cold prophylaxis, there isn't a commercially available vaccination[6].

2)Laryngitis:

It is the inflammation of the larynx (voice box) caused by overuse, irritation, or infection. Adenovirus or influenza virus infection is the cause of acute laryngitis[7].

3)Pharyngitis:

A pharyngitis is an inflammation of the pharynx including the lateral pharyngeal bands and the lymphoid tissues of the posterior pharynx. Along with non-infectious causes like smoking, the aetiology might include bacterial, viral, and fungal infections.

The recommended course of treatment for viral pharyngitis is symptomatic. Acyclovir can be used to treat herpes simplex virus infection in patients who are immunocompromised or if clinically justified. The best course of treatment for streptococcal pharyngitis is penicillin G, albeit the precise antibacterial drugs will vary depending on the causing organism. Erythromycin, tetracyclines, and the new macrolides are effective against mycoplasma and chlamydial infections[8].

4)Acute Rhinitis:

Acute rhinorrhoea is characterized by swelling and inflammation of the nasal mucous membrane, which makes the nose runny and stuffy.A rash, runny nose, sneezing, red eyes, and itching are signs of rhinoitis.

The most frequent causes of acute rhinitis include viral infections, allergic or seasonal rhinitis, and non-allergic or annual rhinitis[9].

5)Otitis:

Ear infections are frequently seen in medical practice, especially in young patients. Otitis media refers to middle ear irritation, whereas otitis externa is an infection of the external auditory canal. Some bacteria, such as Streptococcus pneumonia, are caused by otitis media. Ear pain, nausea, and mild hearing loss are the main symptoms[10].

LOWER RESPIRATORY INFECTION:

Severe or fatal lower respiratory tract infections can involve syndromes, particularly pneumonia. Lower respiratory tract infections can be caused by viruses, mycoplasma, rickettsiae, and fungi, although bacteria are the most common culprit, accounting for a far higher proportion of lower than upper respiratory tract infections.

1)Bronchitis and Bronchiolitis:

The bronchial tree becomes inflamed in bronchiolitis and bronchitis. Usually, a viral upper respiratory tract infection precedes bronchitis, or it

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can be a component of a clinical condition associated with influenza, rubeola, rubella, pertussis, scarlet fever, and typhoid fever. Smoking and bacterial infections with pathogens like H influenzae and S pneumoniae seem to be the main causes of chronic bronchitis, which is characterized by prolonged cough and sputum production. The respiratory syncytial virus is the main cause of bronchiolitis, a viral respiratory illness that affects newborns. Bronchiolitis is also known to be caused by other viruses, such as M pneumoniae on occasion, parainfluenza viruses, influenza viruses, and adenoviruses.

The initial presentation of acute bronchitis is usually the symptom of an upper respiratory tract infection accompanied by a cough. There may be mucopurulent sputum and mild fever increases. Chronic bronchitis is often characterized by a persistent cough and copious amounts of phlegm, especially in the morning. Acute symptom flare-ups and potentially serious respiratory distress can result from the development of respiratory infections.

Usually, bronchiolitis first manifests as coryza and cough. Fever is typical. A worsening cough, elevated heart rate, and agitation ensue. The most notable findings include grunting, nasal flaring, and chest wall retractions. One may observe wheezing or breathlessness. Death or respiratory failure could ensue.

Supportive measures are the standard of care for viral infections, with very few exceptions. Ribavirin is a treatment option for newborns with respiratory syncytial virus infections. For the treatment of influenza type A viruses, amantadine and rimantadine are available as chemoprophylaxis options. Prophylactic antibiotics, bronchodilators, or corticosteroids may be beneficial for some patient groups with chronic bronchitis[11].

2)Pneumonia:

An inflammation of the lung parenchyma is known as pneumonia. A chest x-ray and physical examination can both detect lung tissue consolidation. Anatomically speaking, bronchopneumonia refers to an alveolar process that occurs in a patchy distribution without filling a complete lung lobe, whereas lobar pneumonia indicates an alveolar process involving an entire lung lobe. Pneumonia can be brought on by a variety of things, such as infections, autoimmune illnesses, and environmental pollutants. Numerous classifications are used to group the many infectious agents that cause pneumonia in order to facilitate laboratory testing, epidemiological research, and treatment selection. Community-acquired pneumonias are defined as those that affect normally healthy individuals who are not hospitalised. Hospital-acquired, also known as nosocomial pneumonias, are infections that develop while a patient is in the hospital or residing in an institution like a nursing home[12]. The etiologic microorganisms linked to pneumonia acquired in hospitals and communities differ slightly. However a wide variety of species can result in both kinds of illnesses.

The most frequent cause of acute bacterial pneumonia acquired in the community is streptococcus pneumoniae. It is rare for other streptococci to cause pneumonia. Empyema and hemorrhagic pneumonitis are frequently linked to streptococcus pyogenes pneumonia. Staphylococcus aureus-related community-acquired pneumonia are likewise rare; they typically follow influenza or staphylococcal bacteremia. Patients over 50 years old with chronic obstructive pulmonary disease or alcoholism are more likely to contract infections caused by Haemophilus influenzae (which is typically nontypable) and Klebsiella pneumoniae.

Aerobic gram-negative bacteria are the most frequent cause of nosocomial pneumonia, yet they hardly ever cause pneumonia in healthy people. It is common to identify Enterobacter, Proteus, Klebsiella species, Escherichia coli, and pseudomonas aeruginosa. The pathogens that produce tularaemia, Yersinia pestis, which causes plague, and Neisseria meningitidis, which typically causes meningitis but can also cause pneumonia, particularly in military recruits, are less common agents that cause pneumonia[13].

Pneumonia may result from Mycobacterium tuberculosis. Despite the low incidence of tuberculosis in industrialized nations, tuberculosis infections remain a serious public health concern in the United States, especially among immigrants from developing nations, intravenous drug abusers, HIV-positive patients, and elderly people living in institutions. It is possible for atypical Mycobacterium species to induce lung diseases that are identical to tuberculosis.

Through haematogenous seeding, aspiration of upper airway flora, or inhalation of aerosolised material, infectious pathogens can enter the lower respiratory tract. Lung defense mechanisms that are compromised or overpowered can result in pneumonia. Pneumonia commonly manifests as cough, chest discomfort, fever, dyspnoea, and expectoration. Individuals have tachycardia[14]. Depending on the organism and patient's age, symptoms like headache, dizziness,

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stomach discomfort, nausea, vomiting, and diarrhea may occur.

Therapy decisions are based on clinical history, which includes exposure history, age, underlying condition, prior treatments, prior cases of pneumonia, location, sickness severity, clinical symptoms, and sputum examination until the organism causing the infection is recognized. Therapy is aimed at the particular organism causing the symptoms when a diagnosis has been made.

Patients who are at high risk of contracting pneumococcal infections, such as those with asplenism, the elderly, and those whose immune systems have been impaired by illness or medical therapy, should receive the pneumococcal vaccine. These specific groups should also receive annual influenza vaccinations. There is an enteric-coated vaccine that is only administered to enlistees in the military, and it is made from certain adenovirus serotypes. Trimethoprim/sulfamethoxazole, aerosolized pentamidine, and other antimicrobials can be administered to AIDS patients to prevent Pneumocystis carinii infections[15].

II. RATIONALE AND OBJECTIVES

Reason:

1. Worldwide, one of the most frequent reasons for antibiotic prescriptions is respiratory tract infections. Since these infections have a major role in the use of antibiotics, it is important to evaluate them to make sure that proper prescribing procedures are followed.
2. Inappropriate antibiotic use can lead to adverse outcomes for patients, including treatment failure, increased risk of antibiotic resistance, and potential side effects.
3. Antibiotic-resistant microorganisms are a result of both overuse and misuse of antibiotics. The evaluation's goal is to reduce the likelihood of antibiotic resistance and maintain the usefulness of antibiotics for upcoming generations by evaluating prescribing patterns and encouraging appropriate use.

Significance and need:

The assessment of antibiotic usage in treating respiratory tract infections serves to improve patient outcomes, combat antibiotic resistance, and optimize healthcare resource allocation. Focusing on respiratory illnesses, which account for a significant portion of antibiotic prescriptions, this evaluation seeks to analyse prescribing trends and evaluate their appropriateness. By adhering to evidence-based guidelines and principles of antibiotic stewardship, the evaluation aims to ensure patient well-being, enhance resource efficiency, and contribute to global efforts to combat antibiotic resistance. This initiative offers opportunities for targeted educational interventions and ongoing enhancements in healthcare delivery systems, with the ultimate goal of achieving sustainable and efficient healthcare provision.

Objectives:

The purpose of this study is to investigate and assess the pattern of drug utilization in the treatment of respiratory tract infections.

➢ Evaluation of prescription pattern compliance with the guidelines.

➢ ATC/DDD COMPARISON[16].

➢ Evaluation of clinical outcomes of the patient.

➢ Evaluation of rationality of therapy assessed using WHO core prescription guidelines.

➢ Prevalence of respiratory tract infection and Pharmacoeconomics considerations.

III. MATERIAL AND METHOD

1.Name of the study:

- A drug utilization evaluation of antibiotics in patient with respiratory tract infection in a tertiary care hospital: A prospective, observational study.

2.Study Design:

- This is a prospective Observational Study.

3.Study Duration:

- The study was carried out in SRSS Venus Hospital, Surat (Gujarat), for six months.

4.Number of Patients and Study Site:

- The minimum required sample size was 120 patients.
- Patients Both male and female patients aged 18 and above under the category of RTI.
- SRSS Venus Hospital, Rampura, Katargam, Lal Darwaja, Surat, Gujarat, 395003.

5.Methodology:

- A prospective observational study was conducted in SRSS Venus Hospital, Surat (Gujarat), for six months. Ethical approval was obtained from the IEC. 120 patients fulfilling the inclusion and exclusion criteria were collected, assessed, compiled, and analyzed. The information, gathered from the physician-

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validated CRF, was subjected to analysis using WHO prescribing indicators. Statistical analysis involves calculating means and percentages for various parameters and criteria. Additionally, antibiotics were categorized based on the ATC classification, and the Defined Daily Dose (DDD) was determined. After the study results were obtained, the research drew its conclusion.

6.Statistical Methodology:

- MS-Excel.

7.Inclusion Criteria:

- Both male and female patients aged 18 and above.
- Patients diagnosed with respiratory tract infection.
- Patients who are prescribed with antibiotics.

8.Exclusion Criteria:

- Patients under the age of 18.
- Patient who stays less than 24 hours in the hospital.
- Accidental cases and patients with altered consciousness.
- Patient diagnosed with pulmonary malignancies, occupational lung disease, and VAP.

IV. STATISTICS AND RESULTS

1)Gender-wise distribution (n=120):

A total of 120 prescriptions were analysed and out of which 67(56%) were male and 53(44%) were female. The incidence of RTI was found more in males as compared to females.

GENDER	RATIO	PERCENTAGE
MALE	67	56%
FEMALE	53	44%

TABLE NO. 1 GENDER DISTRIBUTION

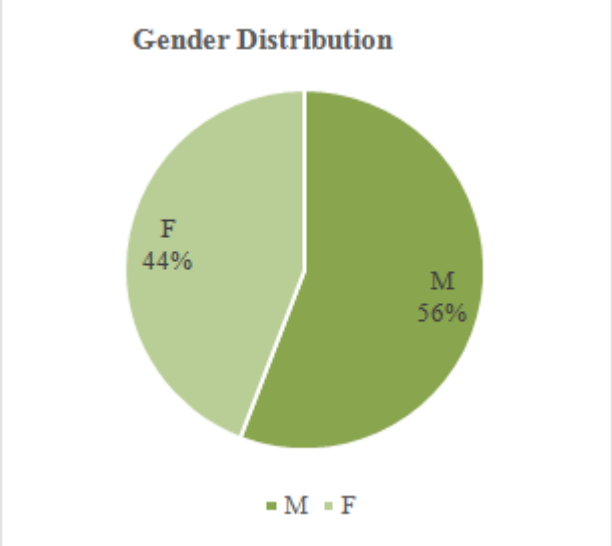

FIG. 1 GENDER DISTRIBUTION

2)Age-wise distribution:

Patients were grouped into 8 groups based on their age. 4(3%) patients were found to be in the age group of 18-28 years, 4(3%) were in the group of 28-38 years, 16(13%) were in the group of 38-48 years, 25(21%) were in the group of 48-58 years, 22(18%) were in the group of 58- 68 years, 29(24%) were in the group of 68-78 years, 19(16%) were in the group of 78-88 years, 1(1%) were in the group of 88-98 years.

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AGE GROUP	RATIO	PERCENTAGE
18-28	4	3%
28-38	4	3%
38-48	16	13%
48-58	25	21%
58-68	22	18%
68-78	29	24%
78-88	19	16%
88-98	1	1%

TABLE NO.2 AGE-WISE DISTRIBUTION

FIG. 2 AGE -WISE DISTRIBUTION

3) Ward–wise distribution:
Patients were in 5 wards. 54(45%) patients were found to be in MICU, 42(35%) were E/AC, 14(12%) were in the General, 5(4%) were in the ICCU, 5(4%) were in the Deluxe.

WARD	RATIO	PERCENTAGE
MICU	54	45%
E/AC	42	35%
GENERAL	14	12%
ICCU	5	4%
DELUXE	5	4%

TABLE NO. 3 WARD-WISE DISTRIBUTION

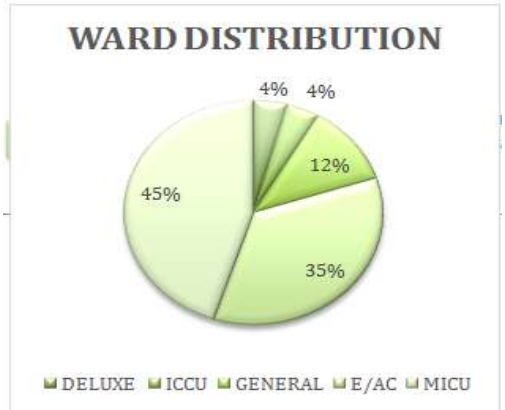

FIG. 3 WARD-WISE DISTRIBUTION

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4)Assessment of signs and symptoms:

In the assessment of signs and symptoms of 120 cases of fever assess in 64(32%), SOB 56(28%), Cough (sputum) 20(10%), Dry cough 15(8%), Chest pain 7(4%), Gen. weakness 7(4%), Respiratory distress 6(3%). Other included pedal edema, anorexia, orthopnea, decreased oral intake, etc.

SIGNS	RATIO	PERCENTAGE (%)
FEVER	64	32
SOB	56	28
COUGH	20	10
DRY COUGH	15	8
CHEST PAIN	7	4
GEN. WEAKNESS	7	4
RESPIRATORY DISTRESS	6	3

TABLE NO. 4 ASSESSMENT OF SIGNS &SYMPTOMS

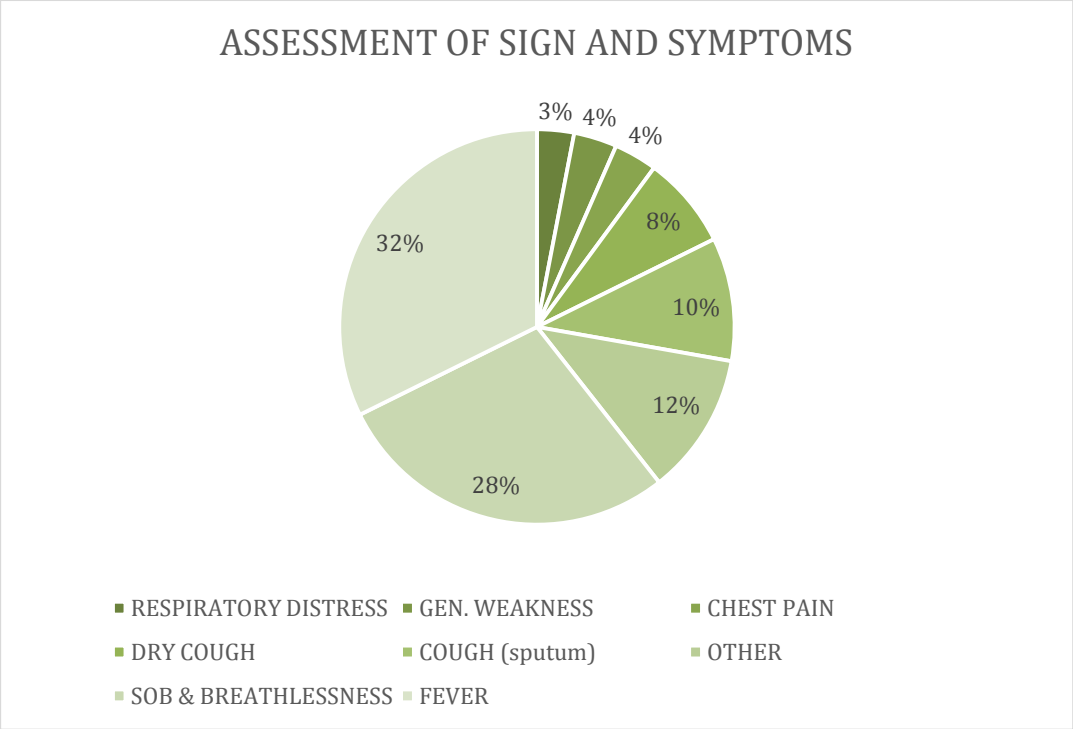

FIG. 4 ASSESSMENT OF SIGNS AND SYMPTOMS

5)Provisional Diagnosis:

In this study the most commonly diagnosed disease was COPD, which was found in 47(31%) patients, followed by Pneumonia in 19(13%) patients, Common Cold in 13(9%) patients, Asthma in 12(8%) patients, HTN in 12(8%) patients, DM-2 in 11(7%) patients, Pyrexia in 11(7%) patients, IHD in 8(5%) patients, Bronchitis in 8(5%) patients, AKI in 2(1%) patients, UA in 2(1%) patients, Breathlessness in 2(1%) patients, AGE in 1(1%) patients, Hypothyroidism in 1(1%) patients, Emphysema in 1(1%) patients, Fatty Liver in 1(1%) patients.

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PROVISIONAL DIAGNOSIS	RATIO	PERCENTAGE (%)
COPD	47	31
PNEUMONIA	19	13
COMMON COLD	13	9
ASTHMA	12	8
HTN	12	8
DM-2	11	7
PYREXIA	11	7
IHD	8	5
BRONCHITIS	8	5
AKI	2	1
UA	2	1
BREATHLESSNESS	2	1
AGE	1	1
HYPOTHYROIDISM	1	1
EMPHYSEMA	1	1
FATTY LIVER	1	1

TABLE NO. 5 PROVISIONAL DIAGNOSIS

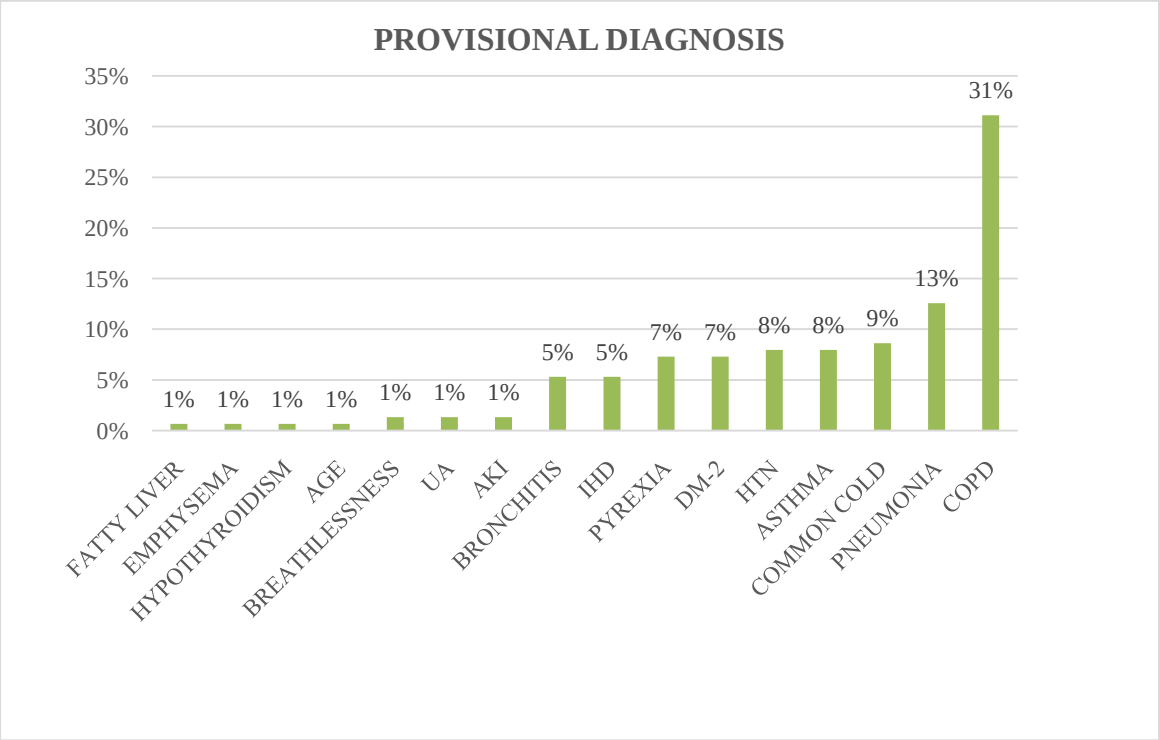

FIG. 5 PROVISIONAL DIAGNOSIS

6)Pathogen isolated among RTI patients:

The most common pathogen isolated was Klebsiella pneumoniae 6(26%), E. Coli. 3(13%), Gram Negative Bacilli 3(13%), Pseudomonas Aeruginosa 3(13%), Citrobacter Koseri 1(4%), Parainfluenza Virus-3 1(4%), Few Gram-Positive Cocci 2(9%), Candida Spp. 1(4%), Corona Virus 229E 1(4%), FLU A+ 2(9%) were detected.

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PATHOGEN	RATIO	PERCENTAGE (%)
KLEBSIELLA PNEUMONIAE	6	26
E. COLI.	3	13
GRAM NEGATIVE BACILLI	3	13
PSEUDOMONAS AERUGINOSA	3	13
CITROBACTER KOSERI	1	4
PARAINFLUENZA VIRUS-3	1	4
GRAM-POSITIVE COCCI	2	9
CANDIDA SPP.	1	4
CORONA VIRUS 229 E	1	4
FLU A +	2	9

TABLE NO. 6 PATHOGEN ISOLATED

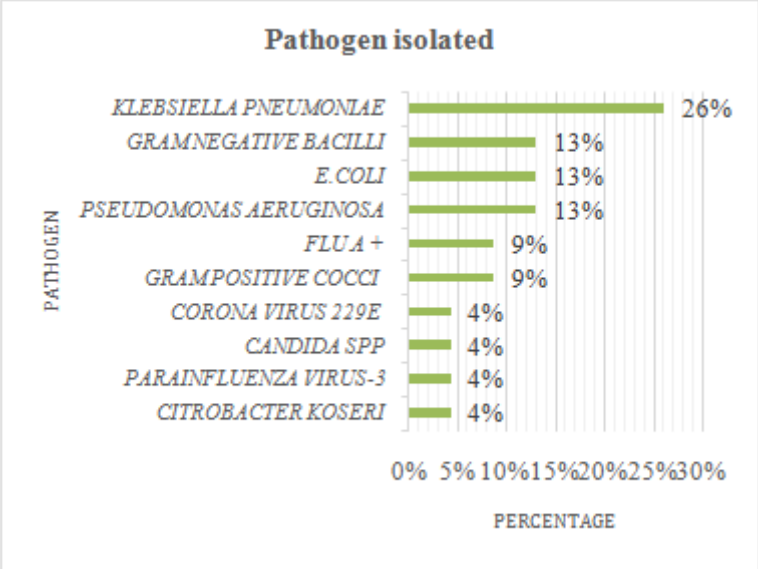

FIG. 6 PATHOGEN ISOLATED

EVALUATION OF PRESCRIPTION PATTERN WITH THE GUIDELINES:

7)Drugs prescribed per encounter:

Out of 120 prescriptions analyzed, 105 were prescribed with 1 to 3 drugs, and 10 were prescribed with 4 to 6 drugs.

Drugs prescribe per encounter	frequency	percentage
1 to 3 drugs	105	91%
4 to 6 drugs	10	9%
>7 drugs	0	0%

TABLE NO. 7 DRUGS PRESCRIBED PER ENCOUNTER

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8)Evaluation of Prescription Pattern with the ICMR Guidelines:

Our analysis revealed a high degree of concordance between prescribed antibiotics and the preferred treatment options outlined in ICMR guidelines for respiratory tract infections (RTIs).

DISEASE	PRESCRIBED TREATMENT	PREFERRED TREATMENT
COPD	Piperacillin + Tazobactam, Ceftriaxone, Cefoperazone+ Sulbactam, Azithromycin, Meropenem, Clarithromycin, Doxycycline, Linezolid, Amoxicillin and Potassium Clavulanate, Sulfamethaxole and Trimethoprim, Clindamycin, Teicoplanin, Mupirocin	Piperacillin-Tazobactam, Cefotaxime with Macrolide, Azithromycin, Clarithromycin, Amoxicillin+ Potassium Clavulanate, Doxycycline
Bronchitis	Ceftriaxone, Cefoperazone and Sulbactam,	Ceftriaxone, Cefoperazone and Sulbactam, Antibiotics Not Required If It Is Viral
Asthma	Ceftriaxone, Azithromycin, Cefoperazone and Sulbactam, Metronidazole,	Ceftriaxone, Azithromycin, Cefoperazone and Sulbactam, Metronidazole, Linezolid, Amoxicillin+ Tazobactam, Levofloxacin, Piperacillin and Tazobactam, Teicoplanin
Pneumonia	Ceftriaxone, Azithromycin, Cefoperazone and Sulbactam, Levofloxacin, Doxycycline, Linezolid, Piperacillin + Tazobactam, Teicoplanin, Sulfamethaxole and Methoprim, Clindamycin	Ceftriaxone, Azithromycin, Cefoperazone and Sulbactam, Levofloxacin, Doxycycline, Linezolid, Piperacillin + Tazobactam, Teicoplanin, Sulfamethaxole and Methoprim, Clindamycin
Emphysema	Cefoperazone + Sulbactam, Linezolid	Amoxicillin, Ceftriaxone, Co-Amoxicillin
Type 2 RF	Ceftriaxone, Azithromycin, Cefoperazone and Sulbactam, Metronidazole, Linezolid, Doxycycline, Amoxicillin + Potassium Clavulnate	Cefoperazone+ Sulbactam, Ceftriaxone, Amoxicillin
Viral Pneumonia	Ceftriaxone, Azithromycin, Cefoperazone and Sulbactam, Doxycycline, Meropenem	Not Needed
Cap	Ceftriaxone, Azithromycin, Cefoperazone and Sulbactam, Meropenem,	Co-Amoxicillin, Macrolide/Doxycycline, Ceftriaxone, Piperacillin + Tazobactam
URTI	Ceftriaxone, Azithromycin, Cefoperazone and Sulbactam, Metronidazole, Linezolid	Amoxicillin, Ceftriaxone, Co-Amoxicillin

TABLE NO. 8 EVALUATION OF PRESCRIPTION PATTERN WITH THE ICMR GUIDELINES

9) Pathogen-Specific Antibiotic Use: Comparing Prescribed Treatments with ICMR Recommendations:

Our analysis revealed a high degree of concordance between prescribed antibiotics and the preferred treatment options except drugs prescribed for coronavirus and Flu A+ outlined in ICMR guidelines for respiratory tract infections (RTIs).

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PATHOGEN	GIVEN DRUG	PREFFERED DRUG
E. coli	Meropenem, Ceftriaxone, Linezolid, Sulfamethaxole and Trimethoprim, Cefoperazone and Sulbactam, Azithromycin, Carbapenem	Cefepime, Cefotaxime, Ciprofloxacin, Gentamycin, Ceftazidime, Imipenem, Netilmicin, Cefoperazone and Sulbactam, Meropenem, Piperacillin and Tazobactam, Tetracycline, Amikacin
Gram-Negative Bacilli	Cefoperazone and Sulbactam, Azithromycin, Oxazolidinone, Carbapenem, Piperacillin and Tazobactam, Mupirocin, Ceftriaxone	Cefepime, Cefotaxime, Ciprofloxacin, Gentamycin, Ceftazidime, Imipenem, Netilmicin, Cefoperazone and Sulbactam, Meropenem, Piperacillin and Tazobactam, Tetracycline, Amikacin
Pseudomonas Aeruginosa	Piperacillin and Tazobactam, Levofloxacin	Piperacillin and Tazobactam, Carbapenem, Fluroquinolone, Aminoglycoside, Cephalosporin
Klebsiella Pneumoniae	Azithromycin, Doxycycline, Meropenem, Clindamycin, Ceftriaxone, Cefoperazone and Sulbactam, Linezolid, Sulfamethaxole and Trimethoprim	Cefepime, Cefotaxime, Ciprofloxacin, Gentamycin, Ceftazidime, Imipenem, Netilmicin, Cefoperazone and Sulbactam, Meropenem, Piperacillin and Tazobactam, Tetracycline, Amikacin
Parainfluenza	Piperacillin and Tazobactam, Azithromycin	Amoxicillin and Clavulanate, Azithromycin
Corona Virus 229e	Clindamycin HCL, Carbapenem	Antibiotics Not Required
Flu A+	Piperacillin And Tazobactam, Azithromycin, Levofloxacin, Ceftriaxone, Metronidazole,	Antibiotics Not Required

TABLE NO. 9 PATHOGEN-SPECIFIC ANTIBIOTIC USE: COMPARING PRESCRIBED TREATMENTS WITH ICMR RECOMMENDATIONS

PREVALENCE OF RTI:

10)Respiratory infections among RTI patients:

In this study, the most commonly diagnosed disease was COPD, which was found in 53(41%) patients, followed by Pneumonia in 38(29%) patients, Asthma in 12(9%) patients, Bronchitis in 10(8%), Laryngitis in 4(3%), 2 COR-P in 3(2%), Pharyngitis in 3(2%), Type 2 Respiratory Failure in 2(2%), Covid Pneumonia 1(1%), emphysema in 1(1%), Bronchiectasis in 1(1%), Rhinitis in 1(1%) patient.

RESPIRATORY INFECTIONS	RATIO	PERCENTAGE (%)
COPD	53	41
PNEUMONIA	38	29
ASTHMA	12	9
BRONCHITIS	10	8
LARYNGITIS	4	3
2 COR-P	3	2
PHARYNGITIS	3	2
RESPIRATORY FALIURE-2	2	2
COVID PNEUMONIA	1	1
EMPHYSEMA	1	1

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BRONCHIECTASIS	1	1
RHINITIS	1	1

TABLE NO. 10 RESPIRATORY INFECTIONS AMONG RTI PATIENTS

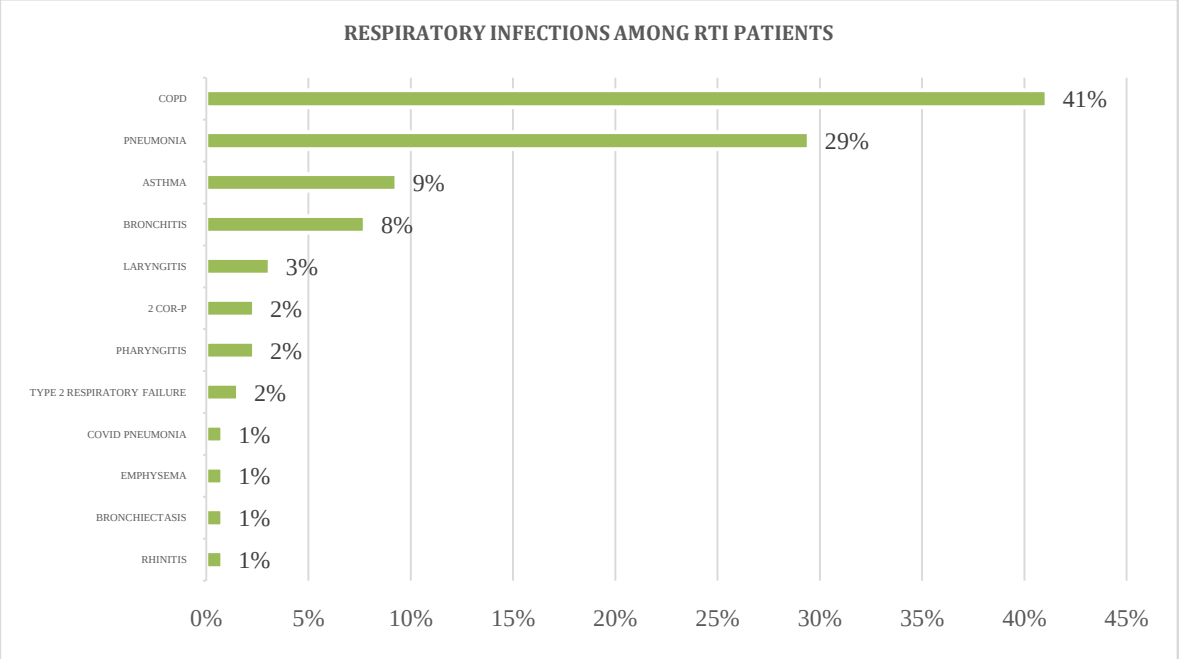

FIG. 7 RESPIRATORY INFECTIONS AMONG RTI PATIENTS

11) CPIS guidelines for pneumonia patients in MICU:

During the trial, 37 patients with pneumonia were hospitalizedin the Medical Intensive Care Unit (MICU). The CPIS criteria were followed in the analysis of the clinical data that were gathered. (CPIS SCORE: 0 TO 6- PNEUMONIA IS LESS LIKELY, 7 TO 12 – PNEUMONIA IS MORE LIKELY).

According to data, Pneumonia is more likely- 20(54%), Pneumonia is less likely – 17(46%).

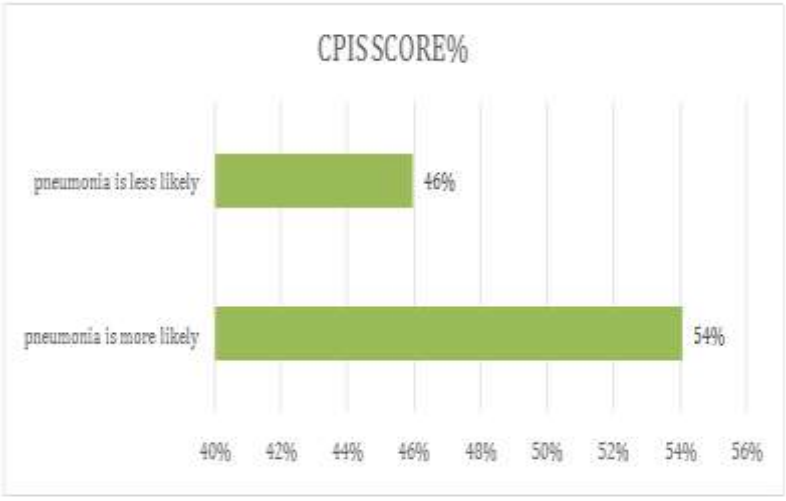

FIG. 8 CPIS FOR PNEUMONIA PATIENTS

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EVALUATION OF THE CLINICAL OUTCOMES OF THE PATIENTS:

12)Length of hospital stay of RTI patients:

Of the 120 patients who were admitted with RTI, 28 (23%) stayed for one to three days, 90 (75%) stayed for four to seven days, and 2 (2%) stayed for seven days or longer. Notable is the finding that 75% of patients stayed for 4–7 days. Standard treatment guidelines for bacterial pneumonia often recommend a 5–7 day course of antibiotics. This correlation suggests potential effectiveness of the antibiotic regimens employed, as most patients might have experienced symptom resolution within that time frame.

Length of hospital stay	Frequency	Percentage
1 day to 3 days	28	23%
4- day to 7 days	90	75%
More than 7 days	2	2%

TABLE NO. 11 LENGTH OF HOSPITAL STAY OF RTI PATIENTS

ATC/DDD COMPARISON AND RATIONALITY OF THERAPY ASSESSED USING WHO CORE PRESCRIPTION GUIDELINES:

13)ATC/DDD comparison results:

The purpose of the analysis was to evaluate how treatments were distributed throughout the study population according to Defined Daily Dose (DDD) and Anatomical Therapeutic Chemical (ATC) classification. Three primary categories were identified from the distribution: rational therapy, overdose, and underdose.

Distribution of therapies:

Rational therapy: Among the total therapies administered, 73% were categorized as rational therapy, indicating adherence to standard dosages as per ATC/DDD guidelines.

Overdose: 18% of the therapies administered were categorized as overdose, suggesting a dosage higher than the recommended standard DDD.

Underdose: 9% of the therapies administered were categorized as underdose, indicating a dosage lower than the recommended standard DDD.

DISTRIBUTION OF THERAPIES	PERCENTAGES (%)
RATIONAL THERAPY	73
OVERDOSE	18
UNDERDOSE	9

TABLE NO. 12 ATC/DDD COMPARISON

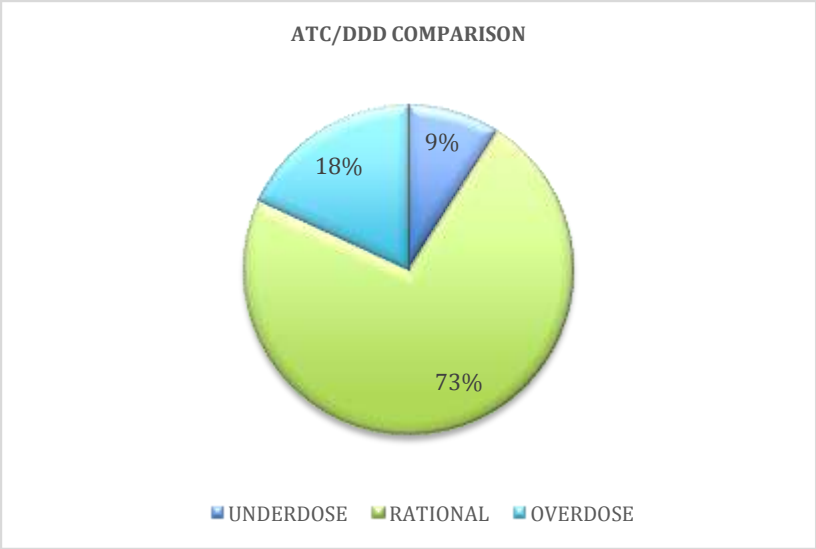

FIG. 9 ATC/DDD COMPARISON

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PHARMACOECONOMICS CONSIDERATION:

14)Antibiotic prescribed for RTI:

From 120 prescriptions mostly prescribed antibiotic is Azithromycin 81(33%), Sulbactam and Cefoperazone 54(22%), Ceftriaxone 28(11%), Meropenem 19(8%), Piperacillin Tazobactam 17(7%), Linezolid 14(6%), Doxycycline 6(2%), Clarithromycin 6(2%), Levofloxacin 5(2%), Clindamycin 4(2%), Amoxicillin and Potassium Clavulnate 3(1%), Mupirocin 3(1%), Teicoplanin 1(0%), Trimethoprim and Sulphamethoxazole 1(0%), Metronidazole 1(0%), Ceftazidime 1(0%), Tetracycline 1(0%), Monobactams 1(0%).

ANTIBIOTIC PRESCRIBED	RATIO	%
AZITHROMYCIN	81	33
SULBACTAM & CEFOPERAZONE	54	22
CEFTRIAXONE	28	11
MEROPENEM	19	8
PIPERACILLIN TAZOBACTAM	17	7
LINEZOLID	14	6
DOXYCYCLINE	6	2
CLARITHROMYCIN	6	2
AMOXICILLIN & POTASSIUM CLAVUNATE	3	1
MUPIROCIN	3	1
TEICOPLANIN	1	0
METRONIDAZOLE	1	0
CEFTAZIDIME	1	0
TETRACYCLINE	1	0
MONOBACTAMS	1	0
TRIMETHOPRIM & SULPHAMETHOXAZOLE	1	0
CLINDAMYCIN	4	2
LEVOFLOXACIN	5	2

TABLE NO. 13ANTIBIOTIC PRESCRIBED FOR RTI

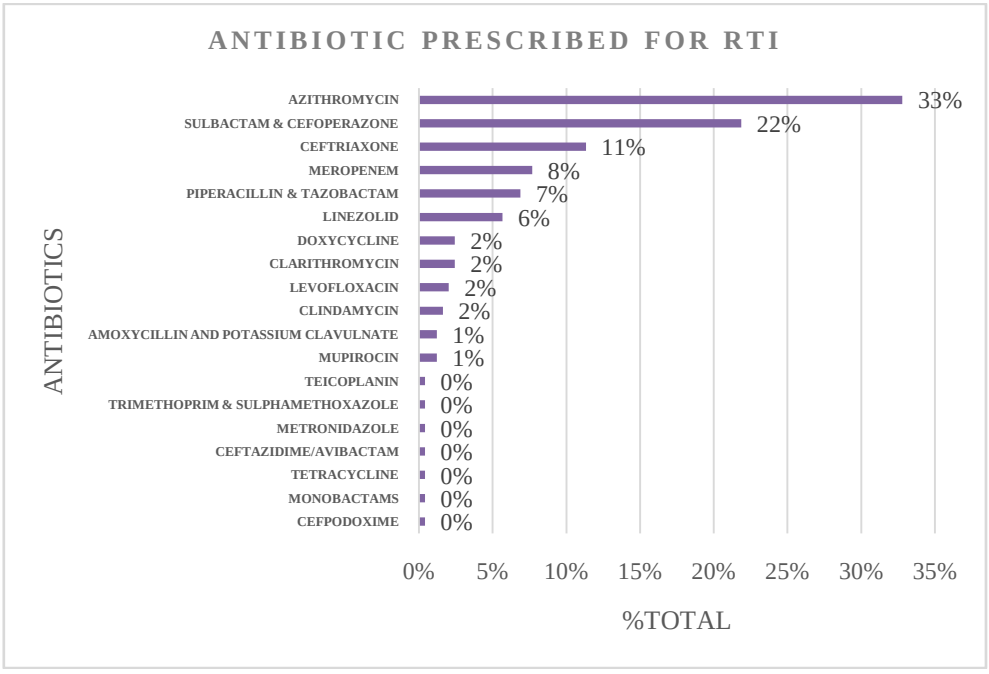

FIG. 10 ANTIBIOTIC PRESCRIBED FOR RTI

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15)Route of the drug administration:
Out of 120 prescriptions, 92(46%) were oral formulation, 110(54%) were intravenous.

Formulations	Frequency	Percentage
Oral	92	46%
Intra venous	110	54%

TABLE NO. 14 ROUTE OF THE DRUG ADMINISTRATION

16) COST OF PRESCRIBED ANTIBIOTICS:

The total cost of antibiotics used for treatment in this study amounted to 10,939.71. Zavicefta was the most expensive antibiotic used, with a total cost of 5,008. The remaining 23 antibiotics Taragocid (15%)1600, Mucolyte (12%)1280, Clindanex (9%)1022, Mero (5%) 590, Tazact (5%) 520.1, Zostum (2%) 220, Oframax (1%) 127.68, Pipzo (1%) 110, Tigebax (1%) 98.21, Monocef (1%) 80, Bacterim (0%) 50, Linid (0%)41, Claribid (0%)37.924, Dalacin (0%)37.924,Cefzone(0%)22, Augmentin(0%)21, T.Bact (0%)20, Flozith (0%)19.2, Azee (0%)13.8, Metro (0%)11, Doxy (0%)8.6, Loxof (0%)6.195,Levoflox (0%)3.3 used in the study accounted for the remaining 5,931.71. Further analysis could explore cost variations based on specific antibiotic type, duration of therapy, and potential cost-saving strategies.

PRESCRIBED ANTIBIOTICS	COST IN RUPPEES	%
ZAVICEFTA	5008	-
TARAGOCID	1600	15
MYCOLYTE	1280	12
CLINDANEX	1022	9
MERO	590	5
TAZACT	520.1	5
ZOSTUM	220	2
OFRAMAX	127.68	1
PIPZO	110	1
TIGEBAX	98.21	1
MONOCEF	80	1
BACTERIM	50	1
LINID	41	0
CLARIBID	37.924	0
DALACIN	37.924	0
CEFZONE	22	0
AUGMENTIN	21	0
T. BACT	20	0
FLOZITH	19.2	0
AZEE	13.8	0
METRO	11	0
DOXY	8.6	0
LOXOF	6.195	0
LEVOFLOX	3.3	0
TOTAL COST	5931.71	

TABLE NO. 15 COST OF PRESCRIBED ANTIBIOTICS

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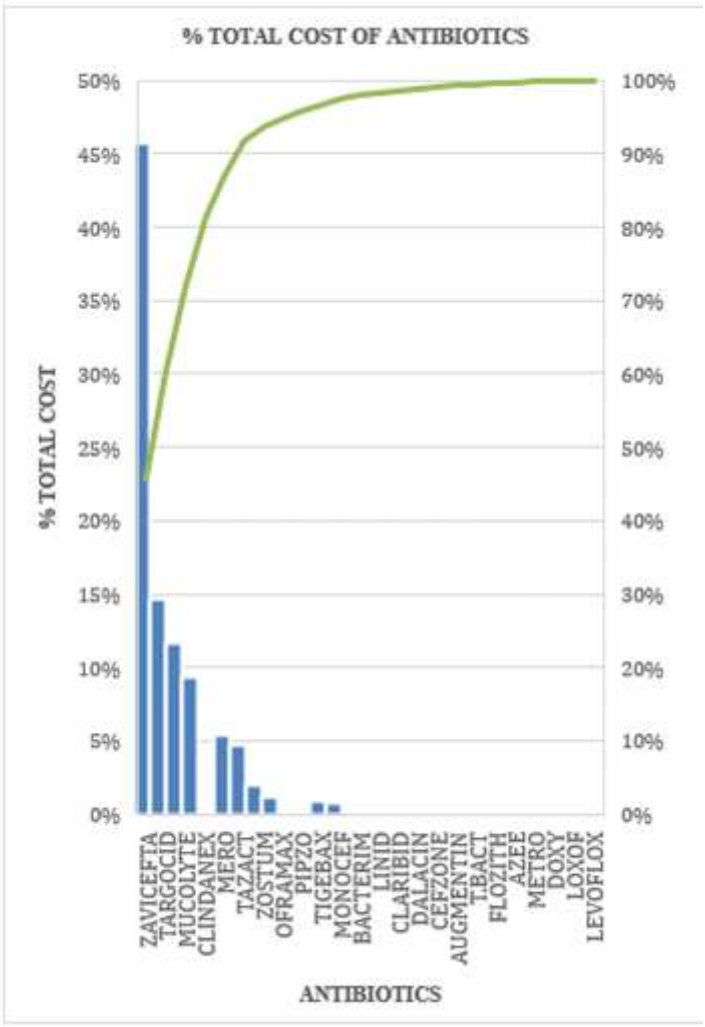

FIG. 11 COST OF PRESCRIBED ANTIBIOTICS

17)Cost Analysis of Antibiotic Prescriptions: Examining Drug Names, Frequency, Dosage, Costs and Potential Overdose Concerns:

This table presents a detailed analysis of antibiotic use in our tertiary care hospital. It examines data on 19 different antibiotics, categorized by drug name, frequency of administration, the total number of patients prescribed each drug, the cost per day of treatment, and the total cost of treatment per patient. Additionally, the table considers potential concerns like overdoses and identifies a total of □ 8,719.50 in additional costs.

D=DRUG, F=FREQUENCY, X=DRUG PRESCRIBED TO TOTAL NO. OF PATIENTS, Y= DAYS, C=COST(RS)/ DAY, Z= COST OF TOTAL DAYS, O= OVERDOSE, E= EXTRA COST (RS)

D	F	X	Y	C	Z	O	E
Ceftazidime	TDS	1	6	5008	30048	1	5008
Teicoplanin	TDS	1	3	1600	4800	1	1600
Amoxicillin And HCL	TDS	1	6	1280	7680	-	
Meropenem	TDS	19	6	590	3540	1	590
Cefoperazone and Sulbactam	BD	54	5	220	1100	-	
Piperacillin and Tazobactam	TDS	17	5	110	550	1	110

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Tigecycline/Avibactam	BD	1	6	98.21	589.26	-	
Ceftriaxone	BD	1	6	80	480	12	960
Sulfamethoxazole and Trimethoprim	BD	1	6	50	300	-	
Linezolid	BD	14	5	41	205	-	
Clarithromycin	BD	6	3	37.924	113.772	1	37.924
Clindamycin	BD	4	6	29.7	178.2	2	59.4
Amoxicillin and Potassium Clavulanate	TDS	3	6	21	126	-	
Metronidazole	TDS	1	5	21	105	8	168
Mupirocin	TDS	3	5	20	100	-	
Azithromycin	OD	81	5	13.8	69	2	27.6
Doxycycline	BD	6	7	8.6	60.2	17	146.2
Levofloxacin	BD	5	5	6.195	30.975	2	12.39
TOTAL					**50,075.407**		**8719.5**

TABLE NO. 16 COST ANALYSIS OF ANTIBIOTIC PRESCRIPTIONS

V. DISCUSSION

This study investigated antibiotic utilization patterns in a tertiary care hospital, focusing on patients diagnosed with respiratory tract infections (RTIs). The findings provide valuable insights into patient demographics, diagnosis distribution, pathogen identification, antibiotic prescribing practices, and treatment costs. Let's delve deeper into the key findings and their implications.

Patient Demographics and Disease Distribution:

• The male predominance (56%) observed in RTI cases aligns with existing literature Harish Govind Naik. et al. This suggests potential biological or behavioural factors contributing to higher male susceptibility.

• COPD emerged as the most prevalent diagnosis 53(41%), followed by Pneumonia 38(29%). Further investigation into risk factors associated with these specific diseases in hospital settings could be informative.

• The analysis revealed a trend towards older patients, with the highest proportion (24%) falling within the 68-78 year age group. This aligns with existing literature suggesting increased susceptibility to RTIs in older populations (Rajaseger Nirmal Kumar. et al).

Diagnosis Distribution:

• Chronic obstructive pulmonary disease (COPD) emerged as the most prevalent diagnosis (31%), followed by pneumonia (13%). This finding highlights the importance of tailoring antibiotic selection and management strategies to these common RTIs in your hospital. The presence of diagnoses like hypertension (HTN), diabetes mellitus type 2 (DM-2), and ischemic heart disease (IHD) in some patients warrants considering potential medication interactions or disease-specific considerations when prescribing antibiotics.

• The inclusion of diagnoses such as common cold, pyrexia (fever of uncertain origin), and dyspnoea broadens the scope of respiratory problems seen in hospitals. It's crucial to remember that not every diagnosis made here calls for the use of antibiotics.

Disease Distribution and Presenting Symptoms:

• The high prevalence of COPD (41%) as the most common diagnosis aligns with its characteristic symptoms like shortness of breath (SOB) and cough (reported in 28% and 10% of patients, respectively). This suggests a potential association between COPD and these presenting complaints.

Clinical Presentation and Antibiotic Selection:

• While fever was the most frequent symptom (32%), it can occur in various RTIs. The dominance of COPD and Pneumonia diagnoses, both of which often present with fever, cough, and SOB, could explain this observation. Examining the specific symptoms associated with antibiotic prescriptions could reveal if clinicians are appropriately targeting antibiotics based on the presenting picture.

Pathogen Identification and Antibiotic Concordance:

• Klebsiella pneumoniae (26%) was the most frequently isolated pathogen, highlighting its significance in RTIs. This aligns with nationwide trends, and continued monitoring of local resistance patterns is crucial (Shambhavi. et al).

• Encouragingly, a high degree of concordance was found between prescribed antibiotics and ICMR

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guidelines for most RTIs. This suggests successful implementation of antibiotic stewardship programs or adherence to established best practices. Exceptions like Corona Virus and Flu A+ might require further investigation into evolving treatment recommendations.

Length of Hospital Stay and Treatment Response:

• The finding that 75% of patients stayed for 4-7 days is noteworthy. Standard treatment guidelines for bacterial pneumonia often recommend a 5–7 day course of antibiotics. This correlation suggests potential effectiveness of the antibiotic regimens employed, as most patients might have experienced symptom resolution within that timeframe.

Antibiotic Use and Cost Analysis:

• Azithromycin (33%) dominated prescribed antibiotics, potentially due to its broad-spectrum activity and patient compliance benefits. Exploring the specific indications for its use could be insightful (Nahid Akbari. et al).

• The analysis revealed a significant proportion (73%) of rational therapy based on ATC/DDD guidelines.

• Out of 120 prescriptions, 92(46%) were oral formulation, 110(54%) were intravenous.

• The cost analysis highlighted Zavicefta as the most expensive antibiotic. Considering its high cost, further research could explore the specific indications for its use and potential cost-saving alternatives.

VI. CONCLUSIONS

This study offered an in-depth review of the use of antibiotics for patients in tertiary care hospitals who had been diagnosed with respiratory tract infections (RTIs). The findings revealed several key points:

• Male predominance in RTIs aligns with existing literature, suggesting potential biological or behavioural factors for further investigation.

• The high prevalence of COPD as the most common diagnosis necessitates exploring associated risk factors specific tothe hospital setting.

• Correlation between COPD and symptoms like SOB and cough highlights the importance of considering presenting complaints alongside diagnoses for appropriate antibiotic selection.

• Encouragingly high concordance with ICMR guidelines signifies successful implementation of antibiotic stewardship programs. However, exceptions like Corona Virus and Flu A+ warrant further study to stay updated with evolving treatment recommendations.

• Length of hospital stay (mostly 4-7 days) potentially reflects the effectiveness of antibiotic regimens, aligning with standard treatment durations for bacterial pneumonia. Further research can solidify this association.

• Azithromycin dominance as the prescribed antibiotic suggests potential benefits of exploring specific indications for its use.

Overall, this study offers valuable insights into optimizing antibiotic use in hospitals. By implementing targeted interventions based on these findings, such as:

• Strengthening antibiotic stewardship programs to monitor adherence to guidelines and identify areas for improvement.

• Investigating the cost-effectiveness of antibiotic options through collaboration with relevant teams. The hospital can ensure effective, affordable, and evidence-based antibiotic therapy for patients with RTIs, ultimately promoting both patient well-being and responsible antibiotic stewardship.

STRENGTHS AND LIMITATIONS

Strengths:

The study's strengths include representative sample size, comprehensive data collection, and analysis of concordance with established guidelines.

Limitations:

• Patient's weight should be considered for dosage calculations.

• Specify that bronchitis is associated with viral or bacterial.

ABBREVIATIONS

AB= ANTIBIOTICS
AIDS= ACQUIRED IMMUNODEFICIENCY SYNDROME
AMR= ANTI-MICROBIAL RESISTANCE
AOM= ACUTE OTITIS MEDIA
ARI= ACUTE RESPIRATORY INFECTION
ATC/DDD= ANATOMICAL THERAPEUTIC CHEMICAL (ATC) AND DEFINED DAILY DOSE (DDD)
CAP= COMMUNITY-ACQUIRED PNEUMONIA
COPD= CHRONIC OBSTRUCTIVE PULMONARY DISEASE
HAP= HOSPITAL-ACQUIRED PNEUMONIA
LRTI= LOWER RESPIRATORY TRACT INFECTION
OPD= OUT-PATIENT DEPARTMENT
RTI= RESPIRATORY TRACT INFECTION
URTI= UPPER RESPIRATORY TRACT INFECTION

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VAP= VENTILATOR ACQUIRED PNEUMONIA
WHO= WORLD HEALTH ORGANIZATION

AUTHOR'S CONTRIBUTION

Khushi Joshi and Rashmi Pandit collaborated on the conceptualization, methodology, data analysis, and drafting of the article, contributing to data collection and manuscript review. Dr. Shwetha Swaminath M. and Dr. Surbhi Chitania provided supervision, project administration, and critical feedback on the manuscript.

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