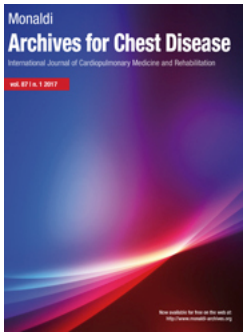

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Prescription patterns and drug utilization in respiratory tract infections: implications for antimicrobial stewardship at a tertiary care teaching hospital

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Abstract

Respiratory tract infections (RTIs) are common causes of hospital admissions and are often treated with multiple medications, including antibiotics, contributing to antimicrobial resistance. Effective drug utilization evaluation (DUE) is essential for ensuring rational drug use in RTI management. This study aimed to assess prescription patterns and drug utilization in RTI patients at a tertiary care hospital, focusing on the rationality of drug use, polypharmacy, adherence to clinical guidelines, and implications for antimicrobial stewardship. A cross-sectional study was conducted at Vivekananda General Hospital, Hubballi, India, from August 2023 to January 2024. Data from 200 RTI inpatients, including demographics, medication types, administration routes, and prescription patterns, were analyzed. Descriptive and inferential statistics were used to evaluate adherence to guidelines and rational drug use. DUE revealed that 50.99% of patients were not prescribed cough syrup. Oral (52%) and intravenous (48%) routes were the most common. Budesonide was the most frequently prescribed bronchodilator (26.49%), and 72.45% of patients received oxygen. Ceftriaxone (12.68%) and azithromycin (11.88%) were the most commonly prescribed antibiotics. A high prevalence of polypharmacy was identified, with 39.50% of patients receiving more than three antibiotics, raising concerns about drug interactions and rationality. The study underscores the need for stricter adherence to clinical guidelines and targeted antimicrobial stewardship in RTI management. Enhanced DUE practices could improve patient outcomes and promote rational drug use.

Key words: antimicrobial stewardship, ceftriaxone, drug utilization evaluation, polypharmacy, prescription patterns, rational drug use.

Introduction

Respiratory tract infections (RTIs) are among the most common illnesses encountered in both outpatient and inpatient settings. They range from mild conditions, such as the common cold and pharyngitis, to more severe diseases like pneumonia and asthma [1]. The management of RTIs often involves the use of antibiotics, which is a significant aspect of clinical practice [2]. However, the frequent and sometimes inappropriate use of antibiotics in RTIs has raised concerns about antimicrobial resistance (AMR) and has underscored the need for effective antimicrobial stewardship [3].

Antimicrobial resistance is a critical global health issue that threatens the effectiveness of antibiotic treatments. It arises from various factors, including overuse, misuse, and the emergence of resistant strains of pathogens [4]. The World Health Organization (WHO) and other health authorities have highlighted the urgent need to address AMR through improved antibiotic stewardship practices [5,6]. Inappropriate prescribing, such as the use of antibiotics for viral infections where they are ineffective, significantly contributes to the development of resistance [6]. Moreover, studies indicate that a substantial proportion of antibiotics are prescribed inappropriately in inpatient settings, exacerbating the AMR crisis [7].

Drug Utilization Evaluation (DUE) is a systematic approach used to assess and improve medication use patterns. In the context of RTIs, DUE involves evaluating the appropriateness, effectiveness, and safety of antibiotic use according to established clinical guidelines [8]. Through DUE, healthcare professionals can identify and rectify patterns of misuse or overuse of antibiotics, which is crucial for optimizing treatment outcomes and mitigating AMR [9]. For example, DUE can reveal whether antibiotics are being prescribed for conditions that do not warrant their use or whether there are discrepancies between actual practices and guideline recommendations [10].

Antimicrobial Stewardship Programs (ASPs) are designed to optimize antibiotic use and combat AMR by promoting evidence-based prescribing practices [11]. ASPs often integrate DUE as a core component to monitor and evaluate antibiotic prescribing, identify areas for improvement, and implement targeted interventions. By focusing on adherence to clinical guidelines and addressing inappropriate prescribing practices, ASPs aim to enhance patient outcomes and reduce the incidence of resistant infections [12].

This study aims to analyze the prescription patterns of antibiotics and other medications used for RTIs in a tertiary care hospital setting. It is a study that aims to understand trends, identify issues, and improve the quality of medication use by examining data on medication types, quantities, conditions treated, and patient demographics, the study identifies inappropriate practices and highlights areas needing intervention. The study also aims to provide a comprehensive overview of medication use patterns beyond antibiotics, such as expectorants, bronchodilators, number of tablets, capsules, and injectables, to offer a holistic view of the therapeutic approaches being employed [13]. Understanding these aspects will help in developing targeted strategies for improving antimicrobial stewardship and optimizing antibiotic use [14].

The rationale for this study is rooted in the need to address the growing problem of AMR and the importance of refining antibiotic prescribing practices. By providing a detailed analysis of current prescription patterns and drug utilization, this research will contribute to the development of more effective antimicrobial stewardship strategies. Additionally, the findings will support the implementation of interventions aimed at reducing inappropriate antibiotic use and promoting evidence-based prescribing practices [15].

Materials and Methods

Study design

A cross-sectional observational study was conducted from August 2023 to January 2024. A pilot study was conducted to determine the sample size. After that, the research comprised 200 patients with RTI diagnosis who were admitted to the pulmonology department at Vivekananda General Hospital Hubballi, India.

Ethical considerations

The study's purpose was conveyed to the patients and their families. The patients provided written informed consent. The KLE College of Pharmacy Ethical Committee gave its approval to the study. (IEC Reference Number: KLECOPH/IEC/2023-24/08)

Study population

Inclusion criteria: patients of either gender above 18 years of age, diagnosed with respiratory disease, and admitted to the inpatient pulmonology department.

Exclusion criteria: patients below 18 years of age, those attending the outpatient department, patients who were not conscious and oriented, patients who did not consent to participate in the study, and pregnant and lactating women were excluded.

Results

Clinical characteristics of study subjects

The study included 200 inpatients from the pulmonology department diagnosed with RTIs. Demographics showed that 141 patients (70.50%) were male and 59 (29.50%) were female. Patients' ages ranged from 18 to 99 years, with the majority i.e. 70 patients (35%) aged 55-69 years, followed by 42 patients (21%) aged 25-39 years, and 41 patients (20.50%) aged 40-54 years. Only 4 patients (2%) were aged 85-99 years. A notable 124 patients (62%) lived in rural areas, compared to 76 patients (38%) from urban areas, indicating a rural predominance. In terms of education, 82 patients (40.50%) were uneducated, while 53 (26.50%) had completed schooling, and 23 (11.50%) had a degree. Only 3 patients (1.50%) had a diploma. Occupationally, 85 patients (42%) were in "Other occupations," 54 (27%) were farmers, 22 (11%) worked in industry, 20 (10%) were construction laborers, and 19 (9.50%) were housewives. Comorbidities were present in 120 patients (60%), and 80 patients (40%) had none. Most patients 125 (87.50%) were below the poverty line. Employment status revealed that 129 patients (64.50%) were poorly employed, 37 (18.50%) were unemployed, and 34 (17%) were well-employed. The predominant diagnosis was lower respiratory tract infection (LRTI) affecting 181 patients (90.50%). Hospital stays were longer than 5 days for 127 patients (63.50%), highlighting a tendency for prolonged hospitalization (*Supplementary Table 1*).

WHO core prescribing indicators

Using WHO core prescribing indicators we found each prescription contained an average of 6 medications. All 1125 medications were administered under generic names, with no brand designations. Injections were used for 48% of the medicines. Every prescription contained at least

one antibiotic, yielding a 100% rate of antibiotic prescriptions. The investigation found a total of 765 different antibiotics. Fixed-dose combinations were issued in 22 instances, accounting for 1.95 percent of all prescriptions. Furthermore, 63.63% of the medications were chosen from the National List of Essential Medicines or the formulary (*Supplementary Table 2*).

Prescribing pattern in the study population

Distribution pattern of antibiotics

In the study population, the prescribing pattern of antibiotics showed a notable distribution among different therapy approaches. Monotherapy was observed in 4.50% of patients, dual therapy in 33%, triple therapy in 23%, and polytherapy in 39.50% of patients. This highlights a significant inclination towards polytherapy in managing RTI (*Supplementary Table 3* and Figure 1).

Distribution of oral and parenteral antibiotics

The administration routes for antibiotics were almost evenly split, with oral antibiotics being used in 52% of cases and parenteral antibiotics in 48% of cases. This distribution indicates a balanced approach between oral and parenteral administration, tailored to the needs of the patients (*Supplementary Table 4* and Figure 2).

Distribution of bronchodilators, inhalers, and cough syrups

The varied usage patterns of bronchodilators, inhalers, and cough syrups were observed in the study. Budesonide was the most frequently prescribed bronchodilator, used by 26.49% of patients, followed by Asthalin at 19.03% and Duolin at 15.30%. Notably, 26.49% of patients did not receive any bronchodilators. Among inhalers, the Forocort Inhaler was used by 22.45% of patients, while a significant majority, 72.45%, required oxygen inhalation (*Supplementary Table 5*). In our study, various cough syrups were prescribed, with notable differences in their usage frequencies. Ascoryl was the most commonly prescribed, accounting for 14.8% of the total prescriptions, followed by Ambroxol and unidentified cough syrup, each constituting 7.43%. Salbutamol was prescribed in 5.94% of cases, Brozedex in 6.93%, and Gryilintus in 4.46%. A significant proportion of the patients, 50.9%, did not receive any cough syrup, while other less commonly used cough syrups made up 1.98% of the prescriptions (*Supplementary Table 5*).

Distribution of oral and parenteral antibiotics

A clear pattern emerged in patient treatment modalities. While only 2.50% of patients received one oral medication, 35.50% were treated with one parenteral medication. As the number of medications increased to two, 23.50% were taken orally and 26.50% parenterally. For three medications, the trend shifted, with 33.50% taken orally versus 20.50% administered parenterally. Among those receiving four medications, 27.00% were oral and 9.50% parenteral. When six medications were prescribed, only 2.00% were oral and 1.00% parenteral. Finally, just 0.50% of patients took seven medications orally (*Supplementary Table 6* and Figure 3).

Drugs used in the treatment of respiratory tract infections

The study's findings reveal the diverse range of drugs used in managing RTIs, with certain antibiotics being particularly prevalent. Ceftriaxone, a broad-spectrum cephalosporin, was the most frequently prescribed, given to 12.68% of patients. Its extensive use highlights its efficacy against a variety of bacterial pathogens, making it essential in RTI treatment. Levofloxacin, a fluoroquinolone, was prescribed to 9.88% of patients, reflecting its strong activity against both gram-positive and gram-negative bacteria, making it a preferred option for complex or atypical RTIs. Azithromycin, prescribed to 11.88% of patients, was also prominent due to its broad coverage and convenient dosing regimen, which enhances patient adherence (*Supplementary Table 7*).

Class of drugs used in respiratory tract infection management

The study highlights the specific roles of drugs used in RTI management. Cephalosporins, prescribed to 20.69% of patients, were the most frequently used drug class due to their broad-spectrum activity against various bacterial pathogens, making them a cornerstone of RTI treatment.

Mucolytics, administered to 24.54% of patients, played a vital role in relieving respiratory symptoms by aiding mucus breakdown and clearance. Macrolides, given to 12.98% of patients, were particularly effective against atypical pathogens like *Mycoplasma pneumoniae*, with additional anti-inflammatory benefits that enhanced their efficacy in treating respiratory infections.

These prescribing patterns demonstrate a strategic approach to RTI management, combining broad-spectrum antibiotics with symptom-targeting therapies such as mucolytics for comprehensive patient care (*Supplementary Table 8*).

Discussion

Our study highlights several critical aspects of drug utilization and prescription patterns in the management of RTIs at a tertiary care teaching hospital. The study observed a high prevalence of antibiotic use, with every patient in the study receiving at least one antibiotic, leading to a 100% rate of antibiotic prescriptions. This finding aligns with previous research, such as the study by Arun et al. (2022), which reported similarly high rates of antibiotic use in RTI management, reflecting a common practice in many clinical settings. However, the widespread use of antibiotics, particularly the high incidence of polytherapy (39.5%), raises concerns about the potential for antimicrobial resistance (AMR) [16-20].

The preference for broad-spectrum antibiotics like ceftriaxone (12.68%) and azithromycin (11.88%) was evident, reflecting their efficacy in treating a wide range of bacterial pathogens. However, the over-reliance on these antibiotics, especially in cases where monotherapy might suffice, underscores the need for more judicious use. This is particularly important in light of the growing global concern over AMR, as emphasized by the World Health Organization (WHO) and other health bodies. The study by Sharma et al. (2021) also emphasized the risks associated with the overuse of broad-spectrum antibiotics, highlighting the need for stricter adherence to antibiotic stewardship principles [21-25].

The study found that 39.5% of patients were subjected to polytherapy, receiving more than three antibiotics. This high level of polypharmacy not only increases the risk of adverse drug reactions (ADRs) but also complicates the clinical management of patients. The findings are consistent with those reported by Singh et al. (2020), who identified polypharmacy as a significant issue in the management of RTIs, often leading to drug-drug interactions and increased healthcare costs. The practice of polypharmacy, particularly in the elderly population, who constituted a significant portion of the study group, is of particular concern due to their increased susceptibility to ADRs [26-28].

The study revealed that while there was a 63.63% adherence to the National List of Essential

Medicines (NLEM) or formulary, there is still room for improvement in ensuring that prescriptions align more closely with established clinical guidelines. The findings suggest that although there is an awareness of the need for guideline-based prescribing, the implementation is not consistent across the board. This inconsistency can lead to suboptimal patient outcomes and contribute to the development of resistant strains of pathogens, as noted by Gupta et al. (2019) [29-32].

The balanced use of oral (52%) and parenteral (48%) antibiotics observed in the study indicates a tailored approach to patient care, which is in line with current best practices that emphasize the importance of selecting the appropriate route of administration based on the severity of the infection and patient-specific factors.

The study by Thomas et al. (2021) also supported the importance of considering both the route and frequency of administration to optimize therapeutic outcomes. Additionally, the high use of oxygen inhalation (72.45%) and the varied use of bronchodilators like budesonide (26.49%) highlight the reliance on supportive therapies in managing RTIs. This finding underscores the need for a holistic approach to RTI management that goes beyond antibiotics to include symptom management and supportive care [33].

The study's findings have significant implications for antimicrobial stewardship programs (ASPs). The high rates of antibiotic use, particularly broad-spectrum antibiotics, and the prevalence of polypharmacy underscore the urgent need for targeted interventions to promote rational drug use. As highlighted by Patel et al. (2020), effective ASPs should focus on reducing unnecessary antibiotic use, promoting adherence to guidelines, and educating healthcare providers about the risks associated with polypharmacy and inappropriate antibiotic use. The study also suggests that there is a need for ongoing monitoring and evaluation of prescription patterns through DUEs to identify areas for improvement and ensure that antimicrobial stewardship goals are being met. By addressing these issues, it may be possible to reduce the incidence of AMR, improve patient outcomes, and ensure the sustainability of antibiotic therapies for future generations [34].

The study provides valuable insights into the current state of drug utilization and prescription patterns in the management of RTIs. While there are areas where the hospital's practices align with best practices, particularly in the balanced use of oral and parenteral antibiotics, there are also significant concerns regarding the high rates of antibiotic use, polypharmacy, and inconsistent adherence to clinical guidelines.

These findings underscore the importance of strengthening antimicrobial stewardship efforts and ensuring that healthcare providers are equipped with the knowledge and tools needed to make evidence-based prescribing decisions. By addressing these challenges, it is possible to improve patient outcomes and combat the growing threat of antimicrobial resistance.

Conclusions

This study investigated prescription procedures and utilization of drugs for RTIs in a tertiary care teaching hospital. The data indicated a significant rate of polypharmacy, as well as worries regarding antibiotic overuse. The study also discovered gaps in the prescription of cough syrups and bronchodilators, indicating that existing procedures may not adequately address symptomatic RTI treatment. The study's single-center design may restrict the generalizability of the findings, and the lack of clinical outcome data and long-term patient follow-up are important limitations. To ameliorate the situation, antibiotic stewardship programs must be strengthened, clinical recommendations must be followed more strictly, and RTI symptoms should be managed with suitable adjunctive medicines. To better understand prescription patterns and their impact on patient health, future research should involve studies conducted at multiple centers and include measures of patient outcomes and long-term follow-up.

This study has some limitations: it was conducted at only one center, did not collect data on clinical outcomes or follow-up, and did not examine how patient demographics or comorbidities might affect prescription patterns. Future studies should address these issues by including multiple centers, gathering clinical outcome data, tracking patients over time, and focusing on the proper use of additional therapies and symptom management. This approach could improve patient outcomes and help reduce unnecessary antibiotic use.

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Online supplementary material:
Supplementary Table 1. Characteristics of patients.
Supplementary Table 2. WHO core prescribing indicator.
Supplementary Table 3. Distribution pattern of antibiotics.
Supplementary Table 4. Distribution of oral and parenteral antibiotics.
Supplementary Table 5. Distribution of bronchodilators, inhalers, and cough syrups.
Supplementary Table 6. Frequency of oral and parenteral antibiotics.
Supplementary Table 7. Drugs used in respiratory tract infection management.
Supplementary Table 8. Class of drugs used in respiratory tract infection management.

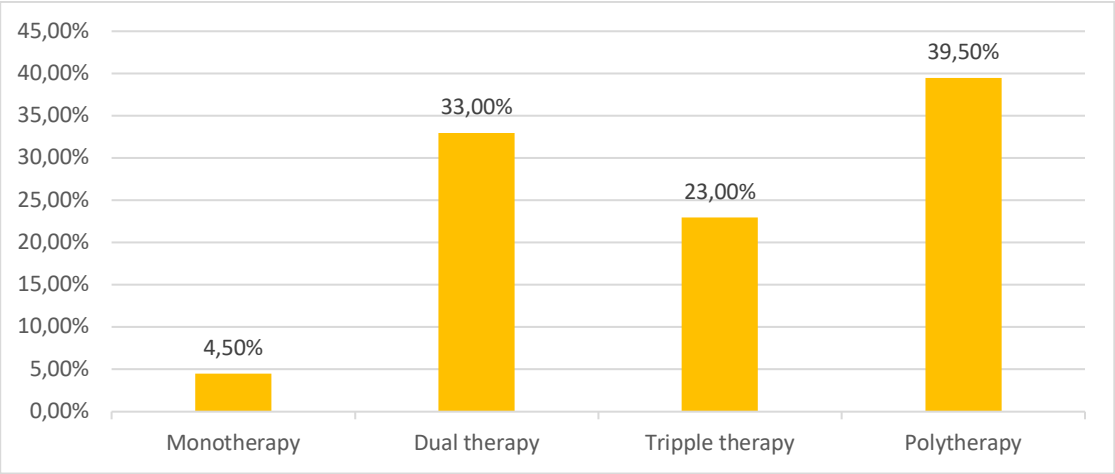

Figure 1. Distribution pattern of antibiotics.

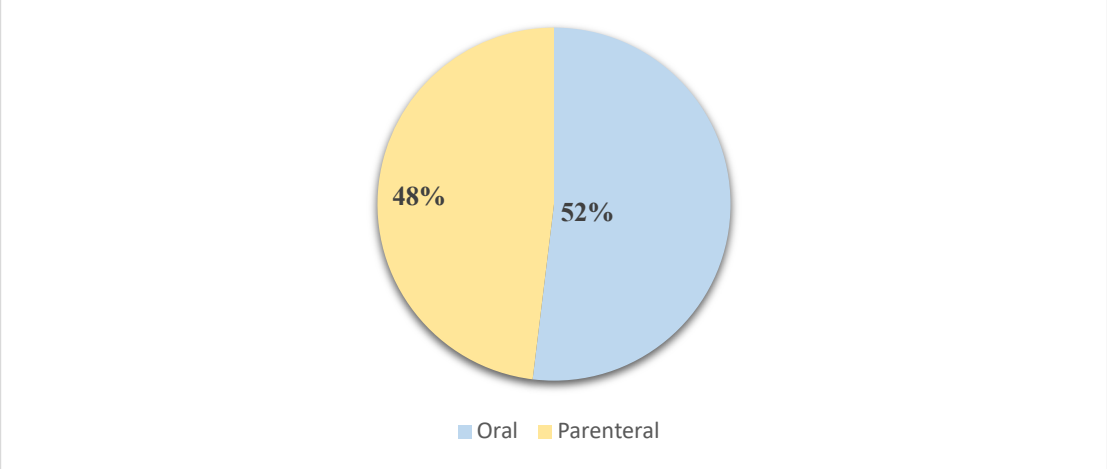

Figure 2. Distribution of oral and parenteral antibiotics.

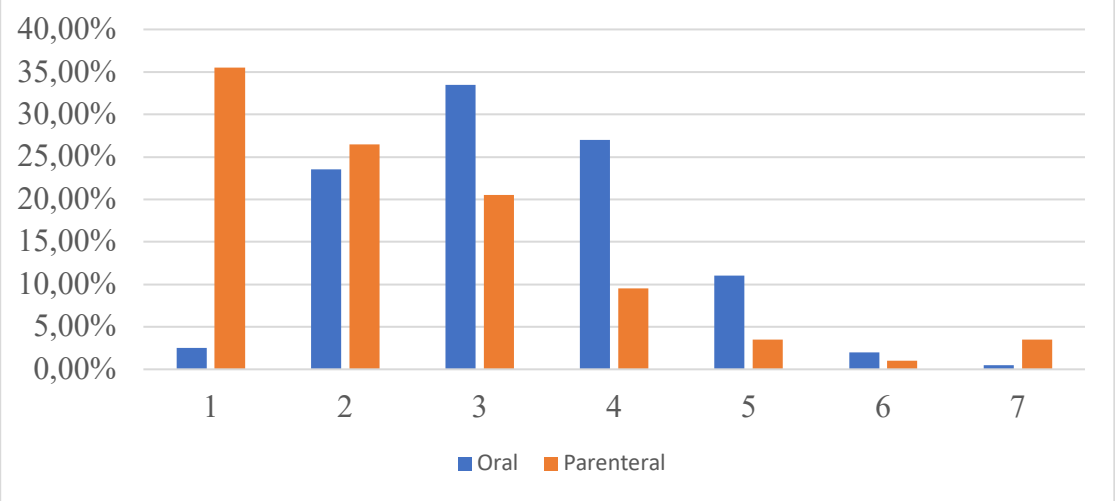

Figure 3. Frequency of oral and parenteral antibiotics.