Radiological Role, Drug Utilization and Associated ADRs in Pediatric Lower Respiratory Tract Infections: A Retrospective Study

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ABSTRACT
Lower respiratory tract infections (LRTIs) in children are a major global cause of morbidity and their successful management requires an integration of pharmacological and radiological interventions. Understanding the prevalence of LRTIs, radiological findings, drug use patterns and related adverse drug reactions (ADRs) could potentially improve diagnosis, treatment strategies and patient outcomes. The medical records of 260 children who received treatment for lower respiratory tract infections (LRTIs) at a tertiary care hospital were used in this observational and retrospective study. Patient demographics, radiological findings, imaging timing and clinical indications were among the information gathered from the records. Treatment patterns were evaluated by analyzing prescribed medicines, including the use of antibiotics and related adverse drug reactions (ADRs). 260 pediatric patients with lower respiratory tract infections (LRTIs) were examined in the study. They were divided into three age groups: 1-12 months (50.0%), 12-36 months (34.6%) and 36-60 months (15.4%). The most prevalent diseases were Viral pneumonia (23%) and bronchiolitis (24%). The most frequent pattern in radiological results was consolidation (46.9%). Peribronchial thickening is the most common feature in mild viral pneumonia cases (59.5%), while diffuse air space and lobar consolidations are linked to 63.6% of severe cases. Early imaging (<48 hours) significantly improved diagnostic accuracy (91%) and led to more treatment changes (86%) compared to delayed imaging (>48 hours). According to drug utilisation patterns, antibiotics were administered the most (81.5%) with common adverse drug reaction diarrhoea. In conclusion, this study identifies important clinical and demographic variables that affect how pediatric lower respiratory tract infections are managed. The results highlight the advantages of early imaging in enhancing diagnostic precision and directing therapy modifications and they highlight distinct radiological patterns associated with the severity of the disease. Drug utilisation studies revealed frequently used medications, such as antibiotics, NSAIDs, bronchodilators and corticosteroids and associated ADRs. By understanding these patterns healthcare providers can enhance the outcomes for pediatric patients.

INTRODUCTION

Pediatric lower respiratory tract infections (LRTIs) can present with a variety of clinical symptoms and outcomes, which are a leading cause of hospitalization and illness in children[1,2]. It is important to identify LRTIs early and accurately to start the right therapies and reduce the risk of complications[3]. From viral infections like pneumonia and bronchiolitis to more serious bacterial infections, pediatric LRTIs can present with various clinical symptoms, each of which requires a different approach to treatment. For the diagnosis and continuous monitoring of LRTIs in children, radiological imaging is essential[4]. Clinical decision-making is greatly impacted by imaging timing and the selection of appropriate modalities, such as CT, ultrasonography and X-rays. Understanding the way various imaging modalities contribute to the identification of radiological patterns can help physicians assess the severity of a disease and adjust treatment regimens accordingly[5,6]. Understanding drug usage patterns is as crucial when managing LRTIs in children[7,8]. The worldwide problem of antimicrobial resistance is exacerbated by the over prescription of antibiotics, despite their need[9]. In addition to antibiotics, drugs such as corticosteroids, NSAIDs and bronchodilators are frequently used to control the course of the disease and relieve symptoms. Adverse drug responses (ADRs), which were mostly linked to LRTI-mandated medications, highlight the importance of cautious prescription and close monitoring[10,11]. The study investigates the intricate relationship between radiological results, prescription recommendations and pediatric LRTI treatment, proposing optimal clinical practices by evaluating common drug regimens and imaging techniques.

Aims of the Study: This study aims to assess the prevalence of radiological findings and drug utilization patterns in lower respiratory tract infections in Pediatric patients.

Objectives:
- To assess the prevalence of various lower respiratory tract infections in children of different ages.
- To explore the radiological patterns seen in lower respiratory tract infections in pediatric patients.
- To analyze the clinical relevance of radiological findings and their correlation with the severity of viral pneumonia in children.
- To evaluate the impact of imaging timing on the accuracy of diagnosis and treatment adjustments for pediatric lower respiratory tract infections.
- To determine patterns of prescribed medications for the treatment of lower respiratory tract infections in children and the adverse drug reactions (ADRs) that have been associated.

MATERIALS AND METHODS

Study Setting: The study was carried out at RVM Institute of Medical Sciences in Laxmakkapalli Village, Siddipet District, Telangana. The hospital's advanced facilities and wide patient range made it an ideal setting to assess radiology utilization, drug prescription patterns and their associations with clinical and demographic characteristics in pediatric patients.

Study Design: This retrospective study examines the medical records of children who were diagnosed with lower respiratory tract infections (LRTIs) in a tertiary care hospital. The study focuses on assessing variables such as demographics, clinical conditions, radiological results, drug utilisation, antibiotic prescriptions and adverse drug reactions (ADRs).

Study Population: In this study, 260 pediatric patients who received treatment at RVM Institute of Medical Sciences for lower respiratory tract infections (LRTIs) were retrospectively analyzed.

Study Period: The study conducted a thorough examination of patient records over a one-year period, from July 2022 to June 2023.

Inclusion Criteria: This study included children ages 0-5 years who were treated at the RVM Institute of Medical Sciences during the study period with the diagnosis of lower respiratory tract infections (LRTIs). The study focused on medical records that detailed radiological treatments, patient demographics, medicine prescriptions, antibiotic usage and the rationale for these procedures.

Exclusion Criteria: The study excluded patients with incomplete medical records or those who were not admitted at the RVM Institute of Medical Sciences throughout the study period. Additionally, to ensure that the study concentrated on standard paediatric LRTI therapy and management, children with conditions beyond the scope of LRTIs that needed expert care were excluded.

Data Collection: For this study, a retrospective analysis of medical records was carried out to collect detailed information on pediatric patients at the RVM Institute of Medical Sciences who were diagnosed with lower respiratory tract infections (LRTIs). Age, gender and other demographic data were gathered for the study. Radiological findings, such as consolidation, ground-glass opacities, pleural effusion and other abnormalities noted. To evaluate its impact on the precision of diagnosis and therapy modifications, the time of imaging following admission was also documented. Data on prescribed drugs and any related adverse drug responses were also recorded.

Statistical Analysis: The prevalence of the disease among various age groups and the distribution of radiological patterns seen in patients with lower respiratory tract infections (LRTIs) were assessed using a descriptive analysis. Comparative analysis was conducted to compare diagnostic accuracy and treatment adjustments between early and delayed imaging groups, as well as to assess the distribution of radiological findings across different disease severity groups. Descriptive statistics were used to assess the patterns of drug usage and related adverse drug reactions in the treatment of pediatric LRTIs.

Ethical Considerations: To preserve participant privacy and confidentiality, all data were anonymized, ensuring that no personal identifiers were utilized throughout the data collection or analysis process.

RESULTS AND DISCUSSIONS

This study evaluated 260 pediatric patients with lower respiratory tract infections, including disease frequency across age groups, radiological findings, the effect of imaging timing on diagnosis and therapy modifications and drug usage patterns The distribution of respiratory infections, the frequency of radiological patterns, the relationships between illness severity and imaging results and the frequently prescribed drugs classes and related adverse drug reactions (ADRs) are highlighted in (Tables 1-4). (Table 1) shows the prevalence of various pediatric lower respiratory infections for each age group. Among the 260 patients, the age group of 1-12 months had the highest prevalence of viral pneumonia (34 cases, 26%) and bronchiolitis (38 cases, 29%).The most frequent condition in the 12-36-month group was still bronchiolitis (21 cases, 23%), followed by viral pneumonia (20 patients, 22%). In comparison to other groups, the 36-60 month group had the lowest prevalence of bronchiolitis (4 cases, 10%) and viral pneumonia (7 cases, 17%). The most prevalent respiratory illness across all age groups was bronchiolitis (63 cases, 24%), closely followed by viral pneumonia (61 cases, 23%). There were no statistically significant variations in the prevalence of respiratory infections (p>0.05) indicating a relatively consistent distribution across all age groups. The radiological characteristics seen in pediatric respiratory illness patients are summarized in (Table 2). Descriptive analysis indicates that consolidation was the most often seen radiological finding, appearing in 122 cases (46.9%). There were 71 patients (27.3%) with ground-glass opacities and 27 cases (10.4%) with pleural effusion. There were pleural effusion, atelectasis and bronchial wall thickening with 27 (10.4%), 14 (5.4%) and 19 (7.3%) cases, respectively. (Table 3) analyses the impact of early and delayed imaging on the accuracy of diagnosis and adjustments

to treatment for LRTIs in the pediatric patients. When imaging was done within 48 hours, it contributed to more treatment adjustments (86%, 96 instances) and improved diagnostic accuracy (91%, 102 cases). In contrast, delayed imaging (done after 48 hours) demonstrated reduced treatment adjustments (78%, 115 cases) and diagnostic accuracy (82%, 121 cases). Significant differences between early and delayed imaging were found by statistical analysis (p-values <0.01 for diagnostic accuracy and <0.05 for therapy modifications), indicating that early imaging results in better treatment outcomes and more accurate diagnoses. The radiological findings for 61 cases of viral pneumonia in relation to the severity of the disease are presented in (Fig. 1). The radiographic findings of peribronchial thickening and poorly defined perihilar marks were the most prevalent among patients with mild disease (n=37), occurring in 59.5% of the cases. The most common observation in moderate disease (n=19) was bilateral patchy patches of consolidation, which were seen in 63.2% of the patients. Diffuse regions of airspace and lobar consolidation, seen in 63.6% of patients each, were present with severe illness (n=11). Significant variations in the distribution of radiological findings among severity groups were found by statistical analysis (p<0.05). (Fig. 1).

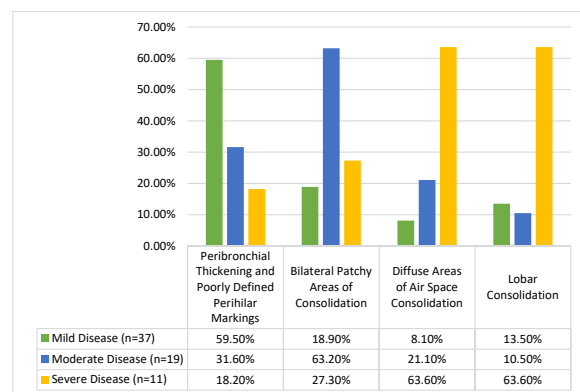|	Peribronchial Thickening and Poorly Defined Perihilar Markings	Bilateral Patchy Areas of Consolidation	Diffuse Areas of Air Space Consolidation	Lobar Consolidation
Mild Disease (n=37)	59.50%	18.90%	8.10%	13.50%
Moderate Disease (n=19)	31.60%	63.20%	21.10%	10.50%
Severe Disease (n=11)	18.20%	27.30%	63.60%	63.60%

Fig. 1: Radiological Findings and Disease Severity in Viral Pneumonia

(Table 4) illustrates the drug utilization patterns and associated adverse drug reactions (ADRs) in the management of LRTIs in pediatric patients. 212 (81.5%) patients received antibiotics, making them the most often prescribed medication class. The most prevalent adverse drug reaction (ADR) among antibiotic users was diarrhoea (6.5% of cases). 204 (78.5%) patients received nonsteroidal anti-inflammatory medicines (NSAIDs) and the most frequent adverse drug reaction (ADR) was gastrointestinal problems (4% of cases). Corticosteroids were provided to 87 (33.5%) patients,

Table 1: Prevalence of Pediatric Lower Respiratory infections

Disease	1-12 months (n=130)	12-36 months (n=90)	36-60 months (n=40)	Overall Prevalence (n=260)
Viral Pneumonia	34 (26%)	20 (22%)	7 (17%)	61 (23%)
Bronchiolitis	38 (29%)	21 (23%)	4 (10%)	63 (24%)
Bacterial Pneumonia	14 (11%)	12 (13%)	6 (16%)	32 (12%)
Croup	21 (16%)	8 (9%)	2 (4%)	31 (12%)
Chronic Bronchitis	5 (3.5%)	4 (4%)	2 (5.5%)	11 (4%)
Respiratory Syncytial Virus (RSV) Infection	23 (18%)	13 (14%)	2 (4%)	38 (15%)

Table 2: Radiological Patterns Observed in Pediatric Respiratory Infections

Radiological Pattern	Number of Cases (n)	Percentage (%)
Consolidation	122	46.9
Ground-glass opacities	71	27.3
Pleural Effusion	27	10.4
Atelectasis	14	5.4
Bronchial Wall Thickening	19	7.3
Others	7	2.7

Table 3: Impact of Early VS. Delayed Imaging on Diagnostic Accuracy and Treatment Adjustments

Imaging Timing	Number of Cases (t)	Diagnostic Accuracy (%) (n)	Treatment Adjustments (%) (n)
Early Imaging (<48 Hours)	112	91% (102)	86% (96)
Delayed Imaging (>48 Hours)	148	82% (121)	78% (115)

Table 4: Drug Utilization Patterns and Common ADRS in Pediatric LRTI Management

Drug Class	Number of Patients (%)	Most Common ADR
Antibiotics	212 (81.5%)	Diarrhoea
NSAIDs	204 (78.5%)	Gastrointestinal issues
Bronchodilators	118 (45.4%)	Tachycardia
Corticosteroids	87 (33.5%)	Oral thrush

with oral thrush being the most frequent adverse drug reaction (4.5% of cases), while bronchodilators were used in 118 (45.4%) patients, with tachycardia being the major adverse drug reaction (5.2% of cases). According to descriptive analysis, the most often used medications were NSAIDs and antibiotics and the distribution of adverse drug reactions (ADRs) was consistent across all drug classes. A comprehensive understanding of the disease patterns and suitable therapies are necessary for the effective management of pediatric lower respiratory tract infections (LRTIs)[12,13]. This study examines the prevalence of various respiratory illnesses, radiological patterns and highlighting the need of timely interventions and appropriate treatment choices.

Prevalence of Pediatric Lower Respiratory Infections: According to our study, the most common lower respiratory tract infection (LRTI) in children under five is bronchiolitis, which is followed by viral pneumonia. These findings are consistent with evidence from throughout the world showing that viruses are the main cause of respiratory illnesses in this age range[14]. Regional studies reveal varying prevalence rates of viral pneumonia, with some suggesting more cases due to differences in vaccine coverage and viral circulation[15]. Further research into pathogenesis and therapeutic approaches for common pediatric LRTI presentations may improve patient care and reduce complications.

Radiological Patterns Observed in Pediatric Respiratory Infections: The most common radiological result in our group was consolidation, which is in line with how pediatric pneumonia usually manifests[16,17].

Pleural effusion and ground-glass opacities were less common, although they have been shown in other studies to be indicators of serious bacterial or viral infections[18,19]. Understanding radiographic patterns is essential for early diagnosis, timely therapy, bacterial and viral infection identification, illness severity assessment and treatment initiation. The study underscores the necessity for further research on radiographic presentations to improve diagnostic accuracy and patient outcomes through early intervention.

Impact of Early vs. Delayed Imaging on Diagnostic Accuracy and Treatment Adjustments: Our study highlights the important role that early imaging plays in improving the accuracy of diagnosis and adjusting treatment for pediatric patients suffering from lower respiratory tract infections (LRTIs). When imaging was done within 48 hours, it was linked to better diagnosis accuracy and a greater incidence of treatment adjustments than when imaging was done later than 48 hours. The positive impacts of early imaging are consistent with other studies that show timely imaging can help with treatment options and enhance clinical outcomes for respiratory infections[20].

Radiological Findings and Disease Severity in Viral Pneumonia: Our study emphasizes the key radiological findings in pediatric viral pneumonia cases and how they relate to the severity of the illness. Peribronchial thickening and poorly defined perihilar markings are common in mild cases, with bilateral patchy consolidation, diffuse airspace consolidation and lobar consolidation becoming more prominent as the disease severity increases. These findings are

consistent with previous studies that found similar patterns to be the indicators of greater severity[21]. According to these findings, certain radiological patterns are more suggestive of the progression of the disease, highlighting the need for a thorough radiological assessment when determining the severity of viral pneumonia.

Drug Utilization Patterns and Adverse Drug Reactions in Pediatric LRTI Management: Our study indicates the widespread usage of several drug classes, with antibiotics being the most often given, in the treatment of pediatric lower respiratory tract infections (LRTIs). Our study's findings about the prevalence of adverse drug reactions (ADRs), such diarrhoea linked to antibiotic usage, necessitate close observation and treatment. Our findings are similar to previous research suggesting the significance of optimizing medication use in pediatric LRTI therapy while maintaining a balance between efficacy and safety[22,23].

Limitations and Areas for Future Research: Although this study provides insightful information on LRTIs in pediatric patients, it has a few limitations. The single-center, retrospective methodology of this study is one of its drawbacks, which might restrict how broadly the results can be generalized and include biases like missing data. Additionally, it lacked an evaluation of long-term results and failed to investigate the function of advanced imaging methods in complex cases. The results may have been impacted by the exclusion of important variables such genetic predispositions, environmental exposures and socioeconomic status. Future studies on pediatric LRTIs should concentrate on long-term results and modern diagnostic tools. It should also investigate cost-effectiveness of treatment options, genetic and environmental impacts and preventative measures.

CONCLUSION

This study emphasizes how important it is to understand drug utilization patterns, radiological findings and clinical presentations in pediatric LRTIs. Our findings show that early imaging enhances the accuracy of diagnosis and treatment adjustments, highlighting the importance of timely interventions. Notable radiological patterns related to the severity of the disease provide valuable guidance for diagnosis and treatment approaches. The analysis of drug utilisation underscores the necessity for appropriate prescribing practices by highlighting the frequency of antibiotics and prevalent adverse drug reactions. Future research should concentrate on developing diagnostic tools, optimizing therapeutic procedures and exploring prophylactic measures to enhance the treatment and outcomes of pediatric respiratory infections.

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