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Original Article

Antibiotic Prescription Patterns in Children with Pneumonia at the Waled Regional General Hospital in Cirebon Regency, West Java, 2023

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Abstract

Irrational antibiotic use and inappropriate prescribing in pneumonia remain major public health concerns, as they contribute significantly to the development of antimicrobial resistance worldwide. This study aimed to describe the pattern of antibiotic prescribing for pneumonia patients under five years old treated at Waled Hospital, Cirebon Regency, in 2023. A descriptive study design was employed using medical record data, with total sampling applied to all eligible cases. Data were analyzed using univariate analysis and presented as frequencies and percentages. A total of 193 pediatric pneumonia cases were included, consisting of both inpatients and outpatients. Lobular pneumonia was the most common diagnosis in both groups. The majority of patients were one year of age. Third-generation cephalosporins were the most frequently prescribed antibiotic class for inpatients (62.3%) and outpatients (89.1%). Parenteral antibiotic formulations were predominantly administered to inpatients, whereas oral antibiotics were used for all outpatients. The duration of antibiotic therapy was appropriate in all cases. Adverse drug reactions were observed in a small proportion of inpatients and were not reported among outpatients. The predominant use of third-generation cephalosporins, particularly in outpatient settings, suggests a potential overreliance on broad-spectrum antibiotics and may reflect deviation from standard first-line treatment recommendations for pediatric pneumonia. These findings highlight the need for regular evaluation of prescribing practices and the implementation of antimicrobial stewardship programs to promote rational antibiotic use and reduce the risk of resistance.

Keywords: Antibiotic Prescribing Patterns, Pneumonia, Toddler Patient.

1. Introduction

Pneumonia remains a leading cause of morbidity and mortality among children under five years old globally, particularly in developing countries. Annually, approximately 800,000 toddlers succumb to this respiratory infection, with Indonesia ranking among the top 15 countries with the highest number of cases, accounting for around 19,000 deaths each year (UNICEF, 2019). The World Health Organization (WHO) has highlighted the vulnerability of this age group due to their underdeveloped immune systems, which makes them more susceptible to widespread and rapid infections (Arista et al., 2023). The burden of this disease is significant, with national data from the Indonesian Ministry of Health showing that 38.78% of toddlers in the country were affected by pneumonia in 2022. This prevalence is particularly high in West Java, which holds the eighth position with a staggering 44.9% of cases (Kemenkes, 2023). Within Cirebon City specifically, a report from 2021 indicated 1,475 cases

of toddler pneumonia, representing 84.8% of the total toddler population in the city (Dinas Kesehatan Kabupaten Cirebon, 2022).

The classification of pneumonia, whether lobar, lobular, or interstitial, plays a crucial role in diagnosis and treatment. Lobular pneumonia, in particular, is frequently observed in infants and young children and is often a secondary infection following upper respiratory tract infections or other debilitating illnesses (Arista et al., 2023). The high incidence of lobular pneumonia in this age group has been consistently documented in various studies (Feng et al., 2025; Supriandi & Mansyah, 2018). While antibiotic therapy is a key component in the clinical management of pneumonia, its irrational use is a major and persistent health challenge that leads to antibiotic resistance. This issue is a global concern affecting both developed and developing nations (Bengoechea & Sa Pessoa, 2019). The misuse or overuse of antibiotics not only fails to effectively treat the infection but also accelerates the development of multidrug-resistant bacteria, complicating future treatments.

The indiscriminate use of antibiotics represents a significant health concern, leading to a global crisis of antimicrobial resistance. This issue arises from various factors, including incorrect prescribing, non-adherence to treatment regimens, and the use of broad-spectrum antibiotics when not clinically necessary. In the context of pediatric pneumonia, the problem is particularly acute given the vulnerability of young patients and the need for precise, evidence-based treatment. Studies have consistently shown that the prescribing of third-generation cephalosporins is a common practice in many hospitals (Anggi, 2019; Worotikan et al., 2019). This widespread use is often due to their broad-spectrum activity, making them a default choice when the specific causative pathogen is unknown (Utsman & Karuniawati, 2020). Yet, this practice contributes to the escalating resistance of common bacterial strains.

Furthermore, the choice of antibiotic formulation whether oral or parenteral is a critical aspect of rational prescribing. While oral administration is safer and more convenient for less severe cases (Pudjiadi et al., 2011), the use of parenteral formulations is often prevalent in inpatient settings to ensure rapid and consistent drug delivery (Kawaguchi et al., 2022). The duration of antibiotic therapy also presents a challenge. Although guidelines recommend a minimum duration to ensure complete eradication of the infection, a lack of adherence can lead to treatment failure and increased resistance. Moreover, the potential for adverse drug reactions, even if infrequent, requires close monitoring, especially in pediatric patients whose metabolic and elimination capacities differ significantly from adults (Ratman, 2019). All these factors combined underscore the need for a thorough evaluation of prescribing practices to ensure patient safety and combat antibiotic resistance.

Given the persistent high prevalence of pneumonia in toddlers in the Cirebon Regency and the global challenge of antibiotic resistance, an in-depth analysis of local prescribing patterns is urgently needed. While previous studies have examined similar topics in other regions, this study is novel as it provides a specific and detailed snapshot of the antibiotic prescribing patterns at Waled Regional General Hospital in Cirebon Regency, West Java, for the year 2023. This research aims to address the existing knowledge gap regarding the specific types, formulations, durations, and adverse effects of antibiotics being prescribed for this patient group. This study aims to describe and evaluate the antibiotic prescribing patterns for pneumonia in children under five at Waled Hospital, Cirebon Regency, against the backdrop of rational use principles and relevant treatment guidelines. By providing a comprehensive overview of these patterns, the findings of this study can serve as a crucial basis for developing more rational prescribing policies and guidelines, ultimately contributing to improved clinical outcomes for patients and a more effective strategy in the fight against antimicrobial resistance.

2. Literature Review

2.1. The Global and National Burden of Pneumonia in Toddlers

Pneumonia remains a critical public health issue worldwide, particularly affecting children under five years of age. It is the leading infectious cause of death for children in this age group, responsible for the deaths of approximately 800,000 toddlers globally each year (UNICEF, 2019). The World Health Organization (WHO) has underscored that children's underdeveloped immune systems make them highly susceptible to this infection, allowing for rapid spread and severe outcomes (Ulfa, 2020). The morbidity and mortality rates from pneumonia are disproportionately high in developing nations, including Indonesia, which is one of 15 countries with the highest number of toddler pneumonia-related deaths, reaching an estimated 19,000 cases annually (UNICEF, 2019).

In Indonesia, national data from the Ministry of Health reported that 38.78% of toddlers suffered from pneumonia in 2022 (Kemenkes, 2023). West Java Province ranks among the highest in prevalence, with 44.9% of total cases in the country (Kemenkes, 2023). Specifically, in Cirebon City, there were 1,475 reported cases of toddler pneumonia in 2021, accounting for 84.8% of the toddler population (Dinas Kesehatan Kabupaten Cirebon, 2022). These statistics highlight the significant epidemiological burden of the disease at the local level and the urgent need for effective management and prevention strategies.

2.2. Pathophysiology and Classification of Pediatric Pneumonia

Pneumonia is an infection of the lung parenchyma, which can be acquired through various pathways, including inhalation, aspiration, or hematogenous spread (Bengoechea & Sa Pessoa, 2019). Clinically, pneumonia is classified based on the anatomical area of the lung affected: lobar pneumonia, lobular pneumonia (bronchopneumonia), and interstitial pneumonia. Bronchopneumonia, defined as inflammation originating in the terminal bronchioles and extending to the alveoli, is the most common form found in young children and infants (Ulfa, 2020). This type of pneumonia is often secondary to an upper respiratory tract infection and is typically caused by bacteria such as Streptococcus pneumoniae and Haemophilus influenzae (Ulfa, 2020).

Multiple studies have confirmed the high prevalence of bronchopneumonia in toddlers. For instance, a study by Supriandi and Mansyah (2018) in Palangka Raya, Indonesia, found that 48% of pediatric pneumonia cases were bronchopneumonia, while a similar study by Nopriyanti (2018) in Bantul reported a higher frequency of 57.8%. These findings are consistent with the results of a study conducted by Feng et al. (2025) in Beijing, China, which also showed bronchopneumonia as the most common type.

2.3. Patient Demographics and Associated Risk Factors

Numerous demographic factors are associated with a higher risk of pneumonia in toddlers (Suminar, 2022). Gender is one such factor, with male toddlers generally showing a higher susceptibility to pneumonia (Astuti Wulandari et al., 2022). This may be due to the narrower diameter of the male airway compared to females, as well as the immunosuppressive effects of testosterone, which contrasts with the immune-boosting effects of estrogen (Utsman & Karuniawati, 2020; Sofia et al., 2021). A study by Sofia et al. (2021) in Bandung found that 53.1% of their pediatric pneumonia patients were male, and similar results were reported by Panji Usman et al. (2020) in Surakarta (61.22%) and Damayanti et al. (2022) in Malang (57.27%).

Further, age is a critical determinant of susceptibility. The highest incidence of pneumonia occurs in children under the age of one (Utsman & Karuniawati, 2020; Sofia et al.,

2021). This is attributed to the immaturity of their cellular and humoral immune systems, which renders them more vulnerable to infectious diseases (Sofia et al., 2021). Similarly, research by Utsman and Karuniawati (2020) in Surakarta found that the majority of cases (83.67%) were in the 1-24 month age group, while a study in Malang by Damayanti et al. (2022) reported that the highest frequency of cases (58.18%) was among children aged 2-12 months.

2.4. Antibiotic Prescribing Patterns and Rationality

Antibiotic therapy is the cornerstone of pneumonia treatment. However, the irrational use of antibiotics defined by incorrect choice, duration, or administration route which contributes significantly to the global challenge of antimicrobial resistance. The most commonly prescribed class of antibiotics for pediatric pneumonia is third-generation cephalosporins (Utsman & Karuniawati, 2020; Sofia et al., 2021). These drugs are favored for their broad-spectrum activity, which is beneficial when the specific causative pathogen is unknown (Utsman & Karuniawati, 2020). Studies in various regions of Indonesia, including Bandung, Indramayu, and Surakarta, have shown that cephalosporins, particularly ceftriaxone and cefixime, are the most frequently prescribed antibiotics for this condition (Sofia et al., 2021).

The route of administration is another key aspect of prescribing patterns. Parenteral (injectable) administration is widely used for inpatients due to its rapid and consistent therapeutic effect, especially for patients who are uncooperative or have difficulty swallowing (Alaydrus, 2017). Conversely, oral antibiotics are the preferred choice for outpatients with less severe illness as they are considered safer and more convenient (Pudjiadi et al., 2011). The duration of antibiotic use is also critical for ensuring a complete cure and preventing resistance. Adherence to a minimum five-day course of antibiotics, even after clinical symptoms improve, is suggested by international guidelines to fully eradicate the bacterial infection (American Thoracic Society & Infectious Diseases Society of America, 2005).

3. Methods

This study employed a descriptive, observational, and retrospective research design to investigate the antibiotic prescribing patterns for toddler pneumonia patients at Waled Regional General Hospital in Cirebon Regency in 2023. This approach allowed for a comprehensive overview of the research variables as they occurred naturally, without any intervention from the researchers (Sugiyono, 2021). The retrospective nature of the study, which relies on analyzing pre-existing data, is a standard and efficient method for evaluating clinical practices, particularly when assessing prescribing patterns and clinical outcomes over a specific time period (Creswell, 2014; Sudaryono, 2018).

3.1. Population, Sample, and Data Collection

The study population consisted of all toddler pneumonia patients treated at Waled Regional General Hospital in 2023. A total sampling technique was used, meaning all patients who met the inclusion criteria were included in the sample. This technique is highly effective when the population size is manageable, as it eliminates sampling error and provides a complete picture of the phenomenon being studied (Emzir, 2012). The inclusion criteria were defined as all patients with a complete medical record containing information on the variables of interest: pneumonia classification, age, gender, type of antibiotic, antibiotic formulation, duration of use, and any reported adverse effects. The exclusion criteria were incomplete medical records and cases where the patient passed away at the hospital in 2023. This meticulous selection process ensures the integrity and reliability of the data.

3.2. Research Instrument and Data Analysis

The primary research instrument was a data collection form used to extract secondary data from the patients' medical records (Sudaryono, 2018). The variables collected included patient demographics (age and gender), disease characteristics (pneumonia classification), and antibiotic-related factors (type, formulation, duration, and adverse effects). This study received ethical clearance from the UGJ Faculty of Medicine Ethics Committee, with approval number 000.9.2/056/KEPK/V/2024, ensuring all research was conducted in an ethical manner. The collected data were analyzed using univariate analysis, which aimed to provide a clear description of the frequency distribution of each variable (Sugiyono, 2021). This method is well-suited for descriptive studies as it allows for the presentation of the study findings in a straightforward manner using percentages and frequencies, which effectively illustrates the antibiotic prescribing patterns for the target population. All data processing was conducted using appropriate statistical software to ensure accuracy and to generate the results presented in this paper.

4. Results and Discussion

4.1. Research Results

The results of research conducted at Waled Regional General Hospital in Cirebon Regency based on 193 medical records are as follows:

Table 1. Distribution of Pneumonia Classification in Toddler Patients at Waled Hospital, 2023

Pneumonia	Pneumonia Lobaris (%)	Pneumonia Lobularis (%)	Total
Inpatient Care	25,7	74,3	100,0
Outpatient Care	29,3	70,7	100,0

Table 1 shows that among 193 pediatric pneumonia patients at Waled Regional General Hospital in Cirebon Regency, lobularis pneumonia was the most common classification, accounting for 75 inpatients (74.3%) and 65 outpatients (70.7%). Conversely, lobaris pneumonia was the least common, with 26 inpatients (25.7%) and 27 outpatients (29.3%).

Table 2. Gender Distribution of Pneumonia Toddler Patients at Waled Hospital, 2023

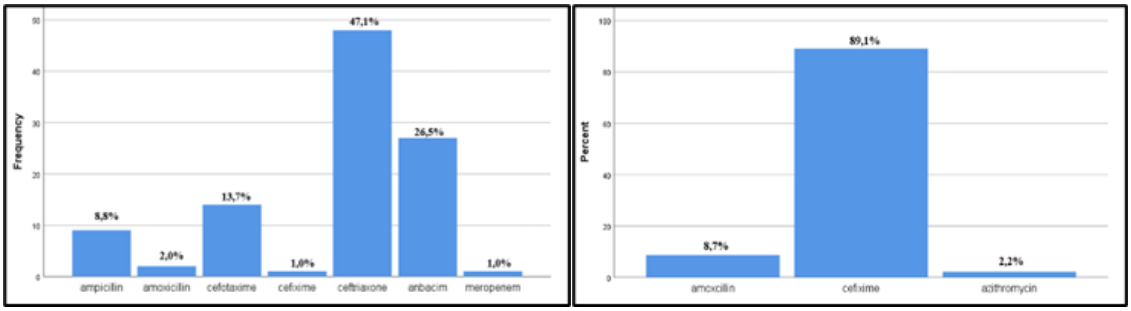
Gender	Male (%)	Female (%)	Total
Inpatient Care	51,5	48,5	100,0
Outpatient Care	54,3	45,7	100,0

Table 2 shows that among 193 pediatric pneumonia patients at Waled Hospital, males had a slightly higher incidence in both inpatient care (52 patients, 51.5%) and outpatient care (50 patients, 54.3%). Females accounted for 49 inpatients (48.5%) and 42 outpatients (45.7%).

Table 3. Age Distribution of Pneumonia Patients in Under-Five Children at Waled Hospital, 2023

Age	1 years old (%)	2 years old (%)	3 years old (%)	4 years old (%)	5 years old (%)	Total
Inpatient Care	38,6	22,8	14,9	8,9	14,9	100,0
Outpatient Care	33,7	28,3	15,2	9,8	13	100,0

Table 3 shows that among 193 pediatric pneumonia patients at Waled Hospital, the highest incidence occurred in 1-year-olds, with 39 inpatients (38.6%) and 31 outpatients (33.7%).



Types of Inpatient Antibiotics Types of Outpatient Antibiotics

Figure 1. Distribution of Antibiotic Types for Pneumonia Toddler Patients at Waled Hospital, 2023

Figure 1 shows that among 193 pediatric pneumonia patients at Waled Hospital, the most commonly used antibiotic for inpatients was ceftriaxone, a third-generation cephalosporin, accounting for 48 cases (47.1%). For outpatients, cefixime, also a third-generation cephalosporin, was most frequently prescribed, with 82 cases (89.1%).

Table 4. Distribution of Antibiotic Formulations for Pneumonia Toddler Patients Waled Hospital, 2023

Antibiotic Preparations	Oral (%)	Parenteral (%)	Total
Inpatient Care	3	97	100,0
Outpatient Care	100,0	0	100,0

Table 4 shows that among 193 pediatric pneumonia patients at Waled Hospital, inpatients predominantly received parenteral antibiotics (98 patients, 97%), while all outpatients received oral antibiotics (92 patients, 100%).

Table 5. Appropriateness of Antibiotic Duration for Pneumonia Toddler Patients at Waled Hospital, 2023

Duration of Use Antibiotics	Appropriate (%)	Inappopriate (%)	Total
Inpatient Care	100	0	100,0
Outpatient Care	100	0	100,0

Table 5 shows that among 193 pediatric pneumonia patients at Waled Hospital, antibiotic duration was appropriate for all patients in both inpatient (101 patients, 100%) and outpatient (92 patients, 100%) settings.

Table 6. Antibiotic Side Effects in Pneumonia Toddler Patients at Waled Hospital, 2023

Side Effect	Yes (%)	No (%)	Total
Inpatient Care	6	94	100,0
Outpatient Care	0	100	100,0

Table 6 shows that among 193 pediatric pneumonia patients at Waled Hospital, side effects occurred in 6 inpatients (6%), while no outpatients experienced side effects (92 patients, 100%).

4.2. Discussion

This observational, retrospective study was conducted from May to June 2024 to analyze secondary data from the medical records of pediatric pneumonia patients at Waled Hospital during 2023. The research aimed to determine the prevalence of pneumonia in toddlers based on classification, gender, age, antibiotic type, antibiotic formulation, treatment duration, and side effects. The findings revealed a total of 193 pediatric pneumonia patients at the hospital in 2023.

4.2.1. Patient Demographics and Clinical Characteristics

The study found that the highest prevalence of pneumonia was the lobular classification, affecting 75 (74.3%) inpatients and 65 (70.7%) outpatients. In contrast, lobar pneumonia was less common, found in 26 (25.7%) inpatients and 27 (29.3%) outpatients. Lobular pneumonia is frequently observed in young children and infants, often caused by bacteria like Streptococcus pneumoniae and Haemophilus influenzae. This finding aligns with similar studies by Supriandi & Mansyah (2018) in Palangka Raya and Feng et al. (2025) in Beijing, China, which also reported higher frequencies of lobular pneumonia.

Regarding gender, the results showed that male toddlers were more affected, with 52 (51.5%) inpatients and 50 (54.3%) outpatients. Female patients were less prevalent, with 49 (48.5%) inpatients and 42 (45.7%) outpatients. This is consistent with the theory that male toddlers have narrower airways, making them more susceptible to respiratory infections (Garina et al., 2016). Additionally, hormones like testosterone may suppress the immune response, whereas estrogen can enhance it (Garina et al., 2016). This result is supported by previous research from Sofia et al. (2021) in Bandung, Utsman and Karuniawati (2020) in Surakarta, and Damayanti et al. (2022) in Malang, all of which found a higher incidence of pneumonia in male children.

In terms of age, the highest frequency was observed in one-year-old toddlers, accounting for 39 (38.6%) inpatients and 31 (33.7%) outpatients. The World Health Organization (WHO) attributes this to the underdeveloped immune systems of children under five, which makes them more vulnerable to infections. This is supported by studies from Sofia et al. (2021) and Utsman and Karuniawati (2020), which reported the highest rates of pneumonia in toddlers between 0 and 24 months old.

4.2.2. Antibiotic Usage and Outcomes

The most frequently prescribed antibiotic was a third-generation cephalosporin, used in 63 (62.3%) inpatients and 82 (89.1%) outpatients. These antibiotics are widely used for pneumonia of unknown etiology due to their broad-spectrum activity against Enterobacteriaceae and penicillin-resistant strains. This finding is in line with studies by Utsman and Karuniawati (2020), Anggi (2019), and Sofia et al. (2021), which also found a high prevalence of third-generation cephalosporin use.

For the antibiotic formulation, parenteral administration was predominant for inpatients, with 98 patients (97%) receiving injections. In contrast, all 92 (100%) outpatients received antibiotics orally. The use of injections for inpatients is beneficial for achieving faster, more consistent effects, especially in uncooperative or unconscious patients (Pradiningsih et al., 2021). Oral antibiotics are considered safer for children with less severe pneumonia who can swallow easily (Pudjiadi et al., 2011). These findings are consistent with research by Alaydrus (2018) and Sinaga (2021), who also reported a high use of injectable antibiotics.

The study found that the duration of antibiotic use was appropriate for all patients, with 101 (100%) inpatients and 92 (100%) outpatients receiving the correct duration of treatment. Rational antibiotic use is crucial for clinical improvement and preventing bacterial resistance.

According to guidelines from the American Thoracic Society & Infectious Diseases Society of America (2005), a minimum of five days of treatment is recommended for adults with pneumonia to ensure complete bacterial eradication. This finding is supported by study from Damayanti et al. (2022), which also found a high rate of appropriate antibiotic duration.

Finally, regarding side effects, only 6 (6%) inpatients experienced side effects, while none of the 92 outpatients did. The presence of side effects in children is a recognized risk due to their different drug absorption, distribution, metabolism, and elimination capacities compared to adults. However, the low incidence rate aligns with findings from other studies (Alaydrus, 2018; Anggi, 2019; Utsman & Karuniawati, 2020), which also reported few or no side effects among pediatric pneumonia patients.

5. Conclusion

This study summarises descriptive findings on antibiotic prescribing patterns in paediatric pneumonia patients at Waled Regional General Hospital in 2023. The most common diagnosis was lobular pneumonia, with the largest patient group being one-year-old boys. Third-generation cephalosporins were the most commonly prescribed antibiotics for both inpatients and outpatients. In terms of administration route, prescribing practices were considered rational, with parenteral antibiotics used for inpatients and oral preparations for outpatients according to the patient's clinical condition.

Nevertheless, the dominant use of broad-spectrum antibiotics in the form of third-generation cephalosporins, especially in outpatients, is a major concern because it may not be fully in line with first-line therapy guidelines that recommend narrow-spectrum antibiotics when clinically indicated. A positive finding from this study is 100% compliance with the duration of antibiotic use according to treatment guidelines. Therefore, the results of this study indicate the need for periodic clinical audits and the implementation of antimicrobial stewardship programmes in hospitals to encourage the use of narrower-spectrum first-line antibiotics in accordance with national guidelines, in order to optimise treatment and prevent antimicrobial resistance.

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