An Overview of Antibiotic Utilization in Pediatric Pneumonia Patients at Tabanan Regional General Hospital

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Abstract. Pneumonia is one of the world's major health problems, especially in children. Empirical antibiotic therapy is the initial management of pneumonia in pediatrics. This is because the culture process is lengthy. To date, research on antibiotic use in pediatric pneumonia patients is limited. The purpose of this study was to analyze the demographic, clinical, and antibiotic therapy characteristics in pediatric patients with pneumonia at Tabanan Regional General Hospital. The method used in this study was descriptive observational with a cross-sectional approach. The data in this study were taken from the medical records of 102 patients. The results showed that most patients were between 1 and 12 months old (49%) and male (66.7%). The main symptoms were cough (84.3%), and most patients did not have comorbidities (70.6%). The duration of treatment was 1-7 days (96.1%). The type of antibiotic most commonly used was cephalosporin antibiotics, specifically ceftriaxone (93.1%), administered via the parenteral route (99%), with a duration of administration of 1-5 days (87.3%). This study concludes that pediatric pneumonia is predominantly experienced by boys under the age of 1 year. The primary antibiotic therapy is cephalosporin (ceftriaxone). Clinically, the majority of patients experience complaints of coughing without other accompanying illnesses.

Keywords: **pediatric pneumonia, antibiotic therapy, ceftriaxone**

1 Introduction

Pediatric pneumonia is a significant health issue worldwide, particularly in developing countries [1]. Studies report that more than 95% of pediatric pneumonia worldwide occurs in developing countries [2]. The incidence rate of pneumonia in children varies depending on the type of pneumonia experienced [1]. As many as 79.3% had community-acquired pneumonia (CAP), 14.4% hospital-acquired pneumonia, and 6.3% ventilator-associated pneumonia [1]. In Indonesia, 15% of total deaths in children are caused by pneumonia [3]. This causes pneumonia to be the second-highest cause of death in children under five years

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of age [3]. Factors that increase the risk of mortality in children are bacteremia and underweight [1]

The management of pneumonia includes antibiotics and supportive therapy [4,5]. Antibiotics are administered based on the type of microorganism causing the infection and the results of the sensitivity test [4,5]. Indeed, the culture process generally takes time, so empirical antibiotic therapy is a solution to treat the problems [4,5]. Empirical antibiotics are generally in the form of broad-spectrum antibiotics, making them useful for both Gram-negative and Gram-positive bacteria [4,5]. Meanwhile, supportive therapy can take the form of oxygen therapy, intravenous fluid administration, correction of electrolyte disorders, and administration of antipyretics, depending on the patient's clinical condition [5].

The first-line antibiotic therapy in pediatric pneumonia is amoxicillin [6]. Amoxicillin is capable of eliminating Streptococcus pneumoniae, the most prominent invasive bacterial pathogen [6]. However, studies in several private and government hospitals in Indonesia found that Ceftriaxone and Cefotaxim are the most commonly prescribed antibiotics [4,7].

A 2018 study found that 81.4% of antibiotic treatments were considered irrational [7]. Although other studies reported that 50% of patients had received appropriate therapy [4]. This irrational use of antibiotics can increase the risk of drug side effects and microbial resistance [4]. In addition, there can also be various other problems, such as an increased risk of superinfection, increased medical treatment costs, toxic effects of drugs, and an increase in the duration of hospitalization [4].

Based on the description above, it is evident that cases of childhood pneumonia remain high. Morbidity and mortality in developing countries remain high. Some studies also reported the existence of irrational prescriptions. Therefore, research related to the description of antibiotic use in pediatric pneumonia patients is crucial for establishing the basis for evaluating the suitability of therapy. This study has not been conducted at a research site; however, preliminary studies found 534 cases of pneumonia in 2022 at Tabanan Hospital. The results of this study are expected to be used as evaluation materials for rational antibiotic treatment.

2 Method

2.1 Ethics approval

This research has received ethical approval from the Research Ethics Commission of Tabanan Regional General Hospital, as indicated by letter number 445/693/TIMKORDIK/RSUD/2024, and a research permit from Tabanan Hospital, as indicated by letter number 445/697/TIMKORDIK/RSUD/2024.

2.2 Study design and population

This study employs an observational design with a cross-sectional approach. The sampling technique used is consecutive sampling. The research was conducted at Tabanan Hospital from June 2024 to September 2024. The sample for this study consisted of 102 participants. The inclusion criteria are pediatric patients diagnosed with pneumonia based on the medical record, aged 0-18 years, and inpatient patients recorded in the hospital register between January 2022 and December 2022. The exclusion criterion is incomplete medical record data.

2.3 Data collection

All data is obtained through medical records. The data include age, gender, primary complaints upon hospital admission, treatment duration, comorbidities, antibiotics administered, route of administration, and duration of antibiotic administration. All data is then processed with SPSS. The processes analyzed include frequency distributions of demographic data, clinical characteristics, and antibiotic therapy. The research data is presented in narrative and tabular form.

3 RESULT AND DISCUSSION

3.1 Demographic Characteristics

The results showed that the majority of patients were children aged 1 month to 12 months (49%) and male (66.7%) (Table 1). These results are in line with research conducted at Ibnu Sina Hospital Makassar, which found that pneumonia was more common in men (52.5%) and the 0-12-month age group (25.2%) [8]. These results are also in line with research conducted at Ulin Banjarmasin Hospital. The study found that the majority of pediatric pneumonia cases occurred in boys (58.16%), aged between 0 and 2 years (83.67%). However, another study found that although pneumonia was more common in boys (54% of cases), 86% of pneumonia cases generally occurred between the ages of 2–36 months [9]. Age is one of the key factors that influence the occurrence of CAP in children. This is because the immune system has not been fully developed in children.

Table 1. Demographic characteristics of pediatric pneumonia patients

Characteristic	Frequency (n = 102)	Percentage (%)
Age		
0 - ≤1 month	1	1.0
>1 - ≤12 months	50	49.0
1 - ≤5 years	33	32.4
>5 – 18 years	18	17.6
Gender		
Male	68	66.7
Female	34	33.3

3.2 Clinical features

Research indicates that the three primary symptoms observed in pediatric pneumonia patients are cough (84.3%), shortness of breath (65.7%), and fever (58.8%). In addition to these primary symptoms, patients also have other comorbidities such as: cold (39.2%), nausea and vomiting (10.8%), diarrhea (6.9%), seizures (5.9%), difficulty eating and drinking (5.9%), heartburn (1%), cyanosis lips (1%), abdominal pain (1%), and heart palpitations (1%).

Based on comorbidities, as many as 30 patients (29.4%) had comorbidities, and the rest did not (70.6%). Comorbidities experienced included febrile seizures (4.9%), gastroenteritis (2%), asthma (11.8%), anemia (5.9%), epilepsy and cerebral palsy (2%), acute diarrhea (2.9%), malnutrition (2%), epilepsy (1%), and gastritis (1%). Judging from the length of treatment, as many as 96.1% of patients were treated for 1-7 days, and only a small percentage were treated for 8-14 days (Table 2). The results of this study were similar to those of previous studies, which reported that 76% of patients had no comorbidities. The presence of comorbidities is also not a predictive factor in patient mortality [1,9]. Stunted children are reported to be more susceptible to disease [10]. However, previous studies have also reported that the majority of patients have a normal nutritional status and are not stunted [9]. Some

patients have been reported to experience comorbid diseases such as congenital heart disease and neurocognitive problems. Patients are generally treated at the PICU with a median length of stay of 9 days and an interquartile range (IQR) of 12 days [1].

Table 2. Clinical features of pediatric pneumonia patients

Clinical features	Frequency (n = 102)	Percentage (%)
Comorbidities		
Present	30	29,4
None	72	70,6
Length of treatment		
1 – 7 days	98	96,1
8 – 14 days	4	3,9

3.3 Antibiotic therapy pattern

The study revealed that most patients received cephalosporin antibiotic therapy, specifically ceftriaxone (93.1%), administered parenterally (99%), for 1-5 days (87.3%) (Table 3). These results align with a study conducted at Dr. M. Djamil Hospital, which found that ceftriaxone is the most commonly prescribed single antibiotic therapy for the management of childhood pneumonia (43.33%). In comparison, the most frequently prescribed combination of antibiotics is ampicillin and gentamicin (33.34%) [11]. Similar results were also found in a 2021 study at Sultan Syarif Mohamad Alkadrie Hospital, which reported that ceftriaxone was the most commonly prescribed single antibiotic (55%) compared to combination therapy, which accounted for only 45.67% [12].

Table 3. Use of antibiotics in pediatric pneumonia patients

Antibiotics therapy	Frequency (n = 102)	Percentage (%)
Types of antibiotics		
Aminoglycoside		
Amikacin	1	1,0
Cephalosporin		
Cefixim	1	1,0
Cefotaxime	1	1,0
Ceftriaxone	95	93,1
Cefuroxime	4	3,9
Delivery route		
Oral	1	1,0
Parenteral	101	99,0
Duration of administration		
1 – 5 days	89	87,3
6 – 10 days	13	12,7

However, this result differs from the recommendation for the first-line antibiotic in pediatric pneumonia cases, namely amoxicillin [6]. Amoxicillin is generally given for 10 days if there is no history of allergies [13]. This difference may have occurred because all patients in this study were inpatients and classified as moderate to severe cases [14]. Penicillin is reported to be effective in eliminating Streptococcus pneumoniae, the leading cause of pneumonia, due to its low minimum inhibitory concentration [14]. In cases of resistance, ceftriaxone is considered to be one of the most effective antibiotics against S.

pneumoniae [14]. Seftriaxone is more stable against many beta-lactamase-producing bacteria, has a broad spectrum of activity compared to penicillin, and can penetrate well into body fluids and tissues [14].

The duration of antibiotic use depends on the patient's condition [15]. If empirical therapy does not show improvement or the patient's condition deteriorates, the administration of antibiotics is adjusted according to the type of causative bacteria and the results of the sensitivity test [15]. Conversely, if the patient shows improvement, empirical therapy can be resumed [15].

This study revealed a typical pattern of antibiotic use in pediatric pneumonia patients at Tabanan Hospital, characterized by the dominance of parenteral ceftriaxone (93.1%), single therapy, and a short duration of administration (1–5 days in 87.3% of patients). Interestingly, most patients were infants under 1 year of age (49%), male (66.7%), without comorbidities (70.6%), and treated for less than 7 days (96.1%), reflecting the clinical profile of mild to moderate pneumonia treated with a short-course parenteral monotherapy approach. The lack of variation in antibiotics, the underutilization of combination therapies, and the tendency towards short-course parenteral monotherapy present a consistent yet straightforward picture of clinical practice. This pattern is quite interesting because it has the potential to reflect treatment efficiency strategies in refractive secondary service facilities, and can serve as a basis for evaluating the effectiveness and rationality of short-term antibiotic therapy in pediatric pneumonia at the regional level.

This study has several limitations, including its retrospective design, which relies on the completeness and accuracy of medical records. It also does not include laboratory results such as culture and sensitivity testing, which are crucial for assessing the appropriateness of antibiotic selection. Furthermore, it did not evaluate the relationship between antibiotic use and patient clinical outcomes. External factors such as drug availability and patient socioeconomic status, which can influence antibiotic use patterns, were not analyzed.

4 CONCLUSION

This study concludes that pediatric pneumonia is predominantly experienced by boys under the age of 1 year. The primary antibiotic therapy is cephalosporin (ceftriaxone). Clinically, the majority of patients experience complaints of coughing without other accompanying illnesses.

For further research, prospective or cohort studies are recommended that allow for the collection of more comprehensive clinical data, including microbiological culture results and antibiotic sensitivity testing. Further research should also consider analyzing patient clinical outcomes, such as length of hospitalization, symptom improvement, complications, and recurrence rates. Multicentric studies involving several hospitals in different regions can increase the generalizability of the findings. Furthermore, exploring external factors such as drug availability, hospital policies, and patients' socioeconomic backgrounds can provide a more comprehensive picture of the factors influencing the patterns and quality of antibiotic use in pediatric pneumonia.

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