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Analysis of the Rationality of Antibiotic Use in Pediatric Bronchopneumonia Patients and its Impact on Clinical Outcomes and Costs at RS Columbia Asia Pulomas Jakarta Period April 2024–April 2025

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ABSTRACT

Bronchopneumonia is one of the leading causes of morbidity and mortality in the pediatric population, especially in developing countries such as Indonesia. This condition also imposes a considerable economic burden due to the long duration of treatment and the frequent use of antibiotics, which are often inappropriate. This study aimed to evaluate the rationality of antibiotic administration in pediatric patients hospitalized with a diagnosis of bronchopneumonia at Columbia Asia Pulomas Hospital Jakarta during the period from April 2024 to April 2025, and to analyze its effect on clinical outcomes and treatment costs. This study used a retrospective cross-sectional design with a total sampling approach of 164 patients through a review of medical records and cost data. The rationality of antibiotic therapy was assessed using the Gyssens method, and the relationship between variables was analyzed using bivariate statistical tests. The study found that 71.9% of rational antibiotic use correlated with a higher clinical improvement rate of 80.5% compared to 52.2% for irrational antibiotic use (p = 0.000). However, there was no significant difference in the duration of hospitalization between rational antibiotic use (4.70 ± 0.82 days) and irrational antibiotic use (5.41 ± 2.25 days) (p = 0.612), nor in the total cost of hospitalization (rational use: Rp 15,956,032.66 ± Rp 5,568,892.10 vs. irrational use: Rp 18,801,283.94 ± Rp 11,292,810.87) (p = 0.658). These results emphasize the importance of antibiotic rationality analysis as an effort to improve clinical outcomes without having a significant impact on cost efficiency or treatment duration.

Keywords: pediatric bronchopneumonia, antibiotic rationality, clinical outcome, hospital costs, gyssens method

INTRODUCTION

Bronchopneumonia is the most common clinical manifestation of pneumonia among children and is the leading cause of death in those under five years of age worldwide (Putri & Amalia, 2023). According to a recent report from the World Health Organization (WHO), in 2021 the disease caused approximately 740,000 deaths in that age group, or about 14% of the total number of deaths among children under five (Kemenkes, 2024). This means that every 43 seconds, one child dies from pneumonia, with the annual death toll ranging from 700,000 to 800,000 cases (Harnofive et al., 2023; Kemenkes, 2024). Based on epidemiological data, the incidence rate of pneumonia in children reaches more than 1,400 cases per 100,000 children worldwide, with the highest mortality occurring in developing countries (Marangu & Zar, 2019; Sulung et al., 2021).

In Indonesia, pneumonia is a significant public health problem, especially in infants and toddlers (Sutriana et al., 2021). More than 19,000 children under five died from the disease in 2018, with 71 children affected every hour (UNICEF, 2019). According to data from Basic Health Research (RISKESDAS), the prevalence of pneumonia in Indonesia was 1.6% in 2013 and increased to 2.0% in 2018 (Aljufri et al., 2021). The incidence rate in DKI Jakarta was 2.3% in 2018 (Setiadi et al., 2019). Data from the Central Statistics Agency (BPS) in 2021 show that West Jakarta had the highest number of pneumonia cases, with 5,850 cases, while East Jakarta ranked second with 5,533 cases. DKI Jakarta is a province where this infectious disease spreads rapidly (BPS DKI Jakarta, 2023).

Pneumonia treatment in children requires a fairly high cost. According to a 2018 study at Sanglah Hospital, the cost of pneumonia treatment in children shows significant financial implications, with an average direct medical expenditure of Rp 3,838,270, direct non-medical expenses of Rp 1,443,076, and indirect costs of Rp 941,905—mainly due to the loss of parental productivity—showing considerable economic pressure on families (Yamananda et al., 2019). One of the main factors contributing to the high cost burden is the irrational use of antibiotics. Inaccuracies in the administration of antibiotics in terms of indications, drug type, dosage, and duration can result in bacterial resistance, prolong hospitalization, increase the risk of complications, and heighten the need for follow-up treatment (Unairnews, 2025). All of these factors ultimately increase the total cost of medical care and burden both the family economy and the healthcare system overall (Wulandari & Kusuma, 2021).

Antibiotics are the main treatment for bronchopneumonia in children, given that most cases are caused by bacterial infections. Empirical antibiotic treatment in hospitals is often necessary because the specific cause of bronchopneumonia usually cannot be clearly identified through laboratory examination upon admission (Sakaningrum & Kurnianta, 2023). Irrational use of antibiotics can lead to antimicrobial resistance, increased side effects, higher treatment costs, toxicity, a longer duration of hospitalization, and even higher mortality rates (Arora, 2022; Xavier et al., 2022). Studies in various hospitals show that errors in the administration of antibiotics—such as improper dosage, duration, or antibiotic choice—still frequently occur in children with bronchopneumonia. This contributes to increased antibiotic resistance and therapy failure, which often necessitate antibiotic switching and extended treatment (Esa et al., 2024; Xavier et al., 2022).

Differences in antibiotic resistance between Jakarta and other regions in Indonesia can be observed from the patterns of antibiotic use, resistance levels, and characteristics of the causative organisms. Recent studies have shown that in Jakarta, the use of broad-spectrum empirical antibiotics in pediatric bronchopneumonia tends to be higher and often irrational, increasing the rate of resistance, especially to antibiotics such as ampicillin, ceftriaxone, and tetracycline (Bidara et al., 2021; Suminar, 2022). Research at Yadika Pondok Bambu Hospital Jakarta showed differences in antibiotic use and resistance patterns compared to hospitals in Yogyakarta, influenced by variations in therapy standards, bacterial profiles, and hospital formularies (Bidara et al., 2021). Another contributing factor is the ease of access to antibiotics in large cities, which increases the risk of inappropriate use and accelerates the development of resistance (Limato et al., 2022; Siahaan et al., 2022). Therefore, antibiotic resistance in pediatric bronchopneumonia in Jakarta is higher than in other regions of Indonesia, indicating the need for stricter antibiotic surveillance in urban areas.

The use of antibiotics can be evaluated through qualitative or quantitative analysis. Qualitative analysis measures the quality of antibiotic use (Hanifah et al., 2022). Regulation of the Minister of Health of the Republic of Indonesia (PERMENKES) Number 8 of 2015 stipulates that institutions are required to implement the Antimicrobial Resistance Control Program (PPRA), with the goal of preventing resistant microorganisms. The regulation uses the Gyssens table to evaluate and classify the quality of antibiotics used (Sundariningrum et al., 2020). The advantage of this method lies in its flowchart format, which assesses all aspects of an antibiotic prescription—including effectiveness, toxicity, cost, and spectrum—while also evaluating dose, duration of treatment, administration interval, route, and timing (Anggraini et al., 2020).

Previous research in Jakarta on the use of antibiotics in pediatric bronchopneumonia has mostly focused on qualitative evaluation using the Gyssens method. The results showed that 51.9–68.1% of antibiotic use was considered rational, while the remainder involved errors in selection of type, dose, or duration (Putri et al., 2020). A 2020 study at Dr. Cipto Mangunkusumo Hospital found that 63.03% of antibiotic use in severe pneumonia cases in pediatric intensive care units was appropriate, while 36.97% was irrational—mainly related to incorrect duration of administration (category IIIA) and inappropriate dosage (category IIA) (Sundariningrum et al., 2020). A 2010 study at Sulianti Saroso Infectious Disease Hospital in Jakarta found that only 40.9% of antibiotic use was appropriate, while 43.8% did not match the indications or dosage (Katarnida et al., 2016). However, these studies have not included sufficient analysis of the economic impact of antimicrobial resistance (AMR) on treatment costs.

Evaluation of empirical antibiotic use in the treatment of pediatric bronchopneumonia is essential, especially in hospitals that treat patients with varying degrees of disease severity. Research at Columbia Asia Pulomas Hospital Jakarta is necessary, given that this hospital serves a diverse patient population in terms of age and nutritional status, providing insight into the challenges of managing bronchopneumonia in Indonesia. Recent data show a high incidence of pediatric bronchopneumonia in this hospital, with an average of 30–40 new cases per month. In addition, the duration of hospitalization is relatively long, averaging 5–7 days per patient, reflecting the severity of the disease and potential complications requiring further treatment. This poses a significant cost burden for both patients and the hospital, as longer treatment and possible complications lead to increased costs.

The main focus of this study is to analyze the relationship between the use of empirical antibiotics and clinical outcomes and treatment costs, and to explore potential improvements in antibiotic management that can reduce the cost burden while improving clinical outcomes for bronchopneumonia patients. This study will also examine the factors influencing antibiotic selection in the hospital. These findings are expected to provide valuable input for antibiotic management policies and offer practical recommendations for better bronchopneumonia treatment. Moreover, this study aims to inform healthcare providers and policymakers about the benefits of appropriate antibiotic use in reducing costs and improving the quality of care for patients with bronchopneumonia.

The use of antibiotics in pediatric patients with bronchopneumonia in hospitals still faces problems related to the rationality of therapy, including the selection of antibiotic type, dosage accuracy, and duration of administration in accordance with clinical guidelines. Inaccurate use of antibiotics can affect clinical outcomes, such as delayed symptom improvement, increased bacterial resistance, and prolonged hospitalization. This condition also directly increases treatment costs, including room fees, additional medications, and other medical services. Therefore, a thorough analysis of the rationality of antibiotic use in pediatric bronchopneumonia patients and its effect on clinical outcomes and treatment costs is essential. This study will address these issues through a retrospective analysis based on patient medical and financial records from April 2024 to April 2025.

METHOD

This study uses a cross-sectional design with a retrospective approach, utilizing secondary data obtained from electronic medical records and documentation of community service costs. The study subjects included all pediatric patients diagnosed with bronchopneumonia who were hospitalized at Columbia Asia Pulomas Hospital Jakarta during the period of April 2024–April 2025, with inclusion criteria focused on patients receiving antibiotic therapy during hospitalization. The selection of subjects was based on inclusion criteria, namely pediatric patients diagnosed with bronchopneumonia, receiving antibiotic therapy, possessing complete and legible medical records, and accompanied by complete treatment cost data. The exclusion criteria included patients with infectious comorbidities and those who were discharged at their own request or referred before completing antibiotic therapy. Data were analyzed descriptively to outline patient characteristics and profiles of antibiotic use, while the rationale for antibiotic use was evaluated using the Gyssens method, with reference to the PPAB of Columbia Asia Pulomas Hospital Jakarta (2024), PNPK Pediatric Pneumonia Management (2025), and IDSA Guidelines (2011). Furthermore, the relationship between the rationality of antibiotic use and clinical outcomes and treatment costs was analyzed using bivariate statistical tests. This study was descriptive-observational in nature, applying a cross-sectional design with purposive sampling, and conducted at Columbia Asia Pulomas Hospital Jakarta, with data collection performed in May 2025 for the treatment period of April 2024–April 2025.

A. Population and research sample

The population involved in this study was pediatric inpatients (0–18 years) at Columbia Asia Pulomas Hospital Jakarta, with a diagnosis of bronchopneumonia and receiving 3897ntibiotic therapy for the period April 2024 – April 2025. The sample in this study included all pediatric patients aged 0 to 18 years who underwent inpatient treatment at Columbia Asia Pulomas Hospital Jakarta, with a diagnosis of bronchopneumonia and received 3897ntibiotic therapy during the period April 2024-April 2025. This study uses 3897ntibi total sampling, namely all populations that meet the inclusion requirements and are not included in the exclusion criteria are used as samples. With this approach, all available and required patient data is included as part of the study subject without random sampling.

The parameters used to select the sample are outlined as follows:

a. Kriteria Inclusive:
   1) Pediatric patients (aged 0–18 years) who are diagnosed with bronchopneumonia as the primary diagnosis.
   2) Receive 3897ntibiotic treatment during hospitalization.
   3) Have a complete and accessible medical record.

4) Complete financial or financing data is available.

b. Exclusion Criteria:

1) Pediatric bronchopneumonia patients with other bacterial infectious diseases.
2) Duration of treatment less than 3 days
3) Patients forced to go home

B. Research Instruments

The instrument used in this study was a data collection sheet prepared by the researcher to obtain information from electronic medical records and patient financial documents. This instrument served to record all antibiotics studied, including patient demographic characteristics, patterns of antibiotic use, clinical outcomes, and details of treatment costs. The data collected included age, gender, type of insurance coverage, comorbidities, results of supporting examinations, and information related to antibiotic use, which encompassed drug name, classification, dosage, frequency, duration of administration, and any therapy modifications. The evaluation of the rationality of antibiotic therapy was carried out using the Gyssens method, referring to the Guidelines for the Use of Antibiotics (PPAB) of Columbia Asia Pulomas Hospital Jakarta (2024), the National Guidelines for Medical Services (PNPK) for the Management of Pneumonia Cases in Children (2025), and the Infectious Diseases Society of America (IDSA) Guidelines (2011). Information on costs included pharmaceutical costs, supporting examination fees, medical and nursing service fees, and room and administrative fees. Meanwhile, clinical outcomes were analyzed based on the length of hospitalization and clinical examinations, including retraction, respiratory rate, and sputum production after three days of treatment. This instrument underwent a validation process by experts in clinical pharmacy, pediatrics, and hospital management to ensure that the measurement tools used were relevant and accurate in describing the required data.

C. Data Analysis Design

The data collected from this study underwent quantitative analysis through descriptive and analytical approaches. Descriptive analysis was used to present an overview of patient characteristics, including age, gender, type of antibiotic therapy, results of supporting examinations, and patterns of antibiotic use—covering type, dose, frequency of administration, and duration of therapy. The data are presented in the form of frequency distribution tables, percentages, averages, standard deviations, medians, and value ranges, depending on the type of data analyzed.

The rationality assessment of antibiotic use was conducted using the Gyssens method, which categorizes antibiotic application based on the level of conformity to treatment guidelines. This assessment refers to the Guidelines for the Use of Antibiotics (PPAB) of Columbia Asia Pulomas Hospital Jakarta (2024), the National Guidelines for Medical Services (PNPK) for the Management of Pneumonia Cases in Children (2025), and the Infectious Diseases Society of America (IDSA) Guidelines (2011). Cost analysis was performed using the Cost of Illness (COI) pharmacoeconomic approach.

After identifying the characteristics of the data, further analysis was carried out using a bivariate test. In this test, a qualitative assessment of antibiotic administration in pediatric patients diagnosed with bronchopneumonia was conducted using the Gyssens criteria, categorizing usage as either rational or irrational. The main dependent variables were clinical outcomes—classified as improved, unimproved, or deceased—and length of stay (LOS).

Another dependent variable was the total average expenditure incurred during treatment. The purpose of this analysis was to examine and confirm the presence of a significant correlation between the rational use of antibiotics, treatment costs, and clinical outcomes. The findings of this bivariate analysis are expected to provide evidence of the relationship between rational antibiotic use and both treatment cost efficiency and improved clinical outcomes.

RESULTS AND DISCUSSION

A. Demographics of Pediatric Bronchopneumonia Patients

The initial tracing of pediatric patients diagnosed with bronchopneumonia recorded a total of 211 patients for the period April 2024 – April 2025. Of these, 164 patients met the inclusion criteria and were included as research subjects without exception. This study adopted 3899a total sampling of children, which included all pediatric patients diagnosed with bronchopneumonia at Columbia Asia Pulomas Hospital Jakarta. Patient demographics are described in table 1.

Table 1 Patient Demographics

Characteristics of the patient	Total (n=164)	(%)
Age		
a. 0 – 1 year	22	13,41
b. 1 – 5 years	89	54,27
c. 6 – 12 years old	50	30,49
d. 13 – 18 years old	3	1,83
Gender		
a. Male	86	52,44
b. Women	78	47,56
Types of Health Insurance		
a. BPJS	29	17,68
b. Insurance	116	70,73
c. Personal	19	11,59
Long Treatment		
a. 3-5 Days	130	79,27
b. 5-7 Days	26	15,85
c. >7 Days	8	4,88
Types of Comorbidity Diseases		
to. Already	2	1,22
b. No	162	98,78

This study involved 164 pediatric patients diagnosed with bronchopneumonia, with the largest proportion in the 1–5-year age group (54.27%), followed by children aged 6–12 years (30.49%) and infants under 1 year (13.41%). These findings align with both national and international research showing high vulnerability among children under five due to developing immune systems and environmental exposures such as air pollution. The sex distribution showed a slight male predominance (52.44%), which may be influenced by anatomical differences—such as slower lung maturation—and hormonal factors that can suppress certain immune responses, making males more susceptible to respiratory tract infections. Metaanalyses have also indicated that, in addition to a higher incidence, the mortality rate from pneumonia in boys is greater than in girls.

In terms of financing and length of treatment, the majority of patients used private insurance (70.73%), followed by BPJS (17.68%) and out-of-pocket payments (11.59%), reflecting relatively good access to healthcare services. Most patients (79.27%) were hospitalized for 3–5 days, indicating a generally good therapeutic response and predominantly mild-to-moderate disease severity. This is consistent with findings from Atma Jaya Hospital, which reported an average length of stay of four days. Two patients in this study had comorbid cardiomegaly and cardiomyopathy, conditions that increase the risk of complications and prolong hospitalization. A study at Hasan Sadikin Hospital in Bandung similarly reported that children with congenital heart disease had an average hospital stay of eight days—significantly longer than children without comorbidities—and a higher risk ratio for prolonged hospitalization.

B. Characteristics of Antibiotic Use

The 3900rational and appropriate use of ntibiotics serves as a fundamental aspect in the treatment of bronchopneumonia in children. The choice of 3900ntibiotic types, whether administered alone or in combination, 3900ntibio with the duration of treatment, is significantly influenced by the observed dominant germ pattern, 3900local ntibiotic resistance, and the clinical status of the patient. To offer a more detailed picture of the use of 3900ntibiotics in pediatric patients with bronchopneumonia in hospitals, the table below presents information regarding the types of 3900ntibiotics used, the number of patients treated with them, the percentage of use, and the average duration of treatment.

Table 2 Patterns of Antibiotic Use

Use of Antibiotics	Types of Drugs	Total (n=164)	(%)	Average Duration of Giving
Single	Ceftriaxone	89	54,27%	3,88
Kombinasi	Cefotaxime + Gentamisin	30	18,29%	4,97
Single	Cefotaxime	11	6,71%	4,18
Kombinasi	Ampisilin-Sulbactam + Gentamisin	10	6,10%	3,9
Kombinasi	Ceftriaxone + Gentamisin	9	5,49%	3,67
Kombinasi	Ceftriaxone + Azithromycin	5	3,05%	5,8
Single	Azithromycin	4	2,44%	3,33
Single	Ampisilin-Sulbactam	3	1,83%	3,33
Single	Erythromycin	1	0,61%	4
Kombinasi	Ceftriaxone + Metronidazole	1	0,61%	5
Kombinasi	Ceftazidime + Gentamisin	1	0,61%	4

The pattern of antibiotic use in pediatric bronchopneumonia cases at Columbia Asia Pulomas Hospital Jakarta showed that monotherapy with ceftriaxone was the most frequently chosen regimen (54.27%), followed by the combination of cefotaxime and gentamicin (18.29%), and ampicillin–sulbactam combined with gentamicin (6.10%). On average, the duration of antibiotic treatment ranged from 3 to 5 days. Combination therapy was usually administered in more critical cases or when complications arose, while monotherapy was more commonly applied in cases without significant complications. This approach aligns with national guidelines from the Indonesian Pediatrician Association (IDAI) and the Infectious

Diseases Society of America (IDSA), which recommend the use of beta-lactam antibiotics—such as ampicillin or penicillin G—along with third-generation cephalosporins like ceftriaxone and cefotaxime as the primary treatment for uncomplicated bronchopneumonia. In contrast, macrolide antibiotics such as azithromycin are suggested when infection by Mycoplasma pneumoniae is suspected (43,94).

Combination regimens, such as ampicillin combined with gentamicin or cefotaxime with gentamicin, are typically reserved for severe clinical scenarios, including respiratory failure, seizures, or feeding difficulties, as well as for patients at risk of monotherapy failure or those suspected of having mixed infections. However, the combined use of cephalosporins and aminoglycosides must be carefully considered due to potential adverse effects, particularly nephrotoxicity (95).

Rational antibiotic use is essential, as non-compliance with established guidelines can increase the risk of bacterial resistance, prolong hospitalization, elevate financial burden, and worsen patients' clinical outcomes. Evaluations of rational antibiotic use in various studies indicate that monotherapy is generally more targeted for non-severe cases, whereas combination therapy is more frequently employed in patients with severe conditions (96).

Several factors influence antibiotic selection, including disease severity, nutritional and immune status, prior antibiotic exposure, and the presence of complications such as nosocomial infections or resistant bacteria—all of which play important roles in determining antibiotic choice (97). Although the duration of antibiotic therapy for monotherapy and combination therapy generally overlaps at 3–5 days, cases requiring combination therapy often exhibit longer hospitalization periods, mainly due to patients' more severe initial clinical condition rather than differences in antibiotic regimens (95,98).

C. Quality of Antibiotic Use in Pediatric Bronchopneumonia Patients Based on Gyssens

In addition to examining antibiotic use patterns, it is also important to assess the quality and rationality of the antibiotic application. This assessment is carried out to ensure that antibiotics are prescribed correctly according to the optimal indications, dosage, route, and duration, with the aim of maximizing therapeutic effectiveness while minimizing the risk of resistance or side effects. Utilizing the Gyssens categorization framework, an overview of the rationale surrounding the use of antibiotics in pediatric patients with bronchopneumonia is provided below, as illustrated in the table below.

Table 3 Rationality of Antibiotic Use Based on Gyssens

Golongan	Criteria	Total (n = 222)	(%)
0	Rational use of antibiotics	168	76,0
I	Inappropriate timing of antibiotic administration	0	0,00
IIA	Antibiotic dosage is not appropriate	23	10,41
IIB	Inappropriate antibiotic administration intervals	0	0,00
IIC	Antibiotic administration route is not suitable	0	0,00
IIIA	Duration of antibiotic administration is too long	14	6,33
IIIB	The duration of antibiotic administration is too short	16	7,24
VAT	The choice of antibiotic is not suitable because there are other antibiotics that are more effective	1	0,45
IVB	The choice of antibiotics is not appropriate because there are other antibiotics that are safer	0	0,00
IVC	The choice of antibiotics is not suitable because there are other antibiotics that are cheaper	0	0,00

IVD	The choice of antibiotic is not appropriate because there are other antibiotics with a narrower spectrum	0	0,00
V	Antibiotic administration is not as indicated	0	0,00
VI	Incompleteness of usage data	0	0,00

1. Category VI - Incomplete Data: There are no cases because medical records with incomplete data have been excluded from the study criteria.
2. Category V - No Indications: No cases, as all 164 pediatric patients had a clear diagnosis of bronchopneumonia with 221 antibiotics evaluated.
3. Category IVD - Too Broad Spectrum: No cases because the selection of antibiotics is in accordance with the PPAB of Columbia Asia Pulomas Hospital, PNPK IDAI 2025, and IDSA 2011 guidelines for empirical therapy.
4. IVC Category - More Expensive Option: There are no cases because the selection of antibiotics is adjusted to the availability of the hospital, BPJS insurance, and patient self-cost according to applicable guidelines.
5. Category IVB - Less Safe: There are no cases although gentamicin is potentially nephrotoxic and ototoxic, as no side effects were found during observation and use as directed.
6. Category IVA - Less Effective: 1 case of a 5-year-old child who received ceftazidime-gentamicin but the condition did not improve after 3 days. Ceftazidime is not recommended as the primary therapy for pediatric community pneumonia.
7. Category IIIB - Too Short Duration: 16 cases (7.21%) with a duration of only 2 days were found, predominantly ceftriaxone, contrary to PPAB which suggests more than 3 days. Risks of therapy failure and bacterial resistance.
8. Category IIIA - Duration Too Long: 14 cases (6.33%) were found with a duration of 8-9 days, exceeding the PPAB recommendation of less than 7 days. Dominated by ceftriaxone and cefotaxime, usually due to a slow clinical response.
9. Category IIC - Non-Suitable Routes: No cases as all grants are in accordance with the guidelines. IV antibiotics include ceftriaxone, ampicillin-sulbactam, cefotaxime, gentamicin, metronidazole, ceftazidime; While azithromycin and erythromycin are administered orally.
10. Category IIB - Inappropriate Intervals: There is no case because all administration intervals are PPAB-compliant, for both time-dependent and concentration-dependent antibiotics such as gentamicin.
11. Category IIA - Inappropriate Dose: 23 cases (10.41%) were found with underdose or overdose, predominantly ceftriaxone. Example: a 1-year-old child of 9.2 kg is given 1000 mg/day (should be 460-920 mg) due to consideration of the severity and ease of giving a 1 gram vial.
12. Category I - Inappropriate Timing: There were no cases because all antibiotics were administered on time as indicated by empirical therapy and following applicable clinical guidelines.
13. Category 0 - Rational Use: A total of 168 cases (76.02%) met all the criteria for rational antibiotic use: appropriate indication, drug selection, dosage, route, interval, time, and duration.

D. Antibiotic Rationality

This section presents findings from the rationality analysis of antibiotic use in pediatric patients diagnosed with bronchopneumonia at Columbia Asia Pulomas Hospital Jakarta, which was assessed using the Gyssens method. The results of the analysis are described in detail in Table 4.

Table 4 Antibiotic Rationality

Category	Total (n=164)	(%)
Rationale	118	71.9%
Irrational	46	28.1%

In table 4 above, the majority of respondents of 118 patients (71.9%) showed good or guideline rationality for the use of antibiotics. This high proportion reflects positive clinical practice, reflecting a more dominant adherence to appropriate antibiotic use guidelines. The rational use of antibiotics is essential to prevent antimicrobial resistance, which is one of the biggest threats in global health today. This is in line with a study conducted at Dr. Doris Sylvanus Palangkaraya Hospital revealing that the percentage of rational antibiotic use among pediatric pneumonia cases jumped to 82.6%, underscoring the need for continuous assessment and training of health staff to ensure adherence to antibiotic use protocols (108).

On the other hand, 46 people (28.1%) still use antibiotics irrationally. Although the percentage is lower, it remains a serious concern. Irrational use of antibiotics includes inappropriate dosage, too long or too short duration of treatment, and inappropriate selection of antibiotics leading to the emergence and growth of bacteria (Extended Spectrum Beta-Lactamase / ESBL), especially in the category of third-generation cephalosporins such as ceftriaxone and ceftazidime (109). This kind of practice contributes to the acceleration of the development of resistant bacteria, therapy failure, increased side effects, and waste of resources (110).

E. Outcome Klinis

In this study, clinical improvement can be interpreted as loss of retraction (withdrawal of chest muscles), return of breathing frequency to normal, and reduction of symptoms after 3 days of treatment. The validation process of clinical improvement data was validated collaboratively by a team of pediatricians and clinical pharmacists at Columbia Asia Pulomas Hospital Jakarta, who further categorized the clinical outcome results as "improving" or "not improving". The results of the analysis are described in detail in Table 5.

Table 5 Clinical Outcomes

Outcome Klinis	Total (n=164)	(%)
Improve	119	72.6%
Not Improved	45	27,4%

In the clinical outcome variable, the results showed a very positive trend. Most of the respondents (119 people or 72.6%) experienced improvement in the condition, indicating success in the therapy and medical interventions given. The high percentage of patients who show this improvement reflects the effectiveness of the treatment received and the patient's ability to respond to therapy. Research conducted at Atma Jaya Hospital Jakarta showed that 97.3% of children under five with hospitalized bronchopneumonia recovered after treatment.

The clinical improvement parameters used in the study included loss of retraction, normalization of respiratory rate, and improvement of other symptoms such as fever and shortness of breath (88).

However, 45 people (27.4%) showed clinical outcomes that had not improved. This group represents patients who may need further attention, treatment adjustments, or more in-depth investigation of factors that hinder the recovery process. Clinical outcomes that have not improved can be influenced by a variety of factors, such as the severity of the initial disease, the presence of complications, resistance to treatment, comorbid conditions, or patient adherence to treatment regimens (111,112).

F. Length of Stay (LOS)

This section displays the duration of hospitalization (Length of Stay / LOS) of pediatric patients with bronchopneumonia at Columbia Asia Pulomas Hospital Jakarta. This analysis is aimed at describing the characteristics and distribution of length of patient care, as well as presenting an overview of their average time in a healthcare facility. The results of the analysis are described in detail in table 6.

Tabel 6 *Length of Stay* (LOS)

Variabel	Mean + SD	Max	Min
LOS	4,90 + 1,41	10	3

The table above shows that the average LOS for patients is determined to be 4.90 days, accompanied by a standard deviation of 1.41 days. This average figure implies that, overall, patients are typically admitted to a healthcare facility for about 5 days. The relatively small standard deviation shows that the duration of treatment for most patients tends to cluster around this average, in other words, the variability in the number of days of hospitalization among patients is not very noticeable, this is in line with a study conducted at PKU Muhammadiyah Hospital Bantul in 2024 revealing that 54.2% of pediatric patients diagnosed with pneumonia undergo treatment for three days, and almost all of these individuals (98.8%) showed a clinically significant improvement, thus facilitating their return within a seven-day period (113).

Variation in length of stay (LOS) for children with bronchopneumonia, which can last from 3 to 10 days, suggests a complex interaction between the patient's clinical state and the efficacy of the treatment given. A shorter period of hospitalization, approximately 3 days, usually occurs in situations where the initial severity is low, there is a rapid response to appropriate antibiotics, and there are no significant complications or comorbidities, allowing for a quick shift to oral and discharge treatment. In contrast, longer treatment durations, up to 10 days, often stem from a high severity of the disease at admission, inadequate response to treatment, the appearance of complications such as pleural effusion or secondary infections, the presence of comorbidities that hinder recovery, or the need for follow-up medical assistance (114,115).

G. Components of Medical Expenses

This section outlines the cost component of treatment for pediatric bronchopneumonia patients at Columbia Asia Pulomas Hospital Jakarta. The purpose of this analysis is to describe the profile and distribution of expenditure per patient, which includes the cost of pharmaceuticals, diagnostic examinations, medical and nursing services, as well as room and administrative costs. Detailed information on the average and standard deviations, together with details of the costs for each category, is provided thoroughly in table V.7.

Table 7 Components of Medical Expenses

Cost Category	Types of Hospital Fees	Average ± elementary school
Pharmaceutical Costs	Cost of Other Drugs	IDR 2,463,118,83 ± IDR 1,792,428.79
	Cost of Antibiotics	IDR 1,197,767,41 ± IDR 1,487,270,05
Medical and Nursing Service Fees	Nursing Costs	IDR 907,473,41 ± IDR 387,194,75
	Medical Rehab Cost	IDR 1,258,226,21 ± IDR 1,281,948,42
	Doctor's Fees	IDR 1,888,398,80 ± IDR 1,004,314,94
Room and Administration Fees	Admin Fees	IDR 547,050,12 ± IDR 829,356,38
	Room Charge	IDR 4,434,392,57 ± IDR 2,057,535,55
	Equipment Cost	IDR 267,429,10 ± IDR 453,801,51
Supporting Examination Fee	Laboratory Fees	IDR 1,773,837.28 ± IDR 1,307,828.65
	Operative Medical Expenses	IDR 207,170,30 ± IDR 237,129,31
	Biaya Medical Supplies	IDR 1,111,146,06 ± IDR 477,348,74
	Radiology Cost	IDR 691,816,58 ± IDR 436,226,70
Total Hospital Cost		**IDR 16,727,647.82 ± IDR 7,637,716.67**

The table above shows that the room cost component is the highest expenditure item in hospital services, with an average of IDR 4,434,392.57 ± IDR 2,057,535.55. Referring to research at Sanglah Hospital in 2018, it was found that room costs took up about 26.9% of the total hospital costs in inpatients (10).

In the Pharmaceutical Cost category, expenditures on other drugs reached the highest average at IDR 2,463,118.83, followed by the average cost of antibiotics at IDR 1,197,767.41. Research indicates that the main allocation of hospital pharmaceutical budgets is directed toward procuring specialty drugs and complementary therapies, while antibiotics continue to represent a significant financial commitment, particularly in cases of infections and chronic diseases. Suboptimal management practices in the use of drugs and antibiotics not only exacerbate the financial burden on patients but also increase the risk of antimicrobial resistance and inefficient resource utilization (116).

In the Medical and Nursing Services Fee category, the doctor's honorarium constituted the largest cost component, averaging IDR 1,888,398.80. This was followed by medical rehabilitation costs at IDR 1,258,226.21 and nursing service costs at IDR 907,473.41. Within the Supporting Examination Costs category, laboratory examinations recorded the highest average cost of IDR 1,773,837.28, followed by consumable medical supplies at IDR 1,111,146.06, and radiology costs at IDR 691,816.56. The costs of medical equipment and operative procedures were comparatively lower in this category. Overall, the total hospital treatment cost averaged IDR 16,727,647.82, with a substantial standard deviation of IDR 7,637,716.67—reflecting variability in patient needs, case complexity, hospitalization duration, and types of medical interventions provided.

H. Analysis of Antibiotic Rationality with Clinical Outcomes

The use of the Chi-Square test was adjusted to the type of data as well as the purpose of analyzing the relationship between the rationality of antibiotic use and clinical outcomes and treatment costs. The Chi-Square test was chosen because it is suitable for analyzing the relationship between two categorical variables, such as whether or not the use of antibiotics is rational and the patient's clinical outcomes, for example, whether they have improved or have not improved. This test does not require normally distributed data and can reveal whether there are significant differences in proportions between groups. If the results of the analysis show a p< value of 0.05, then the relationship between the two variables is considered significant, which means that the rationality of antibiotic use is related to the patient's clinical outcomes. Conversely, if the p-value ≥ 0.05, then no statistically significant relationship was found, and the apparent differences were likely to occur randomly (117). The results of the analysis are described in detail in Table V. 8.

Table 8 Analysis of Antibiotic Rationality with Clinical Outcomes

Variabel Rationalities	Outcome Klinis	Total (n=164)	%	p
Rasional	Improve	95	80.5%	0,000
	Not Improved	23	19,5%	
Irrational	Improve	24	52,2%	
	Not Improved	22	47,8%	

The results of the Chi-Square analysis showed a significant correlation between antibiotic use and clinical outcomes, with 80.5% of patients receiving rational antibiotics experiencing improvement compared to 52.2% in the irrational group ($p = 0.000$), supporting the hypothesis that rational antibiotic use significantly improves clinical conditions.

Several studies have also demonstrated that the rational use of antibiotics substantially contributes to better clinical outcomes. A retrospective observational study involving pediatric pneumonia patients at Dr. Saiful Anwar Hospital Malang found that those who received antibiotics rationally showed accelerated clinical improvement, as evidenced by a reduction in hospitalization duration and normalization of vital parameters, including body temperature, respiratory rate, pulse, and leukocyte count. This observation was supported by strong statistical significance ($p < 0.05$), indicating that the correlation between antibiotic rationality and clinical outcomes was not coincidental (118).

Similarly, a separate study on antibiotic administration in pediatric pneumonia patients at Dr. Sardjito Hospital Yogyakarta identified a significant association between the rationality of antibiotic use and improved clinical outcomes. In this investigation, evaluation using the Gyssens method showed that patients who received antibiotics rationally experienced superior levels of clinical improvement compared to those treated irrationally (119).

In summary, the irrational use of antibiotics not only increases the risk of poor clinical outcomes but also exacerbates issues related to bacterial resistance and potential adverse side effects. Therefore, prudent and rational antibiotic administration is strongly recommended as a key strategy to enhance patient recovery and reduce antimicrobial resistance in healthcare settings (118,119).

I. Analysis of Antibiotic Rationality with LOS

The Mann-Whitney test is used to analyze numerical variables, such as length of stay (LOS), especially when the data does not follow a normal distribution. Therefore, this non-parametric test is more suitable than parametric tests such as the t-test. The Mann-Whitney test compared the median between two independent groups, namely the group of patients with rational and irrational antibiotic use. If the p-value of the Mann-Whitney test is less than 0.05, then there is a significant cost difference between the two groups. Conversely, if the p≥ value is 0.05, then there is no statistically significant difference, suggesting that the median cost difference is likely not due to the influence of antibiotic rationality. Therefore, these two tests are used appropriately according to the data type to provide accurate and reliable analysis results (117,120). The results of the analysis are described in detail in Table 9.

Table V. 9 Analysis of Antibiotic Rationality with LOS

Rationality	Total (n=164)	%	Red ± SD	Min	Max	P
Rationale	118	77,4%	4.70 ± 0.82	3	8	0,612
Irrational	46	22,6%	5.41 ± 2.25	3	10	

The table presents an analysis of the relationship between the rationality of antibiotic use and the duration of patient hospitalization. Of the 164 patients observed, 118 patients (77.4%) received antibiotics rationally, while 46 patients (22.6%) did not. On average, patients who received rational antibiotics showed a slightly shorter stay of 4.70 days (with a range of 3 to 8 days). In contrast, patients who received irrational antibiotics tended to have a longer stay of hospitalization, an average of 5.41 days, with greater variation (range 3 to 10 days).

The results of the Mann-Whitney test showed that there was no statistically significant difference in the duration of hospitalization (LOS) between patients who used antibiotics rationally and those who did not, with a p-value of 0.612. Although on average patients with rational antibiotic use had a slightly shorter length of treatment of 4.70 days compared to irrational patients of 5.41 days, one of the studies conducted at Dr. Sardjito Yogyakarta Hospital assessed the relevance of the rationality of antibiotic administration in pneumonia patients in the intensive care unit showing that the rationality of antibiotic use did affect certain clinical outcomes but did not significantly affect the duration of treatment antibiotic-related stays or costs (120).

J. Analysis of the Rationality of Antibiotics with Pharmaceutical Costs

This section outlines studies on the relationship between rational use of antibiotics and pharmaceutical costs in hospitals. The cost of drugs is an important component, which can be influenced by the rationality of antibiotic prescribing. The Mann-Whitney test was used to determine whether there was a significant difference in pharmaceutical costs including other drugs and antibiotic costs between patients who received antibiotics rationally and irrationally. The results of the analysis are described in detail in table 10.

Table V. 10 Analysis of the Rationality of Antibiotics with Pharmaceutical Costs

Cost Category	Types of Hospital Fees	Rationality	Red ± SD	P
Pharmaceutical Costs	Cost of Other Drugs	Rationale	IDR 2,343,167,72 ± IDR 1,382,626,27	0,839
		Irrational	IDR 2,773,209.55 ± IDR 2,584,736.54	
	Cost of Antibiotics	Rationale	IDR 1,077,696,11 ± IDR 1,202,421.43	0,736
		Irrational	IDR 1,533,399,85 ± IDR 2,043,538.05	

The table shows the results of an analysis that investigates the relationship between the rationality of antibiotic use and pharmaceutical costs, including the cost of other drugs and the price of antibiotics. For the cost of other drugs, patients who received antibiotics rationally spent an average of Rp 2,343,167.72, while patients who did not rationally spend a little more, namely Rp 2,773,209.55. However, this difference was not statistically significant (p-value = 0.839), suggesting that the rationality of antibiotics did not meaningfully affect the cost of other drugs.

Similarly, in the price of antibiotics, patients with rational antibiotic use have an average cost of IDR 1,077,696.11, while patients with irrational antibiotic use have a higher average cost, which is IDR 1,533,399.85. However, this difference was also not statistically significant (p-value = 0.736), suggesting that antibiotic rationality did not significantly affect antibiotic costs.

Research conducted in the Intensive Care Unit of a general hospital by Blanc showed that the enactment of a rational antibiotic utilization policy resulted in a reduction in expenditure on antibiotic drugs of 19-22% over a span of two consecutive years, without changing the underlying clinical characteristics of the patient or the incidence rate of nosocomial infections however, this reduction was not uniformly consistent or statistically significant across the various pharmaceutical cost parameters in the study Alternative (121). Other external factors including patient characteristics, disease severity, and hospital policy implementation, also affect the cost-saving effectiveness of antibiotic rationalization strategies, leading to variability in outcomes across studies (122).

K. Analysis of the Rationality of Antibiotics with the Cost of Medical and Nursing Services

This section discusses the relationship between the rationality of antibiotic use and the cost of medical and nursing services in hospitals. The rationality of antibiotic administration can affect the duration of hospitalization and the complexity of cases, ultimately affecting the cost of medical and nursing services. The Mann-Whitney test was used to find out if there were significant differences in the cost of nursing, medical rehabilitation, and physician services between patients who received antibiotics rationally and irrationally. The results of the analysis are described in detail in table 11.

Table 11 Analysis of Antibiotic Rationality with Medical and Nursing Service Costs

Cost Category	Types of Hospital Fees	Rationality	Red ± SD	P
Medical and Nursing Service Fees	Nursing Costs	Rationale	IDR 852,689,68 ± IDR 321,284,68	0,084
		Irrational	IDR 1,059,436,62 ± IDR 496,044,22	
	Medical Rehab Cost	Rationale	IDR 1,228,256,92 ± IDR 1,099,415.64	0,585
		Irrational	IDR 1,336,812.35 ± IDR 1,681,624.93	
	Doctor's Fees	Rationale	IDR 1,836,093,04 ± IDR 898,607,49	0,193
		Irrational	IDR 2,010,563,88 ± IDR 1,247,571,80	

The table shows the results of an analysis that investigates the relationship between the rationality of antibiotic use and pharmaceutical costs, including the cost of other drugs and the price of antibiotics. For the cost of other drugs, patients who received antibiotics rationally spent an average of Rp 2,343,167.72, while patients who did not rationally spend a little more, namely Rp 2,773,209.55. However, this difference was not statistically significant (p-value = 0.839), suggesting that the rationality of antibiotics did not meaningfully affect the cost of other drugs.

Similarly, in the price of antibiotics, patients with rational antibiotic use have an average cost of IDR 1,077,696.11, while patients with irrational antibiotic use have a higher average cost, which is IDR 1,533,399.85. However, this difference was also not statistically significant (p-value = 0.736), suggesting that antibiotic rationality did not significantly affect antibiotic costs.

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L. Analysis of Antibiotic Rationality with Room and Administration Fees

This section discusses the relationship between the rational use of antibiotics and hospital room and administration costs. The rationality of antibiotic administration can affect the duration of hospitalization and the complexity of administration, ultimately impacting both types of costs. The Mann-Whitney test was used to compare the average administrative costs and room costs between groups of patients with rational and irrational antibiotic use. The results of the analysis are described in detail in table 12.

Table 12 Analysis of Antibiotic Rationality with Room and Administration Costs

Cost Category	Types of Hospital Fees	Rationality	Red ± SD	P
Room and Administration Fees	Admin Fees	Rationale	IDR 460,614,84 ± IDR 723,836,23	0,001
		Irrational	IDR 785,859,29 ± IDR 1,034,282.54	
	Room Charge	Rationale	IDR 4,209,535.78 ± IDR 1,562,720.03	0,244
		Irrational	IDR 5,018,352.42 ± IDR 2,950,158.88	

The table shows the results of the analysis of the relationship between the rationality of antibiotic use and room and administrative costs. For administrative costs, patients who received antibiotics rationally spent an average of Rp 460,614.84, while patients who irrationally spent higher, namely Rp 785,859.29. This difference was statistically significant (p value = 0.001), suggesting that improper use of antibiotics significantly increased administrative costs. However, in room costs, although patients who use irrational antibiotics have a higher average cost (Rp 5,018,352.42) than rational ones (Rp 4,209,535.78), this difference is not statistically significant (p value = 0.244).

Although the rationality of antibiotic use has a different impact on these two types of costs, irrational use significantly increases administrative costs, but it does not have a statistically significant impact on room costs.

M. Analysis of Antibiotic Rationality with Supporting Examination Costs

This section analyzes the relationship between rational antibiotic use and the costs associated with supportive examinations in health facilities. The level of rationality in the administration of antibiotics has a significant influence not only on the effectiveness of therapy, but also on expenditure on diagnostic examinations. The Mann-Whitney test is used to compare the average expenditure on different types of examinations including equipment, labs, surgeries, medical supplies, radiology between patients whose antibiotics are used rationally and those whose antibiotics are used irrationally. The results of the analysis are described in detail in table 13.

Table 13 Analysis of Antibiotic Rationality with Supporting Examination Costs

Cost Category	Types of Hospital Fees	Rationality	Red ± SD	P
Supporting Examination Fee	Equipment Cost	Rationale	IDR 242,965,04 ± IDR 430,242,09	0,354
		Irrational	IDR 335,643,35 ± IDR 513,375,86	
	Laboratory Fees	Rationale	IDR 1,708,791,62 ± IDR 1,088,748.12	0,907
		Irrational	IDR 1,938,025,22 ± IDR 1,772,995,14	
	Operative Medical Expenses	Rationale	Rp 189,451,20 ± Rp 184,142,47	0,404
		Irrational	IDR 251,784,92 ± IDR 339,274.32	
	Biaya Medical Supplies	Rationale	IDR 1,126,895,62 ± IDR 446,292.09	0,372
		Irrational	IDR 1,068,507,05 ± IDR 558,469,71	
	Radiology Cost	Rationale	IDR 679,875,08 ± IDR 394,227,61	0,753
		Irrational	IDR 735,269,54 ± IDR 531,593,94	

In the table showing the results of the comparative analysis of supporting examination costs between the rational and irrational antibiotic-use groups, no statistically significant differences were found across all cost categories. For equipment costs, although the average expenditure in the irrational group (Rp 335,643.35 ± Rp 513,375.86) was higher than in the rational group (Rp 242,965.04 ± Rp 430,242.09), the difference was not statistically significant ($p = 0.354$). A similar pattern was observed in laboratory costs, where the mean value in the irrational group was slightly higher, but the p-value of 0.907 indicated that the difference was not significant.

Operative medical costs also showed a comparable trend. The irrational group recorded a higher average cost (Rp 251,784.92 ± Rp 339,274.32) than the rational group (Rp 189,451.20 ± Rp 184,142.47), yet the difference was not statistically significant ($p = 0.404$). In terms of medical supplies, the difference between the rational and irrational groups was similarly insignificant ($p = 0.372$), even though the rational group showed a slightly higher average cost. The same result was found for radiology costs, where differences in mean expenditure were not statistically significant ($p = 0.753$).

Overall, although variations in average expenditure were observed between the rational and irrational groups across all types of supporting examination costs, none of these differences reached statistical significance. This indicates that the rationality of antibiotic use or other medical interventions does not have a direct impact on the amount of supporting examination costs. It can therefore be inferred that other factors may exert a greater influence on total costs.

Based on these findings, it can be concluded that the rationality of antibiotic use does not have a significant effect on the costs associated with supporting examinations.

N. Analysis of Antibiotic Rationality with Total Hospital Costs

This section provides an analysis of the relationship between rational use of antibiotics and overall hospital costs. The Mann-Whitney test is used to determine whether there is a difference in total hospital costs for patients who are rationally given antibiotics compared to those who receive them irrationally. The results of the analysis are described in detail in table 14.

Table 14 Analysis of Antibiotic Rationality with Total Hospital Costs

Cost Category	Rationality	Red ± SD	P
Total Hospital Cost	Rationale	IDR 15,956,032,66 ± IDR 5,568,892,10	0,658
	Irrational	IDR 18,801,283.94 ± IDR 11,292,810.87	

The table presents the results of a comparative analysis between the rationality of antibiotic use and the total cost of hospital treatment. The findings indicate that the average total hospital cost for patients with rational antibiotic use was IDR 15,956,032.66, with a standard deviation of IDR 5,568,892.10. Meanwhile, patients who received antibiotics irrationally incurred a higher average cost of IDR 18,801,283.94, with a standard deviation of IDR 11,292,810.87. Although there was a difference in mean values between the two groups, the statistical test revealed a p-value of 0.658, which exceeds the significance threshold of 0.05. This suggests that the difference is not statistically significant. Therefore, it can be concluded that there is no significant relationship between the rationality of antibiotic administration and the total cost of patient care in the hospital.

A study conducted in the ICU of Dr. Sardjito Hospital Yogyakarta similarly found that, although there was a difference in the average treatment cost between patients with rational and irrational antibiotic use, the difference was not statistically significant ($p = 0.90$). This finding suggests that rational antibiotic use does not necessarily lead to a significant reduction in total treatment costs (120).

The relationship between the rationality of antibiotic use and the total cost of treatment at Columbia Asia Pulomas Hospital Jakarta is influenced by various internal and external factors. Several studies have noted that disease severity is one of the dominant factors: patients with more serious conditions typically require more intensive interventions, resulting in higher treatment costs even when antibiotics are used appropriately. In addition, variations in the type and price of antibiotics also play a role. Rational use does not always equate to cost savings, as some clinically appropriate antibiotics are relatively expensive. Another contributing factor is the duration of hospitalization—longer stays are associated with proportionally higher total costs. Furthermore, comorbidities increase treatment complexity and the use of medical resources, ultimately driving up overall hospital expenditures (120,122).

CONCLUSION

This study examined pediatric bronchopneumonia patients treated at Columbia Asia Pulomas Hospital Jakarta from April 2024 to April 2025. The predominant age group was 1–5 years (54.27%), with a slight male majority (52.44%). The duration of hospitalization was 3–5 days for most patients (79.27%), and the majority (70.73%) used insurance for payment. Two patients had chronic comorbidities, namely cardiomegaly and cardiomyopathy. The most commonly used antibiotic was ceftriaxone as monotherapy (54.27%), followed by the combination of cefotaxime and gentamicin (18.29%). The average duration of antibiotic administration ranged from 3 to 5 days. Analysis using the Gyssens method showed that 76.02% of antibiotic use was rational, while 23.98% was irrational, primarily due to deviations in dosage and duration from established guidelines. Rational antibiotic use was associated with improved clinical outcomes (80.5% vs. 52.2%, $p = 0.000$). There was also a tendency toward a shorter hospital stay (4.70 days vs. 5.41 days, $p = 0.612$) and lower total treatment costs (Rp

15.9 million vs. Rp 18.8 million, p = 0.658) among patients in the rational use group, although these differences were not statistically significant.

REFERENCES

Aljufri, A. Q., Yasin, N. M., & Wahyono, D. (2021). Rasionalitas terapi antibiotik empiris pada pasien pneumonia di instalasi rawat inap RSUP Dr. Kariadi Semarang. *Majalah Farmaseutik, 17*(1), 89–96.

Anggraini, W., Candra, T. M., Maimunah, S., & Sugihantoro, H. (2020). Evaluasi kualitatif penggunaan antibiotik pada pasien infeksi saluran kemih dengan metode Gyssens. *Keluwih: Jurnal Kesehatan dan Kedokteran, 2*(1), 1–8.

Arora, P. (2022). Impact of clinical pharmacist intervention in rational antibiotic use in pediatric patients. *Journal of Diabetes and Metabolism, 3*(6), 941.

Bidara, F., Saputri, M., Perwitasari, D. A., Kumara, I. F., & Ardhani, M. (2021). Studi penggunaan antibiotik pasien pneumonia anak dengan metode DDD dan DU 90%. *Jurnal Ilmiah Ibnu Sina, 6*(1), 108–115.

BPS DKI Jakarta. (2023). *Jumlah kasus penyakit menurut provinsi/kabupaten/kota dan jenis penyakit 2020* [Internet]. https://jakarta.bps.go.id/indicator/30/504/2/jumlah-kasus-penyakit-menurut-provinsi-kabupaten-kota-dan-jenis-penyakit-.html

Esa, M., Iqbal, R., Hamid, I., Sohail, K., Javaid, Z., Kamal, Z., et al. (2024). Antibiotic therapy failure and the rising challenge of antimicrobial resistance in pediatric pneumonia patients in Khyber Pakhtunkhwa Pakistan. *Journal of Population Therapeutics and Clinical Pharmacology, 31*(9), 1728–1741.

Hanifah, S., Melyani, I., & Madalena, L. (2022). Evaluasi penggunaan antibiotik dengan metode ATC/DDD dan DU90% pada pasien rawat inap kelompok staf medik penyakit dalam di salah satu rumah sakit swasta di Kota Bandung. *Farmaka, 20*(1), 1–8.

Harnofive, L., Natalia, S., & Utami, R. S. (2023). Faktor-faktor yang mempengaruhi kejadian pneumonia pada balita di wilayah kerja Puskesmas Meral Karimun tahun 2023. *Najat: Jurnal Ilmu Farmasi dan Kesehatan, 1*(4), 91–95.

Katarnida, S. S., Murniati, D., & Katar, Y. (2016). Evaluasi penggunaan antibiotik secara kualitatif di RS Penyakit Infeksi Sulianti Saroso, Jakarta. *Sari Pediatri, 15*(6), 369–376.

Kementerian Kesehatan Republik Indonesia. (2024). *Pneumonia terus ancam anak-anak* [Internet]. https://kemkes.go.id/id/pneumonia-terus-ancam-anak-anak

Limato, R., Lazarus, G., Dernison, P., Mudia, M., Alamanda, M., Nelwan, E. J., et al. (2022). Optimizing antibiotic use in Indonesia: A systematic review and evidence synthesis to inform opportunities for intervention. *The Lancet Regional Health – Southeast Asia, 2*, 100013.

Marangu, D., & Zar, H. J. (2019). Childhood pneumonia in low and middle income countries: An update. *Paediatric Respiratory Reviews, 32*, 3–9.

Putri, N. L., Yusmaini, H., & Wiyono, S. (2020). Evaluasi rasionalitas penggunaan antibiotik dengan pendekatan metode Gyssens terhadap luaran klinis pasien balita penderita pneumonia di RSUD Kota Bogor. *Media Kesehatan, 4*(1), 74–87.

Putri, S. E., & Amalia, D. (2023). Bronkopneumonia. *Jurnal Medika Nusantara, 1*(3), 134–145.

Sakaningrum, N. P. M., & Kurnianta, P. D. M. (2023). Prinsip terapi antibiotik empiris untuk infeksi pneumonia pada pediatri. *IM: Jurnal Ilmiah Mahaganesha, 2*(2), 13–21.

Setiadi, F., Kumala, S., R., H. U., & Subhan, A. (2019). Analisis faktor-faktor yang mempengaruhi outcome terapi pasien pneumonia di Rumah Sakit Umum Pusat Fatmawati Jakarta. *Jurnal Kesehatan Tadulako, 5*(3), 1–80.

Sulung, N., Hasyim, H., Samboina, M. T., Juniarti, L., & Sadewa, M. R. (2021). Gambaran pneumonia sebagai penyebab morbiditas dan mortalitas pada anak bawah lima tahun. *Jurnal Kesehatan, 12*, 616–631.

Suminar, F. D. (2022). Rationality evaluation of antibiotic use in pediatric pneumonia at hospitals in Indonesia. *Medical Reports, 1*(2), 27–40.

Sundariningrum, R. W., Setyanto, D. B., & Natadidjaja, R. I. (2020). Evaluasi kualitatif antibiotik metode Gyssens dengan konsep regulasi antimikroba sistem prospektif RASPRO pada pneumonia di ruang rawat intensif anak. *Sari Pediatri, 22*(2), 109–115.

Sutriana, V. N., Sitaresmi, M. N., & Wahab, A. (2021). Risk factors for childhood pneumonia: A case-control study in a high prevalence area in Indonesia. *Clinical and Experimental Pediatrics, 64*(11), 588–595.

Unairnews. (2025). *Analisis biaya medis langsung pasien BPJS bronkopneumonia balita di rumah sakit* [Internet]. https://unair.ac.id/analisis-biaya-medis-langsung-pasien-bpjs-bronkopneumonia-balita-di-rumah-sakit/

UNICEF. (2019). *One child dies of pneumonia every 39 seconds, agencies warn* [Internet]. https://www.unicef.org/indonesia/press-releases/one-child-dies-pneumonia-every-39-seconds-agencies-warn

Wulandari, N., & Kusuma, I. Y. (2021). Rasionalitas penggunaan antibiotik pada pasien pneumonia anak di RSUD Prof. Dr. Margono Soekarjo Purwokerto. In *Seminar Nasional Penelitian dan Pengabdian kepada Masyarakat (SNPPKM)*.

Xavier, S. P., Victor, A., Cumaquela, G., Vasco, M. D., & Rodrigues, O. A. S. (2022). Inappropriate use of antibiotics and its predictors in pediatric patients admitted at the Central Hospital of Nampula, Mozambique. *Antimicrobial Resistance & Infection Control, 11*(1), 79.

Yamananda, A. A. N., Sucipta Putri, W. C. W., & Yuliyatni, P. C. D. (2019). Gambaran biaya rawat inap pengobatan pneumonia pada pasien anak di RSUP Sanglah tahun 2018. *Intisari Sains Medis, 10*(3).