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Cost Minimization Analysis of Antibiotic Drug Use in Pneumonia Patients at Udayana Class II Hospital

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ABSTRACT

Pneumonia is one of the leading causes of morbidity and mortality in Indonesia, with a high economic burden mainly due to antibiotic use, which consumes a large portion of hospital budgets. This study aimed to analyze the cost-minimization of antibiotic therapy in hospitalized pneumonia patients at Tk II Udayana Hospital. A descriptive non-experimental retrospective study was conducted using medical records of pneumonia inpatients at Tk.II Udayana Hospital from January to December 2023. A total of 138 patients met the inclusion criteria. Data analyzed included demographics, length of stay, and direct medical costs. Cost minimization analysis was performed by comparing the average direct medical costs of each antibiotic therapy. Of 233 medical records screened, only 138 fulfilled the criteria. Male patients (53.6%) were slightly more than females (46.4%), with the majority aged 1–5 years (64.5%). Most patients had a length of stay of 1–7 days (99.3%). Antibiotics used included Ceftriaxone, Cefotaxime, Azithromycin, Cefoperazone, and Cefixime (monotherapy or combination). The highest direct medical cost was found in Ceftriaxone monotherapy (IDR 1,973,061 ± 393,521), while the lowest was in Cefixime monotherapy (IDR 1,574,659 ± 39,208). Statistical analysis using the Mann-Whitney test showed no significant difference in costs based on the length of stay (p=0.123). Cefixime monotherapy was the most cost-minimization therapy for pneumonia inpatients at Tk.II Udayana Hospital, with equal clinical effectiveness but lower costs compared to other therapies. This finding may serve as a consideration for hospital formulary development to improve budget efficiency without compromising quality of care.

Keywords: Pneumonia; Antibiotic; Cost Minimization Analysis; Pharmacoeconomic

Introduction

Healthcare costs in Indonesia continue to rise significantly, creating a considerable burden on both patients and the healthcare system. Pharmacoeconomics plays an essential role in evaluating and analyzing treatment costs to improve efficiency and promote rational use of resources (Anwar & Widiastuti, 2020). Pneumonia, an acute infection of the lower respiratory tract caused by bacteria, viruses, fungi, or parasites, remains a leading contributor to morbidity, mortality, and healthcare expenditure. In Indonesia, the cost of treatment for Community-Acquired Pneumonia (CAP) ranges between USD 254 and 1,208,

equivalent to approximately IDR 18.6 million (Admaja et al., 2024). The National Basic Health Research Indonesia., (2018) reported a pneumonia prevalence of 2.21% across all age groups, with the highest rates among the elderly. In 2021, the national prevalence of pneumonia among children under five reached 31.4%, with Bali among the top ten provinces for reported cases (Kemenkes, 2020).

Antibiotics represent the most widely used class of drugs worldwide, accounting for a substantial proportion of hospital budgets (Prasetyo & Kusumaratni, 2018). Prolonged antibiotic use and inappropriate therapy may increase treatment costs, extend hospital stays, and reduce service quality (Musdalipah & Muh.Azdar Setiawan, 2018). Cost minimization analysis (CMA) is therefore crucial for identifying treatment options with equivalent effectiveness but lower costs, ultimately improving patient outcomes while reducing economic burdens (Hasan & Nurwati, 2020). Considering these challenges, this study was conducted at Tk. II Udayana Hospital, a teaching hospital in Denpasar, Bali, with the objective of evaluating the cost-minimization of antibiotic use in pneumonia inpatients as a basis for more efficient resource allocation and better healthcare delivery.

Methodology

The tools used in this study included data collection forms and statistical software for data processing (SPSS 16.0). The materials consisted of inpatient medical records and administrative data of pneumonia patients from January 2023 – December 2023, including patient demographics, diagnosis, prescribed antibiotics, and treatment costs. This study employed a descriptive, non-experimental, retrospective design using medical records and hospital financial data of pneumonia inpatients at Tk. II Udayana Hospital from January to December 2023/2024. A total sampling technique was applied. Inclusion criteria were inpatients with complete medical records and without comorbidities. Exclusion criteria were incomplete or unreadable medical records. The main variable was the cost minimization of antibiotic therapy for pneumonia inpatients.

Procedures

The study consisted of ethical clearance approval, data collection, and data analysis. Secondary data from medical records and hospital billing included: Patient identity (record number, age, sex, body weight) Antibiotic therapy (drug name, dose, duration, dosage form) Direct medical costs (drugs, laboratory, hospitalization, physician visits, nursing care Other costs (administration, rehabilitation).

Data Collection and Analysis

Medical records were collected retrospectively. Descriptive analysis was performed to describe sample characteristics. Cost comparison between antibiotic therapies was analyzed using the independent t-test or the Mann–Whitney U test depending on data distribution, and the statistical analysis was conducted using SPSS 16.0

Result and Discussion

Medical record data were collected from February to March 2025 in the medical records unit of Tk. II Udayana Hospital, Denpasar. Out of a total population of 233 medical records obtained, 95 records were excluded due to incomplete patient data. Therefore, the final sample used in this study consisted of 138 medical records.

Table 1. Demographic Data of Pediatric Inpatient Medical Records with Pneumonia by Gender at Tk. II Udayana Hospital Denpasar

No.	Gender	Number of Patients (people)	Percentage (%)
1.	Perempuan	64	46,4
2.	Laki-laki	74	53,6
	Total	**138**	**100**

Table 1 shows that male pediatric pneumonia inpatients at Tk. II Udayana Hospital outnumber females. This aligns with previous findings suggesting boys are more susceptible due to narrower airway diameters. Pneumonia remains a leading cause of morbidity and mortality in children, with an estimated 19,000 under-five deaths in Indonesia in 2018.

Table 2. Demographics of Medical Records of Inpatient Pediatric Pneumonia Patients Based on Age at Udayana Class II Hospital, Denpasar

No.	Age (years)	Number of Patients (people)	Percentage (%)
1.	1 - 5	89	64,5
2.	6-10	44	31,9
3.	>10-18	138	3,6
	Total	**138**	**100**

Table 2 shows that most pediatric pneumonia inpatients at Tk. II Udayana Hospital were aged 1–5 years, consistent with national data (Riskesdas., 2018) and previous studies reporting the highest prevalence in this age group. Children in early childhood are more vulnerable to pneumonia due to immature immune defenses compared to adults.

Table 3. Characteristics of Pediatric Pneumonia Inpatient Medical Records Based on Length of Stay at Tk. II Udayana Hospital Denpasar

No.	LOS (days)	Number of Patient (n)	Percentage (%)
1.	1-7	137	99,3
2.	>7	1	0,7
	Total	**138**	**100**

Length of stay (LOS) of pediatric pneumonia inpatients at Tk. II Udayana Hospital Denpasar, as shown in 3, was categorized into two groups: 1–7 days and more than 7 days. The majority of patients had a LOS of 1–7 days compared to those hospitalized for more than 7 days. This finding is consistent with Dipiro (2020), who stated that the effective LOS for pneumonia patients ranges between 1 and 7 days. Similarly, a study by Santi, (2018) at Bombana District General Hospital also

reported that most pneumonia patients were hospitalized for 1–7 days. According to the Indonesian Guidelines for the Diagnosis and Management of Community-Acquired Pneumonia, the average treatment duration is either 3 or 7 days. This is in line with the (Kemenkes RI., 2021) guidelines, which recommend an antibiotic treatment duration of 5–7 days (Wahyuni et al., 2025).

Tabel 4. Direct Medical Costs of Antibiotic Therapy Ceftriaxone Alone, Cefotaxime Alone, Azithromycin Alone, Cefoperazone Alone, Cefixime Alone, Ceftriaxone+Azithromycin, and Cefoperazone+Azithromycin

No	Antibiotic	Total Direct Medical Cost
1.	Ceftriaxone single	Rp189.413.831
2.	Cefotaxime single	Rp9.009.210
3.	Azithromycin single	Rp18.860.331
4.	Cefoperazone single	Rp8.192.288
5.	Cefixime single	Rp3.149.317
6.	Ceftriaxon+Azitromycin	Rp52.960.173
7.	Cefoperazon+Azitromycin	Rp2.153.147

This table 4 presents the total direct medical costs of antibiotic therapies, including Ceftriaxone monotherapy, Cefotaxime monotherapy, Azithromycin monotherapy, Cefoperazone monotherapy, Cefixime monotherapy, Ceftriaxone + Azithromycin combination, and Cefoperazone + Azithromycin combination. The cost components considered include antibiotics, hospital room charges, laboratory costs, physician visits, nursing care, supporting costs (medical supplies, meals), and other expenses (general/specialist consultations and emergency department observation). The cost-minimization analysis of pediatric pneumonia inpatients at Tk. II Udayana Hospital Denpasar showed that, among seven antibiotic therapies evaluated, single Cefixime therapy had the lowest mean direct medical cost (Rp. 1,574,659 ± Rp. 39,208). This was lower compared to Ceftriaxone, Cefotaxime, Cefoperazone, and combination regimens. A study by Zainul et al. (2023) at Bekasi District General Hospital also confirmed that Cefixime was the most cost-minimizing therapy (Rp. 1,953,288) compared to Ceftriaxone (Rp. 2,159,061). The higher cost of Ceftriaxone is likely due to its injectable dosage form, which is more expensive than Cefixime, an oral antibiotic available in tablet and syrup forms.

Table 5. Results of the Mann-Whitney Test of Direct Medical Costs Based on Length of Stay

Length of Stay	Number of Patient	Sig (*2-tailed*)
1-7 day	137	0.123
>7 day	1	
Total	**138**	

Statistical testing using the Mann-Whitney test was conducted to determine whether there were differences in direct medical costs between groups based on LOS. The results showed a significance value of 0.123 ($p > 0.05$), indicating no

statistically significant difference between patients with a LOS of 1–7 days and those with a LOS of more than 7 days. This may be due to the imbalance in sample size, as 137 patients were in the 1–7 day group while only one patient was in the >7 day group, thus reducing the sensitivity of the statistical test.

Conclusion

From the results of this study, it can be concluded that:

The highest cost of antibiotic use in pneumonia patients at Tk. II Udayana Hospital was for single Cefotaxime therapy, with an average cost of Rp. 2,252,302 ± Rp. 576,892. The lowest cost of antibiotic use in pediatric pneumonia inpatients at Tk. II Udayana Hospital was for single Cefixime therapy, with an average cost of Rp. 1,574,659 ± Rp. 39,208 in tablet and syrup dosage forms. Considering its comparable efficacy in treating community acquired pneumonia in children, as supported by recent clinical trials and pharmacoeconomic studies in Indonesia, cefixime can be considered an effective and cost-efficient option in hospital settings, particularly in resource-limited environments.

Declaration of Competing Interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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