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Cost-Effectiveness of Antibiotics for Typhoid Fever at Hermana Lembean Hospital

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Abstract

Salmonella typhi bacteria, which contaminate ingested food and beverages and sufferers' feces, urine, or other secretions, are typically to blame for typhoid fever. This study's objectives were to identify the traits of inpatient typhoid fever patients who received antibiotics evaluating the cost-effectiveness of antibiotics for typhoid fever patients receiving inpatient typhoid fever at Hermana Lembean Public Hospital. The cost-effectiveness of antibiotic therapy for inpatients with typhoid fever was examined in this study utilizing descriptive research, which involved retrospective data collecting using secondary data, such as medical record data and record costs of patients who had received inpatient care at Hermana Lembean General Hospital. According to the calculations from the Cost-Effectiveness Analysis, ceftriaxone injectable therapy has an ACER value of Rp. 15.987, and an efficacy of 100%, is the most economical antibiotic treatment.

Keywords: Antibiotic, Cost-effectiveness, Salmonella typhi, Typhoid

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1 Introduction

A severe infectious illness that affects the digestive system is typhoid fever. Salmonella typhi bacteria, which contaminate ingested food and beverages and sufferers' feces, urine, or other secretions, are typically to blame for typhoid fever [1]. Typhoid fever is thought to affect up to 11–21 million people a year, killing 128.000–161.000 people and infecting an average of cases in Southeast Asia, South Asia, and Sub-Saharan Africa [2]. Typhoid fever cases alone total 350–810 per 100.000 people in Indonesia, with a prevalence of 1.6%. They rank fifth among infectious diseases that impact all ages, with a percentage of 6.0%, and fifteenth among causes of death in all ages, with a rate of 1.6% [3]. The use of antibiotics is one of the treatments frequently employed to treat typhoid fever.

Research on antibiotics for typhoid fever patients at the hospital was done by Agnes et al. in 2019, ceftaxime and ceftriaxone are both used in Bhayangkara Manado. Following calculations, the ACER results for cefotaxime were IDR 526.609 per day and IDR 484.789 per day for ceftriaxone. Ceftriaxone was shown to be more effective than cefotaxime in terms of the length of hospitalization, which was shorter than the length of hospitalization for cefotaxime users. As a result, ceftriaxone therapy was more advantageous financially than cefotaxime treatment. For this reason, patients on cefotaxime who want to switch to ceftriaxone medication must pay additional expenditures equal to the ICER value of IDR 340.528 [4]. Compared to the antibiotics cefixime and cefotaxime used to treat typhoid fever at Pancaran Kasih Hospital in Manado, the average total cost of patients with typhoid fever using cefixime therapy was Rp. 2.500.000.912. for patients taking cefotaxime was Rp. 2.594.693. The ACER value for patients receiving cefotaxime therapy was Rp. 1.179.406 per day without a fever, Rp. 1.142.113 for cefixime patients, and Rp. 1.592.700 for ICER values. Patients who use cefotaxime have an ACER value of Rp. 585.703 per day of care, those who use cefixime have an ACER value of Rp. 585.497 per day, and those who utilize an additional length of stay have an ICER value of Rp. 955.620 per day. As a result, cefixime therapy had a better outcome than cefotaxime therapy [5]. Antibiotic resistance can be avoided, treatment costs can be reduced by using fewer antibiotics, treatment times can be cut short, and hospital savings can be increased, leading to better hospital services. Proper antibiotic use can also reduce the number of antibiotics used, which reduces treatment costs. Typhoid fever treatment is relatively expensive; hence pharmacoeconomic studies are required to help with therapy selection and make the chosen treatment more effective and affordable. Cost-effectiveness analysis is one of the pharmacoeconomic techniques appropriate for this situation [6].

Cost-effectiveness analysis is a pharmacoeconomic method for assessing two or more health therapies' relative costs and results (outcomes) [7]. The optimum treatment option can be chosen using a cost-effectiveness analysis to guide decision-making from the available treatment options. Most of the time, cost-effectiveness analysis is measured in output units, such as the number of actions, fatalities that can be avoided, or patients who recover from the condition [8]. Given the preceding context, it is vital to research the cost-effectiveness analysis of antibiotics for typhoid fever inpatients at Hermana Lembean Public Hospital to give the hospital a general overview when developing better medications. This study's objectives were to identify the traits of inpatient typhoid fever patients who received antibiotic therapy as part of their care, to choose the profile of antibiotic use for inpatient typhoid fever patients, to learn more about the costs associated with treating inpatient typhoid fever patients and with evaluating the cost-effectiveness of antibiotics for typhoid fever patients receiving inpatient typhoid fever at Hermana Lembean Public Hospital.

2 Methods

The cost-effectiveness of antibiotic therapy for inpatients with typhoid fever was examined in this study utilizing descriptive research, which involved retrospective data collecting using secondary data, such as medical record data and record costs of patients who

had received inpatient care at Hermana Lembean General Hospital for several numbers of years—the year 2021. The study was carried out between October 31 to November 10, 2022. Patients with typhoid fever who received antibiotic therapy from January 2021 to December 2021 made up the population for this study. Inpatients diagnosed with typhoid fever at the inpatient facility of Hermana Lembean General Hospital, typhoid fever patients using antibiotic therapy with or without comorbidities, patients inpatient with typhoid fever who have a complete and clear medical record, including patient characteristics, length of hospitalization, and antibiotic therapy were the sample of this study. Nonetheless, the following were the exclusion criteria: Individuals with typhoid fever who were discharged from the hospital before a doctor advised they go home, transferred to another hospital, or who passed away while receiving treatment, as well as those whose medical record data were inaccurate, missing, or unreadable.

Patient profiles and treatment profiles were among the data that were descriptively evaluated. The cost of each patient's direct medical care is then calculated. After that, estimate the data's average or Analysis Cost-Effectiveness Ratio (ACER). The antibiotics are considered cost-effective if the expenses are low and the effectiveness is higher. The results of this CEA approach were summarized with the ICER (Incremental Cost-Effectiveness Ratio); if the ICER results obtained a negative or smaller value, it could be assumed that using these antibiotics is more cost-effective and practical than using other pharmacological options, making antibiotic therapy the best therapy.

3 Results and Discussion

Table 1 below shows the characteristics of Hermana Lembean Hospital's typhoid fever inpatients in 2021.

The characteristics of typhoid fever inpatients at Hermana Lembean General Hospital in 2021 can be shown in Table 1. 39 female patients made up 55% of the total population, compared to 32 male patients, who made up 45%. This occurs because women have a weaker immune system than men, which renders them more susceptible to contracting the bacteria that causes typhoid fever. Yet, in most cases, a person's gender is not a determinant that can make them develop typhoid fever. The primary variables that can lead someone to get typhoid fever are often cleanliness and daily activity [9]. Female patients with typhoid fever outnumbered male patients [5]. Sanglah Hospital in Denpasar also revealed that female patients comprised most of those who contracted typhoid fever [10]. Most typhoid fever patients are females [11].

Table 1 Characteristics of people with typhoid fever

Variable	Amount of patients
Identity	
Male	32 (45%)
Female	39 (55%)
Type of Age (year)	
0 – 5	11 (15.5%)
6 – 11	13 (18%)
12 – 16	8 (11.3%)
17 – 25	14 (20%)
26 – 35	11 (15.5%)
36 – 45	4 (5.6%)
46 – 55	4 (5.6%)
56 – 65	4 (5.6%)
> 65	2 (2.8%)

According to the aforementioned table, it is also known that 14 patients, or the majority of cases of typhoid fever, are between the ages of 17 and 25. Children and young adults are more susceptible to typhoid fever because their immune systems have matured, making them more vulnerable to infections [12]. This population is more likely to contract the bacteria that cause typhoid fever because they engage in much physical activity, especially outside the home, and neglect their food and cleanliness [13].

Investigation at Sanglah Hospital in Denpasar, where most typhoid fever patients were between 18 and 25 [10]. Typhoid fever was most prevalent in people between 15 and 25 [14]. The length of stay for typhoid fever patients at Hermana Lembean Public Hospital is displayed in Table 2 based on the patient data obtained.

Table 2 Shows how long patients with typhoid fever stay in hospitals

Types of Antibiotics	Hospitalization Time in Days	Amount of patients	Total
Cefixime capsules	2	2	26 (±3.5 day)
	3	14	
	4	6	
	5	3	
	6	1	
Cefixime Syrup	1	1	15 (±3.7 day)
	2	2	
	3	4	
	4	4	
	5	2	
	6	2	
Ceftriaxone Injection	2	2	21 (±3.6 day)
	3	10	
	4	4	
	5	5	
Ciprofloxacin	3	4	9 (±4,1 day)
	4	3	
	5	1	
	8	1	

Table 2 shows that the antibiotic cefixime, which has a median hospital stay of 3.5 days, is the most effective treatment for typhoid fever. This is because cefixime belongs to the third generation of cephalosporin antibiotics, which are broad-spectrum antibiotics but are more effective against gram-negative bacteria [15]. This finding differs from that of the Dewi et al. study .'s conducted at Karsa Husada Hospital in room S2, where patients receiving ceftriaxone therapy spent less time in the hospital than those receiving cefixime antibiotic medication [16] .

The length of the patient's hospital stay is measured by the LOS (Length of Stay = Long Days of Care). Calculating the interval between the patient's discharge date and hospital admission date yields the length of stay. The success or failure of the patient's therapy determines how long they stay. Also, a patient's length of stay may be affected by the severity of their symptoms and the development of complications [17]. The success of therapy depends on many factors, including the patient's level of compliance with treatment, the choice of the appropriate medication, the quality of their diet, and the severity of the ailment they are now dealing [18,19]. Patient compliance is typically influenced by a variety of factors, including each patient's perception of their health, their history of self-medication, their experiences with prior therapies, their social support network (friends and family), the side effects of the medications they take, and their interactions with healthcare professionals [20]. If the clinical assessment has been met, such as 5-7 days of fever-free patients, the patient's general health improves, complications do not arise or are under control, typhoid fever patients may be discharged [17].

The costs of therapy, antibiotics, lab work and doctor visits are included in the direct medical costs of inpatients, according to research data gleaned from the medical records of typhoid fever patients at Hermana Lembean Public Hospital. Following the Guidelines for Conducting Pharmacoeconomic Research, these expenses are closely tied to those associated with patient care [7] . Table 3 below shows the total direct medical expenses for typhoid fever inpatients at Hermana Lembean General Hospital:

Table 3 Direct Medical Cost Information

Types of Antibiotics	Cost of Antibiotics	Hospital and medical facility costs	Laboratory Costs	Cost of a doctor's visit	Total Immediate Medical Costs
Cefixime capsules	36.000	1.221.500	324.216	179.519	1.761.125
Cefixime Syrup	26.000	1.252.000	282.900	196.000	1.756.900
Ciprofloxacin	8.222	1.026.111	250.833	190.555	1.475.721
Ceftriaxone Injection	99.429	1.021.381	316.856	176.190	1.598.768

Table 3 shows that the direct medical costs of inpatients with typhoid fever at Hermana Hospital Lembean were the highest in patients using the antibiotic Cefixime, amounting to Rp. 1.761.125, - while the lowest total direct medical costs for inpatients with typhoid fever were patients with Ciprofloxacin therapy, which was Rp. 1.475.721,-. The difference in direct medical costs is due to the difference in the length of the patient's hospitalization, where the longer the patient is treated, the greater the costs incurred. The cost of antibiotics is a fee

that must be paid by patients who receive antibiotic therapy during the treatment process at the hospital. The patient's condition is improving, or vice versa can affect the cost of antibiotics. Based on the data obtained, patients must pay the highest cost of antibiotics is the antibiotic ceftriaxone injection, which is Rp. 99.428, - the lowest was the patient with ciprofloxacin antibiotic therapy, Rp. 8.222,-.

Treatment costs are incurred by patients while undergoing treatment at the hospital, consisting of room costs per class, treatment costs, and administrative costs. The length of stay and the type of room class used can affect the big difference in this cost. From the above data, it can be seen that the highest cost of treatment is typhoid fever patients with cefixime syrup therapy, which is Rp. 1.252.000,- and the lowest was in typhoid fever patients with ceftriaxone injection therapy of Rp. 1.021.381,-. *Laboratory fees* are costs incurred by patients for laboratory tests to establish a diagnosis and monitor the conditions of exposure to infectious microorganisms that cause typhoid fever [9] . The data above shows that the highest laboratory costs are for patients with typhoid fever with cefixime antibiotic therapy, which is Rp. 324.216, - The lowest cost of antibiotics in ciprofloxacin antibiotic therapy is Rp. 250.833. The frequency of examination of each patient influences the cost of this laboratory.

The doctor's visit fee is the cost the patient must pay during treatment for the doctor's vision services in the inpatient room. The research data above shows that the highest doctor's visit fee for patients with Cefixime syrup antibiotic therapy is Rp. 196.000, - and the lowest doctor visit costs are those with ceftriaxone injection antibiotic therapy, which is Rp. 176.190,-. Cost-effectiveness analysis (AEB) is a pharmacoeconomic study comparing two or more health interventions that provide different effect sizes to find the best treatment program. In this cost-effectiveness analysis method, it is necessary to calculate ACER and ICER. The calculation of the ACER (Average cost-effectiveness ratio) value is used to determine the costs incurred by patients per day compared to its effectiveness (Lorensia et al., 2018). If the ACER value of a therapy is lower than other treatment therapies, this therapy is the most cost-effective [21]. The results of calculating the ACER value for each treatment of typhoid fever patients at Hermana Lembean General Hospital can be seen in table 4.

Table 4 can assist in assisting in the conclusion of which alternative treatment has the most cost-effective. A table comparing the findings of the cost-effectiveness of antibiotic therapy is provided below.

Table 4 ACER Value Calculation Results

Types of Antibiotics	Total Immediate Medical Costs (Idr)	Effectiveness (%)	ACER score (Idr)
Cefixime capsules	1.761.125	96	18.345
Cefixime Syrup	1.756.900	86,6	20.287
Ciprofloxacin	1.475.721	88,8	16.618
Ceftriaxone Injection	1.598.768	100	15.987
Total	6.592.514	371,4	71.237
Average	1.648.128	92,85	17.809

Table 5 Examines the Links Between Treatment and Cost-Effectiveness

Cost-effectiveness	Lower cost	The cost is the same	Higher costs
Lower cost	A (RIEB is required) Ciprofloxacin	B	C (Dominated) Cefixime Syrup
The cost is the same	D	E	F
Higher costs	G (Dominan) Ceftriaxone Injection	H	I (RIEB is required) Cefixime capsules

Table 5 above shows the effectiveness-cost relationship of the antibiotic therapy employed at Hermana Lembaen General Hospital, which is listed in 4 columns, A, C, I, and G. The antibiotic ciprofloxacin is in column A, where effectiveness is low with lower costs; cefixime syrup antibiotic therapy is in column C, where effectiveness is typical with higher prices; and cefixime antibiotic therapy is in column I, where effectiveness is high, but costs are also high. Column G is the position for ceftriaxone antibiotic therapy, where the price and efficacy of treatment are more favorable. According to the results above, cefixime syrup occupies Column C (dominant position), providing lesser effectiveness but a higher cost. As a result, antibiotic therapy for cefixime syrup does not need to be considered when calculating RIEB. Assume a health intervention is activeness at low cost (Column A) or high effectiveness at a high price (Column I). RIEB must be calculated to choose these health therapies more wisely. Columns A and I in this study were filled with ciprofloxacin and column I with cefixime, making it possible to compare the two antibiotics using RIEB calculations to determine the more cost-effective option. Ceftriaxone injection, however, fills column G, and, if a therapeutic intervention is in a dominant position (column G), then the intervention is chosen, and there is no need to recalculate AEB. Ceftriaxone injection therapy is the most economical course of action for treating typhoid fever in patients at Hermana Hospital Lembean in the years leading up to 2021 [7]. Similar research in various locations is required to assess the cost and efficacy of antibiotic therapy in other areas and provide more references for selecting a more effective antibiotic.

4 Conclusions

There were 71 patients with typhoid fever at Hermana Lembean General Hospital in 2021, ages 0-69, with 45% men and cefixime, cefixime syrup, ciprofloxacin, and ceftriaxone injectable patterns one injectable in typhoid fever patients. Cefixime syrup's one-day hospital stay set the record for the shortest hospital stay, while ciprofloxacin's eight-day stay was the longest. The price of antibiotics, maintenance, lab, and doctor visits are the expenditures associated with treating typhoid fever. According to the calculations from the Cost-Effectiveness Analysis, ceftriaxone injectable therapy has an ACER value of Rp. 15.987, and an efficacy of 100%, is the most economical antibiotic treatment.

5 Declarations

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5.2 Author Contributions

Conceptualization, and Methodology: Lili Musnelina. Writing draft, Review and Editing: Teodhora. Extraction and data analysis: Celin Gracela Tanama

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5.4 Conflicts of Interest

The authors declare no conflict of interest.

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