

ORIGINAL ARTICLE

Cost Effectiveness Analysis Treatment of Pediatric Pneumonia Antibiotic Ceftriaxon and Cefotaxime at Dr. Chasbullah Abdulmadjid Hospital

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ABSTRACT

Introduction: Pneumonia is inflammation in the lung parenchyma. Inflammation occurs due to infection by various organisms like bacteria, viruses, and others. This infection eventually causes the emergence of several signs and symptoms. Ceftriaxone and cefotaxime are antibiotics that are commonly and effectively used in the treatment of pneumonia. **Methods:** The purpose of this study is to determine the total cost of pneumonia treatment provided during hospitalization at RSUD Bekasi City. This research uses the method descriptive research with data retrieval retrospectively. The sample in this research totaled 68 patients, 34 patients used ceftriaxone antibiotics and 34 patients used cefotaxime antibiotics. **Results:** Cefotaxime antibiotic therapy is a more cost-effective therapy compared to Ceftriaxone. This study found the effectiveness of Ceftriaxone 88% and Cefotaxime 70% but did not reach 100% effectiveness due to the large number of patients whose length of stay (LOS) and respiration rate (RR) did not reach the target. The result showed that the average cost of treating patients with Ceftriaxone was Idr 2,171,651 and the average cost of treating patients with Cefotaxime was Idr 2,467,422. **Conclusion:** Ceftriaxone antibiotic therapy is a more cost-effective therapy compared to Cefotaxime which can be, seen from the ACER Ceftriaxone value of IRp. 24,677 and ICER value of Rp. -16,431.651 and the average cost of treating patients using Cefotaxime was Idr 2,467,422.

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Keywords: Cost Effectiveness Analysis; Ceftriaxone; Cefotaxime; Pneumonia

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INTRODUCTION

Pneumonia is inflammation of the lung parenchyma. Inflammation occurs due to infection by various organisms such as bacteria, viruses, and other organisms. This infection eventually causes the appearance of several signs and symptoms of infection as evidenced by the presence of an acute infiltrate on the chest radiograph (1). Antibiotic therapy for pneumonia in children under five based on Dipiro, uses the third generation cephalosporin class of antibiotics, namely ceftriaxone and cefotaxime. Ceftriaxone and cefotaxime are the drugs of choice for the treatment of pneumonia, but it is not known which of the two antibiotics is the more cost-effective treatment option because in

addition to choosing antibiotics that are appropriate and rational, one must also consider cost-effectiveness and to determine this, CEA is necessary (2).

Cost Effectiveness Analysis (CEA) is a pharmacoeconomic method for selecting and assessing the best program or drug for several therapeutic options with the same goal. This method needs to be calculated as Cost-Effectiveness Ratio (ACER) and Incremental Cost-Effectiveness Ratio (ICER). This method is carried out to find out which treatment is more cost-effective of the two selected alternative treatments (3).

MATERIALS AND METHODS

The population used in this study were pediatric pneumonia patients who were hospitalized at the Bekasi Hospital for the period January - December 2019. The study included only pneumonia patients who used a single antibiotic without being

combined with or replaced with other antibiotics in the middle of the day when the patient was being treated. The type of research design carried out is descriptive research with retrospective data collection based on medical records for the January-December 2019 period.

The samples used were patients who met the inclusion and exclusion criteria for medical record data as follows, Inclusion Criteria: 1) Pediatric patients who were hospitalized with a diagnosis using ceftriaxone and cefotaxime antibiotic therapy. 2) Pneumonia patients declared cured by doctors. 3) Patients who have complete medical records or data. Exclusion Criteria : 1) Pediatric patients diagnosed with pneumonia but with other infectious diseases. 2) Incomplete patient medical record data. 3) Pneumonia patients with forced discharge status or who have not been declared cured by a doctor. 4) Patients referred to other hospitals. Measurement of the effectiveness of antibiotics can be seen in decrease in body temperature, length of stay which can be seen in the patient's medical record.

The data were analyzed descriptively in tabular form. After the data has been collected and the editing process has been carried out, the calculation of direct medical costs is then carried out. This data can be used to calculate the average or Analysis Cost-Effectiveness Ratio (ACER) as follows:

$$ACER = \frac{Cost}{Effectiveness}$$

description :

Cost : Average cost of therapy or average direct medical cost

Effectiveness : Outcome (effect) of drug therapy or length of hospitalization.

The lower the cost and the higher the effectiveness, the more cost-effective the treatment is, so that the choice of therapy is the best choice. The results of the CEA can be concluded with ICER (Incremental Cost-Effectiveness Ratio) as follows:

$$ICER = \frac{drug\ cost\ A - drug\ cost\ B}{drug\ effectiveness\ A - drug\ effectiveness\ B}$$

If the ICER calculation shows a negative result or is getting smaller, then an alternative drug is more effective and cheaper, so that the treatment option is the best choice.

Ethical Clearance

This research has received approval from the Health Research Ethics Committee of Bani Saleh High School of Health Sciences with number EC.085/KEPK/STKBS/VI/2022 dated 27th June, 2022.

RESULTS

This research was conducted at the Medical Record Installation and at the SIM-RS (Hospital Management Information System) at Dr. Chasbullah Abdulmajid Hospital. Based on the results of the study, the number of pediatric patients suffering from pneumonia and undergoing hospitalization during the January-December 2019 period was 925 patients based on total sampling, of whom 68 met the inclusion criteria.

Table I : Characteristics pneumonia patients at Dr Chasbullah Abdulmajid Hospital for the period January-December 2019

Characteristics		Frequency n =68	Percentage (%)
Age (years)	0-5	54	79.4
	6-11	11	16.2
	12-16	3	4.4
Gender	Man	41	60.8
	Woman	27	39.7
Length of Hospitalization	1-5	61	89.7
	6-10	7	10.3

Based on table I Pediatric pneumonia patients are dominated by the age of 0-5 years, namely 54 cases (79.4%). reduce. Pneumonia in male pediatric patients is 60.3% greater than in female pediatric patients (39.7%). The results obtained are in accordance with the results of research conducted by Nalang et al (2019) which concluded that pediatric patients with pneumonia were mostly found in male pediatric patients, namely 60.3% compared to 39.7% of female patients. Pneumonia is more common in men.

Pediatric pneumonia patients who were hospitalized at Dr. Chasbullah Abdulmajid Hospital for the January-December 2019 period and who used third-generation cephalosporin antibiotic therapy, namely ceftriaxone, were 34 patients with an average length of stay of 4 days and 34 patients who used cefotaxime antibiotic therapy with an average The average length of hospitalization is 5 days. Contrary to previous research, research conducted by (4) 20 patients who used the antibiotic ceftriaxone had an average length of stay of 7 days and those who used cefotaxime antibiotic therapy had an average length of stay of 6 days.

Direct medical costs for pediatric pneumonia patients during hospitalization at the Dr. Chasbullah

Table II : Average overview direct medical costs on ceftriaxone antibiotic therapy.

No	Cost component	Ceftriaxone antibiotics (Idr)
1.	Cost of treatment	10,363,490
2.	Maintenance costs	58,834,150
3.	Laboratory fee	2,0006,000
4.	Radiology fee	2,632,500
Total direct medical cost		73,836,140
<i>direct medical cost</i>		2,171,651

Abdulmajid Hospital in 2019 include four types of financing: medical costs, treatment costs, laboratory costs and radiology costs. Based on the total direct medical costs of KBS (Healthy Bekasi Card) and KS (Healthy Cards) patients with ceftriaxone the smallest cost was Idr1,036,150 and the largest was Idr3,819,150. The total direct medical cost of using ceftriaxone antibiotics for the 34 patients is Idr. 73,836.140 with a direct medical cost per patient of Idr. 2,171,651.

Based on the total direct medical costs of KBS (Healthy Bekasi Card) and KS (Healthy Cards) patients with cefotaxime the smallest cost is Idr. 1,189,650 and the total biggest direct medical

Table III : Overview of the average direct medical costs of cefotaxime antibiotic therapy.

No	Cost component	Cefotaxime antibiotics
1.	Cost of treatment	12,521,610
2.	Maintenance costs	67,720,750
3.	Laboratory fee	1,797,501
4.	Radiology fee	1,852,500
Total direct medical cost		83,892,361
<i>direct medical cost</i>		2,467,422

cost is Idr. 4,870,150. The total direct medical cost of using Cefotaxime antibiotics for the 34 patients is Idr. 83,892,361. With direct medical cost per patient, which is Idr. 2,467,422.

The percentage of the effectiveness of antibiotic therapy in pediatric pneumonia patients hospitalized at Dr. Chasbullah Abdulmajid Hospital for the period January-December 2019 for Ceftriaxone antibiotic therapy showed an effectiveness of 88% and Cefotaxime showed an effectiveness of 70%.

Based on table V the ACER value of Cefotaxime has a higher number of 35,248 compared to Ceftriaxone which has an ACER value of 24,677.

Table IV : Percentage of the effectiveness of antibiotic therapy in inpatient pneumonia patients at Dr Chasbullah Abdulmajid Hospital for the period January-December 2019

Antibiotics	Number of Patients	Number of patients	Effectiveness (%)
Who hit the target			
Ceftriaxone	34	30	88%
Cefotaxime	34	24	70%
Antibiotics	Number of Patients	Number of patients	Effectiveness (%)
Who hit the target			
Ceftriaxone	34	30	88%
Cefotaxime	34	24	70%

Table V : ACER calculation of the use of Ceftriaxone and Cefotaxime antibiotics in inpatient pneumonia patients at Dr. Chasbullah Abdulmajid Hospital for the period January-December 2019

Antibiotics	Total cost (Idr)	Effectiveness (E)	ACER (C/E)
Ceftriaxone	2,171,651	88%	24,677
Cefotaxime	2,467,422	70%	35,248

Table VI : ACER calculation of the use of Ceftriaxone and Cefotaxime antibiotics in inpatient pneumonia patients at Dr. Chasbullah Abdulmajid Hospital for the period January-December 2019

Antibiotics	Total Cost (C) (Idr)	Effectiveness	C	E	ICER ($\Delta C/\Delta E$)
Ceftriaxone	2,171,651	88%			
			-295,771	18%	-16,431
Cefotaxime	2,467,422	70%			

Based on table VI, the smallest ICER value for the Ceftriaxone antibiotic is -16,431. The ICER value obtained is the amount of additional cost needed to obtain a one unit change in effectiveness in pneumonia patients.

DISCUSSION

Antibiotic therapy used was single antibiotic therapy using additional drug therapy with corticosteroids, namely dexamethasone injection and administration of KA-EN infusion fluids that were tailored to the needs of the patient's body. Giving antibiotics aims to inhibit the growth of bacteria that cause pneumonia. Ceftriaxone has a high antibacterial potential, a broad spectrum of activity against gram-negative and gram-positive bacteria and a low potential for toxicity, while cefotaxime has a wider spectrum of activity against Gram-negative bacteria than Gram-positive bacteria (5). Ceftriaxone has a longer half-life than other cephalosporins, so once a day is sufficient. This drug is indicated for severe infections such as septicemia, pneumonia and meningitis. Ceftriaxone calcium salts sometimes cause precipitation in the gallbladder. But it usually disappears when the drug is stopped (6).

The administration of the corticosteroid drug Dexamethasone aims to improve the respiration rate (RR). Dexamethasone acts as an anti-inflammatory. Dexamethasone administration can reduce inflammation that occurs in the lungs during infection (5). Giving KA-EN infusion fluids aims to maintain a relatively constant volume of body fluids and the composition of the electrolytes in them remains stable. It is a cost that must be incurred to increase effectiveness by switching from one treatment to another.

The difference in direct medical costs for each patient is due to the length of time the patient is hospitalized and the number of patients using drugs, equipment, doctor visit fees and hospital room costs. The longer the patient is hospitalized, the greater the costs to be incurred.

Previous research found the effectiveness of cefotaxime at 100% and ceftriaxone at 85% and

obtained the results that Cefotaxime antibiotic therapy is a more cost-effective therapy compared to cefotaxime. This study found the effectiveness of Ceftriaxone to be 88% and that of Cefotaxime 70% but did not reach 100% effectiveness due to the large number of patients whose LOS and respiration rate (RR) did not reach the target, LOS or maximum length of stay of 5 days although many patients were treated for more than 5 days. The patient returns home with a respiration rate (RR) that has not returned to normal. The normal respiration rate (RR) in pneumonia patients is 24 x/minute (7). Effectiveness is the ability of a drug treatment to restore the target respiration rate (RR) to normal. For stable criteria, the respiratory rate should be 24x/minute. To see the effectiveness of the therapy using Ceftriaxone and Cefotaxime antibiotics in hospitalized pneumonia patients at Dr. Chasbullah Abdulmajid Hospital for the period January - December 2019 in terms of the respiration rate (RR) parameter (8).

Based on table V the ACER value of Cefotaxime has a higher number of 35,248 compared to Ceftriaxone which has an ACER value of 24,677. The ACER value shows that for every 1% increase in effectiveness/outcome, a cost of ACER is required. The lower the ACER value and the higher the effectiveness, the more cost-effective the antibiotic therapy is, so it can be concluded that therapy using the antibiotic Ceftriaxone is the most cost-effective drug for treating pediatric pneumonia patients hospitalized at Dr. Chasbullah Abdulmajid Hospital (9).

Based on table VI, the smallest ICER value for the Ceftriaxone antibiotic is -16,431. The ICER value obtained is the amount of additional cost needed to obtain a one unit change in effectiveness in pneumonia patients. If the ICER calculation shows a negative result or is getting smaller, then an alternative drug is more effective and cheaper, so the treatment option is the best choice. Treatment of pneumonia with the antibiotic Ceftriaxone showed negative results, so it can be concluded that Ceftriaxone is the most cost-effective drug for treating pneumonia patients hospitalized at Dr. Chasbullah Abdulmajid Hospital (10).

CONCLUSION

Based on the results of the study, it can be concluded that the average cost of treatment per patient using Ceftriaxone is Idr 2,171,651 and the average cost of treatment per patient using Cefotaxime is Idr 2,467,422. Ceftriaxone antibiotic therapy is a more cost-effective therapy than Cefotaxime which can be seen from the ACER value of Ceftriaxone of Idr. 24,677 and the ICER value of Idr. -16,431.

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