International Journal Of Health, Engineering And Technology (IJHET) *E-ISSN 2829 - 8683*
Volume 4, Number 6, March 2026, *Page. 1989 - 2000*
Email : editorijhess@gmail.com

Cost-Effectiveness Analysis Of The Use Of Ciprofloxacin And Levofloxacin Antibiotics For Urinary Tract Infections In BPJS Inpatients At RSUD Dr. Moewardi Surakarta

Annisa Nurulita Dyah Savitri[1)], Kharisma Jayak Pratama[2)], Aprilia Puteri Santika[3)]
[1,2,3)] Bachelor of Pharmacy Study Program, Faculty of Health Sciences, Duta Bangsa University, Surakarta

*Corresponding Author
Email : annisasafitri090@gmail.com

Abstract

Urinary tract infections (UTIs) are a significant health burden in Indonesia, with high antibiotic therapy costs in BPJS inpatients. This study aims to analyze the cost-effectiveness of ciprofloxacin versus levofloxacin in BPJS inpatient UTI patients at Dr. Moewardi Surakarta Hospital from January to June 2025. This study used retrospective quantitative descriptive research with secondary data from medical and financial records; the population of all cases met the criteria (n=127) using total sampling. Data extraction instruments were demographic variables, effectiveness (temperature, length of hospitalization), and direct medical costs; CEA analysis via ACER, ICER, and Mann-Whitney test ($p<0.05$). The results showed equivalent effectiveness (ciprofloxacin 36.78%; levofloxacin 35%), ACER of ciprofloxacin Rp470,910 lower than levofloxacin Rp621,220, negative ICER Rp-2,451,792, with no significant difference ($p>0.05$). Conclusion: Both therapies are economically equivalent, supporting the optimization of JKN.

Keywords: Avarage Cost Effectiveness Ratio, Ciprofloxacin, Cost Effectiveness Analysis, Incremental Cost Effectiveness Ratio, Urinary Tract Infection.

INTRODUCTION

Urinary tract infections (UTIs) are one of the most common infections worldwide, with a prevalence reaching millions of cases annually, particularly in women due to the short anatomy of the urethra. In Indonesia, UTIs account for approximately 90-100 cases per 100,000 population per year, or approximately 180,000 new cases annually, often caused by bacteria such as Escherichia coli from the gastrointestinal tract.

Urinary tract infections involve inflammation caused by pathogens entering the urinary system, from the urethra to the kidneys, with symptoms such as dysuria and fever. The global prevalence reaches 8.3 million cases per year according to the WHO, while in Indonesia it reaches 35-42% in adolescents and 27-33% in young adults, particularly women. Risk factors include the proximity of the urinary and gastrointestinal tracts, which allows for bacterial translocation, as well as urinary retention or poor hygiene. Fluoroquinolone antibiotics such as ciprofloxacin and levofloxacin are the mainstay of empirical therapy due to their good absorption and high urinary concentrations.

Hospital data in Indonesia shows that third-generation cephalosporins such as ceftriaxone and fluoroquinolones dominate UTI therapy, with ciprofloxacin and levofloxacin frequently used in BPJS inpatient care. UTIs are the second most common infection after respiratory infections, burdening the national healthcare system through hospitalizations and complications such as pyelonephritis.

Antibiotic use in inpatient UTIs is costly, with levofloxacin contributing up to 39.4% of total treatment costs in some Indonesian hospitals. The total cost, including antibiotics, laboratory costs, doctor visits, and hospitalization, often exceeds millions of rupiah per patient, impacting the sustainability of the National Health Insurance (JKN) and the National Health Insurance (BPJS). These increased costs have the potential to reduce access to services for BPJS patients, while the effectiveness of therapy is not optimal compared to the cost. Without a pharmacoeconomic analysis, choosing antibiotics like ciprofloxacin versus levofloxacin risks being economically inefficient.

The lack of cost-effectiveness analysis (CEA) studies has led to uncertainty about which antibiotics are most cost-effective for UTIs, with ICER and ACER needed for comparison. At regional hospitals like Dr. Moewardi, medical record data demonstrates the need for direct medical cost evaluation to optimize therapy.

This study aims to analyze the cost-effectiveness of ciprofloxacin and levofloxacin inpatients with UTI under BPJS at Dr. Moewardi Hospital, Surakarta, from January to June 2025, using CEA with ACER and ICER. The urgency lies in optimizing JKN financing amidst the high cost of UTI, supporting hospital efficiency. The novelty of this study is the specific comparison of the two fluoroquinolones in the context of BPJS Surakarta in 2025, complementing previous studies that focused on cephalosporins.

RESEARCH METHODS

This study used a descriptive design with a retrospective quantitative approach to analyze the cost-effectiveness of antibiotic therapy in BPJS inpatient urinary tract infections (UTIs) at Dr. Moewardi Surakarta Regional General Hospital. This type of descriptive research aims to systematically describe health phenomena based on secondary data from medical and financial records, in accordance with the research framework guidelines as a guide for data collection. The retrospective approach allows for efficient mining of past data for pharmacoeconomic evaluation using Cost Effectiveness Analysis (CEA) with ACER and ICER.

The primary research instruments included patient medical record data for variables such as identity, UTI diagnosis, antibiotics (ciprofloxacin and levofloxacin), effectiveness (temperature reduction and length of hospital stay), and financial data for direct medical costs (antibiotics, laboratory tests, doctor visits, hospitalization). Data analysis techniques included univariate descriptions, normality tests, the nonparametric Mann-Whitney test for comparisons of effectiveness and costs ($p<0.05$), and calculations of ACER (average cost/effectiveness) and ICER (difference in cost/difference in effectiveness). This approach ensures objective and reliable analysis in quantitative pharmacoeconomic research.

The study population consisted of all medical and financial records of BPJS inpatient UTI patients at Dr. Moewardi Surakarta Regional General Hospital for the period January-June 2025, with a sample of 127 patients using a total sampling technique where the sample is equal to the population for complete representation. Inclusion criteria included a diagnosis of inpatient UTI, use of ciprofloxacin or levofloxacin, age ≥18 years, BPJS participants, and complete data; while exclusion criteria were incomplete data or patient death. This technique is appropriate for limited populations and ensures generalizability to the context of referral hospitals.

The procedure begins with permission from the Undergraduate Study Program of Pharmacy, Duta Bangsa University, Surakarta to Dr. Moewardi Regional General Hospital, followed by observation of the medical record and income units for population identification in December 2025-January 2026. Secondary data collection was carried out retrospectively using a structured form for variable extraction, analyzed with software such as SPSS for description and CEA. The study was conducted at Dr. Moewardi Regional General Hospital, Surakarta, emphasizing the ethics of anonymous data and patient confidentiality according to health research standards.

RESULTS AND DISCUSSION

Data collection was carried out at Dr. Moewardi Surakarta Regional General Hospital using the total sampling technique, namely a sampling technique where the number of samples is the same as the population.(Pratama et al., 2021)This study was conducted by analyzing the cost-effectiveness of using Ciprofloxacin and Levofloxacin antibiotics in BPJS inpatient urinary tract infection patients at Dr. Moewardi Surakarta Regional Hospital from January to June 2025. The population that met the inclusion criteria was 127 patients. The population that had been obtained was then classified based on the antibiotics used, namely ciprofloxacin and levofloxacin.

The study results revealed patient gender, antibiotic therapy, length of hospitalization, and direct costs, including antibiotic medication for UTIs, laboratory costs, doctor visits, and inpatient costs. The

data obtained were used to determine the most appropriate antibiotic therapy using a cost-effectiveness pharmacoeconomic analysis.

Patient Characteristics Analysis

Patient Characteristics Based on Age

Table 1. Patient Characteristics Based on Age of BPJS Inpatient Urinary Tract Infection Patients at Dr. Moewardi Surakarta Regional Hospital.

Age (years)	Number of Patients	Percentage (%)
17-25	3	2.29%
26-35	11	8.40%
36-45	11	8.40%
46-55	26	19.85%
56-65	37	29.77%
>65	39	31.30%
Total	127	100%

Age classification as follows: 1) toddlerhood: 0.5 years, 2) childhood: 5-11 years, 30 early adolescence: 12-16 years 4) late adolescence: 17-25 years, 5) early adulthood; 26-35 years, 6) late adulthood 36-45 years, 7) early elderly: 46-55 years, 8) late elderly 56-65 years, elderly: >65 years (Angga, 2023). The results of data processing related to the characteristics of urinary tract infection patients based on age at Dr. Moewardi Surakarta Regional General Hospital from January to June 2025 can be referred to in table 1.

Based on the table above, it shows that urinary tract infection patients based on age at Dr. Moewardi Surakarta Regional General Hospital in 2025 amounted to 127 patients. Inpatient UTI patients at Dr. Moewardi Surakarta Regional General Hospital occurred mostly in the age range >65 years, namely 39 patients (30.31%), second place in the age range of 56-65 years as many as 37 patients (29.77%), third place in the age range of 46-55 years as many as 26 patients (19.85%), fourth place in the age range of 26-35 years as many as 11 patients (8.49%), age 36-45 years as many as 11 patients (8.40%), in sixth place in the age range of 17-25 years as many as 3 patients (2.29%).

This research is in line with(Marianna et al., 2021)In those aged 65 and above, UTIs are more common due to a combination of physiological factors such as aging, a weakened immune system, comorbidities, and more frequent catheter use. Epidemiology shows that the risk of UTIs increases significantly in older adults compared to younger adults.

Second place was in the 56-65 age range, with 37 patients (29.77%). The 56-65 age group showed a relatively high number of UTI patients because this age group begins to experience a decline in immunity or increased susceptibility to infection.

The third-highest prevalence was found in the 46-55 age group, with 26 patients (19.85%), indicating a relatively high number of UTIs. This can be explained by the decline in physiological function and a decline in the immune system during this age range. In women, the 46-55 age range is associated with the premenopausal phase, characterized by a decline in estrogen levels. This decrease in estrogen causes changes in the mucosa and normal flora of the urinary tract, increasing the risk of urinary tract infections.

Fourth place was placed in the 26-35 age range with 11 patients (8.49%), and 36-45 years with 11 patients (8.40%), indicating that in productive adulthood, the risk of UTI is relatively balanced. In this age range, the immune system is still quite healthy, so the incidence of UTI is more influenced by behavioral factors than degenerative factors. These risk factors include the habit of holding in urine, insufficient fluid intake, sexual activity, and personal hygiene. Sixth place was placed in the 17-25 age range with 3 patients (2.29%).

Patient Characteristics Based on Gender

The characteristics of inpatients with Urinary Tract Infections at Dr. Moewardi Surakarta Regional General Hospital in January-June 2025 based on gender can be seen in the following table.

Table 2. Patient Characteristics Based on Gender

Gender	Number of Patients	Presentation
Man	49	38.17%
Woman	78	61.83%
Total	127	100%

It can be seen in the table that the number of inpatients with Urinary Tract Infections at Dr. Moewardi Surakarta Regional General Hospital from January to June 2025 was 127 patients and it can be seen that the female gender with a total of 78 patients (61.83%) was more than the male gender with a total of 49 patients (38.17%). The incidence of UTI is more common in women than in men because the anatomy of the female urinary tract has a shorter urethra compared to men, in addition to the female urinary organs being closer to the anus and vagina, so that microorganisms will easily enter the urinary tract.

The results of this study are consistent with research at Salatiga Hospital, which found that the highest number of UTI sufferers were women (30 people) (76.92%), and the lowest number were men (9 people) (23.8%). Women are more likely to suffer from UTIs than men because the distance between the bladder and the skin affected by bacteria is 5 cm in women, compared to 20 cm in men.

Patient Characteristics Based on Antibiotics

The results of antibiotic use in inpatients with Urinary Tract Infections at Dr. Moewardi Surakarta Regional Hospital from January to June 2025 can be seen in the following table.

Table 3. Characteristics of Antibiotic Use

Antibiotic Therapy	Number of Patients	Presentation
Ciprofloxacin	87	68.5%
Levofloxacin	40	31.5%
Total	127	100%

Based on the data, it shows that there are two types of antibiotic therapy used by patients with Urinary Tract Infections in inpatient care at Dr. Moewardi Surakarta Regional Hospital with a total of 127 samples using ciprofloxacin antibiotic therapy given to patients with a total of 87 patients (68.5%) and levofloxacin given to patients with a total of 40 patients (31.5%).

This research is in line with which states that in 2015 in the United States, fluoroquinolone antibiotics were used by approximately 23.1 million patients, including ciprofloxacin (70%) and levofloxacin (28%). This is said because levofloxacin is a third-generation fluoroquinolone antibiotic, and ciprofloxacin is a second-generation antibiotic. Both antibiotics are fluoroquinolones that have strong antibacterial properties against bacteria that cause UTIs, so they are still recommended as antibiotics for urinary tract infections.

Characteristics Based on Length of Hospitalization

Length of stay (LOS) is an indicator of the success of patient care in the hospital.(Yuli, 2024). The results of the data on Urinary Tract Infection patients treated at Dr. Moewardi Surakarta Regional Hospital from January to June 2025 obtained the following inpatient data for patients using levofloxacin and ciprofloxacin antibiotic therapy:

Table 4. Patient Characteristics Based on Length of Hospitalization

Antibiotics	Length of Hospitalization	Number of Patients	Presentation
Levofloxacin	1-5 days	12 patients	30%
	6-10 days	20 patients	50%
	11-15 days	6 patients	15%
	16-20 days	2 patients	5%
	Total	40 patients	100%
Ciprofloxacin	1-5 days	32 patients	36.8%
	6-10 days	36 patients	41.4%
	11-15 days	16 patients	18.4%
	16-20 days	3 patients	3.4%
	Total	87 patients	100%

The data in the table above shows that the length of stay (LOS) varied between the two antibiotics, indicating differences in the effectiveness of antibiotic therapy. The effective length of stay based on the hospital's clinical pathway is less than 5 days.

Based on the results of this study, it shows that the length of stay of Urinary Tract Infection patients at Dr. Moewardi Surakarta Regional Hospital with the use of Levofloxacin antibiotics has the highest number, namely the length of stay of 6-10 days (50%). The second position is in the length of stay of 1-5 days (30%), the third is in the length of stay of 11-15 days (15%), and the fourth is in the length of stay of 16-20 days (5%). While the number of length of stay of Ciprofloxacin antibiotics is in the length of stay of 6-10 days (41.4%). The second position is in the length of stay of 1-5 days (36.8%), the third is in the length of stay of 11-15 days (18.4%), and the fourth is in the length of stay of 16-20 days (3.4%).

This research is in line with research At Cibinong Regional Hospital, the maximum length of hospitalization was 6-10 days for 75 patients (79%), because the length of hospitalization was also related to the presence of medical complications during the treatment period which would be influenced by the speed of improvement in the patient's clinical condition and impact the patient's length of hospitalization.

Patient Characteristics Based on Treatment Class

The characteristics of inpatients with Urinary Tract Infections at Dr. Moewardi Surakarta Regional Hospital for the period January-June 2025 can be seen in the table.

Table 5. Patient Characteristics Based on Treatment Class.

Antibiotics	Care Class	Number of Patients	Percentage%
Levofloxacin	I	15	37.5%
	II	3	7.5%
	III	22	55%
	Total	40	100
Ciprofloxacin	I	17	19.5%
	II	21	24.1%
	III	49	56.3%
	Total	87	100

Based on the characteristics of inpatient urinary tract infection patients at Dr. Moewardi Regional Hospital in Surakarta who received either Levofloxacin or Ciprofloxacin, the majority were treated in Class III. Levofloxacin used Class III, 55%, and ciprofloxacin used Class III, 53.3%. This indicates that the majority of patients came from lower-cost treatment classes.

This study is in line with which states that inpatient UTI patients in Indonesian referral hospitals are dominated by class III patients due to the high proportion of BPJS, as well as the existence of hospital policies in selecting antibiotics that consider cost efficiency without reducing the effectiveness of therapy.

Class I hospital rates are higher than Class II and III rates. Hospital management is expected to implement policies to help lower-income families reduce hospital service costs. Under the subsidy concept, class I wards and above must be higher than unit costs to maintain viability. Inpatient room rates are calculated based on the volume of services sold, total fixed costs, variable costs per unit, and desired income.

Patient Characteristics Based on Temperature Percentage

The following is data on patient characteristics based on the percentage of temperature of inpatients with urinary tract infections at Dr. Moewardi Surakarta Regional Hospital for the period January-June 2025, as shown in the table.

Table 6. Percentage of Temperature Decrease in Urinary Tract Infection Patients

Antibiotics	Initial Temperature	Final Temperature	Average Temperature Decrease	Percentage %
Ciprofloxacin	36.9	36.4	0.6	1.63%
Levofloxacin	37.0	36.4	0.7	1.89%

Based on the analysis of the effectiveness of antibiotic therapy in patients with urinary tract infections, it was found that the use of Ciprofloxacin and Levofloxacin resulted in a decrease in body temperature to within the normal range. This indicates that both antibiotics are effective in treating infections characterized by a febrile response in UTI patients.

In the Ciprofloxacin group, patients' body temperature decreased by an average of 0.6°C, from 36.9°C to 36.4°C, representing a 1.63% decrease. Meanwhile, in the Levofloxacin group, the average temperature decreased by 0.7°C, from 37.0°C to 36.4°C, representing a 1.89% decrease. These results indicate that levofloxacin had a slightly higher temperature reduction percentage than Ciprofloxacin, although clinically the difference was not significant.

Research conducted by(Pardede, 2018)Fever during a urinary tract infection is the body's response to a bacterial infection, often indicating a severe infection or spread to the kidneys (pyelonephritis), along with other symptoms such as back pain, chills, and nausea and vomiting. Although fever can occur, it rarely exceeds 38°C in urinary tract infections. Therefore, a decrease in body temperature does not always directly correlate with an accelerated overall clinical recovery.

Normal human body temperature ranges from 36°-37°C, but fever can exceed 37°C. Fever is caused by infection or an imbalance between heat production and heat loss. However, fever plays a role in enhancing the development of specific and nonspecific immunity, aiding recovery, defense against infection, and signaling that the body is experiencing health problems.

Direct Medical Cost Analysis

This study was conducted from the perspective of a healthcare provider, therefore, cost components must be included in this study, namely direct medical costs from healthcare service costs. Direct medical costs include antibiotic costs, laboratory costs, doctor visits, and inpatient costs. Data on direct medical costs obtained from UTI patients hospitalized at Dr. Moewardi Regional General Hospital, Surakarta, can be seen in the appendix. The average direct medical costs are as follows:

Table 7. Average Direct Medical Costs

Types of Antibiotics	Average Cost of Antibiotics (Rp)	Average Laboratory Cost (Rp)	Average Cost of Hospitalization (Rp)	Average Cost of Doctor Visit (Rp)	Average Total Cost (Rp)
Levofloxacin	Rp. 17,575	Rp. 2,343,445	Rp. 18,763,709	Rp. 618,000	Rp. 21,742,209
Ciprofloxacin	Rp. 10,100	Rp. 2,095,905	Rp. 14,666,372	Rp. 557,126	Rp. 17,329,504

The data above shows that the highest average direct medical costs were for patients taking Levofloxacin, at Rp 21,742,209. Meanwhile, the lowest average medical costs were for patients taking Ciprofloxacin, at Rp 17,329,504.

The difference in average total direct medical costs between Levofloxacin and Ciprofloxacin was primarily driven by inpatient and laboratory costs, which were the largest cost components. Patients using Levofloxacin had higher inpatient costs, which may be related to more severe clinical conditions or longer hospital stays. Therefore, although the difference in antibiotic costs is relatively small, total direct medical costs are more influenced by the duration of hospitalization.

Antibiotic Costs

Antibiotic costs are costs incurred by patients to pay for the antibiotics used by patients with urinary tract infections during treatment. This cost is based on the unit price of the antibiotics used in treatment. Table 7 shows that the highest average antibiotic use in patients with urinary tract infections was for Levofloxacin, at Rp 17,575, compared to Ciprofloxacin, at Rp 10,100.

Ciprofloxacin is priced lower than Levofloxacin because it is a newer generation fluoroquinolone with a broader spectrum and therefore relatively high price. The high cost of using levofloxacin is influenced by the unit price, which is indeed more expensive than Ciprofloxacin.(Wahyu et al., 2024). The hospital has set a unit price. This contributes to the high cost of antibiotics, which is based on the amount of medication used.

Laboratory Fees

Laboratory costs are costs directly related to all expenses related to the laboratory. These laboratory tests are intended to confirm the diagnosis and monitor exposure to microorganisms that trigger urinary tract infections.

The highest average laboratory cost was for patients using Levofloxacin antibiotics, which was Rp. 2,343,445, while patients using Ciprofloxacin antibiotics had an average laboratory cost of Rp. 2,095,905. This was because patients using Levofloxacin antibiotics underwent more than one laboratory examination compared to patients using Ciprofloxacin antibiotics, most of whom underwent one laboratory examination.

Inpatient Costs

Inpatient care costs are the costs paid for services and facilities. These costs are influenced by the class of care received; the higher the class, the higher the costs.

The highest average length of hospitalization was found in patients taking Levofloxacin, at Rp 18,763,709, while patients taking Ciprofloxacin had an average length of hospitalization of Rp 14,666,372. This difference was influenced by the longer length of hospitalization and the different treatment classes in the group of patients taking Levofloxacin.

Doctor Visit Fee

The doctor's visit fee is the fee paid for medical treatment services performed by doctors at Dr. Moewardi Surakarta Regional General Hospital. Inpatient community urinary tract infection patients are treated by the main doctor in charge of services (DPJP). However, when the patient has more than one disease and requires treatment from several different specialist doctors, the patient is also treated by the doctor in charge of services (DPJP Raber). The amount of the doctor's visit fee is influenced by the length of the patient's hospitalization (length of stay).

The highest average cost of doctor visits was found in patients using Levofloxacin antibiotics, which was Rp. 618,000, while patients using Ciprofloxacin were Rp. 557,126. Based on table 4, patients with Levofloxacin antibiotic therapy had longer hospitalizations than Ciprofloxacin, the longer the hospitalization, the more frequent treatment carried out by doctors which involved higher doctor visit costs in Levofloxacin antibiotic therapy.

Analysis of Therapy Effectiveness

The effectiveness of antibiotic therapy in inpatients with urinary tract infections at Dr. Moewardi Regional General Hospital, Surakarta, from January to June 2025 was analyzed using parameters such as temperature and length of hospitalization. The results of the analysis of the effectiveness of urinary tract infection therapy are as follows.

Table 8. Effectiveness of Therapy Based on Length of Hospitalization

Antibiotics	Information	Amount	Percentage %
Ciprofloxacin	Effective	32	36.78%
	Ineffective	55	63.22%
	Total	87	100%
Levofloxacin	Effective	14	35%
	Ineffective	26	65%
	Total	40	100%

Based on the results of the table above, the effectiveness of antibiotic therapy for urinary tract infection (UTI) patients, Ciprofloxacin showed an effectiveness of 36.78% and was ineffective at 63.22%, while Levofloxacin had an effectiveness of 35% and was ineffective at 65%.

The study, which assessed the effectiveness of antibiotic therapy in hospitalized patients with urinary tract infections (UTIs), was based on two parameters: changes in body temperature and length of stay. It showed that all patients achieved an effective temperature, enabling fever reduction with antibiotic administration. However, some patients remained categorized as ineffective because their length of stay was longer than 5 days.

A decrease in body temperature does not always correlate with an acceleration in overall clinical recovery. However, the length of hospitalization is often influenced by other factors such as the patient's general condition, comorbidities, and the virulence of the bacteria.

Hospitalizations exceeding 5 days can be caused by the severity of the infection, the presence of comorbidities, and the possibility of infectious complications. Research in Indonesian hospitals shows that UTI patients with comorbidities such as diabetes mellitus or impaired kidney function tend to have longer hospitalizations even when acute clinical signs such as fever have resolved (Sari, 2020).

Table 9. Therapeutic Effectiveness Based on Temperature Reduction

Antibiotics	Information	Amount	Percentage %
Ciprofloxacin	Effective	87	100%
	Ineffective	0	0%
	Total	87	100%
Lefofloxacin	Effective	40	100%
	Ineffective	0	0%
	Total	40	100%

In this study, the ineffectiveness of therapy was more influenced by the length of hospitalization, rather than the failure to reduce body temperature. Patients taking ciprofloxacin tended to have shorter hospitalizations, making it more effective than those taking levofloxacin. These results emphasize that evaluating antibiotic effectiveness in hospitalized patients requires considering various clinical and non-clinical factors.

Cost Effectiveness Analysis

ACER Analysis

This study used a cost-effectiveness analysis method determined by the Average Cost-Effectiveness Ratio (ACER) value. The ACER value represents the amount of costs required for each improvement in treatment outcome.(Shahnaz, 2020)The ACER value is calculated by comparing the average direct medical costs with the therapeutic effectiveness of the antibiotics levofloxacin and ciprofloxacin. The following are the results of the ACER calculation for levofloxacin and ciprofloxacin therapy in inpatients with urinary tract infections at Dr. Moewardi Hospital, Surakarta, from January to June 2025.

Table 10. ACER Value Calculation

Types of Analysis	Levofloxacin	Ciprofloxacin	p-value
Average direct medical costs	Rp. 21,742,730	Rp. 17,329,504	0.087
Effectiveness			
ACER	35%	36.8%	0.256
	Rp. 621,220	Rp. 470,910	-

Description of p-value: Mann Whittney test

Based on the table above, it can be seen that ciprofloxacin antibiotic therapy has a low average direct medical cost of Rp. 17,329,504 with therapeutic effectiveness (36.8%) and a low ACER value of Rp. 470,910. Meanwhile, levofloxacin antibiotic therapy has a high average direct medical cost of Rp. 21,742,730 with effectiveness (35%) and a high ACER value of Rp. 621,220.

The results of the normality test showed that the effectiveness data measured in the levofloxacin and ciprofloxacin therapy groups were not normally distributed. Therefore, the analysis of differences between the two groups was performed using the nonparametric Mann-Whitney test.

Based on the Mann-Whitney test results, there was no significant difference in therapeutic effectiveness between Levofloxacin and Ciprofloxacin ($p > 0.05$). This indicates that both antibiotics have equivalent clinical effectiveness in hospitalized patients with urinary tract infections.

The statistical test results of the cost analysis showed no significant difference in treatment costs between the two treatment groups ($p = 0.087$). Therefore, statistically, the treatment costs of levofloxacin and ciprofloxacin can be considered similar, although descriptively, ciprofloxacin had a lower average cost.

The results, which support the ACER calculations obtained in this study, include a cost-effectiveness table. Based on the level of cost-effectiveness, the antibiotic of choice will be identified in the following table.

Table 11. Cost Effectiveness

Cost Effectiveness	Lower Costs	Same Cost	Higher Costs
Low Effectiveness	A	B	C
Same Effectiveness	D	E	F
		Ciprofloxacin Levofloxacin	
High Effectiveness	G	H	I

The cost-effectiveness table shows that both antibiotics have equivalent clinical effectiveness, as evidenced by the similarity in treatment outcomes. Furthermore, although descriptively, there is a difference in average treatment costs, this difference is not statistically significant, so analytically, the costs of levofloxacin and ciprofloxacin therapy can be considered similar.

In the cost-effectiveness table, levofloxacin and ciprofloxacin are placed in column E, representing the treatment group with equal effectiveness and cost. This placement reflects the statistical results showing clinical and economic equivalence between the two therapies, allowing antibiotic selection to consider other factors such as drug availability, safety profile, and hospital policy.

ICER Analysis

ICER (Incremental Cost Effectiveness Ratio) is a value that shows the additional costs required to produce each change in one unit of treatment outcome.(Shahnaz, 2020)The ICER value is calculated by comparing the difference in average direct medical costs with the difference in effectiveness of the two antibiotics, levofloxacin and ciprofloxacin. The following are the results of the ICER calculation for levofloxacin and ciprofloxacin therapy in inpatients with urinary tract infections at Dr. Moewardi Regional Hospital, Surakarta, from January to June 2025.

Table 12. ICER Value Calculation

Types of Analysis	Levofloxacin	Ciprofloxacin
Average direct medical costs	Rp. 21,742,730	17,329,504
Effectiveness		
ICER	35%	36.8%
	Rp. -2,451,792	

The Incremental Cost-Effectiveness Ratio (ICER) calculation showed a value of -2,451,792 Rupiah. A negative ICER value indicates that ciprofloxacin descriptively has a lower cost with equivalent outcome compared to levofloxacin. However, the Mann Whitney statistical test results showed no significant difference in effectiveness or total costs between the two therapies ($p > 0.05$).

The negative ICER value in this study is not interpreted as a meaningful difference in clinical effectiveness, but rather as a descriptive indicator of a trend in cost-efficiency. Because the effectiveness and costs of the two therapies were not statistically significantly different, ciprofloxacin and levofloxacin are still categorized as having equivalent effectiveness and costs, and are therefore placed in column E of the cost-effectiveness table.

CONCLUSION

This study found that of 127 BPJS inpatient UTI patients at Dr. Moewardi Surakarta Regional General Hospital from January to June 2025, ciprofloxacin (68.5% of patients) and levofloxacin (31.5%) therapy had equivalent clinical effectiveness, with an average temperature reduction of 0.6-0.7°C (1.63-1.89%) and effectiveness based on length of stay <5 days of 36.78% and 35%, respectively. ACER analysis showed that ciprofloxacin was lower (Rp470,910) than levofloxacin (Rp621,220), while a negative ICER (Rp-2,451,792) indicated a tendency for descriptive efficiency of ciprofloxacin, although the Mann-Whitney test found no significant difference in effectiveness ($p=0.256$) or total costs ($p=0.087$). Patient characteristics were dominated by women (61.83%), age >65 years (31.3%), and class III (55.9%), with the highest direct medical costs for inpatient and laboratory care.

However, limitations of this study include the use of retrospective secondary data that is prone to incompleteness, the focus solely on direct medical costs without non-medical costs, and the absence of specific antimicrobial resistance factors or comorbidities. Suggestions for further research include prospective studies with bacterial resistance analysis, broader antibiotic comparisons, and patient perspectives. Practically, these results support hospital policy to prioritize ciprofloxacin as a cost-effective option for BPJS UTIs to optimize JKN coverage, while ensuring close clinical monitoring.

REFERENCES

Angga Aulia Sahadatun, KS (2023). Cost-effectiveness analysis of antibiotic use in hospitalized typhoid fever patients at Dr. Siswanto Air Force Hospital, Adi Soemarmo Air Force Base in 2022. Proceedings of the National Health Information Seminar (SIKesNas).

Ardiansyah, Risnita, & Jailani, MS (2023). Data collection techniques and scientific research instruments. Journal of Qualitative and Quantitative Research, 2(1), 1–9.

Besse, W., Nurgahayu, & Haeruddin. (2022). Factors influencing people to participate in the JKN program. Window of Public Health Journal, 1(3), 157–168.

Creswell, J. W., & Creswell, J. D. (2023). Research design: Qualitative, quantitative, and mixed methods approaches (6th ed.). Sage Publications.

Dyoko, M. (2020). Mechanisms of fever and the body's immune response to infection. Journal of Clinical Health, 5(2), 45–52.

Emzir. (2024). Educational research methodology: Quantitative and qualitative. Rajawali Pers.

Harahap, NI (2019). Profile of antibiotic use in urinary tract infection patients at Datu Beru Takengon General Hospital. Imelda Scientific Journal of Pharmacy, 2(2), 69–74.

Indriyati. (2020). Analysis of inpatient treatment rate calculations based on hospital unit costs. Indonesian Journal of Health Administration, 8(1), 15–23.

Janssens, U. (2024). Functional hemodynamic monitoring. Medizinische Klinik - Intensivmedizin und Notfallmedizin, 119(8), 614–623.https://doi.org/10.1007/s00063-024-01190-4

Kusumaning. (2019). Cost-effectiveness analysis of urinary tract infection treatment using ceftriaxone and cefotaxime antibiotics at Ario Wirawan Lung Hospital, Salatiga. Indonesian Journal of Clinical Pharmacy, 1(1), 20–26.

Marianna, Á., Andrea, L., & Buri, K. (2021). Urinary tract infections in elderly patients: A 10-year study on epidemiology and antibiotic resistance. Journal of Infection and Public Health, 14(6), 765–772.

Marliana Susianti, O. (2024). Formulation of variables and indicators in quantitative educational research. Rokania Journal of Education, 9, 18–25.

Meila, O., & Rahayu, A. (2020). Cost-effectiveness analysis of fixed combination antihypertensive therapy in one hospital in South Jakarta. Pharmacoscript, 2(2), 38–53.https://doi.org/10.36423/pharmacoscript.v2i2.388

Moeloek. (2021). Characteristics of catheterized urinary tract infection patients in the internal medicine inpatient ward of Dr. H. Abdul Moeloek Regional Hospital, Lampung Province. Jurnal Medika Malahayati, 6(4), 345–352.

Monica, S., Irawati, S., & Setiawan, E. (2018). Study of antibiotic use, appropriateness, and costs in pediatric inpatients at a public hospital in Surabaya. Indonesian Journal of Clinical Pharmacy, 7(3), 194–203.https://doi.org/10.15416/ijcp.2018.7.3.194

Nidiya. (2020). Cost-effectiveness analysis of ceftriaxone and cefotaxime in patients with urinary tract infections at Prof. Dr. Soekandar Regional Hospital, Mojokerto Regency. Journal of Pharmacy, 2(1), 11–15.

Pardede, SO (2018). Kidney and urinary tract infections in children: Clinical manifestations and management. Sari Pediatri, 19(6), 364–374.https://doi.org/10.14238/sp19.6.2018.364-74

Pratama, W., Indrayana, B., & Pratama, W. (2021). The effectiveness of online learning in teaching and learning activities. Indonesian Journal of Sport Science and Coaching, 3(1), 33–44.

Putri, PR (2023). Preventive efforts for urinary tract infections through urine screening in adolescent girls. Journal of Public Health, 6, 4317–4327.

Rahmawati, I., & Nugroho, A. (2021). Overview of urinary tract infection incidence based on patient characteristics. Andalas Health Journal, 10(3), 389–396.

Raini, M. (2016). Fluoroquinolone antibiotics: Benefits and disadvantages. Health Research and Development Media, 26(3), 163–174.

Sari, DP, & Handayani, R. (2020). Factors influencing the length of hospitalization of patients with urinary tract infections. Journal of Clinical Nursing, 11(1), 45–52.

Sartika, D., Primadiamanti, A., & Hidayaturahmah, R. (2023). Cost-effectiveness analysis between pantoprazole and omeprazole in gastritis patients at Mutiara Bunda Hospital. Indonesian Journal of Clinical Pharmacy, 6(2), 211–219.

Shahnaz. (2020). A pharmacoeconomic study underlying treatment selection in Indonesia. Farmaka, 16(3), 134–145.

Subhaktiyasa, PG (2024). Comprehensive understanding of student truancy behavior. Scientific Journal of Educational Professions, 9(4), 2721–2731.

Sugiyono. (2022). Quantitative, qualitative, and R&D research methods. Alfabeta.

Wahyu, TW, Serlin, A., & Febriyanti, PA (2024). Cost-effectiveness analysis of the use of cefoperazone and levofloxacin antibiotics in urinary tract infections. Indonesian Journal of Clinical Pharmacy, 12(2), 101–110.

Wiyati, R., et al. (2024). Analysis of antibiotic use costs in BPJS inpatient urinary tract infection patients. Indonesian Journal of Hospital Pharmacy, 8(1), 55–63.

Wulandari. (2020). The influence of hormonal changes on the incidence of urinary tract infections in premenopausal women. Journal of Reproductive Health, 11(2), 89–96.

Yuli, A. (2024). Length of stay as an indicator of hospital service quality. Indonesian Journal of Health Management, 12(1), 25–32.