International Journal Of Health, Engineering And Technology (IJHET) *E-ISSN 2829 – 8683*
Volume 4, Number 4, November 2025, Pages 957 – 956
Email :editorijhess@gmail.com

Evaluation of Antibiotic Use in Pediatric Patients with Urinary Tract Infections at Ir. Soekarno General Hospital, Sukoharjo, in 2025

Zahro Lailatus Sa'adah[1], Vivin Marwiyati rohmana[2], Bangkit Riska Permata[3]

[1,2,3]Duta Bangsa University

Email: zahrolailatus11@gmail.com, vivinmarwiyati@udb.ac.id, risen_riskapermata@udb.ac.id.

Abstract

Urinary tract infections (UTIs) are common bacterial infections in children requiring antibiotic therapy, but irrational use can lead to resistance and adverse outcomes. This study aimed to evaluate the rationality of antibiotic prescribing in pediatric UTI cases based on established management guidelines. Using a descriptive observational and retrospective design, data were collected from medical records of pediatric inpatients diagnosed with UTI at Ir. Soekarno Sukoharjo Regional General Hospital in 2024. Evaluation focused on the accuracy of patient selection, antibiotic choice, and dosage appropriateness according to national standards, while clinical outcomes were assessed from temperature normalization at discharge. Results showed that most antibiotic prescriptions adhered to clinical guidelines, with appropriate antibiotic selection and dosing contributing to positive treatment outcomes. All patients demonstrated clinical improvement, reflected by normalization of body temperature at discharge. The study concludes that antibiotic prescribing for pediatric UTI at the study site was generally rational and effective, supporting favorable clinical recovery. Continuous monitoring and adherence to antibiotic stewardship principles are essential to maintain treatment efficacy and minimize the risk of resistance development.

Keywords: Antibiotics, Drug Rationality Evaluation, Urinary Tract Infection, Pediatrics

INTRODUCTION

Urinary Tract Infection (UTI) is one of the most common bacterial infections in the pediatric population, with a global prevalence of 6-8% in febrile infants, sick children in primary care, and older children with urinary symptoms (Anggraini et al., 2020; Kaufman et al., 2019). According to the World Health Organization (2019), UTIs rank second as the most common infectious disease after respiratory tract infections, with approximately 8.3 million cases reported annually globally. Recent epidemiological data indicate that approximately 150 million people worldwide are diagnosed with UTIs annually, with Escherichia coli as the predominant pathogen causing 80-87% of cases in the pediatric population (Megawati et al., 2023; Maringhini et al., 2024). The anatomical and physiological characteristics of the urinary tract in children are different from those in adults, combined with an immature immune system, making the pediatric population highly susceptible to this infection with the potential for long-term complications such as kidney scarring and impaired renal function (Zemer et al., 2024).

The clinical manifestations of UTI in children present significant diagnostic complexity due to nonspecific symptoms and variations according to age group. Neonates and infants often present with nonspecific systemic manifestations such as fever, irritability, vomiting, and failure to thrive, while older children may present with more classic symptoms such as dysuria, urgency, and suprapubic pain (Pohl & Rushton, 2021; Erdiana & Teng, 2025). Recent epidemiological studies project an increase in the global burden of UTI, with a predicted increase in the incidence rate reaching 6,486.39 per 100,000 population by 2050, indicating a significant upward trend of 43.50% compared to 2022 (He et al., 2025). An accurate diagnosis requires a combination of history taking, physical examination, urinalysis, and urine culture,

but interpretation of test results in children is often challenging due to the difficulty of obtaining sterile specimens and the variability of symptoms across age groups (Maringhini et al., 2024).

Antimicrobial resistance in pediatric UTI pathogens has become a serious global threat, with the increasing prevalence of extended-spectrum beta-lactamase (ESBL)-producing bacteria and resistance to first-line antibiotics. A recent multinational study showed that E. coli resistance to ampicillin reached 53.4% in OECD countries and 79.4% in non-OECD countries, while resistance to trimethoprim-sulfamethoxazole ranged from 23.6% to 60.3% depending on the country's economic status (Zemer et al., 2024). Alarming data show a significant increase in the prevalence of ESBL-producing E. coli from 6.1% in 2007 to 25.4% in 2021, with very high levels of resistance to third-generation cephalosporins (>90%) and fluoroquinolones (Lin et al., 2025). This phenomenon of antimicrobial resistance not only increases morbidity and mortality but also contributes to increased health care costs and longer duration of hospitalization (Bamford et al., 2024).

Irrational antibiotic use has been identified as a major driver of antimicrobial resistance, with approximately 50% of antibiotic therapy initiated inappropriately without proper identification of the etiologic agent. Evaluative studies indicate that 50-80% of antibiotic use in pediatric UTIs is still considered irrational based on the 4T criteria (correct indication, correct patient, correct drug, and correct dose), with varying degrees of rationality across healthcare institutions (Amrullah et al., 2022; Rismayanti & Bakhtiar, 2023). The Indonesian context presents particular challenges in managing pediatric UTIs, where access to microbiology services remains limited, implementation of antimicrobial stewardship (AMS) programs faces various structural and organizational barriers, and resistance patterns vary significantly across regions (Limato et al., 2022). Systematic research on the optimization of antibiotic use in Indonesia shows that the implementation of AMS in hospitals still faces limitations in resources, microbiology laboratory infrastructure, and hierarchical organizational structures that hinder the effectiveness of stewardship programs (Brigadoi et al., 2024).

This study aims to evaluate antibiotic use in pediatric UTI patients at Ir. Soekarno Sukoharjo Regional General Hospital analyzes the rationality of antibiotic use, including appropriate indications, appropriate patient selection, appropriate drug selection, and appropriate dosage according to national management guidelines, and identifies the relationship between rationality of drug use and patient clinical outcomes. The urgency of this study is very high considering the increasing prevalence of antimicrobial resistance in pediatric UTI pathogens and the need for local data to optimize antibiotic use in the post-COVID-19 pandemic era, which has changed global antibiotic use patterns (Selifiana et al., 2023). The novelty of this study lies in the comprehensive approach to evaluating the quantity and quality of antibiotic use using multiple methods assessment, a combination of Gyssens criteria analysis with outcome-based evaluation, and a focus on a regional hospital setting that is representative of the characteristics of Indonesian health services. This can contribute evidence-based data to the development of rational antibiotic use policies and antimicrobial stewardship programs at the regional level (Erdiana & Teng, 2025; He et al., 2025).

RESEARCH METHODS

Types and Methods of Research

This study employed a retrospective observational research design with a descriptive quantitative approach. According to Sugiyono (2021), quantitative research is a research method based on the philosophy of positivism and is used to study specific populations or samples. The sampling technique is generally random, and data collection using research instruments, and quantitative or statistical data analysis is used to test predetermined hypotheses. Retrospective research is defined as a non-interventional observational study that involves a review and reassessment of medical record databases to analyze past events (de Sanctis et al., 2022). This retrospective research design was chosen because it is time-efficient and relatively low-cost, and allows researchers to analyze data already available in medical records without the need for intervention or manipulation of research subjects (Gardner & Hunt, 2023). This study adopted the Drug Utilization Evaluation (DUE) framework, which is a comprehensive

review to evaluate the marketing, distribution, prescribing, and use of drugs in the community with the aim of ensuring drug therapy is in accordance with current standards of care (Sarfaraz et al., 2025).

The antibiotic use evaluation method in this study refers to the 4T rationality criteria (correct indication, correct patient, correct drug, and correct dose) based on the Regulation of the Minister of Health of the Republic of Indonesia Number 28 of 2021 concerning Guidelines for Antibiotic Use, and uses the WHO core drug use indicators. This evaluative approach aligns with the WHO recommendation that Drug Utilization Review (DUR) is a systematic and continuous quality improvement activity to ensure effective and appropriate drug use (Carver et al., 2023). Creswell & Creswell (2023) emphasize that a quantitative research design with a descriptive-evaluative approach is highly appropriate for examining the phenomenon of drug use in healthcare settings because it allows for objective measurement of quantifiable variables and comparison with established standards.

Data Analysis Instruments and Techniques

The research instrument used was a data collection sheet (case report form) developed based on WHO guidelines for drug use investigations in healthcare facilities, covering patient demographic data, clinical information, antibiotic prescribing patterns, and therapeutic outcomes. Secondary data was obtained through a review of the medical records of inpatients diagnosed with UTI in 2024 at Ir. Soekarno Sukoharjo Regional General Hospital. According to Sugiyono (2022), secondary data is a data source that does not directly provide data to the data collector, but rather through other people or documents, which, in the context of health research, are medical records stored in the hospital information system. Data collection was carried out using a systematic documentation method using a structured checklist to ensure the consistency and completeness of data collected from each medical record (Ramgopal et al., 2025).

The data analysis technique used descriptive analysis with the help of SPSS software version 29.0 for quantitative data processing and Microsoft Excel 2021 for data management. The analysis was conducted descriptively by presenting data in the form of frequency distributions, percentages, means, and standard deviations according to the type of variable analyzed. To evaluate the rationality of antibiotic use, WHO core drug use indicators were applied, including the average number of drugs per prescription, the percentage of drugs prescribed by generic name, the percentage of prescriptions containing antibiotics, the percentage of drugs prescribed from the Essential Medicine List (EML), and other indicators relevant to the research context (Goruntla et al., 2023). The assessment of the rationality of antibiotic use was conducted by comparing actual prescribing practices with standards established in national and international guidelines, then calculating the percentage of accuracy for each evaluation parameter. Analysis of the relationship between rationality of drug use and clinical outcomes used non-parametric statistical tests, considering the characteristics of the data that were not normally distributed, in line with recommendations for evaluative research in clinical settings (Chenchula et al., 2022).

Population and Sample

The population of this study was all pediatric patients aged 0-18 years diagnosed with UTI and receiving inpatient care at Ir. Soekarno Sukoharjo Regional General Hospital between January and December 2024. According to Sugiyono (2021), a population is a generalized area consisting of objects or subjects that have certain qualities and characteristics determined by researchers to be studied and then conclusions drawn. The selection of the pediatric UTI patient population was based on the consideration that this age group has specific pathophysiological characteristics, bacterial resistance patterns, and therapeutic approaches that require separate evaluation (Maringhini et al., 2024). The sampling technique used is total sampling or census, namely a sampling technique in which all members of the population who meet the inclusion criteria are used as research samples.

Inclusion criteria included pediatric patients aged 0 months to 18 years diagnosed with UTI based on clinical and laboratory examinations, receiving antibiotic therapy for UTI treatment, and hospitalized at Ir. Soekarno Sukoharjo Regional General Hospital during 2024, and having complete and accessible medical records. Exclusion criteria included patients with a documented history of severe allergy to antibiotics, patients not receiving antibiotics as part of UTI treatment, patients referred to another hospital before completion of therapy, and patients with incomplete or inaccessible medical records. The application of strict inclusion and exclusion criteria aimed to minimize selection bias and ensure homogeneity of the study sample, as emphasized in the guidelines for conducting retrospective observational studies (de Sanctis et al., 2022). Based on preliminary data from the medical records department of Ir. Soekarno Sukoharjo Regional General Hospital, it is estimated that there are

approximately 60-80 pediatric UTI cases per year that meet the study inclusion criteria; thus, using the total sampling technique can provide a comprehensive representation of the target population.

Research Procedures

The research procedure began with an ethical clearance application to the Health Research Ethics Commission (KEPK) of Ir. Soekarno Sukoharjo Regional General Hospital and a research permit application to the hospital director. After obtaining ethical and administrative approval, coordination was conducted with the medical records department to identify and access patient data that met the research criteria. The next stage was the compilation of the research database using a coding system to maintain patient confidentiality, in line with research ethics principles that emphasize the protection of privacy and confidentiality of subject data (de Sanctis et al., 2022). The data collection process was carried out systematically using a validated structured worksheet, including the extraction of demographic, clinical, therapeutic, and patient outcome data from electronic and manual medical records.

Evaluation of the rationality of antibiotic use is conducted through several stages of analysis, starting with an assessment of the appropriateness of the indication based on clinical diagnosis and supporting examination results, an assessment of patient appropriateness by considering contraindications and allergy history, an assessment of drug appropriateness based on the antimicrobial spectrum and local resistance patterns, and an assessment of dosage appropriateness based on pediatric dosage calculations in accordance with therapeutic guidelines (WHO, 2019). Each evaluation parameter is assessed independently by researchers using established standard references, and in doubtful cases, consultation with a clinical pharmacologist is conducted to ensure the accuracy of the assessment. The collected data is then verified and cleaned to remove missing data or outliers that could affect the validity of the analysis results (Ramgopal et al., 2025).

The data analysis phase was conducted using a multi-level approach, starting with univariate analysis to describe the baseline characteristics of the study population, followed by bivariate analysis to evaluate the relationship between drug rationality variables and clinical outcomes, and multivariate analysis, if necessary, to control for confounding variables. Interpretation of results was carried out by comparing the study findings with WHO standards, national guidelines, and the results of similar studies in comparable settings. Internal validity of the study was maintained through the application of strict inclusion and exclusion criteria, standardization of the data collection process, and the use of validated instruments. While external validity was considered through comparability of the characteristics of the study population with pediatric UTI patient populations in similar hospitals (Creswell & Creswell, 2023). Limitations of retrospective observational studies, such as potential bias and confounding factors, were anticipated through sensitivity analysis and a comprehensive discussion in the interpretation of the study results.

RESULTS AND DISCUSSION

Patient Characteristics Based on Gender

Grouping of Urinary Tract Infection patients based on gender has the aim of knowing how many Urinary Tract Infection patients are female and male, and to compare which gender is most affected by Urinary Tract Infection in the inpatient and outpatient installations of Ir. Soekarno Sukoharjo Regional General Hospital in 2024.

The following are the characteristics of Urinary Tract Infection patients in the Inpatient and Outpatient Units of Ir. Soekarno Sukoharjo Regional Hospital in 2024, based on gender.

Table 1. Characteristics of Urinary Tract Infection patients based on gender

No	Gender	Number of Patients	Percentage (%)
1.	Man	22	36.0%
2.	Woman	39	64.0%
	Total	61	100%

Based on Table 1. The results of the data grouping of the gender of urinary tract infection

patients at RSUD Ir. Soekarno Sukoharjo inpatient and outpatient in 2024. The data in this study shows that urinary tract infection patients with female gender (64.0%) are more than male patients (36.0%). This is due to the difference in the length of the urethra, where the length of the urethra in women is only 4 cm, while in men it is approximately 17.5 cm to 20 cm. The difference in the length of the urethra causes women to be more at risk of developing UTIs because it is located close to the anus so that microorganisms can more easily reach the urethra and cause infection, while the risk of UTI in men is low because in addition to the urethra being longer, it also has prostate fluid that protects against bacterial infections due to its bactericidal properties. (Agustiningrum et al., 2024).

This finding aligns with previous theories and research suggesting that girls are at higher risk of developing UTIs. Anatomically, the female urethra is shorter and located closer to the anus than the male, facilitating the migration of bacteria from the perianal area to the urinary tract. Furthermore, in infants and toddlers who have not yet been trained in personal hygiene, the risk of urinary tract contamination also increases. In research bySelifiana et al 2023Also explained that UTI sufferers in women were more common, with a total of 101 (65.58%) patients, while in men, there were 53 (34.42%). The same researchRismayanti & Bakhtiar in 2023Explained that the incidence of urinary tract infections was dominated by women, amounting to 38 patients (60.9%), while men accounted for 17 patients (30.91%).

This is because the female urethra is closer to the anus than the male urethra, allowing bacteria to easily enter the urinary tract and nest in the surrounding organs. The female urethral meatus is located close to the anus, allowing bacteria to easily enter the urinary tract and cause infection. Poor genital hygiene is also a reason why women are susceptible to urinary tract infections, such as poor handwashing habits and the incorrect method of wiping the genitals from back to front after urinating and defecating. Wet genitals can allow fungi and bacteria to multiply, which can infect the area around the genitals. As a result, it can cause reproductive health problems such as urinary tract infections.(Ismayanti, 2024).

Patient Characteristics Based on Age

Table 2. Characteristics of Urinary Tract Infection Patients Based on Age

No	Age (Years)	Number of Patients	Percentage (%)
1.	13 years old	11	18.0%
2.	4 – 6 years	17	27.9%
3.	7 – 9 years	17	27.9%
4.	10 – 12 years	13	21.3%
5.	13 – 15 years	1	1.6%
6.	16 – 18 years old	2	3.2%
	Total	61	100%

Based on Table 2, the characteristics of urinary tract infection patients from 61 patients, the most common age groups were 4-6 years and 7-9 years, with 17 patients (27.9%) each. This was followed by the 10-12 years age group with 13 patients (21.3%), and the 1-3 years age group with 11 patients (18.0%). Meanwhile, the 13-15 years and 16-18 years age groups recorded the fewest number of patients, with only 1 patient (1.6%) and 2 patients (3.2%) respectively.

This distribution indicates that the majority of urinary tract infection patients are between preschool and early elementary school age. This is a developmental period when children become more physically active and often lack good genital hygiene habits. Furthermore, suboptimal urinary control and frequent urinary retention among school-age children can be risk factors for urinary tract infections.(Pardede et al., 2020).

This is in line with research.Adhitama et al 2021Explains that the highest incidence of Urinary Tract Infections is in the 0-11 year age group with 57 cases (90.5%). Urinary tract infections are often experienced by women because women have a shorter urethra compared to men, so the female population has a greater risk of bacterial infection in the perineum and the urinary bladder.(Gunduz & Altun, 2020).

Patient Characteristics Based on Body Weight

Table 3. Patient Characteristics Based on Body Weight

No	Body Weight (Kg)	Number of Patients	Percentage (%)
1.	9 – 14 kg	12	19.6%
2.	15 – 20 kg	19	31.1%
3.	21 – 26 kg	8	13.1%
4.	27 – 32 kg	10	16.3%
5.	33 – 38 kg	5	8.1%
6.	39 – 47 kg	5	8.1%
7.	48 – 50 kg	2	3.2%
	Total	61	100%

Based on Table 3. Showing that the characteristics of urinary tract infection patients from 61 patients are known, the largest group is in the range of 15–20 kg, namely 19 patients (31.1%). This shows that most patients are in the toddler to preschool age; this group is the largest population in this study, which indicates that early childhood is a group that is quite vulnerable to urinary tract infections.

The second largest group was the 9-14 kg group with 12 patients (19.6%), followed by the 27-32 kg group with 10 patients (16.3%). Meanwhile, patients weighing over 33 kg were relatively few, with only 5 patients in the 33-38 kg and 39-47 kg groups each (8.1%), and only 2 patients in the 48-50 kg group (3.2%).

This distribution reflects that the majority of UTI patients in this study were young to middle-aged children, who still have developing immune systems and are more susceptible to UTIs. Antibiotic dose adjustments in pediatric patients are highly weight-dependent, making this distribution important in evaluating the appropriateness of antibiotic administration.(Agustiningrum et al., 2024).

Growth is a matter related to the problem of changes in size, quantity, and dimension that can be measured by weight and length. Development is the increase in ability in more complex body structures and functions in a regular and predictable pattern as a result of the maturation process.(Sunaryanti et al., 2020).

Factors influencing a child's growth and development are broadly divided into two categories: genetic and environmental. Genetic factors play a key role in achieving optimal growth and development, resulting in healthy children who grow into high-quality individuals. Good growth is characterized by the intensity and speed of cell division, tissue sensitivity to stimuli, the age of puberty, and the cessation of bone growth. The environment significantly influences a child's growth and development. The environment referred to here encompasses the biophysico-psychosocial and spiritual environments that influence a child from conception, birth, growth, and development into adulthood, and ultimately, the end of life. Environmental factors are broadly divided into three categories: prenatal, intranatal, and postnatal. Nutrition and immunization are part of the postnatal environment that influences a child's growth and development (Sunaryanti et al., 2020).

Changes in body weight are a very important indicator for monitoring children's growth. If the child's weight gain (BB) is lower than it should be, the child's growth will be disrupted, and the child is at risk of experiencing malnutrition, and vice versa if the weight gain is greater than it should be, it is an indication of the risk of overnutrition (Hanifah, 2020).

Classes Based on Antibiotic Groups

Table 4. Groups

No	Group Antibiotics Single Therapy	Name Antibiotics	Amount Patient	Percentage
1.	Fluoroquinolones	Ciprofloxacin Levofloxacin	- 1	- 1.6%
2.	3rd generation cephalosporin	Cefixime Ceftriaxone Cefotaxime	15 - 2	24.5% - 3.2%
3.	Penicillin	Amoxicillin Ampicillin Sulbactam Ampicillin Injection	- - 2	- - 3.2%
4.	Aminoglycosides	Gentamicin	-	-
	Combination Therapy			
5.	3rd generation cephalosporin + penicillin	Cefixime + Ampicillin Inj	4	6.5%
		Cefixime + Ampicillin Sulbactam	1	1.6%
		Cefotaxime + Ampicillin Inj	2	3.2%
6.	Aminoglycoside + Penicillin + 3rd generation cephalosporin	Gentamicin + Ampicillin Inj + Cefixime + Ampicillin Sulbactam	1	1.6%
7.	Penicillin + Aminoglycoside	Ampicillin + Gentamicin	4	6.5%
8.	3rd generation cephalosporin +	Cefixime + Ampicilin	1	1.6%

	Penicillin + Aminoglycoside	sulbactam + Gentamicin		
9.	Fluoroquinolone + 3rd generation cephalosporin	Ciprofloxacin + Cefixime	1	1.6%
		Levofloxacin + Cefixime	1	1.6%
10.	3rd generation cephalosporin + Aminoglycoside	Cefotaxime + Gentamicin	1	1.6%
11.	3rd generation cephalosporin	Cefixime + Cefotaxime	17	14.7%
12.		Cefixime + Ceftriaxone	7	14.7%
Total			61	100%

Based on Table 4. Regarding the use of antibiotics given to patients with urinary tract infections in the Inpatient Institution of Ir. According to Soekarno Sukoharjo Regional General Hospital in 2024, it is known that the use of the most commonly prescribed type of antibiotic, namely the third-generation cephalosporin group, is the most dominant use, both in single therapy and combination. A total of 27.9% of patients received third-generation cephalosporins as single therapy, such as Cefixime, Cefotaxime, and Ceftriaxone. In addition, combinations between third-generation cephalosporins (such as Cefixime and Cefotaxime or Cefixime and Ceftriaxone) were found in 26.2% of patients, which indicates a tendency for dual use in the same class.

Cephalosporin and penicillin combination therapy was also used quite frequently (11.3%), such as combinations (cefixime and ampicillin) or (cefotaxime and ampicillin). Meanwhile, penicillin and aminoglycoside combinations were used in 6.5% of patients, and a combination of all three classes (cephalosporin, penicillin, and aminoglycoside) was found in 1 patient (1.6%). This indicates that in some cases, especially those with severe or complex conditions, physicians choose multi-class combinations to broaden the antibacterial spectrum.

The use of fluoroquinolones, such as levofloxacin or ciprofloxacin, either alone or in combination with a third-generation cephalosporin, has also been documented, although to a limited extent (approximately 4.8%). Due to potential side effects and age restrictions, the use of fluoroquinolones in pediatric patients is generally restricted and only used when other alternatives are ineffective.

Cefixime is a single antibiotic often used to treat UTIs. This is because it is cheaper and more affordable. Cefixime is a third-generation oral cephalosporin antibiotic with broad-spectrum activity against both gram-positive and gram-negative bacteria. Cefixime is highly active against a wide range of bacteria, including Streptococcus sp., Streptococcus pneumoniae, Branhamella catarrhalis, Escherichia coli, Proteus sp., and Haemophilus influenzae. Cefixime's mechanism of action is as a bactericidal agent that inhibits cell wall formation by binding to and inhibiting cell wall transpeptidase.(Pokhrel, 2024).

Prescribed antibiotics can be either monotherapy or combination therapy, depending on the severity of the disease or the doctor's and patient's desire for a speedy recovery. Combination antibiotics are generally used to treat serious infections where the cause is unknown. In this case, the antibiotic combination aims to achieve the broadest possible spectrum of antimicrobial activity. Furthermore, the use of antibiotic combinations can provide a synergistic effect and prevent the development of resistance to the antibiotics used.

Rationality of Antibiotic Use

The rational or wise use of antibiotics is the use of antibiotics appropriate to the cause of the infection, with an optimal dosage regimen, optimal duration of administration, minimal side effects, and minimal impact on the emergence of resistant microbes (Ministry of Health Regulation, 2011). Antibiotics are drugs used to prevent and treat bacterial infections. In general, antibiotics are used for infections other than bacteria, such as viruses, fungi, or other non-infectious diseases. Inappropriate use of antibiotics can make treatment less effective and lead to resistance. According to the WHO, antibiotic resistance is a condition in which bacteria, viruses, fungi, and parasites cannot be killed by antibiotics. Rationality in this study includes: appropriate indication, appropriate patient, appropriate drug, and appropriate dosage.

Right Indication

Table 5. Accurate results of UTI patient indications at the Inpatient Installation of Ir. Soekarno Sukoharjo Regional Hospital

No	Evaluation	Amount	Percentage (%)
1.	Right Indication	61	100%
2.	Incorrect Indication	-	-
	Total	61	100%

Source: Processed data, 2025

Based on Table 5, the number of accurate indications in urinary tract infection patients at the Inpatient Unit of Ir. In 2024, Soekarno Sukoharjo Regional Hospital in 2024 was 61 patients (100%). Accurate indications are the accuracy in selecting therapy according to the disease diagnosed by the doctor, based on the National Medical Forum and the Ir. Soekarno Sukoharjo Regional Hospital.

In this study, patients received antibiotic therapy appropriately (100%) because it matched the disease diagnosed by the doctor. This is in line with research.Selifiana et al 2023The accuracy of antibiotic indications at Dr. M. Salamun General Hospital in 2021 showed a result of 154 (100%), meaning all patients received appropriate therapy according to the indications for urinary tract infections. In the study,Paluseri et al 2022Also showed the accuracy of antibiotic use indications in UTI patients at Hasanuddin University Teaching Hospital in 2021, with 74 patients (100%).

Right Patient

Table 6. Accurate results of UTI patients in the Inpatient Institution of Ir. Soekarno Sukoharjo Regional Hospital

No	Evaluation	Amount	Percentage (%)
1.	Right Patient	42	68.9%
2.	Incorrect Patient	19	31.1%
	Total	61	100%

Source: Processed data, 2025

Based on Table 6, the number of appropriate patients in urinary tract infection patients at the Inpatient Unit of Ir. In 2024, Soekarno Sukoharjo Regional Hospital in 2024 was found that 42 patients (68.9%) were included in the appropriate patient category, while 19 patients (31.1%) were categorized as inappropriate patients. This evaluation was carried out based on the appropriateness of clinical indications for antibiotic administration according to the 2021 Management of Male Genital UTIs.

Different from research resultsSelifiana et al 2023The accuracy of antibiotic indications at Dr. M. Salamun General Hospital in 2021 showed a result of 154 (100%), meaning all patients received appropriate therapy according to the indications for urinary tract infections. In the study,Paluseri et al 2022Also showed the accuracy of antibiotic use indications in UTI patients

at Hasanuddin University Teaching Hospital in 2021, with 74 patients (100%).

This patient's inappropriateness indicates a discrepancy between the patient's clinical condition and the antibiotic therapy administered, which contradicts the principles of rational antibiotic use as stipulated in the 2021 Guidelines for the Management of Male Genital UTIs. Some of the reasons and causes underlying this inappropriateness include: Administering antibiotics without a strong clinical indication for a UTI; some patients in this group did not show typical symptoms of a urinary tract infection or did not have a fever (body temperature <38°C) upon arrival at the hospital. Based on guidelines, acute UTIs are generally characterized by fever and symptoms of systemic infection. If the patient does not show these signs, then antibiotic administration is irrational.(Putri et al., 2023).

Overuse of Combination Antibiotics: Some patients receive more than two types of antibiotics simultaneously without any clinical indication of severe infection, sepsis, or prior therapy failure. Unreasonably combining antibiotics not only increases the risk of resistance but also increases the likelihood of side effects and the cost of treatment.

Right Medicine

Table 7. Accurate results of medication for UTI patients at the Inpatient Institution of Ir. Soekarno Sukoharjo Regional Hospital

No	Evaluation	Amount	Percentage (%)
1.	Right Medicine	50	82.0%
2.	Incorrect Medication	11	18.0%
	Total	61	100%

Source: Processed data, 2025

Based on Table 7, the number of patients with urinary tract infections is 50 patients (82.0%) who received the correct antibiotic use, while 11 patients (18.0%) received the incorrect antibiotic use. This indicates that the majority of drug use in Urinary Tract Infection (UTI) patients in the Inpatient Unit of Ir. Soekarno Sukoharjo Regional Hospital does not comply with the reference of the Minister of Health Regulation Number 28 of 2021 concerning guidelines for antibiotic use used by researchers.

Among the inappropriate medication groups, the most common cause is inappropriate dosage for the patient's body weight, particularly for the 100 mg oral dose of cefixime, which is widely used in children weighing over 15–20 kg. Based on the 2021 guidelines for the management of male genital UTIs, the pediatric cefixime dose (8 mg/kg/day) for patients weighing 20–30 kg should be 160–240 mg per day. However, most patients receive only 100 mg/day, which can pharmacokinetically lead to suboptimal therapeutic effectiveness and increase the risk of bacterial resistance.

Different from the research results(Riatri, 2021)This shows that the use of antibiotics in urinary tract infection patients at Prof. Dr. WZ Johannes Kupang Regional Hospital in 2018 was 51 patients receiving the correct medication (100%). In this study,(Hartantia et al., 2020)Also showed that of the 37 patients at Soe Regional Hospital, the correct prescription of medication was given (100%).

Inappropriate medication in patients receiving antibiotics is categorized as inappropriate based on several reasons as follows: The use of antibiotics that are not recommended for children, fluoroquinolone antibiotics such as ciprofloxacin and levofloxacin were found to be used in several patients, even though this group is not recommended for children except in certain conditions (for example, very severe infections and high resistance), because it has side effects on bone and joint growth.

Irrational antibiotic combination administration occurs when two to five antibiotics are used simultaneously without a clear clinical indication (such as sepsis or failure of first-line

therapy). For example, the concurrent use of cefixime, cefotaxime, gentamicin, and ampicillin-sulbactam in patients without signs of severe infection.

Right Dose

Table 8. Results of the correct dosage of UTI patients in the Inpatient Institution of Ir. Soekarno Sukoharjo Regional Hospital

No	Evaluation	Amount	Percentage (%)
1.	Right Dose	43	70.5%
2.	Incorrect dosage	18	29.5%
	Total	61	100%

Source: Processed data 2025

Table 8 shows that the number of accurate doses in urinary tract infection patients at Ir. Soekarno Sukoharjo Regional Hospital shows that 43 patients (70.5%) received the correct antibiotic dose, while 18 patients (29.5%) received the incorrect dose. This assessment refers to the dosage provisions in the 2021 Management of Male Genital UTIs, which stipulate that antibiotic administration in children must be adjusted according to body weight (in units of mg/kgBW/day), age, and severity of infection.

Dosage inaccuracies in this study were caused by several error patterns. Overdose (dose too high). Some patients received antibiotic doses exceeding the maximum recommended limit for their body weight. For example, cefixime 200 mg twice daily was given to a child weighing <15 kg, when the recommended maximum is around 100 mg per day. Underdose (dose too low). There were also cases of administering doses below the therapeutic threshold, making them insufficient to eradicate the bacteria that cause UTIs. For example, cefixime 100 mg once daily was given to a child weighing >25 kg.

In the researchArfathunnisah et al in 2023. At Siti Hajar Islamic Hospital in Mataram, the accuracy of the results for the correct dose was 87.2%, while the incorrect dose was 12.8%. And in the researchNawakasari et al., 2019RSUP X Klaten 2017 stated that the number of drugs that did not meet the dosage accuracy was 72.36%, and antibiotic drugs that met the dosage accuracy were 27.63%.

Rationality of Drugs to Clinical Outcomes

Table 9. Table of Drug Rationality for Clinical Outcomes.

Correlations

			Right Medicine	Right Dose	Exit Temperature
Spearman's rho	Right Medicine	Correlation Coefficient	1,000	.005	.015
		Sig. (2-tailed)	.	.971	.907
		N	61	61	61
	Right Dose	Correlation Coefficient	.005	1,000	-.353**
		Sig. (2-tailed)	.971	.	.005
		N	61	61	61
	Exit Temperature	Correlation Coefficient	.015	-.353**	1,000
		Sig. (2-tailed)	.907	.005	.
		N	61	61	61

Based on the results of the analysis using the Spearman correlation test, the relationship

between drug accuracy and dosage accuracy has a correlation coefficient of 0.005 with a p-value of 0.971. This indicates that accuracy in antibiotic selection does not correlate significantly with the accuracy of the dose given. In a clinical context, this may occur because the choice of antibiotic type is usually based on the diagnosis and therapy guidelines, while the determination of the dose is more influenced by individual patient factors such as weight, age, and health conditions. Therefore, even though the drug is selected according to guidelines, there is no guarantee that the selected dose is according to guidelines, there is no guarantee that the dose given is also appropriate.

The correlation between medication accuracy and discharge temperature also showed a very weak relationship ($r = 0.015$; $p = 0.0907$), indicating no significant relationship between the two variables. In clinical practice, this can be influenced by many factors that contribute to a decrease in patient body temperature, including the patient's immune response, the severity of the infection, patient compliance, and additional therapies other than antibiotics. Therefore, medication accuracy alone does not guarantee clinical improvement that can be measured through body temperature.

On the other hand, the relationship between dosage accuracy and patient temperature showed a significant negative correlation coefficient ($r = -0.353$; $p = 0.005$). This negative number indicates that the more accurate the antibiotic dosage given, the lower the patient's temperature tends to be, reflecting clinical improvement. From a physiological perspective, an appropriate antibiotic dosage will achieve optimal therapeutic concentrations in the blood and tissues, thus being more efficient in killing or inhibiting the growth of bacteria that cause urinary tract infections. This is consistent with the principles of antibiotic pharmacodynamics, where administering a dosage appropriate to the weight and age of pediatric patients is crucial for achieving optimal therapeutic effects and preventing resistance. The results of this study highlight the importance of evaluating appropriate antibiotic dosages in pediatric patients with urinary tract infections, as inappropriate dosages can lead to delayed symptom improvement, prolonged hospitalization, and potentially increase the risk of complications or antibiotic resistance.

CONCLUSION

A study evaluating antibiotic use in pediatric patients with urinary tract infections at Ir. Soekarno Sukoharjo Regional General Hospital in 2024 showed significant findings regarding the rationality of antibiotic therapy. Of the 61 patients evaluated, the majority were female (64.0%), with the largest age group in the 4-9 year range (55.8%), which is in accordance with the general epidemiological characteristics of pediatric UTIs. Evaluation of antibiotic rationality using the 4T criteria showed that all patients (100%) received appropriate therapy for the indication, but there were still gaps in other parameters, with 68.9% appropriate therapy, 82.0% appropriate drug, and 70.5% appropriate dose. Third-generation cephalosporins dominated the choice of therapy, both singly and in combination, with optimal clinical outcomes where all patients experienced improvement in body temperature to normal upon discharge. Correlation analysis revealed a significant relationship between appropriate dosage and clinical outcome ($r = -0.353$; $p = 0.005$), indicating that appropriate dosage contributed to normalization of patient body temperature, while appropriate medication did not correlate significantly with the outcome.

Limitations of this study include its retrospective design, which relied on complete medical records, the unavailability of urine culture and sensitivity testing data for all patients, resulting in empirical guidelines for evaluating drug efficacy. Clinical outcomes were measured solely from body temperature, without considering other clinical indicators such as leukocytosis or systemic symptoms. Future studies are recommended to employ a prospective design with long-term follow-up to evaluate therapeutic effectiveness and recurrence rates, and to incorporate comprehensive microbiological data for correlation analysis of resistance patterns with empirical antibiotic choice. Practical implementation of this study includes the development of a standard weight-based pediatric antibiotic administration protocol at Ir. Soekarno Sukoharjo Regional General Hospital, enhanced training of medical personnel on calculating appropriate pediatric antibiotic dosages, and the development of a system for monitoring the rationality of antibiotic use as part of an antimicrobial stewardship program to reduce

the risk of resistance and improve the quality of pediatric healthcare.

REFERENCES

Adhitama, W., Puspitasari, I., & Laksanawati, I. S. (2021). Evaluasi luaran klinis terapi antibiotika pada pasien anak rawat inap dengan infeksi saluran kemih di RSUP Dr. Sardjito Yogyakarta. *Majalah Farmaseutik*, 17(2), 166-174. https://doi.org/10.22146/farmaseutik.v17i2.48803

Agustiningrum, F. A., Amrullah, A. W., & Rahardjoputro, R. (2024). Kajian rasionalitas penggunaan antibiotik pada anak dengan infeksi saluran kemih di RSUD Dr. Moewardi Surakarta. *Journal Buana Farma*, 4(3), 185-196. https://doi.org/10.36805/jbf.v4i3.1118

Amrullah, A. W., Purwaningsih, A. E. D. A., Rahardjoputro, R., & Murharyati, A. (2022). Evaluasi rasionalitas penggunaan antibiotik pada pasien dengan infeksi saluran kemih di rumah sakit X di Surakarta. *JURNAL MANAJEMEN DAN PELAYANAN FARMASI (Journal of Management and Pharmacy Practice)*, 12(2), 116-126. https://doi.org/10.22146/jmpf.73613

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. https://doi.org/10.24123/kesdok.v2i1.2876

Arfathunnisah, A., Pertiwi, A. D., Suhada, A., & Rahmawati, S. (2023). Evaluasi penggunaan antibiotik pada pasien anak rawat jalan infeksi saluran kemih di Rumah Sakit Islam Siti Hajar Mataram. *Pharmaceutical and Traditional Medicine*, 7(2), 59-67. https://doi.org/10.33651/ptm.v7i2.643

Bamford, A., Kontou, P., Patel, S., & Donà, D. (2024). Tackling the threat of antimicrobial resistance in neonates and children. *Clinical Microbiology and Infection*, 30(4), 456-463. https://doi.org/10.1016/j.cmi.2024.01.012

Brigadoi, G., Tranchino, L., Garzon, B., Opri, R., Da Dalt, L., & Donà, D. (2024). Impact of an antibiotic stewardship program on adherence to antibiotic prescription in children admitted with urinary tract infection. *Therapeutic Advances in Infectious Disease*, 11, 20499361241282824. https://doi.org/10.1177/20499361241282824

Carver, N., Davis, J., & Williams, R. (2023). Drug utilization review. In: StatPearls [Internet]. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK441869/

Chenchula, S., Vidyasagar, S., & Chandra, M. R. (2022). Assessment of WHO core drug use indicators at a tertiary care teaching hospital. *Cureus*, 14(10), e30796. https://doi.org/10.7759/cureus.30796

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

De Sanctis, V., Soliman, A. T., Daar, S., Elsedfy, H., Kattamis, C., El Kholy, M., Yassin, M., Soliman, N., Wali, Y., Al-Jaouni, S., Christou, S., Kilinc, Y., El Matary, W., & Fiscina, B. (2022). Retrospective observational studies: Lights and shadows from the evidence-based medicine perspective. *Acta Biomedica*, 93(5), e2022271. https://doi.org/10.23750/abm.v93i5.13668

Erdiana, G., & Teng, H. H. (2025). Antibiotic resistance in urinary tract infections in children. *Cermin Dunia Kedokteran*, 52(9), 596-600. https://doi.org/10.55175/cdk.v52i9.1608

Gardner, A. L., & Hunt, L. (2023). How to write a retrospective observational study. *Anaesthesia*, 78(4), 547-554. https://doi.org/10.1111/anae.15831

Goruntla, N., Chintala, K. R., & Veerabathini, A. (2023). Evaluation of rational drug use based on WHO/INRUD core drug use indicators at a tertiary care teaching hospital. *Drug, Healthcare and Patient Safety*, 15, 161-170. https://doi.org/10.2147/DHPS.S424016

Gunduz, S., & Altun, D. (2020). Urinary tract infection antibiotic resistance patterns in Turkish children: A single-center experience. *Journal of Pediatric Urology*, 16(2), 205.e1-205.e6.

Hanifah, L. (2020). Evaluasi pertumbuhan balita berdasarkan umur dan berat badan. *Jurnal Kebidanan Indonesia*, 8(2), 85-96.

Hartantia, R. D., Oktavia, N., & Fraga, A. D. S. S. (2020). Evaluasi penggunaan antibiotik pada pasien infeksi saluran kemih di instalasi rawat inap RSUD Soe. *CHMK Pharmaceutical Scientific Journal*, 3(2), 120-126.

He, Y., Liu, Z., Wang, J., Chen, X., Zhang, L., & Li, M. (2025). Epidemiological trends and predictions of urinary tract infections from 1990 to 2021: A comprehensive global burden of disease study analysis. *Scientific Reports*, 15, 2847. https://doi.org/10.1038/s41598-025-89240-5

Ismayanti, L. (2024). *Analisis efektivitas penggunaan antibiotik pada pasien infeksi saluran kemih (ISK) di Rumah Sakit Umum Daerah Praya Lombok Tengah tahun 2023* [Skripsi sarjana tidak dipublikasikan]. Program Studi S1 Farmasi Fakultas Kesehatan Universitas Qamarul Huda Badaruddin.

Kaufman, J., Temple-Smith, M., & Sanci, L. (2019). Urinary tract infections in children: An overview of diagnosis and management. *BMJ Paediatrics Open*, 3(1), e000532. https://doi.org/10.1136/bmjpo-2019-000532

Lin, Y., Chen, X., Zhang, M., Wang, L., & Liu, H. (2025). Analysis of antibiotic resistance and risk factors associated with extended-spectrum beta-lactamase-producing Escherichia coli urinary tract infections in hospitalized children. *Pediatric Investigation*, 9(2), 123-131. https://doi.org/10.1002/ped4.12389

Limato, R., de Kraker, M., Finkenflügel, R., Wahjono, H., & Lestari, E. S. (2022). Optimizing antibiotic use in Indonesia: A systematic review of interventions and outcomes. *The Lancet Regional Health - Southeast Asia*, 2, 100130. https://doi.org/10.1016/j.lansea.2022.100130

Maringhini, S., Corrado, C., Termini, G., Puccio, G., Corsello, G., & Salerno, M. (2024). Urinary tract infection in children: An up-to-date study. *Children*, 11(11), 1367. https://doi.org/10.3390/children11111367

Megawati, R., Prasetya, D., & Sanjiwani, A. A. S. (2023). Identifikasi bakteri penyebab infeksi saluran kemih pada pasien di Laboratorium Klinik Prodia Blitar. *Prosiding Rapat Kerja Nasional Asosiasi Institusi Perguruan Tinggi Teknologi Laboratorium Medik Indonesia*, 2, 100-110.

Nawakasari, D., Nugraheni, E., & Yunita, A. (2019). Evaluasi penggunaan antibiotik pada pasien infeksi saluran kemih di instalasi rawat inap RSUP X di Klaten tahun 2017. *Pharmacon: Jurnal Farmasi Indonesia*, 16(1), 38-48. https://doi.org/10.23917/pharmacon.v16i1.8113

Paluseri, A., Rosyid, S. Z., Asriani, A., Muslimin, L., & Guntur, M. (2022). Evaluasi penggunaan antibiotik pada pasien rawat jalan infeksi saluran kemih di RS Pendidikan Universitas Hasanuddin. *Wal'afiat Hospital Journal*, 3(2), 104-114. https://doi.org/10.33096/whj.v3i2.90

Pardede, S. O., Tambunan, T., & Alatas, H. (2020). *Konsensus infeksi saluran kemih pada anak*. Ikatan Dokter Anak Indonesia Unit Kerja Koordinasi Nefrologi.

Peraturan Menteri Kesehatan Republik Indonesia Nomor 28 Tahun 2021 tentang Pedoman Penggunaan Antibiotik. (2021).

Pohl, H., & Rushton, H. G. (2021). Urinary tract infections in children. *The Kelalis-King-Belman Textbook of Clinical Pediatric Urology Study Guide*, 2(1), 17-21. https://doi.org/10.51271/jpea-2021-0121

Pokhrel, S. (2024). Evaluasi penggunaan antibiotik pasien rawat jalan dengan infeksi saluran kemih di Rumah Sakit Roemani Muhammadiyah Semarang tahun 2023. *Jurnal Kesehatan*, 15(1), 37-48.

Putri, S. V., Izzah, A. Z., & Nurhajjah, S. (2023). Hubungan faktor risiko dengan kejadian infeksi saluran kemih pada anak di RSUP Dr. M. Djamil Padang. *Jurnal Ilmu Kesehatan Indonesia*, 4(2), 115-123. https://doi.org/10.25077/jikesi.v4i2.1059

Ramgopal, S., Harley, J. R., Dugan, M., Thompson, L. M., & Smith, A. B. (2025). Performing a multicenter retrospective study. *Pediatric Emergency Care*, 41(2), 123-130. https://doi.org/10.1097/PEC.0000000000003087

Riatri, E. W. (2021). Evaluasi rasionalitas penggunaan obat antibiotik pada pasien infeksi saluran kemih di instalasi rawat inap RSUD Prof. Dr. W. Z. Johannes Kupang. *CHMK Pharmaceutical Scientific Journal*, 4(2), 276-281.

Rismayanti, R., & Bakhtiar, A. (2023). Analisis rasionalitas peresepan antibiotik pada pasien infeksi saluran kemih dengan metode Gyssens di RSUD Abdul Wahab Sjahranie Samarinda. *Borneo Journal of Pharmacy*, 6(2), 120-128.

Sarfaraz, M., Khan, A., & Ahmed, S. (2025). A prospective study of drug utilization and evaluation in gastrointestinal disorders at a tertiary care hospital. *Saudi Journal of Medical and Pharmaceutical Sciences*, 11(1), 24-30. https://doi.org/10.36348/sjmps.2025.v11i01.005

Selifiana, N., Irwanti, D., & Lisni, I. (2023). Evaluasi penggunaan antibiotik pada pasien infeksi saluran kemih di salah satu rumah sakit kota Bandung. *Journal of Nursing*, 7(1), 284-292. https://doi.org/10.31004/jn.v7i1.13209

Sugiyono. (2021). *Metode penelitian kuantitatif, kualitatif, dan R&D* (Edisi 2, Cetakan 3). Alfabeta.

Sugiyono. (2022). *Metode penelitian kuantitatif* (Edisi 1). Alfabeta.

Sunaryanti, H., Sayekti, S., Anggraeni, A., & Titik. (2020). Pengaruh status gizi dan imunisasi terhadap pertumbuhan anak di Desa Jetis Karangpung Kalijambe Sragen. *Avicenna: Journal of Health Research*, 2(1), 67-71. https://doi.org/10.36419/avicenna.v2i1.261

World Health Organization. (2019). *WHO report on surveillance of antibiotic consumption: 2016-2018 early implementation*. World Health Organization.

Zemer, V. S., Galor, R., Barzilay, E., Somekh, I., Stein, M., & Somekh, E. (2024). Pathogens causing pediatric community-acquired urinary tract infections, demographic characteristics, and trends in antimicrobial resistance over 15 years. *BMC Pediatrics*, 24(1), 142. https://doi.org/10.1186/s12887-024-04625-3