

Evaluation of Antibiotic Use in Pediatric Inpatients Diagnosed with Urinary Tract Infection at a Private Hospital in Yogyakarta

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doi <https://doi.org/10.24071/jpsc.v23i1.1085>

 J. Pharm. Sci. Community, 2026, 23(1), 92-104

Article Info

Received: 2025-06-08

Revised: 2025-08-21

Accepted: 2025-09-05

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Keywords:

antibiotics, urinary tract infection, rational drug use, antimicrobial resistance, triangulation

ABSTRACT

The prevalence of urinary tract infections (UTIs) among Indonesian children remains high, with antibiotics as the primary therapy. This study evaluated the patterns and appropriateness of antibiotic use in pediatric inpatients with UTIs at a private hospital in Yogyakarta in 2023, based on the hospital's Clinical Practice Guidelines (CPGs) using a descriptive-analytic research with a mixed methods study design including both quantitative and qualitative data collection. Data collection involved retrospective medical record review of 55 patients, prospective observation of therapeutic management, and in-depth interviews with prescribers and hospital administrators. Medical records review showed that 98% of patients received antibiotics, with 100% appropriateness in indication and patient, 63.54% in antibiotic selection, and 21.82% in dosing. Common antibiotics included injectable ceftriaxone (40.54%), cefotaxime (18.82%), and gentamicin (16.22%). Observations indicated general adherence to CPGs, while interviews revealed prescribing decisions were influenced by patient condition, clinical progress, guidelines, and prescriber experience. Hospital management expressed support for rational antibiotic use through funding and infrastructure provision. Despite generally appropriate prescribing practices, gaps remain in antibiotic selection and dosing. Suggested strategies include combined educational interventions for prescribers and managerial measures to strengthen and implement CPGs, aiming to optimize antibiotic use and reduce the risk of resistance.

INTRODUCTION

Urinary tract infections (UTIs) are one of the most common bacterial infections in children. Up to 8% of children will experience at least one UTIs and up to 30% of infants and children can have recurrent infections (Simões e Silva *et al.*, 2019). Prevalence rates of UTIs vary by gender and age. UTIs affect 8.4% of girls and 1.7% of boys before 7 years of age. Timely diagnosis and treatment of UTIs in children are essential to prevent both acute morbidity and long-term complications (Barola *et al.*, 2024). According to research conducted in the Special Region of Yogyakarta, the highest prevalence of UTIs is found in women and the age group of

children aged 6-16 years, with *Escherichia coli* (*E. coli*) and *Pseudomonas aeruginosa* (*P. aeruginosa*) being the most frequently identified bacterial species as the cause (Albaniah, 2020). Antibiotics are the primary treatment for acute UTI (Becknell *et al.*, 2015). Antimicrobial resistance (AMR), which refers to microbial resistance to antimicrobials, has emerged as a worldwide health concern with significant negative consequences that can compromise the quality of healthcare. The development and dissemination of AMR are strongly associated with the patterns of antimicrobial use and the spread of resistant pathogens (Menteri Kesehatan Republik Indonesia, 2015).

Promoting patient safety and achieving optimal therapeutic outcomes within healthcare systems necessitates the appropriate and rational utilization of medications. This approach entails prescribing and administering pharmaceutical agents that are aligned with the patient's clinical condition, delivered in the correct dosage, for an appropriate duration, and at a cost that is economically feasible. In contrast, irrational drug use is associated with a range of adverse consequences, including the emergence of antimicrobial resistance, increased incidence of adverse drug reactions, elevated treatment costs, and a general decline in the quality of pharmacotherapy (Nyabuti *et al.*, 2020). Such irrational practices may include inappropriate antibiotic use, polypharmacy, and non-adherence to established clinical treatment guidelines. Addressing and improving medication use practices is critical in mitigating the morbidity and mortality linked to irrational pharmacological interventions (Nyabuti *et al.*, 2020). To support this goal, the World Health Organization (WHO) has established a set of core indicators to evaluate rational medicine use, such as the prescribing indicator, which assesses the proportion of patient encounters involving antibiotic prescriptions in healthcare settings (Mamo & Alemu, 2020).

Hospitals play a vital role in providing comprehensive healthcare services, including inpatient, outpatient, and emergency care (Tuloli *et al.*, 2021). Several common issues in antibiotic use within clinical practice in hospital include inappropriate selection of antibiotics, incorrect dosing, improper dosing intervals, and suboptimal duration of therapy. In cases of UTI, initiation of antibiotic therapy is generally preceded by laboratory examinations that support the diagnosis, with empiric antibiotics administered as the initial treatment. This study was conducted as an evaluation of antibiotic use in pediatric inpatients diagnosed with UTIs by determining the profile of antibiotics usage.

METHODS

The study was a descriptive-analytical research using a mixed methods study design with quantitative and qualitative data collection. The study consisted of four phases, involving the triangulation method and the selection of antibiotic prescribing improvement strategies. Phase 1 of the triangulation data analysis method was a retrospective cross-sectional analysis

which included reviewing antibiotic prescription documents. Phase 2 was a prospective observational study of the prescribing process. Phase 3 was a qualitative inquiry in the form of in-depth interviews with the prescribers and hospital managers. After the data triangulation analysis results were obtained, the process was continued to the phase 4, which was choosing strategies to improve and optimizing antibiotic use based on the results of the triangulation analysis (Management Sciences for Health, 2012b). The in-depth interview process began by the development of an interview instrument. Professional judgment assessments was conducted on the interview guide prior to its use as a research instrument. This instrument consisted of structured guidelines tailored for both prescribers and hospital managers, formulated based on data collected during the earlier phases of the study. The adequacy of these guidelines was evaluated to ensure they could elicit the necessary information. The interview questions were open-ended to allow for detailed qualitative insights.

Data collection was conducted retrospectively by reviewing medical records documents and prospectively by conducting observations of the prescribing practices, as well as in-depth interviews with the prescribers and the management.

The population of the prescription document review phase comprises all prescriptions for pediatric inpatients with UTIs during the 2023 period, totalling 114 prescriptions. The inclusion criteria for the study are all prescriptions for pediatric inpatients aged under 18 years old (Minister of Law and Human Rights of the Republic of Indonesia, 2014) includes both male and female, were diagnosed as uncomplicated UTIs during the 2023 period, and prescribed by pediatric specialists. The exclusion criteria are incomplete medical records data; prescriptions from paediatrician consultant; patients discontinuing treatment upon their own request; and patients deceased during the therapy period. The determination of the sample size was made using the Slovin formula $n = N / 1 + N(e)^2$ from the research population that met the inclusion and exclusion criteria (Ismail *et al.*, 2022). Based on Slovin's formula, the calculated sample size was 89 medical records. Following data screening, there were only 55 medical records that met the

inclusion and exclusion criteria. The instruments of the study were the data collection sheets, observation of antibiotic prescribing management sheets, guidelines for in-depth interviews with prescribers and for hospital management. Data collected included the patient's initials, gender, age, weight, symptoms, diagnosis, laboratory assessments' result, number and types of antibiotics prescribed, and duration of antibiotic use.

There were four prescribers identified in the document observation data included in the observations of the prescribing process. For the in-depth interviews, four prescribers and three hospital managers, including the head of the antimicrobial stewardship program, the head of the clinical practice guidelines committee, and the medical director were included. Prior to participation, informed consent was obtained from all respondents. The interviews were audio-recorded and subsequently transcribed for analysis.

Contributing factors to current antibiotic use practices were identified through the combined findings of prescribing document reviews, direct observations of the prescribing process, and in-depth interviews with prescribers. Strategies to improve antibiotic use were selected based on the insights gathered from the interviews with hospital administrators. An educational intervention was considered appropriate if the underlying issue stemmed from insufficient knowledge among prescribers. Managerial interventions were chosen when problems were related to system-level or organizational inefficiencies, while regulatory strategies were applied when prescriber behavior was the core issue. Depending on the complexity of the findings, a single strategy or a combination of two or three strategies could be implemented (Management Sciences for Health, 2012)

To ensure data accuracy and validity, the study employed triangulation analysis methods (Kaufmann *et al.*, 2015). This approach integrated findings from pediatric UTIs prescribing pattern reviews, observations of the prescribing process, and perspectives obtained from both prescribers and hospital managers regarding antibiotic use. Through those methods, the study aimed to develop a comprehensive and evidence-based strategy for optimizing antibiotic prescribing practices. The study has passed the ethical review by the Hospital Ethics and Legal Committee of Panti Rapih Hospital in Yogyakarta as shown by the certificate of ethical eligibility number: 014/SKEPK-KKE/II/2024.

RESULTS AND DISCUSSION

Uncomplicated urinary tract infections (UTIs) are the most common bacterial infections affecting the lower urinary tract, and involving the bladder and associated structures. Cases occur in healthy individuals with no structural abnormalities of the urinary tract or significant comorbidities. Patient's characteristics based on gender, age, symptoms, laboratory assessments, and the antibiotics prescribed were used to determine the diversity of the patients.

Despite being very common and largely studied, managing UTIs in children poses clinical challenges, particularly because symptoms in young children are often nonspecific and subtle. A high degree of clinical suspicion is therefore required. UTIs should be considered in all children under the age of two who present with unexplained fever (Leung *et al.*, 2019). UTIs in pediatric patients can also result in irreversible damage to the renal parenchyma, potentially leading to chronic renal insufficiency and associated complications. To mitigate these risks, early and effective antibiotic therapy is essential. However, the rising prevalence of antibiotic resistance among uropathogens complicates the selection of optimal empirical therapy and renders clinical guidelines rapidly outdated, posing ongoing challenges in the management of pediatric UTIs (Esposito *et al.*, 2022). Over-diagnosis can result in unnecessary and potentially invasive investigations, unwarranted antibiotic use, and increased risk of antibiotic resistance. Conversely, under-diagnosis or delayed treatment may lead to recurrent infections and increase the risk of renal scarring, which can subsequently contribute to hypertension and chronic kidney disease. Thus, prompt and accurate diagnosis, along with appropriate antimicrobial therapy, are critical to optimizing clinical outcomes (Leung *et al.*, 2019).

Most of the patients in this study are females (78.18%). Patients were divided into three age categories: neonatus-5 years old (52.73%), >5-10 years old (32.73%), and >10 years old (14.55%). These results are consistent with a previous study indicating that the prevalence of UTIs varies depending on age and sex, ranging from 3–10% in girls and 1–3% in boys. In Indonesia, a study involving 200 children revealed that 35% of those aged 1–5 years and 22% of those aged 6–10 years had UTIs, with a higher prevalence observed in females (67%)

Table 1. Characteristics of Patients

Characteristics of Patients	Patients (n55)	
	n	%
Gender		
Male	12	21.82
Female	43	78.18
Age (years)		
0-5	29	52.73
>5-10	18	32.73
>10	8	14.55
Symptoms		
Fever	46	83.64
Vomiting	31	56.36
Diarrhea	10	18.18
Fluid oral intake difficulty	8	14.55
Dysuria	2	3.64
Increased urinary frequency	1	1.82
Abdominal pain	6	10.91
Lower back pain	0	0.00
Bedwetting	0	0.00
Strong-smelling urine	0	0.00
Laboratory Examinations		
No Laboratory Examinations	1	1.82
Normal Result	7	12.73
Abnormal Result	47	85.45

Table 2. Parenteral Antibiotics Choices (Ikatan Dokter Anak Indonesia (IDAI), 2011)

Ceftriaxone	75mg/kg/day
Cefotaxime	150mg/kg/day divided every 6 hours
Ceftazidime	150mg/kg/day divided every 6 hours
Cefazolin	50mg/kg/day divided every 8 hours
Gentamicin	7.5mg/kg/day divided every 6 hours
Amikacin	15mg/kg/day divided every 12 hours
Tobramycin	5mg/kg/day divided every 8 hours
Ticarcillin	300mg/kg/day divided every 6 hours
Ampicillin	100mg/kg/day divided every 6 hours

compared to males (33%) (Sukmonurcahyo & Hartono, 2024). The two most commonly observed symptoms are fever (84%) and vomiting (55.36%). The percentage of patients who have undergone laboratory examinations and showed abnormal urine test results is 85.45%, while the other 12.73% showed normal results, and 1.82% did not undergo laboratory examinations. The complete results are summarized in Table 1.

The rate of antibiotics prescription in pediatric inpatients was 98% (Figure 1). The other 2% of pediatric inpatients were not prescribed antibiotics but received symptomatic medicines, including paracetamol, ibuprofen,

ketorolac, ranitidine, domperidone, omeprazole, vitamins, and others. Among patients who were given antibiotics, 72.22% were given single antibiotics and 27.78% were given a combination of antibiotics (Figure 2). According to the Clinical Practice Guidelines (CPGs) for UTI in pediatric patients (Clinical Practice Guidelines Team, 2021), the use of combination antibiotics in the management of UTI is not specifically mentioned. However, the rationale for using combination antibiotic therapy warrants further analysis. The most commonly prescribed antibiotics during hospitalization were Ceftriaxone injection (40.54%), Cefotaxime

injection (18.92%), and Gentamicin injection (16.22%) (Table 4).

Results of the study showed that among patients that received single antibiotic therapy 92.30% patients received antibiotics regimen in accordance with the CPGs. Antibiotic regimens used as therapy that were not in accordance with the CPG were Metronidazole and Ciprofloxacin (Tables 2-4).

Based on the review of medical records from 55 pediatric inpatients diagnosed with urinary tract infections (UTIs), 100% of patients met the criteria for appropriate indication and appropriate patient identification. However, only 63.64% met the criteria for appropriate antibiotic selection, and 5.45% for appropriate dosage (Tables 5 & 6). These findings indicate variations in several aspects of rational antibiotic use, with significant implications for the quality of UTI management and the increased risk of antimicrobial resistance.

An observational study was conducted on the therapy management process involving four pediatricians during their clinical encounters with patients. The observation

encompassed the entire process from diagnosis to prescription. A total of 10 patients were observed. Diagnostic procedures were based on supporting data, including medical history (anamnesis), physical examination, and laboratory investigations. During anamnesis, data collected included patient identification, body weight measurement, vital signs (body temperature, heart rate, and blood pressure), reported symptoms such as fever, nausea, vomiting, dysuria, and others, as well as the patient's treatment history. Laboratory tests, particularly urinalysis, were performed to support the diagnosis of UTIs.

Based on the diagnostic findings, particularly the results of laboratory tests and antibacterial sensitivity tests, the pediatricians determined the appropriate therapy, including the rational selection and prescription of antibiotics. This process was accompanied by the provision of information, counseling, and education to the patient and their family regarding the therapeutic program and its objectives. Subsequent monitoring was done to assess the patient's clinical progress. The process of rational prescribing is illustrated in Figure 3.

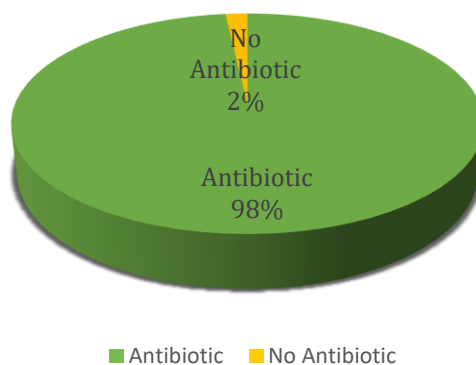


Figure 1. Percentage of Antibiotics Prescription.

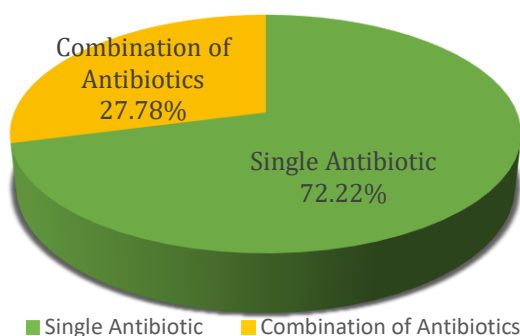


Figure 2. Percentage of Single Antibiotic and Combination Antibiotics Use.

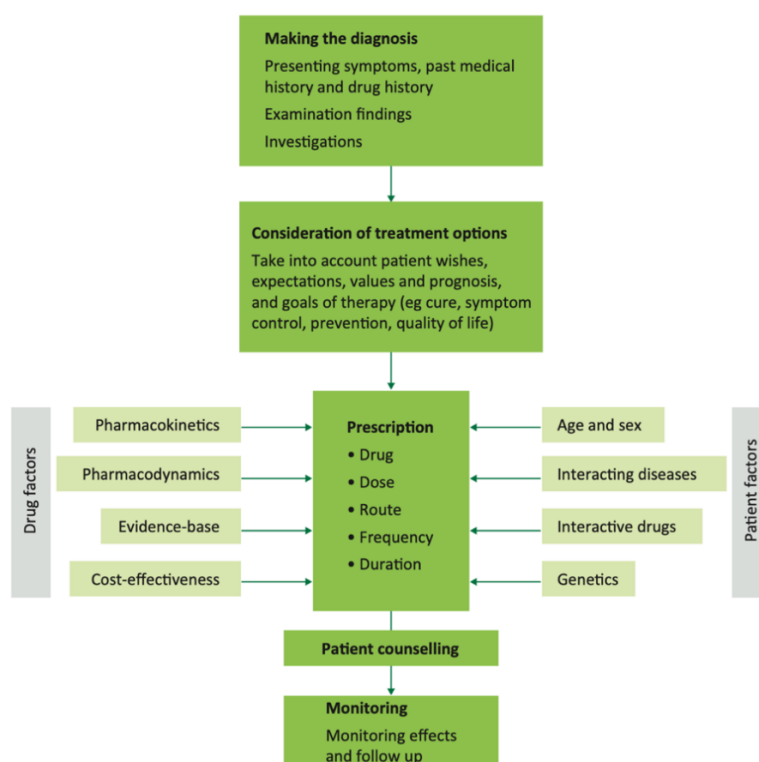


Figure 3. The Process of Rational Prescribing (Maxwell, 2016).

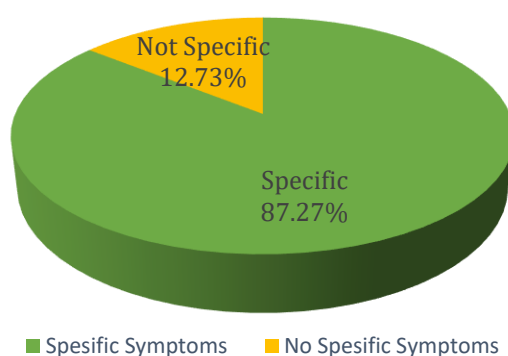


Figure 4. Percentage of Symptoms and Urinalysis Abnormalities.

Prescribing should be informed by a clearly established primary diagnosis, along with any pertinent secondary diagnoses. Ideally, these diagnoses are determined or confirmed by the prescribing clinician, who assumes responsibility for the outcomes of the chosen therapy. It is essential to acknowledge the inherent uncertainty in clinical diagnosis, since this uncertainty plays a critical role in evaluating the balance between therapeutic benefits and potential harms. For example, antibiotics are commonly prescribed based on an assumed

bacterial susceptibility, with the expectation of clinical improvement. However, subsequent antimicrobial sensitivity testing may indicate that the prescribed agent was inappropriate, thereby exposing the patient to unnecessary risks without offering a therapeutic benefit (Maxwell, 2016).

Observation of the patient therapy management process indicated that all of the pediatricians observed, adhered to the rational prescribing protocol. However, based on inpatient medical record data, 1.82% of patients

did not undergo any laboratory evaluation (Table 1). Additionally, antibacterial sensitivity testing was not performed for any of the patients.

It is essential to identify the factors that affect antibiotic prescribing decisions (Zanichelli *et al.*, 2019). In-depth interviews were conducted with prescribing clinicians to explore the factors influencing antibiotic prescribing. As antibiotics represent the primary treatment modality for UTIs, accurate diagnosis is crucial to guide appropriate antibiotic use. The CPGs outline specific diagnostic criteria, including symptoms, clinical examination findings, and laboratory investigations, particularly urinalysis, to support the diagnosis.

As an introduction to the in-depth interview, prescribers stated that they are already aware of and understand the issue of antibiotic resistance and the dangers associated with failing to implement timely control measures. Antibiotic resistance has indeed become a critical public health concern, necessitating great caution in antibiotic prescribing practices—particularly in cases of UTI, where antibiotics are the primary treatment modality. It is imperative to avoid irrational antibiotic use, especially in pediatric patients (P1, P2, P3, P4).

The hospital has established CPGs for the management of UTIs, which were developed collaboratively by the Clinical Practice Guidelines Development Team and the Pediatric Medical Staff Group. During the information-gathering process regarding the clinical CPGs for the management of UTIs at the hospital, it was found that one of four prescribers was unaware that such guidelines had been developed, while the others were informed of the CPGs and had participated in its development through coordination with the CPGs development team.

The prescribers reported that, in addition to considering standard therapy guidelines (STGs), the selection of therapy—particularly antibiotics—is also influenced by their clinical experience and competence in clinical assessment. To support and enhance their clinical competence, the physicians consistently update their knowledge by attending seminars, symposiums, workshops, and by referring to the latest guidelines issued by the Indonesian Pediatric Society (Ikatan Dokter Anak Indonesia, IDAI). As one prescriber stated: *"There is always ongoing development in medical knowledge and*

guidelines, including in the management of UTIs. Although the Standard Treatment Guidelines (STGs) from IDAI have not been updated for some time, I continue to attend seminars, workshops, and symposia to stay informed about the latest advances in disease management. By combining this updated knowledge with experiences, I have gained during my practice as a pediatrician, I feel confident in making therapeutic decisions for my patients, including antibiotic selection" (P1, P3, P4).

All four prescribers stated that once a UTI diagnosis is established, antibiotic therapy becomes the primary treatment option, in addition to symptomatic management based on the patient's presenting symptoms: *"When the patient's symptoms and urinalysis results support a UTI diagnosis, antibiotics are indeed the main treatment option. UTI symptoms can sometimes be non-specific, but based on experience and literature, commonly observed signs include fluctuating fever for two to three days—often high at night—and vomiting. So, even in the absence of typical urinary symptoms, the presence of fever and vomiting can already raise suspicion of a UTI"* (P1, P2, P3, P4). This addresses the question arising from the patient medical record data, which showed that 14% of patients did not exhibit specific symptoms (only fever and vomiting) and did not demonstrate any abnormalities in urinalysis examination results (Figure 5).

As additional information, one respondent added: *"Patients suspected of having a UTI will undergo a urinalysis laboratory examination. While awaiting the test results, empirical antibiotic therapy will be initiated. The laboratory findings will not only support the diagnostic process but also be used to monitor the patient's clinical progress"* (P1, P2, P3, P4).

While awaiting culture results, initiating prompt antibiotic therapy for symptomatic UTI is recommended based on clinical presentation and positive urinalysis findings, in order to eliminate the infection and enhance clinical outcomes. The selection of antibiotics should be guided by local antimicrobial resistance patterns (Leung *et al.*, 2019). Empirical antibiotic use among inpatients was frequently inappropriate and excessive. Such misuse—whether due to inappropriate selection or excessive administration—can contribute to increased healthcare costs. Clinical decision-making regarding empirical antibiotic

therapy should be guided by the patient's specific clinical characteristics. Therefore, clinicians must exercise greater prudence in the selection and use of antibiotics (Luo *et al.*, 2023).

Regarding the absence of antibacterial sensitivity testing results, prescribing physicians noted: "Ideally, antibacterial sensitivity testing should be conducted to identify the most appropriate antibiotic. However, such testing is rarely performed, primarily due to its relatively high cost. Consequently, antibiotic therapy is more frequently guided by clinical guidelines, professional experience, existing literature, and ongoing evaluation of the patient's clinical condition. If the patient's condition improves with empirical antibiotic therapy or treatment based on current guidelines, then the antibiotic may be continued. Sensitivity testing is reserved for cases where it is deemed truly necessary—for example, when the patient does not show improvement with empirical treatment" (P1, P4).

Based on medical records data and in-depth interviews, the antibiotics selected for

treatment were primarily third-generation parenteral cephalosporins. "For the management of urinary tract infections (UTIs), the primary parenteral antibiotics typically used are cephalosporins, such as ceftriaxone or cefotaxime. In addition, injectable gentamicin may also be considered a drug of choice" (P1, P2, P3, P4). A second or third generation cephalosporin and amoxicillin-clavulanate are drugs of choice in the treatment of acute uncomplicated UTI. Parenteral antibiotic therapy is recommended for infants ≤ 2 months and any child who is toxic-looking, hemodynamically unstable, immunocompromised, unable to tolerate oral medication, or not responding to oral medication. A combination of intravenous ampicillin and intravenous/intramuscular gentamicin or a third-generation cephalosporin can be used in those situations (Leung *et al.*, 2019). Prescribers also reported having additional considerations when determining the therapeutic dosage. These considerations include the patient's clinical condition and the severity of the presenting symptoms.

Table 3. Oral Antibiotics Choices (Ikatan Dokter Anak Indonesia (IDAI), 2011)

Amoxicillin	20-40 mg/kg/day divided into 3 doses
Sulfonamide	
a. Trimethoprim (TMP)-Sulfamethoxazol (SMX)	6-12 mg TMP and 30-60 mg SMX/kg/day divided into 2 doses
b. Sulfisoxazole	120-150 mg/kg/day divided into 4 doses
Cephalosporines:	
Cefixime	8 mg/kg/day divided into 2 doses
Cefpodoxime	10 mg/kg/day divided into 2 doses
Cefprozil	30 mg/kg/day divided into 2 doses
Cephalexin	50-100 mg/kg/day divided into 4 doses
Loracarbef	15-30 mg/kg/day divided into 2 doses

Table 4. Type of Single Antibiotic Prescribed

Type of Antibiotics Used	Patients (n=37)	
	n	%
Ceftriaxone Injection	15	40.54
Cefotaxime Injection	7	18.92
Gentamicin Injection	6	16.22
Ampicillin Injection	3	8.11
Cefixime Syrup	2	5.41
Amoxicillin Drop	2	5.41
Metronidazole Injection	1	2.70
Ciprofloxacin Injection	1	2.70

Table 5. Appropriateness of Antibiotic Prescribing

Antibiotic	Body Weight (kg)	Dosage	Dose Recommendation (mg/day)	*
Ceftriaxone Inj	5.6	1 x 400mg	420	X
Ceftriaxone Inj	6.66	2 x 250 mg	500	✓
Ceftriaxone Inj	13	1 x 1000 mg	975	X
Ceftriaxone Inj	13.6	2 x 500mg	1020	X
Ceftriaxone Inj	14	2 x 500 mg	1050	X
Ceftriaxone Inj	17.4	2 x 600 mg	1305	X
Ceftriaxone Inj	18	2 x 700 mg	1350	X
Ceftriaxone Inj	18	2 x 500 mg	1350	X
Ceftriaxone Inj	19	3 x 500 mg	1425	X
Ceftriaxone Inj	19	2 x 750 mg	1425	X
Ceftriaxone Inj	19	2 x 1000 mg	1425	X
Ceftriaxone Inj	23	2 x 1000 mg	1725	X
Ceftriaxone Inj	24	2 x 1000 mg	1800	X
Ceftriaxone Inj	25	2 x 1000mg	1875	X
Ceftriaxone Inj	30	2 x 1000 mg	2250	X
Cefotaxime Inj	11	3 x 350 mg	1650	X
Cefotaxime Inj	11.5	2 x 500 mg	1725	X
Cefotaxime Inj	14	3 x 500 mg	2100	X
Cefotaxime Inj	14	3 x 350 mg	2100	X
Cefotaxime Inj	18	3 x 500 mg	2700	X
Cefotaxime Inj	27	2 x 1000 mg	4050	X
Cefotaxime Inj	29	2 x 1 gram	3480	X
Ampicillin Inj	8.4	3 x 250 mg	840	X
Ampicillin Inj	8.6	3 x 300 mg	860	X
Ampicillin Inj	23	3 x 700 mg	2300	X
Gentamicin Inj	6.5	1 x 35 mg	48.75	X
Gentamicin Inj	12	1 x 60 mg	90	X
Gentamicin Inj	15	1 x 75 mg	112.5	X
Gentamicin Inj	17	1 x 80 mg	127.5	X
Gentamicin Inj	23.6	1 x 125 mg	180	X
Gentamicin Inj	31	1 x 150mg	232.5	X
Cefixime Syr	16	2 x 100mg	128	X
Cefixime Syr	22.5	2 x 100mg	184	X
Amoxicillin Drop	5.4	3 x 70mg	108-216	✓
Amoxicillin Drop	7.2	3 x 90mg	144-288	✓

* ✓ = antibiotic use followed dose recommendation.

X = antibiotic use did not follow dose recommendation.

Based on the Consensus on Pediatric Urinary Tract Infection, to date, there remains a lack of standardization in the management of UTIs in children, and several aspects of treatment

continue to be subject to controversy. Various management protocols have been developed based on findings from multicenter studies, including clinical trials and meta-analyses.

Although differences exist among these protocols, they are generally complementary in nature. In cases where a UTI is suspected in a child, empirical antibiotic therapy should be initiated based on the most likely causative organisms while awaiting urine culture results. Subsequent treatment should be adjusted according to the culture and sensitivity findings. The choice of empirical antibiotics should be guided by local antimicrobial resistance patterns; in the absence of such data, reference may be made to pathogen sensitivity profiles reported in the literature. Clinical improvement is generally expected within 48 to 72 hours of initiating therapy. If no clinical response is observed within this timeframe, it may indicate that the chosen antibiotic is ineffective or that the patient is experiencing a complicated UTI, in which case a change in antibiotic therapy should be considered.

In-depth interviews conducted with three hospital managers uncovered strategies that could be implemented to improve the quality of antibiotic usage.

The Head of The Antimicrobial Stewardship Program (ASP) Team stated the following: *"The antimicrobial stewardship program team could facilitate updated knowledge discussions related to antibiotic selection. Their role is to stay informed about the latest developments in antibiotics and focus on guiding appropriate antibiotic choices through scientific discussions and guideline-based flowcharts. Although differences in antibiotic selection may still occur, these can be influenced by several factors, including the patient's clinical progress and available antibacterial sensitivity results"* (P5).

One of the key topics discussed was the development of therapeutic guidelines for UTIs. Given the range of available treatment options, it was essential for prescribers to engage in consensus-building discussions to determine a standardized reference for UTI management. This need arose from findings in the in-depth

interviews, which revealed differences in the references used by different prescribers.

The Head of The Clinical Practice Guidelines Team stated the following: *"It was essential to develop comprehensive disease-specific guidelines, including UTIs. These guidelines are important because they provide a reference and framework to support healthcare professionals in delivering care aligned with standardized clinical practices. Nevertheless, clinical decisions may still be tailored to the individual patient's condition as needed"* (P6). Regarding the fact that some prescribers were still unaware of the existence of the CPG, the Head of The Clinical Practice Guidelines Team stated: *"Indeed, following the development of the CPG, it remains the responsibility of the team to disseminate the guidelines to all prescribers and to regularly update the standards in accordance with advancements in medical science"* (P6).

Managers were ready to support funding and other aspects needed for the implementation of both educational and managerial strategies to improve the quality of antibiotics used. The Medical Director stated the following: *"Antibiotic resistance is a critical global issue that urgently requires attention. Currently, antibiotic resistance is increasingly prevalent, including among pediatric patients. Therefore, it is essential to ensure accurate antibiotic prescribing to provide patients with appropriate therapy using effective, non-resistant antibiotics, while simultaneously preventing the further escalation of antibiotic resistance. The antibiotic resistance control program has been adopted by the Indonesian government and formalized through the Ministry of Health regulations. One key measure is the establishment of an antimicrobial stewardship program (ASP) team, tasked with evaluating antibiotic use within hospitals. The evaluation results are reported to hospital management, who then provide feedback to relevant stakeholders. These reports also guide actions needed to improve the quality of antibiotic usage. Management will support this effort through initiatives such as updating knowledge on UTIs,*

Table 6. Summary of Antibiotic Use Appropriateness Analysis

Indicator	Patients (n=55)	%
Appropriate indication	55	100%
Appropriate patient	55	100%
Appropriate type of antibiotic	35	63.64%
Appropriate antibiotic dosage	3	5.45%

antibiotic use, and other related activities, including the development of Standard Treatment Guidelines (STGs) for UTIs" (P7).

Based on the results of the in-depth interviews, strategies to improve the quality of antibiotic use involve a combination of educational and managerial approaches. The educational strategies include updating knowledge related to the management of UTIs in children through seminars, workshops, and organizing discussion forums among prescribers, all of which are developed and facilitated by the ASP Team.

The ASP team is responsible for helping to prevent or minimize antibiotic resistance resulting from inappropriate antibiotic use. The team also contributes to the development of antibiotic policies and clinical guidelines aimed at reducing both the overall rate of antibiotic prescribing and the incidence of inappropriate antibiotic selection (Lutfiyati *et al.*, 2022). Implementing an ASP is considered a fundamental approach to minimizing the development and spread of antimicrobial resistance in hospital environments (Setiawan *et al.*, 2022). Thus, the ASP team can carry out these responsibilities by implementing education and training initiatives (Menteri Kesehatan Republik Indonesia, 2015).

The educational strategies are subsequently followed by managerial strategies, which include reviews conducted by hospital management and the continuous updating of clinical practice guidelines (CPGs) in collaboration with the Clinical Guidelines Development Team. This process particularly focuses on establishing standardized antibiotic types and dosages appropriate for the treatment of UTIs. From the perspective of hospital management, the development of STGs for specific conditions is considered essential, since they serve as a reference for prescribers and support the delivery of high-quality, guideline-adherent clinical care. As a result, patients can receive treatment based on a standardized therapeutic approach (Management Sciences for Health, 2012). There is an urgent necessity to formulate a comprehensive, multisectoral national action plan, while concurrently implementing established, evidence-based interventions for the prevention and containment of antimicrobial resistance (Parathon *et al.*, 2017).

CONCLUSIONS

Based on the result of this study, it can be concluded that 98% of the sample received antibiotic therapy. The most frequently used antibiotics in accordance with the Clinical Practice Guidelines were injectable ceftriaxone (40.54%), cefotaxime (18.82%), and gentamicin (16.22%). Factors influencing antibiotic prescription are the patient's initial condition and clinical progression, standard treatment protocols, and the clinician's experience. Strategies to improve the quality of antibiotic use in pediatric inpatients with urinary tract infections (UTI) at a private hospital are organizing educational programs for prescribers, covering the management of UTI from diagnosing to treatment, and then supported by managerial strategies to develop practical guidelines. Further study is needed to develop and implement updated standard guidelines.

ACKNOWLEDGEMENTS

Gratitude and appreciation to the prescribers, hospital management, administrators, Head of the Medical Records Department, and all staff of the Pharmacy Department of a private hospital in Yogyakarta for their contributions to this study.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

REFERENCES

- Albaniah, A. O. (2020). Gambaran Kejadian Infeksi Saluran Kemih Berdasarkan Jenis Kelamin, Usia, dan Bakteri Penyebab di Daerah Istimewa Yogyakarta. *Nasional Sekolah Tinggi Ilmu Kesehatan*.
- Barola, S., Grossman, O. K., & Abdelhalim, A. (2024). Urinary Tract Infections in Children. <https://www.ncbi.nlm.nih.gov/books/NBK599548/>
- Becknell, B., Schober, M., Korbel, L., & Spencer, J. D. (2015). The diagnosis, evaluation and treatment of acute and recurrent pediatric urinary tract infections. *Expert Review of Anti-Infective Therapy*, 13(1), 81–90. <https://doi.org/10.1586/14787210.2015.986097>
- Clinical Practice Guidelines Team (2021). *Pedoman Praktik Klinik: Infeksi Saluran Kemih pada Anak*. The Royal Children's Hospital.
- Esposito, S., Biasucci, G., Pasini, A., Predieri, B.,

- Vergine, G., Crisafi, A., Malaventura, C., Casadio, L., Sella, M., Pierantoni, L., Gatti, C., Paglialonga, L., Sodini, C., La Scola, C., Bernardi, L., Autore, G., Canto, G. D., Argentiero, A., Cantatore, S., ... Iughetti, L. (2022). Antibiotic resistance in paediatric febrile urinary tract infections. *Journal of Global Antimicrobial Resistance*, 29, 499–506. <https://doi.org/10.1016/j.jgar.2021.11.003>
- Ikatan Dokter Anak Indonesia (IDAI). (2011). *Konsensus Infeksi Saluran Kemih Pada Anak*.
- Ismail, I. A., Pernadi, N. L., & Febriyanti, A. (2022). How to grab and determine the size of the sample for research. *International Journal of Academic and Applied Research (IJAAR)*, 6(9), 88-92.
- Kaufmann, C. P., Stämpfli, D., Hersberger, K. E., & Lampert, M. L. (2015). Determination of risk factors for drug-related problems: A multidisciplinary triangulation process. *BMJ Open*, 5(3), 1–7. <https://doi.org/10.1136/BMJOPEN-2014-006376>
- Leung, A. K. C., Wong, A. H. C., Leung, A. A. M., & Hon, K. L. (2019). Urinary tract infection in children. *Recent Patents on Inflammation & Allergy Drug Discovery*, 13(1), 2–18. <https://doi.org/10.2174/1872213X13666181228154940>
- Luo, Y., Guo, Z., Li, Y., Ouyang, H., Huang, S., Chen, Y., Li, K., Ji, Y., Zhu, H., Luo, W., Liu, X., Li, X., Xia, J., & Liu, X. (2023). Appropriateness of empirical antibiotic therapy in hospitalized patients with bacterial infection: A retrospective cohort study. *Infection and Drug Resistance*, 16, 4555–4568. <https://doi.org/10.2147/IDR.S402172>
- Lutfiyati, H., Yasin, N. M., Thobari, J. A., & Ikawati, Z. (2022). The implementation of antimicrobial stewardship in Indonesia: a regional survey in hospitals. *Journal of Advanced Pharmacy Education and Research*, 12(4), 19–26. <https://doi.org/10.51847/d6u4SIWaYj>
- Mamo, D. B., & Alemu, B. K. (2020). Rational drug-use evaluation based on World Health Organization core drug-use indicators in a tertiary referral hospital, Northeast Ethiopia: A cross-sectional study. *Drug, Healthcare and Patient Safety* 12, 15-21. doi: 10.2147/DHPS.S237021
- Management Sciences for Health. (2012). *Promoting Rational Prescribing. In: MDS-3: Managing Access to Medicines and Health Technologies*. <http://www.msh.org/resource-center/ebookstore/copyright.cfm.Website:www.mds-online.org>
- Maxwell, S. R. (2016). Rational prescribing: The principles of drug selection. *CME Clinical Pharmacology*, 16(5), 459–64. doi: 10.7861/clinmedicine.16-5-459
- Menteri Hukum dan Hak Asasi Manusia Republik Indonesia. (2014). *Undang-Undang Republik Indonesia Nomor 35 Tahun 2014 Tentang Perubahan Atas Undang-Undang Nomor 23 Tahun 2002 Tentang Perlindungan Anak*.
- Menteri Kesehatan Republik Indonesia. (2015). *Peraturan Menteri Kesehatan Republik Indonesia Nomor 8 Tahun 2015 Tentang Program Pengendalian Resistensi Antimikroba di Rumah Sakit*.
- Nyabuti, A. O., Okalebo, F. A., & Guantai, E. M. (2020). Examination of WHO/INRUD Core Drug Use Indicators at public primary healthcare centers in Kisii County, Kenya. *Advances in Pharmacological and Pharmaceutical Sciences*, 2020. <https://doi.org/10.1155/2020/3173847>
- Parathon, H., Kuntaman, K., Widiastoety, T. H., Muliawan, B. T., Karuniawati, A., Qibtiyah, M., Djanun, Z., Tawilah, J. F., Aditama, T., Thamlikitkul, V., & Vong, S. (2017). Progress towards antimicrobial resistance containment and control in Indonesia. *BMJ (Online)*, 358, 31–35. <https://doi.org/10.1136/BMJ.J3808>
- Setiawan, E., Cotta, M. O., Abdul-Aziz, M. H., Sosilya, H., Widjanarko, D., Wardhani, D. K., & Roberts, J. A. (2022, March 1). *Indonesian Healthcare Providers' Perceptions and Attitude on Antimicrobial Resistance, Prescription and Stewardship Programs*. Taylor & Francis. https://www.tandfonline.com/doi/epdf/10.2217/fmb-2021-0193?src=getftr&utm_source=mendeley&getftr_integrator=mendeley
- Simões e Silva, A. C., Oliveira, E. A., & Mak, R. H. (2019). Urinary tract infection in pediatrics: an overview. *Jornal de Pediatria*, 96(Suppl 1), 65. <https://doi.org/10.1016/J.JPED.2019.10.006>
- Sukmonurcahyo, R. H., & Hartono. (2024). *Infeksi Saluran Kemih pada Anak-Laporan Kasus*. 8(1).
- Tuloli, T. S., Abdulkadir, W. S., & Rasdianah, N. (2021). Evaluasi mutu pelayanan kefarmasian berdasarkan Standar Pelayanan Minimal (SPM) di Instalasi

- Farmasi. *Journal Syifa Sciences and Clinical Research*, 3(2), 87-97.
<https://ejurnal.ung.ac.id/index.php/jsscr/article/view/9668>
- Zanichelli, V., Tebano, G., Gyssens, I. C., Vlahović-Palčevski, V., Monnier, A. A., Stanic Benic, M., Harbarth, S., Hulscher, M., Pulcini, C., & Huttner, B. D. (2019). Patient-related determinants of antibiotic use: A systematic review. *Clinical Microbiology and Infection*, 25(1), 48-53
<https://doi.org/10.1016/j.cmi.2018.04.031>