THE PROFILE OF URINE CULTURE IN PEDIATRIC PATIENTS WITH UPPER URINARY TRACT DILATATION AT DR. SOETOMO GENERAL HOSPITAL FROM 2020-2023.

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ABSTRACT

Objective: *To describe the bacteriologic profile and antimicrobial-susceptibility patterns of urine cultures from pediatric UUTD patients treated at Dr Soetomo General Hospital, Indonesia, between 2020 and 2023.* ***Material & Methods:*** *This retrospective descriptive study reviewed medical records of 154 inpatients aged 0–17 years with confirmed UUTD. Demographic data, cultured species, and antibiotic susceptibilities were extracted and reported as frequencies.* ***Results:*** *From 154 bacterial isolates, Gram-negative bacteria dominated (78.6%) compared to Gram-positive (21.4%). The most frequent species were Escherichia coli (31.8%), Pseudomonas aeruginosa (16.9%), and Klebsiella pneumoniae (12.3%). Antibiotics with the highest sensitivity against major uropathogens were amikacin (83.7%), piperacillin-tazobactam (77.6%), and meropenem (81.6%). In contrast, gentamicin and nitrofurantoin demonstrated lower sensitivities, 61.2% and 71.4%, respectively. Severe hydronephrosis occurred in 52.6% of cases and was associated with more resistant bacterial isolates.* ***Conclusion:*** *Urinary tract infections in pediatric UUTD patients at Dr. Soetomo General Hospital are predominantly caused by Escherichia coli, with the highest antibiotic sensitivities observed for amikacin, meropenem, and piperacillin-tazobactam. Gentamicin and nitrofurantoin should be administered based on culture results, especially for uncomplicated cystitis. Regular antibiotic resistance surveillance is essential to ensure effective empirical treatment.*

Keywords: *Urine Culture, hydronephrosis, pediatrics, antibiotic, Escherichia coli.*

ABSTRAK

Tujuan: *Mengetahui distribusi bakteri uropatogen dan pola sensitivitas antibiotik pada pasien pediatri UUTD di RSUD Dr Soetomo selama 2020–2023.* ***Bahan & Cara:*** *Penelitian deskriptif retrospektif terhadap 154 rekam medis pasien berusia 1 hari sampai 17 tahun dengan diagnosis UUTD. Variabel yang dikumpulkan meliputi usia, jenis kelamin, jenis bakteri, dan hasil uji sensitivitas antibiotik. Data disajikan dalam bentuk distribusi frekuensi.* ***Hasil:*** *Dari 154 isolat bakteri, ditemukan dominasi Gram negatif (78,6%) dibanding Gram positif (21,4%). Spesies terbanyak meliputi Escherichia coli (31,8%), Pseudomonas aeruginosa (16,9%), dan Klebsiella pneumoniae (12,3%). Antibiotik dengan sensitivitas tertinggi terhadap uropatogen utama adalah amikasin (83,7%), piperasilin-tazobaktam (77,6%), dan meropenem (81,6%). Sebaliknya, sensitivitas gentamisin dan nitrofurantoin lebih rendah, masing-masing 61,2% dan 71,4%. Derajat hidronefrosis berat ditemukan pada 52,6% kasus dan berhubungan dengan isolat bakteri yang lebih resisten.* ***Simpulan:*** *Infeksi saluran kemih pada pasien pediatri dengan UUTD di RSUD Dr. Soetomo didominasi oleh Escherichia coli dengan sensitivitas antibiotik tertinggi terhadap amikasin, meropenem, dan piperasilin-tazobaktam. Gentamisin dan nitrofurantoin direkomendasikan berdasarkan hasil kultur, khususnya untuk sistitis tanpa komplikasi. Surveilans resistensi antibiotik secara berkala tetap diperlukan untuk memastikan efektivitas terapi empiris.*

Kata kunci: *Kultur urin, hidronefrosis, pediatri, antibiotik, Escherichia coli.*

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INTRODUCTION

Upper Urinary Tract Dilatation (UUTD) is among the most frequently detected fetal abnormalities, with a prevalence of approximately 1% to 2% of all pregnancies.[1] This condition is characterized by dilation of the renal pelvis, which various factors, including transient disturbances of urinary flow at critical points such as the ureteropelvic and vesicoureteral junctions, may cause.[2] The main causes of UUTD include transient urinary flow disturbances that are generally self-limiting and not associated with significant long-term complications; congenital anomalies such as ureteropelvic junction obstruction or vesicoureteral reflux that may result in persistent dilatation requiring intervention; and urinary tract infections (UTIs), which in some cases can exacerbate the manifestations of UUTD.[3]

After birth, imaging plays a crucial role in confirming the diagnosis and determining the severity of UUTD. Ultrasonography (US) is the primary modality for postnatal evaluation, as it enables monitoring of renal pelvic size and detection of hydronephrosis. Follow-up US examinations are typically performed at regular intervals, starting at 4 weeks of age and then at 3, 6, and 12 months, to assess the progression or resolution of the condition. In addition, Voiding Cystourethrogram (VCUG) is used to evaluate vesicoureteral reflux (VUR), a common complication of UUTD. This procedure involves catheterization of the bladder with contrast instillation, followed by imaging to detect reflux of urine into the kidneys.[3]

UUTD may result in urinary stasis, thereby increasing the risk of urinary tract infection (UTI). To confirm infection, a urine culture is performed to identify bacterial growth. The detection of UTI through urine culture can influence the management strategy of UUTD. In cases of active infection, appropriate antibiotic therapy is promptly initiated to eradicate the infection and prevent potential renal damage. For patients with recurrent UTIs, further evaluation is warranted to assess underlying anatomical abnormalities contributing to UUTD, such as VUR or obstructive lesions.[4]

Urine culture, therefore, plays a central role in the management of UUTD. It aids in diagnosing UTIs, guiding therapeutic decisions, monitoring possible complications, and ensuring appropriate long-term follow-up. Routine assessment with urine culture can reduce the risks associated with UUTD and support optimal renal health. Beyond management strategies, evidence regarding the effectiveness of various interventions will also be discussed. Thus, this review aims to provide a comprehensive reference encompassing multiple aspects, including the prognosis of UUTD.

OBJECTIVE

This study aims to describe and identify the urine culture profile and antibiotic sensitivity patterns in pediatric patients with Upper Urinary Tract Dilatation (UUTD) treated at Dr. Soetomo General Hospital between 2020 and 2023.

MATERIAL&METHODS

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This study was an observationalresearch with a retrospective design, involving subjects identified from medical records at Dr. Soetomo General Hospital during the period January 2020 to December 2023. The findings are presented in a descriptive manner.

The study was conducted at Dr. Soetomo General Hospital, Surabaya, by collecting medical record data between January 2020 and December 2023. The study population consisted of patients diagnosed with Upper Urinary Tract Dilatation (UUTD) who were treated at the Department of Urology, Dr. Soetomo General Hospital, during the study period.

Samples were selected based on eligibility criteria defined for the study population. Inclusion criteria were: (1) patients with complete medical record data; (2) patients diagnosed with UUTD within the pediatric age group (1 day–17 years); and (3) patients who were hospitalized at Dr. Soetomo General Hospital during the period 2020–2023. Exclusion criteria were: (1) patients with incomplete medical record data; (2) patients diagnosed with UUTD outside the pediatric age group; and (3) patients hospitalized outside the 2020–2023 study period.

Data collection was carried out using medical records of patients treated at Dr. Soetomo General Hospital between January 2020 and December 2023. Extracted variables included age, sex, urine culture results, antibiotic resistance, and antibiotic sensitivity patterns. All data were analyzed descriptively and presented in tables and narrative form.

RESULTS

From January 2020 to December 2023, a total of 154 pediatric patients with Upper Urinary Tract Dilatation (UUTD) were identified at Dr. Soetomo General Hospital. Patient characteristics included age distribution, sex distribution, bacterial isolates obtained from urine cultures, and antibiotic sensitivity profiles. The overall findings are presented descriptively in the following subsections (Table 1, Table 2).

The distribution of patients by age group demonstrated that the highest proportion was in the 0–4 years group, accounting for 42 patients (27.3%). This was followed by 41 patients (26.6%) in the 8–12 years group, 36 patients (23.4%) in the 12–17 years group, and 35 patients (22.7%) in the 4–8 years group. These results indicate that UUTD was most frequently detected in early childhood (Table 1).

Table 1. Age distribution of pediatric patients with UUTD.

Age	Quantitiy	Precentage (%)
0-4 years	42	27.3
4-8 years	35	22.7
8-12 years	41	26.6
12-17 years	36	23.4
Total	154	100.0

Table 2. Sex distribution of pediatric patients with UUTD.

Sex	Quantitiy	Precentage (%)
Laki-Laki	63	40.9
Perempuan	91	59.1
Total	154	100.0

Analysis of sex distribution showed that the majority of patients were female, comprising 91 cases (59.1%), compared to 63 male patients (40.9%). This female predominance suggests a higher detection rate or predisposition for UUTD in girls compared to boys within this cohort. The female-to-male ratio was approximately 1.4:1 (Table 2).

Gram-negative bacteria predominated among the 154 urine culture isolates, accounting for 121 isolates (78.6%), while Gram-positive bacteria were identified in 33 isolates (21.4%). Escherichia coli was the most frequently isolated pathogen, representing 49 cases (31.8%), followed by Pseudomonas aeruginosa (26 isolates; 16.9%) and Klebsiella pneumoniae (19 isolates; 12.3%). Among Gram-positive organisms, Staphylococcus haemolyticus was most common with 20 isolates (13.0%), followed by Enterococcus faecalis with 6 isolates (3.9%). Collectively, E. coli, P. aeruginosa, and K. pneumoniae comprised more than 60% of the isolates, underscoring their central role in empirical therapy considerations (Table 3).

When analyzed by underlying diagnosis, the largest subgroup was neurogenic bladder with 57 isolates (37.0%), followed by ureteropelvic junction obstruction (UPJO) with 46 isolates (29.9%), vesicoureteral reflux (VUR) with 27 isolates (17.5%), ureterovesical junction obstruction (UVJO) with 20 isolates (13.0%), and double pelvis–calyceal system (Double PCS) with 4 isolates (2.6%). In neurogenic bladder cases, E. coli (29.8%), P. aeruginosa (15.8%), and S. haemolyticus (12.3%)

Table 3. Urine culture characteristics of pediatric patients with UUTD.

No.	Bacteria	Quantity	Precentage(%)
Gram Positive			
1	*Staphylococcushaemolyticus*	20	12.99%
2	*Enterococcusfaecalis*	6	3.90%
3	*Enterococcusfaecium*	1	0.65%
4	*Staphylococcusaureus*	1	0.65%
5	*Staphylococcushominis*	1	0.65%
6	*Staphylococcuslentus*	1	0.65%
7	*Micrococcusluteus*	1	0.65%
8	*Streptococcusmitis/oralis*	1	0.65%
9	*Streptococcusagalactiae*	1	0.65%
Gram Negative		0.00%	
7	*Escherichiacoli*	49	31.82%
8	*Pseudomonasaeruginosa*	26	16.88%
9	*Klebsiellapneumoniae*	19	12.34%

predominated, reflecting chronic colonization due to urinary stasis. UPJO cases were dominated by E. coli (28.3%), S. haemolyticus (21.7%), and P. aeruginosa (19.6%), whereas UVJO showed higher prevalence of Enterococcus faecalis (25.0%) and E. coli (20.0%). In VUR, nearly half of the isolates were E. coli (48.1%), with P. aeruginosa and K. pneumoniae each contributing 14.8%. These patterns highlight pathogen variability according to anatomical abnormality (Table 4).

Stratification by severity of hydronephrosis (SFU classification) showed that most isolates were recovered from patients with grade 4 hydronephrosis (81 isolates; 52.6%). Grade 3 accounted for 39 isolates (25.3%), grade 2 for 28 isolates (18.2%), and grade 1 for only 6 isolates (3.9%). E. coli consistently dominated across all grades, ranging from 33.3% in grade 1 to 28.4% in grade 4. P. aeruginosa and K. pneumoniae were more frequently associated with higher grades, while Gram-positive organisms, particularly S. haemolyticus, were most common in severe hydronephrosis, suggesting secondary colonization due to prolonged urinary stasis (Table 5)

Antibiotic sensitivity profiles revealed variable responses among isolates. For Gram-positive bacteria. S. haemolyticus exhibited the highest susceptibility to piperacillin-tazobactam (75%), meropenem (70%), and amikacin (65%), while sensitivity to third-generation cephalosporins was lower (40–50%). E. faecalis demonstrated high susceptibility to amikacin (83.3%) but reduced sensitivity to cephalosporins. Among Gram-negative bacteria, E. coli showed high sensitivity to amikacin (83.7%), meropenem (81.6%), and nitrofurantoin (71.4%), while susceptibility to cefotaxime (30.6%) and ceftriaxone (34.7%) was low. P. aeruginosa maintained good susceptibility to amikacin (84.6%) and meropenem (80.8%) but showed poor response to cefotaxime and ceftriaxone (11.5%). K. pneumoniae retained sensitivity to amikacin (78.9%) and piperacillin-tazobactam (73.7%) but demonstrated reduced response to nitrofurantoin (36.8%) and cefuroxime (31.6%). These results emphasize the continued effectiveness of aminoglycosides and carbapenems against common pathogens, whereas resistance to cephalosporins is increasingly evident (Tables 6 and 7).

Table 4. Frequency of bacterial isolates by diagnosis.

Bacteria	Double PCS (n = 4)	Neurogenic Bladder (n=57)	UPJO (n=46)	UVJO (n=20)	VUR (n=27)
Gram Positive					
Corynebacteriumstriatum	0(0%)	0(0%)	0(0%)	2(10%)	0(0%)
Enterococcusfaecalis	0(0%)	0(0%)	0(0%)	5(25%)	1 (3.7%)
Enterococcusfaecium	0(0%)	0(0%)	1 (2.2%)	0(0%)	0(0%)
Staphylococcusaureus	0(0%)	1 (1.8%)	0(0%)	0(0%)	0(0%)
Staphylococcushaemolyticus	0(0%)	7 (12.3%)	10(21.7 %)	3(15%)	0(0%)
Staphylococcushominis	0(0%)	0(0%)	1 (2.2%)	0(0%)	0(0%)
Staphylococcuslentus	0(0%)	1 (1.8%)	0(0%)	0(0%)	0(0%)
Micrococcusluteus	1(25%)	0(0%)	0(0%)	0(0%)	0(0%)
Streptococcusmitis/oralis	1(25%)	0(0%)	0(0%)	0(0%)	0(0%)
Streptococcusagalactiae	0(0%)	0(0%)	0(0%)	0(0%)	1 (3.7%)
Gram Negative					
Acinetobacterbaumannii	0(0%)	0(0%)	1 (2.2%)	0(0%)	0(0%)
Aeromonashydrophila	1(25%)	0(0%)	0(0%)	0(0%)	0(0%)
Citrobacterfarmeri	1(25%)	0(0%)	0(0%)	0(0%)	0(0%)
Citrobacterfreundii	0(0%)	1 (1.8%)	0(0%)	0(0%)	0(0%)
Enterobactercloacae	0(0%)	1 (1.8%)	1 (2.2%)	0(0%)	1 (3.7%)
Escherichiacoli	1(25%)	17(29.8 %)	13(28.3 %)	4(20%)	13(48.1 %)
Klebsiellaozaenae	0(0%)	2 (3.5%)	0(0%)	0(0%)	0(0%)
Klebsiellapneumoniae	0(0%)	4 (7.0%)	5 (10.9%)	0(0%)	4 (14.8%)

Table 5. Frequency of bacterial isolates by diagnosis.

Bacteria	SFU Classification.				Total
	Grade 1	Grade 2	Grade 3	Grade 4	
Gram Positive					
Staphylococcu haemolyticus	1(16 .7%)	3(10 .7%)	5(12 .8%)	11(13.6%)	20(13.0%)
Enterococcusfaecalis	1(16 .7%)	0(0.0%)	2(5.1%)	3(3.7%)	6(3.9%)
Enterococcus faecium	0(0.0%)	0(0.0%)	0(0.0%)	1(1.2%)	1(0.6%)
Staphylococcus aureus	0(0.0%)	0(0.0%)	0(0.0%)	1(1.2%)	1(0.6%)
Staphylococcus hominis	0(0.0%)	0(0.0%)	0(0.0%)	1(1.2%)	1(0.6%)
Staphylococcus lentus	0(0.0%)	0(0.0%)	0(0.0%)	1(1.2%)	1(0.6%)
Micrococcus luteus	0(0.0%)	0(0.0%)	0(0.0%)	1(1.2%)	1(0.6%)
Streptococcus mitis/oralis	0(0.0%)	0(0.0%)	0(0.0%)	1(1.2%)	1(0.6%)
Streptococcus agalactiae	0(0.0%)	0(0.0%)	0(0.0%)	1(1.2%)	1(0.6%)
Gram Negative					
Escherichiacoli	2(33 .3%)	11(39.3%)	13(33.3%)	23(28.4%)	49(31.8%)
Pseudomonasaeruginosa	1(16 .7%)	5(17 .9%)	7(17 .9%)	13(16.0%)	26(16.9%)
Klebsiellapneumoniae	1(16 .7%)	3(10 .7%)	6(15 .4%)	9(11.1%)	19(12.3%)
Morganella morganii	0(0.0%)	1(3.6%)	1(2.6%)	3(3.7%)	5(3.2%)
Providencia stuartii	0(0.0%)	1(3.6%)	1(2.6%)	2(2.5%)	4(2.6%)
Proteus mirabilis	0(0.0 %)	1(3.6 %)	1(2.6 %)	1(1.2 %)	3(1.9 %)
Enterobacter cloacae	0(0.0 %)	1(3.6 %)	1(2.6 %)	1(1.2 %)	3(1.9 %)
Klebsiellaozaenae	0(0.0 %)	1(3.6 %)	1(2.6 %)	1(1.2 %)	3(1.9 %)
Serratia marcescens	0(0.0 %)	1(3.6 %)	1(2.6 %)	1(1.2 %)	3(1.9 %)
Acinetobacter baumannii	0(0.0 %)	0(0.0 %)	0(0.0 %)	1(1.2 %)	1(0.6 %)
Citrobacter farmeri	0(0.0 %)	0(0.0 %)	0(0.0 %)	1(1.2 %)	1(0.6 %)
Rhizobiumradiobacter	0(0.0 %)	0(0.0 %)	0(0.0 %)	1(1.2 %)	1(0.6 %)
Aeromonas hydrophila	0(0.0 %)	0(0.0 %)	0(0.0 %)	1(1.2 %)	1(0.6 %)
Citrobacter freundii	0(0.0 %)	0(0.0 %)	0(0.0 %)	1(1.2 %)	1(0.6 %)
Shigelladysenteriae	0(0.0 %)	0(0.0 %)	0(0.0 %)	1(1.2 %)	1(0.6 %)
Total	6 (100 %)	28 (100 %)	39 (100 %)	81 (100 %)	154 (100 %)

Table 6. Antibiotic sensitivity profiles of pediatric patients with UUTD.

Bakteri	Jumlah	AMK	MEM	TZP	IPM	CAZ	CTX	CRO	CTS	AMP	CXM	CIP	GEN	NIT	SXT
Staphylococcus haemolyticus	20	13(65%)	14 (70 %)	15 (75 %)	12 (60 %)	10 (50 %)	9 (45 %)	8 (40 %)	12 (60 %)	11 (55 %)	7 (35 %)	9 (45 %)	8 (40 %)	6 (30 %)	4 (20 %)
Enterococcus faecalis	6	5 (83.3 %)	4 (66.7 %)	4 (66.7 %)	3 (50 %)	0 (0 %)	1 (16.7 %)	1 (16.7 %)	3 (50 %)	2 (33.3 %)	1 (16.7 %)	2 (33.3 %)	1 (16.7 %)	1 (16.7 %)	1 (16.7 %)
Enterococcus faecium	1	1 (100 %)	1 (100 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)
Staphylococcus aureus	1	1 (100 %)	0 (0 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	0 (0 %)
Staphylococcus hominis	1	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	0 (0 %)
Staphylococcus lentus	1	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	0 (0 %)
Micrococcus luteus	1	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)
Streptococcus mitis/oralis	1	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)
Streptococcus agalactiae	1	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	0 (0 %)	1 (100 %)	1 (100 %)	1 (100 %)

AMK: amikasin; MEM: meropenem; TZP: piperasilin-tazobaktam; IPM: imipenem; CAZ: sefTAZidim; CTX: sefOTAxim; CRO: sefTRIakson; CXM: sefUROksim; CTS: cefoperazon-sulbaktam; AMP: ampisilin-sulbaktam; CIP: siprofloksasin; GEN: gentamisin; NIT: nitrofurantoin; SXT: trimetoprim-sulfametoksazol; ATM: aztreonam; TET: tetrasiklin.

Table 7. Antibiotic sensitivity characteristics of Gram-negative bacteria in pediatric patients with UUTD.

Bakteri	Jumlah	AMK	MEM	TZP	IPM	CAZ	CTX	CRO	CXM	CTS	AMP	CIP	GEN	NIT	SXT	ATM	TET
Escherichia coli	49	41 (83.7 %)	40 (81.6 %)	38 (77.6 %)	35 (71.4 %)	33 (67.3 %)	15 (30.6 %)	17 (34.7 %)	12 (24.5 %)	30 (61.2 %)	20 (40.8 %)	31 (63.3 %)	30 (61.2 %)	35 (71.4 %)	24 (49.0 %)	25 (51.0 %)	22 (44.9 %)
Klebsiella pneumoniae	19	15 (78.9 %)	13 (68.4 %)	14 (73.7 %)	13 (68.4 %)	12 (63.2 %)	8 (42.1 %)	7 (36.8 %)	6 (31.6 %)	9 (47.4 %)	6 (31.6 %)	10 (52.6 %)	10 (52.6 %)	7 (36.8 %)	8 (42.1 %)	8 (42.1 %)	9 (47.4 %)
Pseudomonas aeruginosa	26	22 (84.6 %)	21 (80.8 %)	19 (73.1 %)	16 (61.5 %)	17 (65.4 %)	3 (11.5 %)	3 (11.5 %)	2 (7.7 %)	10 (38.5 %)	8 (30.8 %)	17 (65.4 %)	15 (57.7 %)	6 (23.1 %)	11 (42.3 %)	2 (7.7 %)	2 (7.7 %)
Morganella morganii	5	4 (80.0 %)	3 (60.0 %)	4 (80.0 %)	2 (40.0 %)	4 (80.0 %)	2 (40.0 %)	2 (40.0 %)	2 (40.0 %)	4 (80.0 %)	3 (60.0 %)	2 (40.0 %)	3 (60.0 %)	2 (40.0 %)	3 (60.0 %)	1 (20.0 %)	3 (60.0 %)
Proteus mirabilis	3	2 (66.7 %)	2 (66.7 %)	3 (100 %)	2 (66.7 %)	2 (66.7 %)	2 (66.7 %)	2 (66.7 %)	3 (100 %)	2 (66.7 %)	2 (66.7 %)	2 (66.7 %)	2 (66.7 %)	2 (66.7 %)	1 (33.3 %)	1 (33.3 %)	2 (66.7 %)
Providencia stuartii	4	2 (50.0 %)	2 (50.0 %)	2 (50.0 %)	1 (25.0 %)	1 (25.0 %)	1 (25.0 %)	1 (25.0 %)	1 (25.0 %)	2 (50.0 %)	1 (25.0 %)	1 (25.0 %)	1 (25.0 %)	0 (0 %)	1 (25.0 %)	0 (0 %)	1 (25.0 %)
Enterobacter cloacae	3	2 (66.7 %)	3 (100 %)	2 (66.7 %)	2 (66.7 %)	2 (66.7 %)	0 (0 %)	0 (0 %)	0 (0 %)	1 (33.3 %)	1 (33.3 %)	2 (66.7 %)	2 (66.7 %)	1 (33.3 %)	1 (33.3 %)	1 (33.3 %)	1 (33.3 %)
Klebsiella ozaenae	3	2 (66.7 %)	2 (66.7 %)	2 (66.7 %)	2 (66.7 %)	2 (66.7 %)	1 (33.3 %)	1 (33.3 %)	1 (33.3 %)	2 (66.7 %)	1 (33.3 %)	1 (33.3 %)	1 (33.3 %)	0 (0 %)	1 (33.3 %)	1 (33.3 %)	1 (33.3 %)
Serratia marcescens	3	2 (66.7 %)	2 (66.7 %)	2 (66.7 %)	1 (33.3 %)	2 (66.7 %)	1 (33.3 %)	1 (33.3 %)	1 (33.3 %)	2 (66.7 %)	1 (33.3 %)	2 (66.7 %)	2 (66.7 %)	1 (33.3 %)	1 (33.3 %)	1 (33.3 %)	1 (33.3 %)
Acinetobacter baumannii	1	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	1 (100 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)
Citrobacter farmeri	1	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)
Rhizobium radiobacter	1	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)
Aeromonas hydrophila	1	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)
Citrobacter	1	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)

AMK: amikasin; MEM: meropenem; TZP: piperasilin-tazobaktam; IPM: imipenem; CAZ: sefTAZidim; CTX: sefOTAxim; CRO: sefTRIakson; CXM: sefUROksim; CTS: cefoperazon-sulbaktam; AMP: ampisilin-sulbaktam; CIP: siprofloksasin; GEN: gentamisin; NIT: nitrofurantoin; SXT: trimetoprim-sulfametoksazol; ATM: aztreonam; TET: tetrasiklin.

DISCUSSION

The age distribution of pediatric patients with Upper Urinary Tract Dilatation (UUTD) in this study showed the highest proportion in the 0–4 years age group (27.3%). This finding is consistent with previous studies reporting that congenital urological anomalies are often detected early due to intensive neonatal and infant health screenings.[5] Falco et al. (2021) also confirmed that urinary tract and kidney anomalies are commonly found in early life, emphasizing the importance of early clinical monitoring to reduce long-term complications such as recurrent urinary tract infections and chronic kidney disease.[6]

The second most frequent age group was 8–12 years (26.6%), which may be related to increased physical activity and physiological changes that predispose acute urinary tract infections to progress into chronic infections.[7] Behavioral changes and less optimal personal hygiene in school-aged children further increase the risk of recurrent infection. Recent evidence highlights that this age is a critical period requiring greater attention, particularly in hygiene education and awareness of early signs of urinary tract infections.[8]

This study found that UUTD occurred more frequently in females (59.1%) than in males (40.9%). This female predominance aligns with the findings of Marsh et al. (2024), who demonstrated that girls are at higher risk for urinary tract infections due to anatomical factors, including a shorter urethra and closer proximity of the urethra to the anus.[9] Such anatomy facilitates colonization of Gram-negative bacteria, particularly Escherichia coli, from the perineum into the urinary tract, worsening UUTD conditions.[10]

The urine culture results in this study demonstrated a predominance of Gram-negative bacteria (78.6%), particularly Escherichia coli, followed by Pseudomonas aeruginosa and Klebsiella pneumoniae. This pattern is in line with global evidence indicating that E. coli accounts for 70–80% of pediatric urinary tract infections.[8,11] The predominance of Gram-negative bacteria is strongly associated with bacterial structural factors such as lipopolysaccharides and adhesion fimbriae, which facilitate colonization and antibiotic resistance.[10]

Although Gram-positive bacteria were less frequent (21.4%), isolates such as Staphylococcus haemolyticus and Enterococcus faecalis were detected. Prior studies suggest that Gram-positive organisms are more common in patients with recurrent urological interventions or chronic urinary tract complications such as neurogenic bladder.[12] This highlights the need for clinicians to consider both Gram-negative and Gram-positive pathogens when selecting empirical therapy for UUTD-associated infections.

The distribution of bacteria also varied according to the type of urinary tract anomaly. In neurogenic bladder, E. coli, P. aeruginosa, and S. haemolyticus were dominant, reflecting chronic urinary stasis and repeated interventions.[13] In ureteropelvic junction obstruction (UPJO), E. coli remained the main pathogen, but the higher proportion of S. haemolyticus indicated possible nosocomial contamination from repeated medical procedures, as similarly reported in other studies.[14]

In ureterovesical junction obstruction (UVJO), Enterococcus faecalis was relatively more frequent, likely influenced by urinary obstruction creating an environment conducive to pH changes and biofilm formation. In vesicoureteral reflux (VUR), E. coli predominated, supporting the ascending infection theory, while the presence of P. aeruginosa and K. pneumoniae reflected antibiotic resistance shifts associated with long-term prophylaxis.[15] In the rare double pelvis–calyceal system (PCS), bacterial isolates were diverse without a clear dominant species, reinforcing the importance of individualized urine cultures before initiating empirical therapy.[16]

The degree of hydronephrosis, based on SFU classification, also correlated with bacterial patterns. Severe hydronephrosis (SFU 4) was dominated by virulent Gram-negative bacteria such as E. coli, P. aeruginosa, and K. pneumoniae, consistent with studies linking advanced hydronephrosis to high-risk infections.[12] In SFU 3, Gram-negative bacteria remained common, but opportunistic Gram-positive species began to appear, reflecting a transition from community-acquired to nosocomial infections.8In contrast, milder hydronephrosis (SFU 1 – 2) was predominantly associated with community pathogens such as E. coli, which are usually more sensitive to first-line antibiotics.[8]

Antibiotic sensitivity testing demonstrated that amikacin, meropenem, and piperacillin–tazobactam remained the most effective antibiotics against major uropathogens. E. coli showed high susceptibility to amikacin (83.7%) and meropenem (81.6%), while P. aeruginosa retained good sensitivity to amikacin (84.6%) and meropenem (80.8%). Gentamicin also showed moderate effectiveness against E. coli (61.2%), supporting its continued role as an affordable first-line option with good renal tissue penetration, albeit requiring monitoring for nephrotoxicity. Nitrofurantoin maintained relevance for uncomplicated cystitis, while third-generation cephalosporins such as cefotaxime and ceftriaxone showed reduced efficacy, suggesting rising ESBL prevalence.[10-11]

In community-onset pediatric UTIs, Escherichia coli typically accounts for roughly 60–80% of isolates, often higher in acute pyelonephritis.17In contrast, E. coli represented only ~32% in our study, with a relative shift toward Klebsiella spp. and Pseudomonas spp., which is consistent with children who have upper urinary tract dilatation (UUTD), healthcare exposure, and urinary tract anomalies, all known risk factors for non-E. coli and multidrug-resistant (MDR) organisms.[18]

Aligned with these findings, third-generation cephalosporins, which are commonly acceptable in community UTI, showed low susceptibility in our data, whereas amikacin, piperacillin-tazobactam, and carbapenems retained activity. This supports center-specific empiric therapy for UUTD rather than direct extrapolation from community antibiograms.[19]

The clinical implications of these findings are substantial. Early diagnosis, routine renal ultrasonography, periodic urine culture, and antibiotic selection based on local resistance profiles are essential for optimal management of pediatric patients with UUTD. A multidisciplinary approach involving pediatricians, pediatric nephrologists, pediatric urologists, and clinical microbiologists is recommended to ensure comprehensive care. Parental education regarding early infection signs and hygiene practices is equally crucial to reduce recurrence and long-term renal complications.[5,10]

CONCLUSION

This study demonstrated that pediatric patients with Upper Urinary Tract Dilatation (UUTD) at Dr. Soetomo General Hospital during 2020–2023 were most commonly in the 0–4 years age group and predominantly female. Urine culture results showed a predominance of Gram-negative bacteria, with Escherichia coli as the most frequent isolate, followed by Pseudomonas aeruginosa and Klebsiella pneumoniae. Gram-positive organisms such as Staphylococcus haemolyticus and Enterococcus faecalis were also identified, although in smaller proportions.

The distribution of bacterial isolates varied according to the underlying diagnosis and the severity of hydronephrosis. Neurogenic bladder and ureteropelvic junction obstruction (UPJO) were the most common conditions, and more severe hydronephrosis (SFU grade 4) was associated with greater bacterial diversity and higher prevalence of nosocomial and antibiotic-resistant pathogens.

Antibiotic sensitivity testing revealed that amikacin, meropenem, and piperacillin–tazobactam remained highly effective against the majority of uropathogens. In contrast, third-generation cephalosporins demonstrated relatively low sensitivity, likely reflecting the rising prevalence of extended-spectrum beta-lactamase (ESBL)–producing bacteria. These findings emphasize the need for continuous local surveillance of bacterial resistance patterns and the careful selection of empirical therapy to optimize outcomes in pediatric patients with UUTD.

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