

Evaluation of Complicated Urinary Tract Infections at a Tertiary Care Hospital in Bangladesh

Syed Fazlul Islam^{1*}, Ferdous Jahan¹, Md. Kabir Hossain¹, Rana Mokarram Hossain², Md. Rezaul Alam¹, S. M. Remin Rafi³, Md. Masudul Karim³, Mst. Romena Alam⁴, A. K. M Shahidur Rahman³

¹Associate Professor, Department of Nephrology, Bangladesh Medical University (BMU), Dhaka, Bangladesh

²Professor, Department of Nephrology, Bangladesh Medical University (BMU), Dhaka, Bangladesh

³Medical Officer, Department of Nephrology, Bangladesh Medical University (BMU), Dhaka, Bangladesh

⁴Assistant Professor, Department of Hematology, Rajshahi Medical College, Rajshahi, Bangladesh

DOI: <https://doi.org/10.36347/sjams.2025.v13i11.004>

| Received: 08.09.2025 | Accepted: 30.10.2025 | Published: 03.11.2025

*Corresponding author: Dr. Syed Fazlul Islam

Associate Professor, Department of Nephrology, Bangladesh Medical University (BMU), Dhaka, Bangladesh, Email: dr.ripon113@gmail.com

Abstract

Original Research Article

This prospective cross-sectional study was conducted at the Department of Nephrology, Bangladesh Medical University (BMU), Dhaka, Bangladesh over a period of four years from January 2020 to December 2023. A total of 1000 patients were evaluated to identify and analyze different categories of complicated urinary tract infections (cUTIs) along with their presentation, bacteriology, antibiotic sensitivity and treatment response. Their demographic profile, clinical presentations, obstructive features, co-morbidities, antibiotic sensitivity/resistant patterns and treatment responses were all documented appropriately. Their mean age was 36 ± 4 years and 54.5% were female. Most of the cUTI cases (80%) presented with dysuria followed by hematuria (35%), flank or suprapubic pain (30%) and urgency (30%). Majority patients (72%) with cUTI had neutrophilic leukocytosis, elevated C-reactive protein (CRP) had 80% study cases and bacterial colony count $>10^5$ cfu/ml. was found in 82% cases. Upper UTI was observed in 78% cases and lower UTI was in 22% patients. The major types of cUTI were acute pyelonephritis (52%) then acute complicated cystitis (12%), acute emphysematous pyelonephritis (3%), pyonephrosis (1.5%) and urosepsis (1%) were detected. Normal renal function was observed in 55% patients, remaining showed different grades of renal impairment. The most frequent anatomical abnormalities were Autosomal Dominant Polycystic Kidney Disease (ADPKD) and pelvic kidney. Various types of obstructive features were observed in the study population. Diabetes mellitus was the leading co-morbidities among patients with cUTI. Escherichia coli (E. coli) was detected as the major pathogenic bacteria in 48% cases. Among gram positive bacteria Staphylococcus aureus was detected in 6% cases. Antibigram showed Colistin, Meropenem and Tegecycline, had highest degree of antibacterial sensitivity against E-coli (85.5%). Staphylococcus aureus was sensitive to Linezolid (92%) and Vancomycin (84%). Pseudomonas was sensitive to imipenem (85%) and Amikacin (76%). Klebsiella was sensitive in 90% instance to Tazobactam and Piperacillin with Meropenem (84%), Enterococci was sensitive in 86% cases to Amoxicillin and Clavulanic acid with Levofloxacin (75%), Proteus was sensitive in 70% occasion to Meropenam, Staphylococcus saprophyticus was sensitive in 76% instance to Lenozolid with Vancomycin (64%), Group-B streptococci was sensitive in 80% instance to Meropenem and Amoxicillin with Clavulanic acid (70%) respectively. Treatment response was not uniform, the study found that a 14-days antibiotic course provided better clinical outcomes compared to a 10-days treatment.

Keywords: Antibiotic Sensitivity/Resistant Patterns, Acute pyelonephritis, Complicated Urinary Tract Infection (cUTI), Treatment Response, Obstructive Features.

Copyright © 2025 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

1. INTRODUCTION

The term "urinary tract infection" (UTI) refers to a wide range of medical conditions, from the asymptomatic presence of bacteria in the urine to severe kidney infections that ultimately progress to sepsis [1]. Complicated urinary tract infection (cUTI) is widely used for an infection that occurs in a patient with a

structural or functional abnormality of the genitourinary tract that impedes urine flow or in the presence of the underlying diseases [2]. cUTIs are infections that occur in the presence of anatomical or functional abnormalities, comorbidities, instrumentation (e.g., catheters or stents), immunosuppression, renal insufficiency, or any other obstetric conditions [3]. A

Citation: Islam SF, Jahan F, Hossain MK, Hossain RM, Alam MR, Rafi SMR, Karim MM, Alam MR, Rahman AKMS. Evaluation of Complicated Urinary Tract Infections at a Tertiary Care Hospital in Bangladesh. Sch J App Med Sci, 2025 Nov 13(11): 1817-1825.

complicated urinary tract infection (cUTI) is one that poses a higher risk of treatment failure. Urinary tract infections (UTIs) are among the most common bacterial infections globally, affecting 150 million of people each year [4]. One of the most frequent causes of sepsis in hospitalized patients is urinary tract infections (UTIs) [3]. The lifetime risk for women is estimated at 50–60%, while men have a lifetime risk of about 14% [5]. Common symptoms include dysuria, urgency, frequency, hematuria, and suprapubic pain. However, in complicated cases, systemic symptoms such as fever, chills, nausea, vomiting, and flank pain are common. In elderly individuals, atypical presentations such as confusion or delirium may occur. Which suggest that the infection has spread beyond the bladder, potentially to the kidneys. The epidemiology of cUTI is complex and dynamic. A recent systematic review estimated that cUTIs, including acute pyelonephritis and catheter-associated UTIs (CAUTIs), account for a substantial proportion of UTIs requiring hospital care globally [6]. Factors that predispose individuals to cUTI generally by causing obstruction or stasis of urine flow, facilitating entry of uropathogens into the urinary tract by bypassing normal host defense mechanisms, providing a nidus for infection that is not readily treatable with antimicrobials, or compromising the host immune system [7]. The majority of UTIs are caused by the colonization of the urogenital tract with rectal and perineal bacteria. The most prevalent organisms include *Escherichia coli*, *Enterococcus*, *Klebsiella*, *Pseudomonas*, and other *Staphylococcus* or *Enterococcus* species [8]. Of these, *Escherichia coli* remains the single most common pathogen in both uncomplicated and complicated UTIs, but in cUTIs there is a broader spectrum of pathogens and a higher prevalence of antimicrobial resistance [8]. In diabetes mellitus complicated UTI occur in form of renal and perirenal abscess, emphysematous pyelonephritis, papillary necrosis or xantho-granulomatous pyelonephritis. Urinary tract infections (UTIs) are more common in chronic kidney disease (CKD) patients than in the general population due to urinary stagnation, urine alkalization, and a lack of flushing action [9]. UTIs are significantly more common in older persons. Elderly people with CKD are especially prone to sepsis due to multiple comorbidities, frequent and prolonged hospital stays, poor immunological responses, and age-related functional deficits [10]. Uropathogen virulence determinants are less important in the pathogenesis of complicated UTIs compared with uncomplicated UTIs. However, infection with multi-drug resistant uropathogens is more likely with complicated UTI. Primary cause of urosepsis is assumed that ascending UTI from the bladder to the kidney, with resultant bacteremia [11]. Urosepsis in adults comprise approximately 25% of all sepsis cases following an episode of complicated urinary tract infection (cUTI) [12]. Gram-negative bacteria (21–54%) are most commonly associated, while gram-positive organisms are less frequently (2–15%) involved [13]. These infections often involve multidrug-resistant

organisms and are associated with higher morbidity, mortality, and healthcare costs compared to uncomplicated UTIs [13]. This study was aimed to evaluate different types of complicated urinary tract infection (cUTI) with their clinical presentation, bacteriology, antibiotic sensitivity/resistant pattern along with treatment response.

2. METHODOLOGY

This prospective observational study was conducted in the Department of Nephrology, Bangladesh Medical University (BMU), Dhaka, Bangladesh from January 2020 to December 2023. A total of 1,000 patients aged 18–80 years with complicated urinary tract infections (cUTIs) were evaluated over this four-year period to identify associated complicating factors, comorbidities, and underlying structural or functional abnormalities. Study population was enrolled following purposive sampling technique. Adult patients of both sexes with structural or functional abnormalities of the urinary tract, all stages of chronic kidney disease (CKD), renal allograft recipients, and patients on maintenance hemodialysis were included. The study excluded patients who were on antibiotic medication and subjects refused to participate. This study included only culture positive urinary tract infection cases. The following are study variables: demographic profile- age, sex; clinical variables such as- renal function status, urinary tract instrumentation, catheterization, and stenting, obstructive uropathies like renal stones, hydronephrosis (HDN), and hydroureteronephrosis (HUN). Duration of hospital stay was also recorded. Temperature, pulse, blood pressure, suprapubic, and loin tenderness were all recorded in accordance with clinical parameters. All pertinent baseline tests like- complete blood count (CBC) with erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), urine for routine microscopic examination (R/M/E), urine- culture (both aerobic and anaerobic) with sensitivity test, fungal stain, serum procalcitonin, D-dimer, serum creatinine, estimated glomerular filtration rate (eGFR), ultrasonogram (USG) of kidney, ureter, and bladder (KUB) region with prostate and MCC, and post-voidal residual urine volume were done following standard procedure. In all indicated cases: intravenous urogram (IVU), retrograde urethrogram (RGU), micturating cystourethrogram (MCU), plain X-ray KUB, non-contrast computed tomography (CT) scan of KUB, and CT urogram were performed. Patients with, complicated UTI (cUTI) and urosepsis were identified. All cUTI cases were followed up with evaluating urine microscopy on the seventh and fourteenth days following the initiation of antibiotics.

3. RESULTS AND OBSERVATIONS

The purpose of this study was to evaluate various cUTI types, the causing organisms, and the pattern of antibiotic sensitivity/resistance in relation to treatment response. A total of 1000 patients with complicated UTI were enrolled for final analysis. Of

them, 455 (45.5%) males and 545 (54.5%) females. The mean age of the study patients was 34 ± 6 years. Their age ranges from 18 years to 80 years.

Regarding clinical presentation; it was observed that, most of the UTI cases presented with dysuria

reported in 80% of cases. Other common symptoms included hematuria (35%), flank or suprapubic pain (30%), urgency (30%), and less frequently observed symptoms were cloudy urine (15%), hesitancy (10%), dribbling (10%), urinary incontinence (6%), and urinary retention (2%) (Table- 1).

Table 1: Clinical presentations of complicated UTI patients (N= 1000)

Clinical presentations*	Number (n)	Percentage (%)
Dysuria	800	80%
Hesitancy	100	10%
Cloudy urine	150	15%
Hematuria	350	35%
Urgency	300	30%
Dribbling	100	10%
Flank pain/Supra pubic pain	300	30%
Nausea/Vomiting	250	25%
Urinary retention	20	2%
Urinary incontinence	60	6%

*Multiple response

The biochemical and microbiological findings of patients with complicated UTIs are displaying in Table- 2. The most frequent abnormalities were elevated C- reactive protein [CRP (80%)], while neutrophilic leukocytosis was found in 72% cases and raised serum creatinine (32%) was also observed. Urine routine

microscopic examination of the study patients revealed presence of pus cells in the majority cases, while bacterial colony counts exceeding 10^5 cfu/mL were found in 82% of urine samples, indicating significant bacteriuria (Table- 2).

Table 2: Biochemical and microbiological parameters of the study cases

Parameters	Frequency (n)	Percentage %
Neutrophilic leucocytosis	720	72%
Raised serum creatinine	320	32%
Raised CRP	800	80%
Thrombocytopenia	30	3%
Positive blood culture	15	1.5%
Raised serum pro-calcitonin	110	11%
Mild to moderate proteinuria (1+ to 2+)	100	10%
Massive proteinuria (+++)	60	6%
Raised D-dimer	30	3%
Urine for mucus thread	15	1.5%
Urine for pus cell		
05-10 /HPF	420	42%
10-30 /HPF	390	39%
Plenty /HPF	150	15%
Bacterial colony count		
$10^2 - 10^3$ cfu/ml	70	7%
$10^3 - 10^4$ cfu/ml	110	11%
$>10^5$ cfu/ml	820	82%

Figure- 1 illustrates the distribution of anatomical location of complicated urinary tract infections (UTIs) among the study population. Upper

urinary tract infections were predominant (78%), while lower urinary tract infections accounted for 22% cases.

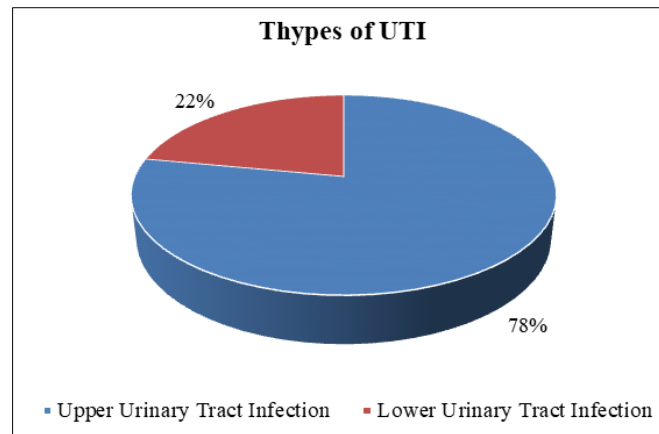


Figure 1: Types of UTI among the study population

The classification of complicated urinary tract infections (UTIs) revealed that, the most common presentation was acute pyelonephritis (52%), followed by cystitis (22%) and recurrent acute pyelonephritis (11%). Less frequent forms included emphysematous

pyelonephritis (3%), pyonephrosis (1.5%) and urosepsis (1%). This distribution indicates that upper urinary tract involvement - particularly acute pyelonephritis was the predominant pattern among complicated UTI cases (Figure- 2).

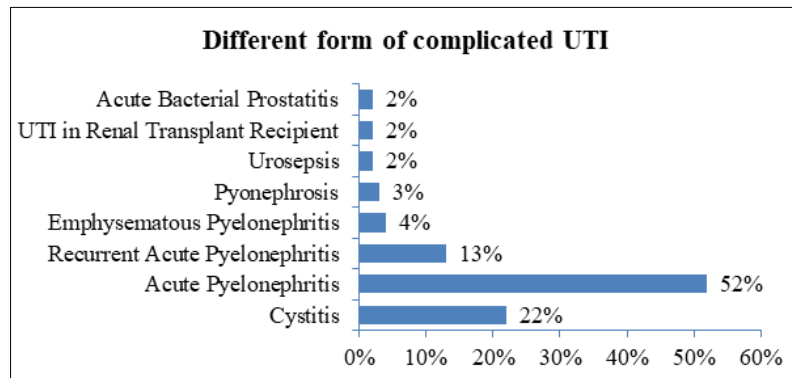


Figure 2: Different form of complicated UTI

Different anatomic and obstructive abnormalities among patients with complicated urinary tract infections were detected. The most frequent abnormalities were Autosomal Dominant Polycystic Kidney Disease (ADPKD) and pelvic kidney. Other notable findings included pelvi- ureteric junction (PUJ) obstruction (6%) and benign renal cysts (4.8%). Less

common lesions comprised bladder neck hypertrophy (1.5%), posterior urethral valves (1.2%) and horseshoe kidney (1.1%) respectively. This pattern reflects a diverse range of congenital, structural, and acquired obstructive uropathies contributing to complicated UTIs. (Table- 3)

Table 3: Different anatomical and obstructive abnormalities in complicated urinary tract infection cases

Abnormalities	Frequency (n)	Percentage (%)
Pelvi- ureteric junction (PUJ) obstruction	45	6%
Vasico ureteric junction (VUJ) obstruction	60	2%
Bladder neck hypertrophy	15	1.5%
Stricture urethra	30	3%
Posterior urethral valves	12	1.2%
Horseshoe kidney	11	1.1%
ADPKD	96	9.6%
Pelvic kidney	75	7.5%
Benign cyst	48	4.8%
Renal stone	26	2.6%
Reflux nephropathy (unilateral or bilateral)	25	2.5%
Medullary sponge kidney	06	0.6%

Abnormalities	Frequency (n)	Percentage (%)
Hypo plastic kidney	15	1.5%
Angiolipoma kidney	30	3%
Phimosi	08	0.8%
Bladder diverticulum	18	1.8%
Neurogenic bladder	20	2%
Indwelling urinary catheter	25	2.5%
Unilateral renal agenesis	10	1%
Bladder neoplasm	09	0.9%
Renal cell carcinoma	10	1%
Prolapse uterus	12	1.2%
Pelvic malignancy	08	0.8%

Among the study population, the most prevalent comorbidities were diabetes mellitus (11%), followed by secondary glomerulonephritis (GN) in 7% and primary glomerulonephritis (GN) in 6% cases. Immunosuppressive therapy (6%), bladder cancer (6%),

and steroid (4%) use were also observed in notable proportion. Less frequent but clinically relevant associations included renal cell carcinoma (1.5%), renal transplantation recipient (2%), pregnancy (1%), and indwelling D–J stents (2%) (Table- 4).

Table 4: Co- morbidities among the patients with cUTI

Co- morbidities	Frequency (n)	Percentage (%)
Diabetes mellitus	110	11%
Primary GN	60	6%
Secondary GN	70	7%
Renal cell carcinoma	15	1.5%
Immunosuppressive medication	60	6%
Steroid therapy	40	4%
Pregnancy	10	1%
Cancer Chemotherapy	30	3%
Bladder cancer	60	6%
Collagen vascular disease	45	4.5%
Renal transplant recipient	20	2%
Cortical scar	03	0.3%
D-J stent in -situ	20	2%

Analyzing the causative organisms in complicated urinary tract infections showed that, Gram-negative bacteria were the predominant pathogens, with *E. coli* (48%) being the most common isolate, followed by *Pseudomonas* (14%), *Proteus* (10%), and *Klebsiella* (8%). Among Gram-positive organisms, *Staphylococcus*

aureus (6%) and *Enterococci* (4%) were the leading isolates. This distribution indicates that *E. coli* and other Gram-negative bacteria are the major causes of complicated UTIs, with occasional involvement of Gram-positive and fungal pathogens ((Table- 5).

Table 5: Organisms responsible for complicated UTI

Organisms	Frequency (%)
Gram positive bacteria	
<i>Staphylococcus aureus</i>	6%
<i>Staphylococcus saprophyticus</i>	3%
<i>Enterococci</i>	4%
Group-B <i>Streptococcus</i>	2%
Gram negative bacteria	
<i>E. coli</i>	48%
<i>Klebsiella</i>	8%
<i>Pseudomonas</i>	14%
<i>Proteus</i>	10%
<i>Actinobacteria</i>	1.73%
Other	
<i>Candida</i>	3.33%

The patterns of renal impairment among patients with complicated urinary tract infections is depicted in Figure- 3. The majority of patients had normal renal function (55%), while acute kidney injury (AKI) in 10% cases and chronic kidney disease (CKD) in 23% patients were also observed. AKI on CKD was present in 8% cases, and patients on maintenance hemodialysis having cUTI were in 4% of study cases, indicating that a substantial proportion of patients exhibited varying degrees of renal dysfunction.

was in 23% patients were also observed. AKI on CKD was present in 8% cases, and patients on maintenance hemodialysis having cUTI were in 4% of study cases, indicating that a substantial proportion of patients exhibited varying degrees of renal dysfunction.

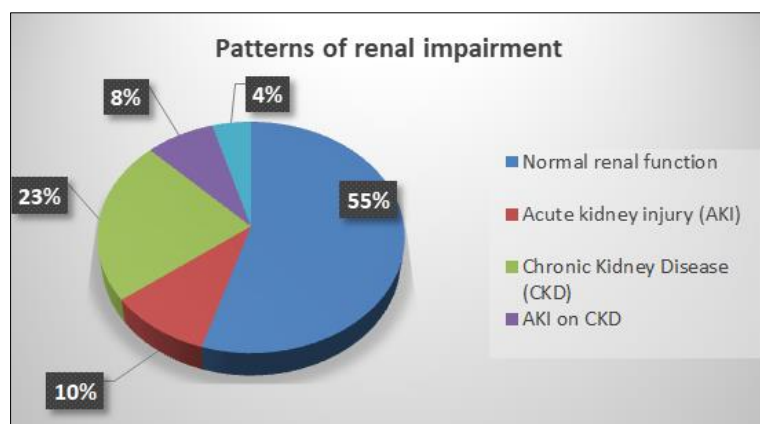


Figure 3: Patterns of renal impairment among patients with cUTI (n= 45)

Antimicrobial sensitivity pattern of isolates from complicated urinary tract infections indicated that, *E. coli* was sensitive to colistin 85.5%, meropenem around 80%. *Klebsiella* was 90% cases sensitive to Tazobactam and Piperacillin. Both *Proteus* and

Pseudomonas showed highest degree of sensitivity to Meropenem (70%). Among gram positive bacteria *Staphylococcus aureus* and *Saprophyticus* sensitive to Linezolid 76% and Vancomycin 64% respectively (Table- 6).

Table 6: Antimicrobial agents showing high bacterial sensitivity

Bacteria	Antibiotics	Sensitive %	Resistance %
<i>E.Coli</i>	Colistin	85.5%	15.5%
	Meropenem	80%	20%
	Tigecycline	65%	35%
<i>Klebsiella</i>	Tazobactam +Piperacillin	90%	10%
	Meropenem	84%	16%
	Tigecycline	86%	14%
Enterococci	Amoxicillin +Clavulenic acid	86%	14%
	levofloxacin	75%	25%
<i>Staphylococcus aureus</i>	Linezolid	92%	8%
	Vancomycin	84%	16%
	Tigecycline	90%	10%
<i>Proteus</i>	Meropenem	70%	30%
	Amikacin	64%	36%
	levofloxacin	55%	45%
<i>Pseudomonas</i>	Imipenem	85%	15%
	Amikacin	76%	24%
	Tigecycline	85%	15%
<i>Staphylococcus Saprophyticus</i>	Linezolid	76%	24%
	Vancomycin	64%	36%
Group-B Streptococci	Meropenem	80%	20%
	Amoxicillin +Clavulenic acid	70%	30%

We observed the treatment responses up to 14 days from starting treatment. The majority of patients with cystitis (n=220) and acute pyelonephritis (n=520) showed clinical improvement within 10 days, whereas those with recurrent or severe infections- such as

pyonephrosis (n=30), emphysematous pyelonephritis (n=40), UTI in renal transplant recipient (n=20) and urosepsis (n=20) required extended therapy up to 14 days. (Table- 7).

Table 7: Treatment responses 10 days versus 14 days

Category of infection	Number of patients (n)	Number of patients showing response within 10 days	Number of patients showing response within 14 days
Cystitis	220	175	45
Acute Pyelonephritis	520	410	110
Recurrent Acute Pyelonephritis	130	60	70
Acute bacterial prostatitis	20	5	15
Pyonephrosis	30	10	20
UTI in renal transplant recipient	20	6	14
Emphysematous Pyelonephritis	40	8	32
Urosepsis	20	7	13

4. DISCUSSION

Urinary tract infection (UTI) is one of the most difficult medical issues to treat. Urinary tract infections that develop in the presence of structural or functional abnormalities of the urinary tract, in any immunocompromised state, or other risk factors that raise the possibility of treatment failure or serious sequelae are referred to as complicated UTI (cUTI) [2]. The difference between complicated and uncomplicated urinary tract infections is crucial because antimicrobial resistance is more prevalent and the response to treatment is frequently unsatisfactory when complicating factors are present. The prevalence of UTI rises with age, reaching roughly 7% in women 50 years of age or older and 3.6% in males 70 years of age or older [2]. According to earlier research, the sepsis rate in cUTI patients varies from 20.8 to 32.9% based on a number of underlying conditions [14]. Treatment of complicated urinary tract infection (cUTI) is challenging for both medical specialists and nephrologists. The current study was aimed to evaluate the anatomical and functional abnormalities of the kidneys that cause complicated urinary tract infections (cUTIs). This four-year prospective cross-sectional study (January 2020–December 2023) was conducted at the Department of Nephrology, Bangladesh Medical University (BMU) Dhaka, Bangladesh, comprising 1,000 patients with complicated urinary tract infections (cUTIs).

In this cohort most of the cUTI cases (80%) presented with dysuria then common symptoms included hematuria (35%), flank or suprapubic pain (30%), urgency (30%), cloudy urine (15%), hesitancy (10%), dribbling (10%), urinary incontinence (6%), and urinary retention (2%). These findings indicate that painful and irritative urinary symptoms were predominant among patients with complicated UTIs [15]. In this study, the most common laboratory test abnormalities were high CRP (80%), neutrophilic leukocytosis (72%), and elevated serum creatinine (32%). The majority of cUTI patients had pus cells in their urine sample, and 82% had bacterial colony counts above 10^5 cfu/mL, indicating severe bacteriuria. These findings were supported by related previous studies [15, 16].

Among the study population, upper urinary tract infections were the most common (78%), with

lower urinary tract infections accounting for 22% of the study cases. This data differs from usual notion that patients with complicated UTI focused on a very particular patient population such as individuals have anomalies in the structure of their urinary tract, immunocompromised or catheterized. In this cohort, acute pyelonephritis accounted for 52% of cUTI cases, followed by cystitis (12%), recurrent acute pyelonephritis (11%), emphysematous pyelonephritis (3%), pyonephrosis (1.5%) and urosepsis (1%). According to this distribution, the most common pattern among complicated UTI cases was upper urinary tract involvement, specifically acute pyelonephritis.

The study patients with complicated UTIs were shown to have a variety of anatomical and obstructive problems. Autosomal Dominant Polycystic Kidney Disease (ADPKD) and pelvic kidney were the most common. Benign renal cysts (4.8%) and occlusion of the pelvi-ureteric junction (PUJ) (6%) were other noteworthy findings. Less frequent abnormalities included horseshoe kidney (1.1%), posterior urethral valves (1.2%), and bladder neck hypertrophy (1.5%). A wide variety of congenital, structural, and acquired obstructive uropathies that contribute to cUTIs are reflected in this pattern. Posterior urethral valves are known to cause recurrent complicated UTI in children; however, since this study included adults (18 years and older), such cases were rare. In adults, renal stone disease was the most common cause of recurrent UTI, more frequent in males than females. In our cohort, upper urinary tract infections, mainly pyelonephritis and its complicated forms, were predominant.

Diabetes mellitus (DM) was the most common comorbidity among the study population (11%), followed by secondary glomerulonephritis (7%) and primary glomerulonephritis (6%). Significant percentages of bladder cancer (6%), immunosuppressive therapy (6%), and steroid use (4%) were also noted. However, renal cell carcinoma (1.5%), renal transplant recipients (2%), pregnancy (1%), and indwelling D-J stents (2%), were less common but nonetheless clinically significant association. Overall, these findings highlight that both systemic diseases and structural renal factors play significant roles in predisposing patients to complicated UTIs [17]. Emphysematous infection and

pyonephrosis were uncommon but important, typically occurring in diabetic or immunocompromised patients [18]. Pelvi-ureteric junction (PUJ) obstruction was another important cause of recurrent UTI in children. In elderly males, conditions such as bladder diverticulum, bladder neoplasms (benign or malignant), and emphysematous prostatitis with significant post-void residual (PVR) urine were the predominant etiologies. In elderly females, genital prolapse, cervical lesions, and fibroid uterus were the major causes contributing to complicated UTIs, particularly in the presence of diabetes and other metabolic abnormalities. The substantial proportion of study patients with renal impairment (AKI, CKD, or AKI on CKD) underscores that renal dysfunction both predisposes to and is a consequence of cUTI [19].

According to the analysis of the causative organisms of cUTI; Gram-negative bacteria were the most prevalent pathogens. The most common isolate was *E. coli* (48%) followed by *Pseudomonas* (14%), *Proteus* (10%), and *Klebsiella* (8%). On the other hand, *Staphylococcus aureus* (6%) and *Enterococci* (4%) were the most common isolates among Gram-positive organisms. This distribution suggests that the primary cause of complicated UTIs is *E. coli* and other Gram-negative bacteria, with sporadic involvement of fungal and Gram-positive infections. These findings were consistent with a couple previous studies [20, 21].

In our study, *Staphylococcus aureus* showed high sensitivity to Linezolid (92%) and Vancomycin (84%), findings comparable to a study from Eastern India where all *S. aureus* isolates were fully susceptible to Linezolid and approximately 88.3% to Vancomycin [22]. *Klebsiella* species demonstrated high sensitivity to Piperacillin–Tazobactam (90%), Meropenem (84%) and Tigecycline 86%, whereas another study reported only moderate susceptibility to these agents (41.7% and 66–70%, respectively) [23]. *Staphylococcus saprophyticus* exhibited 76% sensitivity to Linezolid and 64% to Vancomycin, while *Enterococcus* species were 86% sensitive to Amoxicillin–Clavulanic acid and Levofloxacin (84%). Similar reports from southeastern Bangladesh, *E. coli* in our study remained largely sensitive to Carbapenems (e.g., Meropenem, Imipenem) and Amikacin, though resistance to first-line agents was widespread [24]. However, the risk-benefit balance (antibiotic toxicity, resistance development and cost) must be weighed. Most of the bacteria of *Staphylococcus* is sensitive to Linezolid, Vancomycin, Tezobactam and piperacillin. Multiple regional reviews and hospital series consistently report *E. coli* as leading (often 40–60% or higher of isolates) cause in both community and many complicated UTI; but with a larger share of non-*E. coli* Gram-negatives (*Klebsiella*, *Pseudomonas*) in hospital/complicated infections were also reported [2]. Linezolid and Vancomycin showed high efficacy against gram-positive organisms (92% and 84%); while Colistin, Meropenem, and Piperacillin–Tazobactam remained

effective against gram-negative bacteria. However, multidrug resistance was notable, emphasizing the need for rational use of antibiotics. Our study also showed that a 14-day treatment course yielded better than 10 days treatment. Certain guidelines support longer duration of treatment for cUTI, especially in the presence of renal involvement or complicating factors [25].

5. CONCLUSION

Complicated urinary tract infections are common and often associated with structural abnormalities, diabetes or renal impairment. *E. coli* remains the predominant pathogen, showing high sensitivity to Colistin and Meropenem. Early diagnosis, appropriate antibiotic selection based on culture sensitivity, and management of underlying causes are essential for successful outcomes. A 14-day antibiotic regimen is more effective than a 10-day course in treating complicated urinary tract infections.

Limitations of the Study

This study was done in only one Hospital. Therefore, results from this study are not a country representative finding. Urine culture and related investigations were done in different centers so uniformity was not maintained. Moreover, categorization of urinary tract infection was not adequately classified because of vague presentation.

Conflicts of Interest: The authors declared no conflict of interest regarding this publication.

REFERENCES

1. Al Lawati H, Blair BM, Larnard J. Urinary tract infections: core curriculum 2024. *American Journal of Kidney Diseases*. 2024 Jan 1;83(1):90-100.
2. Melekos MD, Naber KG. Complicated urinary tract infections. *International journal of antimicrobial agents*. 2000 Aug 1;15(4):247-56.
3. Sabih A, Leslie SW. Complicated Urinary Tract Infections. In: StatPearls. StatPearls Publishing, Treasure Island (FL); 2025. PMID: 28613784.
4. Stamm WE, Norrby SR. Urinary tract infections: disease panorama and challenges. *The Journal of infectious diseases*. 2001 Mar 1;183(Supplement_1):S1-4.
5. Kwok M, McGeorge S, Mayer-Coverdale J, Graves B, Paterson DL, Harris PN, Esler R, Dowling C, Britton S, Roberts MJ. Guideline of guidelines: management of recurrent urinary tract infections in women. *BJU international*. 2022 Nov;130:11-22.
6. Broughton E, Bektas M, Colosia A, Kuper K, Fernandez MM, Al-Taie A, Kotb R. A Systematic Literature Review of the Epidemiology of Complicated Urinary Tract Infection. *Infectious Diseases and Therapy*. 2025 Apr 24:1-25.
7. Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options.

- Nature reviews microbiology. 2015 May;13(5):269-84.
8. Lodise TP, Chopra T, Nathanson BH, Sulham K, Rodriguez M. Epidemiology of complicated urinary tract infections due to Enterobacterales among adult patients presenting in emergency departments across the United States. In Open Forum Infectious Diseases. Oxford University Press. 2022 Jul 1; 9(7):315.
 9. Swartz S, Kolinski J, Hadjiev J, Chou E, Malone C, Zhang J, Yan K, Havens P. Urinary tract infection in young infants: practice patterns in evaluation and treatment. Hospital Pediatrics. 2020 Sep 1;10(9):792-6.
 10. Tang Y, Jiang J, Zhao Y, Du D. Aging and chronic kidney disease: epidemiology, therapy, management and the role of immunity. Clinical Kidney Journal. 2024 Sep;17(9):sfae235.
 11. Dimitrijevic Z, Paunovic G, Tasic D, Mitic B, Basic D. Risk factors for urosepsis in chronic kidney disease patients with urinary tract infections. Scientific reports. 2021 Jul 13;11(1):14414.
 12. Petrosillo N, Granata G, Boyle B, Doyle MM, Pinchera B, Taglietti F. Preventing sepsis development in complicated urinary tract infections. Expert Review of Anti-infective Therapy. 2020 Jan 2;18(1):47-61.
 13. Mazzariol A, Bazaj A, Cornaglia G. Multi-drug-resistant Gram-negative bacteria causing urinary tract infections: a review. Journal of chemotherapy. 2017 Dec 22;29(sup1):2-9.
 14. Dreger NM, Degener S, Ahmad-Nejad P, Wöbker G, Roth S. Urosepsis—etiology, diagnosis, and treatment. Deutsches Ärzteblatt International. 2015 Dec;112(49):837.
 15. Hertz MA, Skjöt-Arkil H, Heltborg A, Lorentzen MH, Cartuliales MB, Rosenvinge FS, Nielsen SL, Mogensen CB, Johansen IS. Clinical characteristics, factors associated with urinary tract infection and outcome in acutely admitted patients with infection; an exploratory cross-sectional cohort study. Heliyon. 2024 Jun 30;10(12): e32815.
 16. Wirth M, Suda KJ, Burns SP, Weaver FM, Collins E, Safdar N, Kartje R, Evans CT, Fitzpatrick MA. Retrospective cohort study of patient-reported urinary tract infection signs and symptoms among individuals with neurogenic bladder. American journal of physical medicine & rehabilitation. 2023 Aug 1;102(8):663-9.
 17. Lodise TP, Manjelievskaia J, Marchlewicz EH, Rodriguez M. Retrospective cohort study of the 12-month epidemiology, treatment patterns, outcomes, and health care costs among adult patients with complicated urinary tract infections. In Open Forum Infectious Diseases. Oxford University Press. 2022 Jul 1; 9(7):307.
 18. Gupta K, Hooton T. Acute complicated urinary tract infection (including pyelonephritis) in adults. UpToDate. Calderwood SB, Bloom A, eds. Wolters Kluwer: Waltham, MA. 2022.
 19. Yeh TH, Tu KC, Wang HY, Chen JY. From acute to chronic: unraveling the pathophysiological mechanisms of the progression from acute kidney injury to acute kidney disease to chronic kidney disease. International journal of molecular sciences. 2024 Feb 1;25(3):1755.
 20. Islam SF, Hossain MK, Jahan F, Faroque MO, Ahmed AH, Mojumder MM, Salahuddin M, Morshed SM, Hossain RM, Islam SM, Salam MA. Evaluation of Patients having Urinary Tract Infection with Antibiotic Sensitivity and Resistance Pattern at a Tertiary Care Hospital in Bangladesh. Sch J App Med Sci. 2025 Jan;1:120-9.
 21. Yi-Te C, Shigemura K, Nishimoto K, Yamada N, Kitagawa K, Sung SY, Chen KC, Fujisawa M. Urinary tract infection pathogens and antimicrobial susceptibilities in Kobe, Japan and Taipei, Taiwan: an international analysis. Journal of International Medical Research. 2020 Oct;48(2):0300060519867826.
 22. Mohanty S, Behera B, Sahu S, Praharaj AK. Recent pattern of antibiotic resistance in Staphylococcus aureus clinical isolates in Eastern India and the emergence of reduced susceptibility to vancomycin. Journal of Laboratory Physicians. 2019 Oct;11(04):340-5.
 23. Anwar S, Ahmed SA, Nigar I, Khan RR, Setu SK, Sattar AN, Roy CK, Ahmed S, Saleh AA. Analysis of the current Bacteriological Profile and Antibiotic Susceptibility Patterns of Organisms Isolated from Aural Swabs in a Tertiary Care Hospital in Dhaka, Bangladesh. Fortune Journal of Health Sciences. 2024;7(4).
 24. Sultana KF, Akter A, Saha SR, Ahmed F, Alam S, Jafar T, Saha O. Bacterial profile, antimicrobial resistance, and molecular detection of ESBL and quinolone resistance gene of uropathogens causing urinary tract infection in the southeastern part of Bangladesh. Brazilian Journal of Microbiology. 2023 Jun;54(2):803-15.
 25. Ramakrishnan K, Scheid DC. Diagnosis and management of acute pyelonephritis in adults. American family physician. 2005 Mar 1;71(5):933-42.