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Pattern of Organisms and their Sensitivity to Antibiotics in Patients Suffering from Urinary Tract Infections

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Abstract **Original Research Article**

Background*:** Urinary Tract Infections (UTIs) are among the most common infections affecting patients in both community and hospital settings. The rising trend of antimicrobial resistance among uropathogens has become a major concern, particularly in developing countries like Bangladesh, where empirical treatment often precedes microbiological confirmation. ***Objective: To identify the predominant microbial organisms responsible for UTIs and evaluate their antimicrobial susceptibility patterns among patients admitted to a tertiary medical college hospital in Bangladesh. ***Methods:*** This cross-sectional study was conducted from January 2023 to December 2024 at Tertiary Medical College Hospital, Bangladesh. A total of 100 urine samples were collected from patients clinically diagnosed with UTI. Standard microbiological techniques were used to isolate and identify organisms. Antibiotic susceptibility testing was performed using the Kirby-Bauer disk diffusion method in accordance with CLSI guidelines. Data were analyzed using SPSS version 25. ***Results:*** Out of 100 samples, 84 showed significant bacterial growth. *Escherichia coli* was the most prevalent isolate (62%), followed by *Klebsiella pneumoniae* (14%), *Enterococcus faecalis* (9%), *Pseudomonas aeruginosa* (7%), and *Proteus mirabilis* (4%). E. coli isolates demonstrated high sensitivity to nitrofurantoin (85%) and fosfomycin (78%) but showed marked resistance to ciprofloxacin (68%) and ampicillin (74%). Multidrug resistance was observed in 41% of isolates. ***Conclusion:*** E. coli is still the most common cause of UTIs, but the fact that it is becoming more resistant to antibiotics is worrying. Empirical antibiotic therapy must be guided by local antibiograms to improve treatment outcomes and reduce resistance trends. Continuous surveillance and rational antibiotic use are crucial in managing UTIs effectively in Bangladesh.

Keywords: Urinary tract infection, antimicrobial resistance, uropathogens, antibiotic sensitivity.

INTRODUCTION

Urinary Tract Infections (UTIs) remain one of the most prevalent bacterial infections affecting individuals across all age groups, with a higher incidence in females due to anatomical and physiological factors. Globally, UTIs account for millions of physician visits and hospital admissions annually, placing a significant burden on hsealthcare systems [1]. UTIs are one of the most common reasons for empirical antibiotic prescriptions in Bangladesh, especially in outpatient and emergency settings [2].

The etiological agents of UTIs are predominantly Gram-negative bacilli, with *Escherichia coli* being the most frequent pathogen, followed by *Klebsiella pneumoniae*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, and *Enterococcus* species [3]. The spectrum of uropathogens may vary based on geographical location, patient demographics, comorbidities, and healthcare practices [4]. Additionally, the increasing prevalence of antibiotic-resistant strains has significantly complicated the management of UTIs [5].

Antimicrobial resistance (AMR) is becoming a global public health problem. Organisms that make

extended-spectrum beta-lactamase (ESBL) and strains that are resistant to multiple drugs (MDR) are becoming more widespread [6]. In many cases, clinicians initiate empirical therapy before culture reports are available, often leading to inappropriate use of broad-spectrum antibiotics, which further accelerates resistance [7]. This practice is especially concerning in low- and middle-income countries where access to diagnostic microbiology is limited and stewardship practices are still evolving [8].

The inappropriate and excessive use of antibiotics has led to an alarming trend of resistance among uropathogens in Bangladesh [9]. Without timely intervention through updated surveillance and appropriate prescribing guidelines, the effectiveness of available antibiotics may diminish further, leading to increased morbidity, hospital stays, and healthcare costs [10].

Emerging resistance to first-line agents such as ciprofloxacin, ampicillin, and trimethoprim-sulfamethoxazole has left clinicians with limited therapeutic options [11]. The growing resistance also affects the outcomes of hospitalized patients, particularly those with catheter-associated urinary tract infections (CAUTIs), who are at increased risk of treatment failure and sepsis [12]. Furthermore, regional variations in susceptibility patterns necessitate regular local antibiogram updates to guide empirical therapy more effectively [13].

Previous studies conducted in other South Asian countries have also reported a sharp rise in resistant strains, emphasizing the need for country-specific data to implement targeted interventions [14]. The problem is compounded by the over-the-counter availability of antibiotics and lack of public awareness, which further fuels inappropriate self-medication practices [15]. Strengthening microbiological surveillance and antibiotic stewardship programs within tertiary care hospitals is, therefore, essential.

It is very important to know the local microbial patterns and how sensitive they are in order to guide efficient empirical therapy and avoid problems. Therefore, this study aims to determine the current pattern of organisms causing UTIs and evaluate their antibiotic susceptibility in patients attending a tertiary medical college hospital in Bangladesh.

OBJECTIVE

The objective of this study was to determine the pattern of organisms responsible for urinary tract infections (UTIs) and to evaluate their antimicrobial sensitivity profiles among patients admitted to a tertiary medical college hospital in Bangladesh.

METHODOLOGY

Study Design and Duration

This was a cross-sectional observational study conducted over a two-year period from January 2023 to December 2024.

Study Location

The study was carried out in the Department of Gynecology and inpatient medicine wards of a Tertiary Medical College Hospital in Bangladesh.

Study Population

Patients of all age groups and both sexes, clinically diagnosed with UTIs and admitted to the hospital, were considered eligible. Individuals who had received antibiotic treatment within 72 hours prior to urine collection or those with incomplete clinical data were excluded from the study.

Sample Size

A total of 100 urine samples were collected and analyzed during the study period.

Specimen Collection and Processing

Midstream, clean-catch urine samples were obtained from all participants following standard aseptic precautions. In cases of catheterized patients, samples were collected directly from the catheter port using sterile techniques. All specimens were immediately transported to the microbiology laboratory and cultured on Cystine Lactose Electrolyte Deficient (CLED) agar and MacConkey agar.

Identification of Organisms

Bacterial isolates were identified by standard microbiological procedures, including colony morphology, Gram staining, and biochemical tests such as TSI, citrate utilization, urease, indole, oxidase, and catalase tests.

Antibiotic Sensitivity Testing

Following the Clinical and Laboratory Standards Institute (CLSI) 2022 standards, the Kirby-Bauer disc diffusion method was used on Mueller-Hinton agar to test for antimicrobial susceptibility. Some of the antibiotics that were evaluated were ampicillin, ciprofloxacin, nitrofurantoin, ceftriaxone, cefotaxime, imipenem, fosfomycin, and cotrimoxazole.

Data Analysis

The results were compiled and analyzed using SPSS version [25]. Descriptive statistics were used to summarize the frequency and distribution of bacterial isolates and their antibiotic resistance patterns. Multidrug resistance (MDR) was defined as resistance to at least one agent in three or more antimicrobial categories.

RESULTS

A total of 100 urine samples from clinically diagnosed UTI patients were processed during the study period. Among them, 84 samples (84%) showed significant bacterial growth, while 16 samples yielded either no growth or mixed flora not suitable for analysis. The findings are described below in tabular form.

Table 1: Demographic Distribution of UTI Patients (n=100)

Variables	Number (n)	Percentage (%)
Age Group (years)		
0–18	10	10%
19–40	32	32%
41–60	38	38%
>60	20	20%
Sex		
Male	38	38%
Female	62	62%

This table shows that the majority of UTI cases occurred in the 41–60 age group, with females comprising 62% of the study population. The data reinforces the known higher susceptibility of women to UTIs due to anatomical and physiological factors.

Table 2: Frequency of Isolated Organisms from Positive Cultures (n=84)

Organism	Number (n)	Percentage (%)
Escherichia coli	52	62%
Klebsiella pneumoniae	12	14%
Enterococcus faecalis	8	9%
Pseudomonas aeruginosa	6	7%
Proteus mirabilis	4	5%
Others	2	3%

This table shows that E. coli was the most frequently isolated organism (62%), followed by *K. pneumoniae* and *E. faecalis*, indicating a predominance of Gram-negative organisms.

Table 3: Antibiotic Sensitivity Pattern of *E. coli* (n=52)

Antibiotic	Sensitive (n)	Sensitivity (%)
Nitrofurantoin	44	85%
Fosfomycin	41	78%
Ciprofloxacin	17	32%
Ampicillin	13	25%
Ceftriaxone	29	56%
Imipenem	48	92%

This table highlights that *E. coli* was most sensitive to imipenem (92%) and nitrofurantoin (85%), while it showed notable resistance to ampicillin and ciprofloxacin. These findings underline the reduced efficacy of commonly used oral antibiotics and the need for updated empirical therapy guidelines.

Table 4: Multidrug Resistance (MDR) Among Isolated Organisms (n=84)

Organism	MDR Isolates (n)	Percentage (%)
E. coli	21	40.4%
Klebsiella pneumoniae	5	41.7%
Pseudomonas aeruginosa	4	66.7%
Enterococcus faecalis	2	25.0%
Proteus mirabilis	1	25.0%

A significant proportion of the isolates, particularly *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*, demonstrated multidrug resistance. This suggests growing antimicrobial resistance among common uropathogens, posing challenges to effective treatment.

Table 5: Empirical Antibiotic Use Before Hospital Admission (n=100)

Antibiotic Used	Patients (n)	Percentage (%)
Ciprofloxacin	38	38%
Cefixime	21	21%
Nitrofurantoin	12	12%
Azithromycin	9	9%
Unknown/No antibiotics	20	20%

Most patients had taken antibiotics like ciprofloxacin or cefixime prior to hospitalization. This trend may contribute to the high resistance observed and highlights the need for stricter antibiotic stewardship and public education on appropriate antibiotic use.

DISCUSSION

The current study gives crucial insights into the microbial patterns and drug sensitivity profiles among UTI patients hospitalized to a tertiary medical institution in Bangladesh. The predominance of Escherichia coli (62%) as the causative organism aligns with findings from both national and international studies, where E. coli consistently emerges as the leading uropathogen in both community- and hospital-acquired infections [16]. The higher prevalence among females (62%) in our study reflects well-documented anatomical factors such as shorter urethral length and proximity to the anus, which facilitate easier bacterial ascent into the urinary tract [17].

A concerning aspect revealed by this study is the high degree of antimicrobial resistance among the isolated pathogens. Over 40% of E. coli isolates were multidrug-resistant (MDR), similar to trends seen in other developing countries facing unregulated antibiotic usage and limited stewardship programs [18]. Pseudomonas aeruginosa showed the highest MDR rate (66.7%), consistent with its intrinsic resistance mechanisms and environmental adaptability [19]. The emergence of MDR strains significantly reduces treatment options and increases the risk of complications such as pyelonephritis and urosepsis [20].

Nitrofurantoin and imipenem emerged as the most effective antibiotics against E. coli in this study, with sensitivities of 85% and 92%, respectively. This finding is comparable with previous reports from tertiary hospitals in India and Pakistan, which also showed high efficacy of nitrofurantoin and carbapenems in complicated UTIs [21]. Conversely, resistance to ciprofloxacin and ampicillin was alarmingly high, possibly due to their widespread empirical use prior to culture sensitivity testing [22].

The empirical use of antibiotics, especially ciprofloxacin (used by 38% of patients before hospital admission), further emphasizes the need for a region-specific antibiogram to guide first-line treatment and avoid unnecessary exposure to ineffective antibiotics [23]. The lack of public awareness and ease of over-the-counter antibiotic access in Bangladesh are key contributors to this rising resistance [24]. National policy reforms, including prescription-only antibiotic sales and community-level education, are essential to curb this trend [25].

Another critical observation was the increased resistance in Klebsiella pneumoniae and Pseudomonas aeruginosa, both of which are notorious for harboring ESBL and carbapenemase genes [26]. These resistance mechanisms are not only difficult to treat but also capable of horizontal gene transfer, posing a broader public health threat [27]. Strict infection control practices and isolation protocols in hospitals are necessary to prevent cross-transmission of such strains.

This study also underscores the importance of continuous surveillance. The susceptibility patterns observed differed slightly from those reported in previous years, which reflects the dynamic nature of antimicrobial resistance. Without real-time monitoring and data dissemination, empirical therapy is likely to remain outdated and ineffective.

The strength of this study lies in its microbiological rigor and the representation of a real-world inpatient population. However, it is limited by its single-center design and relatively small sample size, which may not reflect broader national trends. Further multicenter research with larger cohorts is recommended to validate these findings and shape national treatment guidelines.

CONCLUSION

This study reveals that *E. coli* is the predominant uropathogen in hospitalized UTI patients in a tertiary care setting in Bangladesh. High resistance to commonly used antibiotics like ciprofloxacin and ampicillin was observed, while nitrofurantoin and imipenem remained effective. The presence of multidrug-resistant organisms highlights the urgent need for updated local treatment guidelines and effective antibiotic stewardship programs. Additionally, public education and stricter control over antibiotic dispensing are essential steps toward curbing antimicrobial resistance and improving patient outcomes.

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