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Antibiotic Resistance and Sensitivity Patterns among UTI Patients in a Tertiary Care Hospital

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Abstract **Original Research Article**

Background: Urinary tract infections (UTIs) are among the most common bacterial infections worldwide, with Escherichia coli as the leading causative agent. Rising antimicrobial resistance complicates empirical therapy, particularly in low- and middle-income countries (LMICs). This study aimed to determine the prevalence of uropathogens and their antibiotic resistance and sensitivity patterns in patients with culture-confirmed UTIs at a tertiary care hospital in Bangladesh. ***Methods:*** This cross-sectional observational study included 100 patients diagnosed with UTIs at Comilla Medical College Hospital from January to June 2018. Midstream urine samples were cultured, and the isolates were identified using standard microbiological methods. Antibiotic susceptibility was tested using the disc diffusion method, and the results were interpreted according to the CLSI guidelines. ***Results:*** Escherichia coli was the most commonly isolated organism (86%), followed by Klebsiella spp. (9%) and Enterococcus spp. (5%). Carbapenems showed the highest sensitivity (imipenem, 100%; meropenem, 96%), followed by amikacin (92%), tazobactam (99%), and nitrofurantoin (88%). Resistance was highest for ceftriaxone (55%), ciprofloxacin (48%), cotrimoxazole (47%), and ceftazidime (47%); however, carbapenem resistance was low (1–4%). ***Conclusion:*** Carbapenems and aminoglycosides remain highly effective for UTIs in this setting; however, resistance to commonly prescribed antibiotics is alarmingly high. Empirical treatment protocols should be revised based on the updated local antibiograms.

Keywords: urinary tract infection, antimicrobial resistance, Escherichia coli, carbapenems, antibiotic sensitivity.

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INTRODUCTION

Urinary tract infections (UTIs) are the most common bacterial infections in the world and can occur across all age and sex groups, with the burden being disproportionately among women because of anatomy and physiological factors [1]. They constitute a great source of morbidity, which results in repeated prevalence of illness, low quality of life, as well as high medical costs [2]. UTIs are a major cause of empirical antibiotic prescriptions in community-based and hospital environments.

The most common causative agent is *Escherichia coli*, which causes most community-based infections and a significant number of hospital-acquired infections [3]. *Klebsiella pneumonia*, *Enterococcus spp.*, Proteus mirabilis, and others are other pathogens of clinical interest, and their prevalence differs depending on location, patient type, and care facility [4]. UTI management has grown complex over the past few decades because of the explosive spread of antimicrobial resistance.

There have been growing reports of resistance to widely used antibiotics- like trimethoprim-sulfamethoxazole, fluoroquinolones and third-generation cephalosporins- making routine empirical regimens less effective [5]. Of special interest is the development of extended-spectrum β-lactamase (ESBL)-producing enterobacteria, which are multidrug resistant with few treatment options remaining available [6]. Possible factors underlying these are pervasive empirical prescribing with no confirmation of the culture, the accessibility of antibiotics that are self-prescribed over the counter, and the absence of excellent antimicrobial stewardship in much of the remaining low- and middle-income countries [7].

UTIs in both urban and rural areas are not uncommon in Bangladesh, with the use of empirical therapy widespread in the country. Nevertheless, dominant resistance to important agents that include ciprofloxacin, ceftriaxone, and cotrimoxazole is on the increase as observed in several hospital-related studies [8]. Associated with the lack of more localized up-to-date susceptibility data, there is a very real risk of key clinicians using outdated trends of resistance, risking failure of treatment and promotion of resistance development.

Most surveillance studies in the region focus on large urban tertiary hospitals, which may not reflect the broader population or smaller hospital settings. Additionally, there is limited literature on the resistance and sensitivity patterns to last-resort antibiotics such as carbapenems and aminoglycosides, which are increasingly used in complicated or recurrent infections [9]. Understanding current resistance trends in these agents is crucial for preserving their effectiveness.

This study aims to fill these gaps by determining the distribution of uropathogens and their resistance and sensitivity patterns in patients with culture-confirmed UTIs at a tertiary care hospital in Bangladesh. The findings will provide evidence to guide empirical therapy, contribute to the development of hospital antibiotic policies, and help anticipate emerging resistance threats in the local setting.

METHODOLOGY & MATERIALS

This cross-sectional observational study conducted among the indoor and outdoor patient in the Department of Medicine, Comilla Medical College Hospital (CoMCH), from 1st January’2018 to 30th June ’2018. A total of 100 patients with UTI (fever, frequency of micturition, dysuria, and suprapubic pain), urine R/M/E showing pus cells >10/HPF, and urine culture showing a colony count of ≥ 10^5 CFU/ml were included in this study.

Selection Criteria:

Inclusion Criteria:

- All patients fulfilling the criteria of UTI (dysuria, frequency, fever and pain in lower abdomen)
- Age > 12 years
- Both sexes
- Urine culture positive for bacteria and/or urine for R/M/E –plus cell>10/HPF
- Those who are agree to take part in this study.

Exclusion Criteria:

- Age below 12 years.
- Those who refuse to take part in this study
- Those patients were on antibiotic advised to were excluded from this study
- Patients presented with active menstruation, PID, tube-ovarian diseases, appendicitis, colitis, severe other infections e.g. sepsis

Data Collection and Study Procedure:

Adult patients with UTI features were selected according to the selection criteria. Convenience sampling was used to enroll 100 participants. After describing the purpose, methods, and benefits, written consent was obtained from each patient. All patients underwent a detailed history, clinical examination, and relevant investigations.

Freshly voided midstream clean-catch urine samples were collected from patients in sterile screw-capped universal containers. Specimens were labelled and transported to the microbiology laboratory for processing within half an hour of collection. A modified semi-quantitative technique using a standard calibrated bacteriological loop transferred 0.001 ml of sample on blood agar and MacConkey agar media. After urine absorption into agar, the plates were inverted and incubated aerobically at 37°C for 24 h. The plates were examined macroscopically for bacterial growth. Colony counts were performed using a semi-quantitative method. The number of colonies obtained was multiplied by 1000 to obtain colony-forming units (cfu)/ml 15. Growth was considered significant if the colony number was >105 colony-forming units (CFU)/ml. The colonial appearance and morphological characteristics of the isolated bacteria were noted, and Gram staining was performed for identification. The characteristic bacteria were aseptically isolated from the samples. Antimicrobial sensitivity tests were performed using the disc diffusion technique with Muller-Hinton Agar. Results were expressed as sensitive or resistant based on the size of the zone of inhibition. The antibiotics used for susceptibility testing were meropenem and imipenem, including amoxycillin, amoxyclav, cefotaxime, ceftriaxone, cephalexin, nalidixic acid, nitrofurantoin, mecillinum, amikacin, cefixime, ceftazidime, cefuroxime, cephradine ciprofloxacin cotrimoxazole, gentamycin, tazobactum.

Statistical Data Analysis:

Data analysis was performed by using SPSS version 19.0. Student t-test will be done to compare the groups. P values <0.5 will be considered as significant.

Ethical Consideration:

The study was approved by the ethical review committee of Comilla Medical College Hospital, and the Helsinki Declaration was followed throughout the entire research process. Informed consent was obtained from all participants after explaining the study's purpose in Bangla. Participants were informed that their involvement was voluntary and that they could withdraw at any time without consequences. All personal and medical information was kept strictly confidential to ensure privacy.

RESULTS

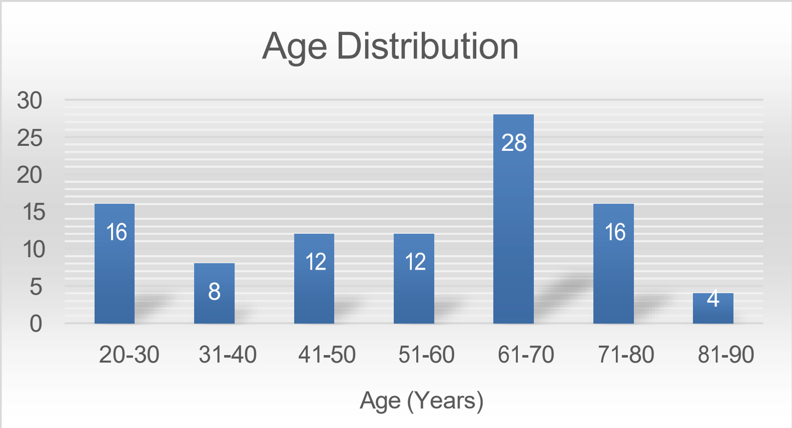

Figure 1: Age Distribution of the Study Population (n=100)

Figure 1 shows the age distribution of the study patients. From this table, it is seen that 28% patients in the study population were in the age group of 61-70 years, followed by 16% in the age group of 20-30 years and 71-80 years. Only 4% were in the age group of 81-90 years.

Table I: Distribution of Bacterial Pathogen Among the Study Patients (n=100)

Pathogen	Male (%)	Female (%)	Total
E. coli	35	51	86
Klebsiella	2	7	9
Enterococcus	1	4	5
Total	38	62	100

Table I shows the distribution of uropathogens among the study patients. Culture report of urine samples shows the most common pathogen is *E. coli*, which was found in 86% of the study patients. It was also observed that *Klebsiella* and *Enterococci* were isolated from 9% and 5% of the urine samples, respectively. It can also be noted that the maximum number of isolates was distributed among the females. The number of isolates from urine samples of females was statistically ($p<0.05$) higher than that of males.

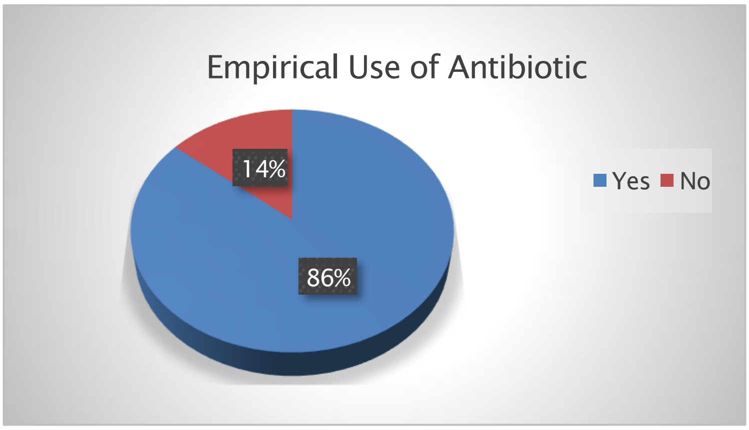

Figure 2: Empirical Use of Antibiotics by the Study Population

Figure 2 shows that about 10% persons were treated with antimicrobials before inclusion in the study. However, majority (90%) of them were not treated before the culture and sensitivity.

Table II: Antibiotic Resistant Pattern Among the UTI Patients (n=100)

Antibiotics	Resistance (%)	Total (%)
Imipenum	1	100
Meropenum	4	100
Amicacin	8	100
Tazobactum	1	100
Gentamycin	10	100
Nitrofurantine	12	100
Mecillium	12	100
Colistin	16	100
Ceftazidim	47	100
Cotrimazole	47	100
Ciprofloxacin	48	100
Ceftriaxon	55	100

Table II shows the antibiotic resistance pattern of the study patients. It is seen from the table that imipenem and meropenem resistance were found in 1% and 4% of the study patients, respectively. It can also be observed that a high degree of resistance against commonly used antibiotics- ceftazidime, cotrimazole, ciprofloxacin, and Ceftriaxone was found. In vitro resistance of the isolates to these antibiotics varied from 47% to 55%.

Table III: Antibiotic Sensitivity Pattern Among the UTI Patients (n=100)

Antibiotics	Sensitivity (%)	Total (%)
Imipenum	99	100
Meropenum	96	100
Amicacin	92	100
Tazobactum	99	100
Gentamycin	90	100
Nitrofurantine	88	100
Mecillium	88	100
Colistin	84	100
Ceftazidim	53	100
Cotrimazole	53	100
Ciprofloxacin	52	100
Ceftriaxon	45	100

Table III shows the antibiotic sensitivity pattern of the study patients. From this table, it is seen that Carbapenems that include imipenems (99.5%), meropenum (96%) were more sensitive for UTI patients than others. It was also noted that amikacin, tazobactum, gentamycin, nitrofurantoin, and mecillinum were found to be highly effective antibiotics against most of the uropathogens.

DISCUSSION

This cross-sectional observational study conducted among 100 patients in the Department of Medicine, Comilla Medical College Hospital, provides valuable insights into the demographic distribution, pathogen prevalence, and antibiotic resistance patterns among UTI patients. The age distribution revealed that the largest proportion of patients (28%) were aged 61–70 years, followed by 16% each in the 20–30 years and 71–80 years groups, and only 4% in the 81–90 years group. Ferede *et al.,* similarly reported that elderly patients are at increased risk for developing UTIs and exhibiting higher levels of antibiotic resistance [10]. They attributed this to factors such as weakened immunity, comorbidities like diabetes, and age-related genitourinary changes. The agreement between these studies and our findings reinforces the role of age as a significant determinant of UTI risk.

In our study, the predominant microbiological finding revealed that *Escherichia coli* was the nosocomial pathogen with the highest isolation at 86%, followed by members of *Klebsiella spp.* spp. (9%) and *Enterococcus spp.* (5%). Our findings were also supported by Prakash and Saxena and Saleh *et al.,* in which *E. coli* was underscored as the most frequent source of UTIs [3,11]. The *E. coli* prevalence in our microbiology samples was, however, significantly higher than the 75 percent reported by Majumder *et al.,* in a comparable hospital laboratory in Bangladesh [8].

This discrepancy might be attributed to differences in the periods of studies, antibiotic control measures or excessive usage of broad-spectrum antibiotics, which selectively stimulate the survival of *E. coli*.

Regarding antimicrobial susceptibility, we found that the most sensitive agents against uropathogens were carbapenems, and, especially, imipenem (100% sensitivity) and meropenem (96% sensitivity). Goodman *et al.,* performed a retrospective cohort study of 40,137 patients in 175 US hospitals who had culture-positive UTIs, with overall carbapenem resistance in just 3.1% of instances, similar to our experience with low resistance rates [12]. High carbapenem effectiveness was also reported in rural Tamil Nadu, India, where infection occurred in multidrug-resistant *E. coli* by Arjunan *et al.,*[13].

This study also indicated high activity of amikacin (92%), tazobactam (99%), gentamicin (90%), nitrofurantoin (88%) and mecillinum (88%). The findings correspond with Prais *et al.,* who discovered that nitrofurantoin and aminoglycosides have a role in treating community-acquired UTIs in pediatrics and adults [14]. These drugs may be empirically used in the right clinical situations, especially nitrofurantoin in uncomplicated one, since these drugs retain their sensitivity.

Although these positive results were encouraging, resistance levels were very concerning among some of the more popular empirical agents used: ceftriaxone (55%), ciprofloxacin (48%), cotrimoxazole (47%), and ceftazidime (47%). These tendencies were found by Kashef *et al.,* who mentioned an increase in resistance to fluoroqunolones and the third-generation cephalosporins in community-acquired UTIs [5]. This presents a very high challenge because most of these agents are still in use in most clinical stations, mostly non-culture confirmed.

After making comparisons between our rates of resistance against carbapenem and those of other studies, we discovered them to be significantly lower. Senewiratne *et al.,* found that 7.6 percent of *E. coli* isolates from hospitalized patients were resistant to carbapenem which all of which were multidrug resistant [15]. Probably, the variations in the resistance rates could be explained by different antibiotic prescription patterns, local pathogen epidemiology, and infection control measures.

The findings also reflect the global worry of multidrug-resistant *Klebsiella* species that often acquires plasmid-mediated resistance genes at an exceptionally swift rate. This feature was pointed out by Khan and Musharraf, who discussed how difficult it is to treat infections with these organisms [16].

Overall, this study's results support previous findings while also providing updated local data essential for empirical therapy decision-making. The comparison with prior literature confirms the continuing dominance of *E. coli* as the primary uropathogen, the retained potency of carbapenems and certain aminoglycosides, and the worrying trend of high resistance to commonly used agents. This underscores the urgent need for regular surveillance, updated empirical treatment protocols, and implementation of antimicrobial stewardship programs to preserve antibiotic efficacy and mitigate resistance spread.

LIMITATIONS OF THE STUDY

The study was limited to a single tertiary hospital over six months, which may not reflect the patterns in other regions or healthcare settings. While the sample size was adequate for local insights, it restricted the generalizability of the findings.

CONCLUSION

This study confirms *E. coli* as the predominant uropathogen in UTIs at Comilla Medical College Hospital, with high sensitivity to carbapenems and aminoglycosides and resistance to commonly used agents such as ceftriaxone, ciprofloxacin, and cotrimoxazole. These findings emphasize the need to update empirical therapy guidelines based on local resistance data. Continuous antimicrobial surveillance, targeted stewardship programs, and improved diagnostic practices are crucial for combating the rising threat of antimicrobial resistance and preserving the effectiveness of critical antibiotics.

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