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Prevalence and Antimicrobial Susceptibility Patterns of Uropathogens in a Tertiary Care Centre in Prayagraj, Uttar Pradesh: A Cross-Sectional Study

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ABSTRACT

Urinary tract infections (UTIs) are a major public health concern as antimicrobial resistance among the uropathogens is on a rise.

Aim- This cross-sectional study aimed to determine the prevalence and antimicrobial susceptibility patterns of uropathogens in a tertiary care center in Prayagraj, Uttar Pradesh, from December 2022 to May 2023.

Methods- A total of 1477 urine samples were analyzed, with 357 samples showing significant bacterial growth on Cystine Lactose Electrolyte-Deficient (CLED) media were further processed of antimicrobial susceptibility by Kirby Bauer disc diffusion method following CLSI M-100 guidelines.

Findings- The prevalence of UTI was 24.2%. _Escherichia coli_ (58.3%) was the most common uropathogen, followed by _Klebsiella pneumoniae_ (18.5%) and _Enterococcus spp._ (9.8%). Antimicrobial susceptibility testing revealed high resistance to ampicillin (82.4%) and cotrimoxazole (78.6%), while amikacin (84.3%) and nitrofurantoin (79.6%) showed better susceptibility. Multidrug-resistant (MDR) strains were observed in 88.5% of isolates.

Conclusions- These findings highlight the need for local antimicrobial susceptibility data to guide empirical therapy and combat antimicrobial resistance in this region.

Keywords: Urinary tract infection, uropathogens, antimicrobial susceptibility, multidrug resistance.

INTRODUCTION

Urinary tract infections (UTIs) are among the most common bacterial infections globally, affecting millions annually and posing significant challenges due to increasing antimicrobial resistance (AMR).[1] UTI refers to a wide range of clinical conditions, from the asymptomatic presence of bacteria in the urine to severe kidney infection with subsequent sepsis.[2] Global Burden of bacterial UTI 150 million cases per year with 236,790 deaths reported in 2019.[3] About 50% of women are affected by UTI at some time of their life. Premenopausal women are 20-40 times more likely to have a UTI than men of the same age.[4] UTIs are heterogeneous with regard to their etiology, clinical manifestations, and disease course. UTI range from simple (e.g., urethritis and cystitis) to severe (e.g., pyelonephritis, bacteremia, and septic shock).[2] In recent years, the resistance of uropathogens to previously effective antibiotics has become a global phenomenon.[5]

In India, UTIs are a leading cause of morbidity, particularly in outpatient and inpatient settings, with community-acquired and hospital-acquired infections showing distinct microbial profiles and resistance patterns.[6] The emergence of multidrug-resistant (MDR) uropathogens complicates empirical treatment, necessitating region-specific data on microbial prevalence and susceptibility patterns.[5]

Prayagraj, located in the eastern part of Uttar Pradesh, India, lacks comprehensive, up-to-date epidemiological data on uropathogens, despite its large population and high burden of infectious diseases. Previous studies in the region have indicated a high prevalence of MDR uropathogens, with _Escherichia coli_ and _Klebsiella pneumoniae_ being predominant.[7] This study aimed to assess the prevalence and antimicrobial susceptibility patterns of uropathogens in a tertiary care center in Prayagraj over a six-month period (December 2022–May 2023), using a sample size of 1477 urine samples, of which 357 showed significant bacterial growth on CLED media.

MATERIALS AND METHODS

Study Design and Setting

This was a cross-sectional study conducted at Department of Microbiology, Motilal Nehru Medical College, Prayagraj, Uttar Pradesh, India from December 2022 to May 2023. The hospital serves a diverse population from urban and rural areas, providing both inpatient and outpatient services.

Sample Collection and Inclusion Criteria

A total of 1477 midstream urine samples were collected from patients with suspected UTIs, including both symptomatic outpatients and inpatients. Male and female patients attending OPD were directed clearly on how to collect sample aseptically.

Inclusion criteria: patients of all ages and genders presenting with clinical symptoms suggestive of UTI (e.g., dysuria, frequency, urgency, or fever) or those with risk factors such as diabetes or pregnancy.

Exclusion criteria: Samples with contamination or insignificant colony counts (<10^5 CFU/mL).

Microbiological Methods

Urine samples were inoculated onto Cystine Lactose Electrolyte-Deficient (CLED) agar using a calibrated loop (0.001 mL) and incubated aerobically at 37°C for 18–24 hours. Significant bacteriuria was defined as ≥10^5 colony-forming units (CFU)/mL using Himedia colony counter . Bacterial identification was performed using standard biochemical tests, including Gram staining, catalase, oxidase, indole, methyle red, triple sugar iron and urease tests.

Antimicrobial Susceptibility Testing:

Antimicrobial susceptibility was determined using the Kirby-Bauer disk diffusion method on Mueller-Hinton agar, as per CLSI M-100 guidelines 32nd Edition 2022. [8]

RESULTS

Prevalence of Uropathogens

Of the 1477 urine samples analyzed, 357 showed significant bacterial growth, indicating a UTI prevalence of 24.2%. The distribution of uropathogens is shown in Table 1. *Escherichia coli* was the most common isolate (142/357, 40%), followed by *Klebsiella pneumoniae* (82/357, 23%), *Enterococcus spp.* (18/357, 5%), Pseudomonas aeruginosa (47/357, 13%), and *Staphylococcus aureus* (68/357, 19%).

Table 1: Distribution of Uropathogens Isolated from Urine Samples (n=357)

Uropathogen	Number of Isolates	Percentage (%)
Escherichia coli	142	40
Klebsiella pneumoniae	82	23
Enterococcus spp.	18	5
Pseudomonas aeruginosa	47	13
Staphylococcus aureus	68	19

Antimicrobial Susceptibility Patterns

The susceptibility patterns of the major uropathogens are summarized in Table 2. *Escherichia coli* showed high resistance to ciprofloxacin (77%) and norfloxacin (70%), with better susceptibility to fosfomycin (85%), nitrofurantoin (82.7%) and carbapenem. *Klebsiella pneumoniae* exhibited with highest resistance to ampicillin sulbactam (75%) and cefazolin (71%) but 100% susceptibility to aztreonam and 99.3% susceptibility to meropenem. *Enterococcus spp.* showed high resistance to cotrimoxazole (82.9%) but good susceptibility to nitrofurantoin (80.0%). *Pseudomonas aeruginosa* was resistant to ciprofloxacin (82.0%) but susceptible to tobramycin (92%) and aztreonam (91.4%). *Staphylococcus aureus* highest resistance to penicillin (73%) and maximum susceptibility to linezolid (99.4%).

Table 2: Antimicrobial Susceptibility Patterns of Major Uropathogens (%)

Antibiotic	*E. coli* (n=142) %	*K. pneumoniae* (n=82) %	*Enterococcus spp.* (n=18)%	*P. aeruginosa* (n=47%	*S.aureus*
Cotrimoxazole	78	79	17.1	-	34
Ciprofloxacin	23	53	45.7	18	41.2
Cefepime	73	68	-	-	-
Ceftazidime	-	-	-	68	-
Cefoxitin	39	22	-	-	-

Levofloxacin	40.4	39.4	51.4	36.0	63
Amikacin	70	73	-	72.0	-
Gentamicin	75	81	-	-	41
Nitrofurantoin	82.7	75.8	80.0	83	76.32
Cefotaxime	32	40	-	61.4	-
Imipenem	82	80	-	76.0	-
Meropenem	84	99.3	-	81	-
Aztreonam	73	100	-	91.4	-
Piperacillin-tazobactam	75	67	-	82	-
Ampicillin-sulbactam	49	25	-	-	-
Tobramycin	-	-	-	92	-
Norfloxacin	30	34	-	68	-
Cefazolin	38	29	-	16	-
Fosfomycin	85	87	-	87	-
Tetracycline	46	56	47.2	-	60
Vancomycin	-	-	65	-	59
Erythromycin	-	-	-	-	48
Clindamycin	-	-	-	-	53
Penicillin	-	-	-	-	27
Minocycline	-	-	-	-	78
Linezolid	-	-	-	-	99.4

Demographic and Clinical Characteristics

Among culture-positive patients, females (62.7%) outnumbered males (37.3%). The highest prevalence was observed in the 21–40 age group (38.4%), followed by the >60 age group (22.1%). Common risk factors included diabetes (28.6%) and previous UTI history (15.4%).

DISCUSSION

The prevalence of UTI in this study (24.2%) is lower than that reported in a previous study from Prayagraj (79.9%), likely due to differences in inclusion criteria and study settings. The predominance of *E. coli* and *K. pneumoniae* aligns with global and regional trends, where these Gram-negative bacteria are the leading causes of UTI [9].

The observed resistance to ciprofloxacin and norfloxacin suggests these agents are no longer suitable for empirical therapy in this region [10]. In contrast, amikacin and nitrofurantoin remain effective, particularly for uncomplicated UTIs, supporting its use as first-line agents for community-acquired infections [11].

These findings underscore the importance of routine culture and susceptibility testing, especially in tertiary care settings where MDR pathogens are prevalent [12]. The lack of microbiological facilities in rural areas of Uttar Pradesh highlights the need for region-specific antibiograms to guide empirical therapy [13].

CONCLUSION

This study reveals a UTI prevalence of 24.2% in a tertiary care center in Prayagraj, with *E. coli* and *K. pneumoniae* as the predominant uropathogens. High rates of antimicrobial resistance and MDR prevalence necessitate a shift toward susceptibility-guided therapy. Amikacin and nitrofurantoin are viable empirical treatment options. Continuous surveillance and development of local treatment guidelines are critical to address the growing challenge of AMR in this region.

Conflict of Interest

The authors declare no commercial or financial conflicts of interest.

REFERENCES

1. Foxman B. Urinary tract infection syndromes: occurrence, recurrence, bacteriology, risk factors, and disease burden. Infect Dis Clin North Am. 2014;28(1):1-13. doi:10.1016/j.idc.2013.09.003.
2. Hooton TM. Clinical practice. Uncomplicated urinary tract infection. N Engl J Med. 2012;366(11):1028-37. doi:10.1056/NEJMcp1104429.
3. Institute for Health Metrics and Evaluation (IHME). Global Burden of Disease Study 2019 (GBD 2019) Results. Seattle, WA: IHME; 2020. Available from: http://ghdx.healthdata.org/gbd-results-tool.
4. Foxman B. Epidemiology of urinary tract infections: incidence, morbidity, and economic costs. Am J Med. 2002;113 Suppl 1A:5S-13S. doi:10.1016/s0002-9343(02)01054-9.
5. Tandogdu Z, Wagenlehner FM. Global epidemiology of urinary tract infections. Curr Opin Infect Dis. 2016;29(1):73-9. doi:10.1097/QCO.0000000000000228.
6. Akhtar N, Rahman R, Akhter S, Sultana R, Rahman MM. Antimicrobial resistance in uropathogens: current scenario in India. J Family Med Prim Care. 2022;11(9):4954-60. doi:10.4103/jfmpc.jfmpc_176_22.
7. Bhargava K, Nath G, Bhargava A, Kumari R, Aseri GK, Jain N. Bacterial profile and antibiotic susceptibility pattern of uropathogens causing urinary tract infection in the eastern part of Northern India. Front Microbiol. 2022;13:965053.
8. CLSI. Performance Standards for Antimicrobial Susceptibility Testing. 32nd ed. Clinical and Laboratory Standards Institute; 2022.
9. World Health Organization. Global antimicrobial resistance surveillance system (GLASS) report: urinary tract infections. Geneva: WHO; 2021.
10. Kumar S, Yadav M, Patel R. Antibiotic resistance trends in urinary tract infections in North India: a multicentre study. J Antimicrob Chemother. 2022;77(5):1345-52.
11. Gupta K, Hooton TM, Naber KG, et al. International clinical practice guidelines for the treatment of acute uncomplicated cystitis and pyelonephritis in women: a 2010 update by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases. Clin Infect Dis. 2011;52(5):e103-20.
12. Tandogdu Z, Wagenlehner FM. Global epidemiology of urinary tract infections. Curr Opin Infect Dis. 2016;29(1):73-9.
13. Mishra P, Tripathi MK, Rao PS. Challenges in microbiological diagnostics in rural India: implications for antimicrobial stewardship. J Glob Antimicrob Resist. 2023;32:78-84.

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324