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A STUDY OF CLINICO BACTERIOLOGICAL PROFILE OF URINARY TRACT INFECTION

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ABSTRACT

Background: Bacterial infections of the urinary tract are among the most prevalent in clinical practice and are becoming more complex because of antimicrobial resistance. Effective empirical treatment and infection control necessitate the identification of the most prevalent pathogens and their susceptibility to these pathogens. This study aimed to determine the clinical presentation, bacteriological profile, and antibiotic sensitivity patterns of culture-positive UTIs in adults at a tertiary care hospital. **Materials and Methods:** This hospital-based cross-sectional study included 150 adult patients who tested positive for a urinary tract infection and showed clinical signs of infection at the Trichy SRM Medical College Hospital and Research Centre. Midstream urine samples were collected and processed using standard microbiological methods. Antibiotic susceptibility testing was conducted using the Kirby-Bauer disk diffusion method, following CLSI guidelines. SPSS version 26 was used to analyse the data. **Result:** *Escherichia coli* was the most frequently isolated pathogen, accounting for 65.4% of cases, with a high proportion of ESBL producers. *Pseudomonas* (6%) and *Klebsiella* (24.7%) were also found. Aminoglycosides and nitrofurantoin exhibited superior sensitivity, whereas fluoroquinolones and cotrimoxazole exhibited high resistance rates. The most prevalent risk factor for complicated UTIs (52.7%) was diabetes mellitus, which accounted for 92.7% of the cases. **Conclusion:** The increased prevalence of uropathogens that produce ESBLs and multidrug resistance highlights the necessity of localised antibiograms and antimicrobial management. Aminoglycosides and nitrofurantoin remain useful empirical choices. Individualised treatment and routine monitoring are crucial to overcome resistance.

INTRODUCTION

Urinary tract infections (UTIs) are one of the most frequently observed bacterial infections in clinical settings worldwide. These illnesses affect people of all ages, but women, older adults, and immunocompromised individuals are more likely to develop them. The clinical spectrum of UTIs varies widely, from asymptomatic bacteriuria to severe systemic infections, such as pyelonephritis. These infections can cause serious complications, such as repeated episodes, renal scarring, and, in severe situations, sepsis.[1]

The main causative organisms are gram-negative bacteria, such as Escherichia coli (E. coli), Klebsiella pneumoniae, Proteus mirabilis, Staphylococcus saprophyticus, and Enterococcus faecalis.[2,3] Antimicrobial resistance (AMR) makes it more difficult to manage UTIs effectively. Multidrug-resistant strains of E. coli and K. pneumoniae have been reported with rising frequency, particularly in low- and middle-income countries, due to unregulated antibiotic use and inadequate infection control practices.[4,5]

Studies from various regions in India and abroad demonstrate significant geographic variability in both the microbial profiles and the antimicrobial susceptibility patterns of uropathogens.[6,7] For example, it has been repeatedly shown that nitrofurantoin and aminoglycosides (such as amikacin and gentamicin) continue to be more effective than often recommended oral medications like ampicillin and cotrimoxazole, which have concerningly high rates of resistance.[8,9]

Given these concerns, localised epidemiological data on the distribution of uropathogens and their

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resistance patterns are essential for optimising empirical antibiotic therapy and informing hospital-specific strategies. This is especially crucial in tertiary care centres that handle a high burden of complicated UTI cases, often with comorbidities or treatment histories that predispose them to resistant infections. This study sought to answer the following critical question: What is the clinico-bacteriological profile of tract infections in adult patients attending a tertiary care hospital in Southern India?

Trichy SRM Medical College Hospital and Research Centre, a tertiary care facility with a diverse patient population, served as the location for the investigation. Given the known regional variations in uropathogen incidence and antibiotic resistance patterns, the justification is the urgent need for institution-specific data to inform empirical treatment options in UTI cases.[10]

By identifying the most prevalent infectious agents, their manifestations in patients, and their increasing resistance, this study will assist physicians in making more precise diagnoses and providing more effective treatments. Moreover, it aids the overarching public health goal of mitigating antibiotic resistance through informed stewardship initiatives. Accordingly, this study aimed to evaluate the clinico-bacteriological features and antimicrobial sensitivity profiles of culture-positive adult UTI cases in our setting.

MATERIALS AND METHODS

This cross-sectional study was conducted on 150 adult patients with clinical indications of a urinary tract infection at Trichy SRM Medical College Hospital and Research Centre for six months.

Inclusion and exclusion criteria

The study population consisted of 150 adult patients aged 18 years or older with clinical indications of a urinary tract infection and a positive urine culture. The study did not include patients with vesicoureteric reflux, urinary diversions such as ileal loops, or those who had received antibiotic treatment within 48 hours before sample collection.

Methods

A standardised proforma was used to record comprehensive clinical histories after obtaining informed consent and ethical approval. Early morning urine samples were sent for culture and sensitivity testing using conventional bacteriological methods, and midstream urine samples from symptomatic individuals were obtained and subjected to regular urinalysis. Following the criteria of the Clinical and Laboratory Standards Institute (CLSI), isolated uropathogens were identified, and their antibiotic susceptibility profiles were ascertained using the Kirby-Bauer disk diffusion method. Demographic data, clinical features, organisms isolated, and sensitivity patterns were systematically documented.

Statistical Analysis

Statistical analyses were performed using SPSS software version 26.0. Descriptive statistics were used to present the distribution of organisms according to age and sex. Chi-square tests were used to examine the association between clinical presentation and both sex and organism type.

RESULTS

The age distribution of UTI cases revealed that the largest proportion (28%) was found in the 51–60 age group, followed by the 41–50 (22.7%) and 61+ age groups (20%). The lowest percentage of cases (7.3%) occurred among those aged 21–30 years.

Males accounted for 55.3% of the cases, whereas females accounted for 44.7%. Fever was the most frequently reported symptom in terms of clinical presentations, occurring in 47.3% of patients. The most common symptoms were increased frequency of urination (41.3%), burning micturition (26%), dysuria (14%), and flank pain (12.7%).

A small percentage of patients reported widespread weakness (0.7%) or lower abdominal pain (4.7%). According to the duration of symptoms before presentation, 26% of patients had symptoms for 4-6 days, whereas 71.3% had symptoms for 3 days or less. Only 1.3% of patients experienced symptoms that persisted for > 10 days, while another 1.3% did so after 7-9 days.

Of the group, 92.7% had a reported complex UTI, whereas only 7.3% had an uncomplicated episode. Diabetes mellitus was the most commonly reported comorbidity among the risk variables evaluated, occurring in 52.7% of cases. Only 10% had a history of recurrent UTIs, 14% had a history of catheterisation, and 20.7% had a recent history of urogenital instrumentation. Immunosuppression (0.7%) and renal stones (2%) were less often reported risk factors (Table 1).

Table 1: Demographic, clinical, and risk factor distribution

		Number of Patients	Percentage
Age Group (years)	<20	17	11.3%
	21-30	11	7.3%
	31-40	16	10.7%
	41-50	34	22.7%
	51-60	42	28%
	>61	30	20%
Gender	Male	83	55.3%
	Female	67	44.7%
Clinical Presentation	Fever	71	47.3%
	Increased frequency of urination	62	41.3%

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	Burning micturition	39	26%
	Flank pain	19	12.7%
	Dysuria	21	14%
	Pain in the lower abdomen	7	4.7%
	Generalized weakness	1	0.7%
Duration of symptoms (days)	≤3	107	71.3%
	4-6	39	26%
	7-9	2	1.3%
	>10	2	1.3%
Complicated UTI	Yes	139	92.7%
	No	11	7.3%
Risk factors	Catheterization	21	14%
	Diabetes mellitus	79	52.7%
	Immunosuppression	1	0.7%
	Recent history of urogenital instrumentation	31	20.7%
	Recurrent urinary tract infection	15	10%
	Renal stones	3	2%

E. coli was the most often isolated pathogen, with 64 (42.7%) being ESBL-positive and 34 (22.7%) being ESBL-negative. The second most prevalent isolates were Klebsiella species, which included 30 ESBL-negative (20%) and 7 ESBL-positive (4.7%) strains. The other gram-negative species identified were Pseudomonas spp. (6%), Citrobacter freundii (2%), and Enterobacter spp. (1.3%). Enterococcus faecalis, a gram-positive bacterium, was found in only one case (0.7%).

Fluoroquinolones were the most commonly used antibiotics, with ciprofloxacin, norfloxacin, and ofloxacin prescribed in 110 of 150 cases (73.3%). Gentamicin was the next most commonly prescribed antibiotic, with 73 prescriptions (48.7%), followed by cotrimoxazole (33.3%) and amikacin (28%) prescriptions. Nitrofurantoin, recommended in 28% of cases, remains an essential oral therapy option, especially for uncomplicated UTIs. Carbapenems were used less frequently, with imipenem and meropenem used in only 5 (3.3%) and 4 (2.7%) patients, respectively (Table 2).

Table 2: Distribution of uropathogens and antibiotic sensitivity patterns

		Number of Patients	Percentage
Organism	*Citrobacter freundii*	3	2%
	Enterobacter spp.	2	1.3%
	Enterococcus faecalis	1	0.7%
	ESBL-positive *E. coli*	64	42.7%
	ESBL-negative *E. coli*	34	22.7%
	ESBL-positive *Klebsiella*	7	4.7%
	ESBL-negative *Klebsiella*	30	20%
	Pseudomonas	9	6%
Antibiotic	Amikacin	42	28%
	Ciprofloxacin	110	73.3%
	Cotrimoxazole	50	33.3%
	Gentamicin	73	48.7%
	Imipenem	5	3.3%
	Meropenem	4	2.7%
	Nitrofurantoin	42	28%
	Norfloxacin	110	73.3%
	Ofloxacin	110	73.3%

DISCUSSION

This hospital-based cross-sectional study aimed to assess the clinico-bacteriological profile of UTIs and their antibiotic sensitivity patterns in adult patients at a tertiary care centre in Southern India. The study revealed a predominance of extended-spectrum beta-lactamase (ESBL)-producing E. coli among the isolates and demonstrated a concerning level of resistance to commonly prescribed antimicrobials, such as fluoroquinolones and cotrimoxazole. These findings highlight the importance of specialised, evidence-based antimicrobial stewardship methods and reflect national concerns regarding the increasing frequency of multid drug-resistant uropathogens.

Our results demonstrated that E. coli was the most commonly isolated pathogen, with ESBL-positive strains accounting for 42.7% of all infections, followed by ESBL-negative E. coli (22.7%), ESBL-negative Klebsiella (20%), and Pseudomonas spp. (6%). Fluoroquinolones (ciprofloxacin, norfloxacin, and ofloxacin) were the most frequently used antimicrobials (73.3%), despite their moderate susceptibility profiles. Aminoglycosides, such as gentamicin (48.7%) and amikacin (28%), retained relatively better activity. The study consisted predominantly of patients with complicated UTIs (92.7%), many of whom had diabetes mellitus (52.7%) and recent urological procedures (20.7%).

Several studies have validated these results; for example, a study conducted in Kerala discovered that

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the most prevalent uropathogens were E. coli (46.4%) and Klebsiella pneumoniae (22.6%). These bacteria were most susceptible to carbapenems and amikacin but highly resistant to cotrimoxazole and fluoroquinolones.[11] Additionally, a five-year retrospective study conducted in North Kerala revealed a steady increase in third-generation cephalosporin and piperacillin-tazobactam resistance. E. Coli and Klebsiella accounted for 72% of the isolates.[12]

The focus on both clinical and bacteriological profiles, methodical methodology, and real-world clinical applicability are the strongest points of our study. Culture-positive symptomatic patients were included using stringent diagnostic criteria, and sensitivity testing was performed according to the CLSI guidelines. However, limitations include its single-centre setting and short study duration, which may not reflect seasonal or long-term resistance trends. A relatively small sample size precluded robust subgroup analyses, particularly for less frequently isolated organisms.

In India, the increasing number of organisms that produce ESBL is a serious concern. Similar to the antimicrobial resistance trends we reported in our study, E. coli was the predominant pathogen in Rajasthan (37.2%) and exhibited notable resistance to ciprofloxacin (72.5%) and cotrimoxazole (78.75%).[10] High levels of resistance to cephalosporins and fluoroquinolones were also noted in a Bihar investigation; sparfloxacin and gatifloxacin were found to be more effective substitutes in vitro.[13]

A North Indian study conducted at a teaching hospital reported that 64% of isolates were E. coli, with high resistance to ampicillin (87–89%) and cephalosporins (35–82%) among gram-negative bacteria. The fact that 32% of Staphylococcus aureus isolates were methicillin-resistant (MRSA) is noteworthy since it shows that both gram-positive and gram-negative uropathogens are becoming more resistant to antibiotics.[14] Similarly, a surveillance study from Gujarat found E. coli to be the predominant isolate (51.9%) with extensive resistance to ampicillin and third-generation cephalosporins, while nitrofurantoin and aminoglycosides retained good efficacy.[15]

A multicentric investigation comparing resistance patterns in Northern and Southern India revealed significant regional variations in pathogen frequency and susceptibility. Amikacin showed the lowest resistance (14%), and E. coli (55.1%) was the most common infection in Southern India. This supports our finding that aminoglycosides are still comparatively effective even in the face of rising multidrug resistance.[7] In a recent ICU-based study, E. coli (26.6%) and K. pneumoniae (17.5%) were dominant among patients with catheter-associated UTIs, and high multidrug resistance (MDR) rates were associated with older age and prolonged catheterization, highlighting risk factors aligned with our study demographics.[16]

Our study's male predominance of 55.3% was a noteworthy finding, as it defies conventional UTI epidemiology, which normally shows a higher prevalence among females. The increased prevalence of complex UTIs and catheter-associated infections in men, which has also been noted in studies involving hospitalised or intensive care unit patients, maybe the cause of this change. More research should be conducted on these sex differences, especially in tertiary care settings with elderly or comorbid patients.

Our results support the need for tailored empirical treatment based on local antibiograms and evidence. Routine ESBL screening in tertiary care facilities is supported by the identification of ESBL-producing strains as a significant burden on healthcare systems. To inform focused interventions, future research should incorporate longitudinal surveillance, multicentre data, and molecular characterisation of resistance pathways. Investigating the potential of predictive algorithms and quick diagnoses with electronic health records for real-time resistance prediction is urgently needed. Recurrence and problems can be decreased, and therapeutic approaches can be more precisely tailored with the use of longitudinal outcome tracking associated with resistance profiles. This study addressed the primary objective by identifying key clinical symptoms, risk factors, and distribution of uropathogens, particularly ESBL-producing strains.

CONCLUSION

Our study demonstrates that E. coli, particularly ESBL-producing strains, is the predominant uropathogen in adult UTIs at our tertiary care centre, with high resistance to fluoroquinolones and cotrimoxazole. Aminoglycosides and nitrofurantoin showed better efficacy, supporting their use in empirical therapy. Most cases were complicated UTIs, frequently associated with diabetes and prior instrumentation history. These findings emphasise the need for routine culture, localised antibiograms, and antibiotic use stewardship. Future multicentre longitudinal studies should monitor resistance evolution and assess the impact of targeted antimicrobial stewardship interventions.

REFERENCES

1. Matthews SJ, Lancaster JW. Urinary tract infections in the elderly population. Am J Geriatr Pharmacother. 2011; 9:286–309. https://doi.org/10.1016/j.amjopharm.2011.07.002.
2. Mancuso G, Midiri A, Gerace E, Marra M, Zummo S, Biondo C. Urinary tract infections: the current scenario and future prospects. Pathogens. 2023; 12:623. https://doi.org/10.3390/pathogens12040623.
3. Malhotra V, Maheshwari M, Broor S, Devi LS. Profile of bacterial uropathogens and their antibiotic susceptibility patterns in clinically suspected cases of urinary tract infections in a rural hospital in Haryana, India. Int J Med Microbiol Trop Dis. 2016; 3:14–8. https://doi.org/10.5958/2394-2800.2016.00003.1.

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4. Mussema A, Admasu D, Bawore S, Abdo R, Seid A. Bacterial profile, antimicrobial resistance, and factors associated with urinary tract infection among pregnant women at Hosanna Town Health Facilities, Central Ethiopia. Georgian Med News. 2023; 342:113–21. https://pubmed.ncbi.nlm.nih.gov/37991965/
5. Halboup A, Al-Khazzan A, Battah M, Areqi A, Khamaj F, Al-Arifi S. Urinary tract infections management in the developing countries. In: Al-Worafi YM, editor. Handbook of Medical and Health Sciences in Developing Countries: Education, Practice, and Research. Cham: Springer International Publishing; 2023. p. 1–19. https://doi.org/10.1007/978-3-030-74786-2_64-1.
6. Dhanvijay AN. Insights into urinary tract infection bacteriology and antimicrobial sensitivity: a study from a central Indian tertiary care hospital. Int J Sci Res. 2024. https://doi.org/10.21275/sr24507170208.
7. Gupta S, Kapur S, Padmavathi D. Comparative prevalence of antimicrobial resistance in community-acquired urinary tract infection cases from representative states of northern and southern India. J Clin Diagn Res. 2014;8(9):9–12. https://doi.org/10.7860/JCDR/2014/9349.4889.
8. Shams F, Afroz S, Akter R, Tangim SF, Sarkar D, Paul S. Bacteriological profile and antibiotic resistance pattern in children with urinary tract infection in a tertiary care hospital. Sir Salimullah Med Coll J. 2022. https://doi.org/10.3329/ssmcj.v29i2.58966.
9. Aseffa A, Abubeker R, Asemene N, Fentew S, Mihret A, Beyene D, et al. Bacteriological profile and antibiotic resistance pattern of urinary tract pathogens isolated at National Referral Laboratory, Ethiopian Public Health Institute. Ethiop J Health Sci. 2020;2. https://www.researchgate.net/publication/336042418_Bacteriological_profile_and_antibiotic_resistance_pattern_of_urinary_tract_pathogens_isolated_at_national_reference_laboratory_Ethiopian_Public_Health_Institute
10. Meena M, Kishoria N, Meena D, Sonwal VS. Bacteriological profile and antibiotic resistance in patients with urinary tract infection in tertiary care teaching hospital in western Rajasthan, India. Infect Disord Drug Targets. 2020. https://doi.org/10.2174/1871526520666200318110447.
11. Roshni VS, Rafeeda K. Bacteriological profile and antibiogram of urinary tract infections at a tertiary care hospital in Kerala, India: a retrospective study. J Clin Diagn Res. 2024. https://doi.org/10.7860/jcdr/2024/68553.19413.
12. Rajeevan S, Ramakrishna Pai J, Ahmed S, George A, Edavaloth P. Five years trend of bacteriological profile and antibiogram of urinary tract infections at a rural medical college hospital in North Kerala, India: 2012–16. Indian J Microbiol Res. 2020; 7:175–81. https://doi.org/10.18231/j.ijmr.2020.031.
13. Prasad RR, Shree V. Antimicrobial Susceptibility Pattern and Microbiological Profile of Uropathogens among Patients in a Tertiary Care Hospital in Bihar. Int J Sci Res 2015; 4:1632-35. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Antimicrobial+susceptibility+pattern+and+microbiological+profile+of+uropathogens+among+patients+in+a+tertiary+care+hospital+in+Bihar&btnG=#d=gs_cit&t=1745565917382&u=%2Fscholar%3Fq%3Dinfo%3A-VPwZLyZdIQJ%3Ascholar.google.com%2F%26output%3Dcite%26scirp%3D0%26hl%3Den
14. Khatter S, Sharma B, Bajaj A, Gupta K, Kaur I. Bacteriological profile of uropathogens and their susceptibility pattern at a teaching hospital in North India: a retrospective study. Int J Sci Res. 2018;6. https://doi.org/10.36106/ijsr
15. Sodagar NR, Trivedi S. Microbiological profile and antibiotic susceptibility pattern of uropathogens in Anand district of Gujarat, India. J Biomed Pharm Res. 2015;4. https://europub.co.uk/articles/microbiological-profile-and-antibiotic-susceptibility-pattern-of-uropathogens-in-anand-district-of-gujarat-india-A-3590
16. Ahmed S, Shree N, Narula AS, Nirala P, Majid H, Garg A, et al. The prevalence of multidrug resistance in uropathogens of patients admitted in the intensive care unit of a tertiary care hospital. Naunyn Schmiedebergs Arch Pharmacol. 2024. https://doi.org/10.1007/s00210-024-03108-5.

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