Section: Microbiology

Original Research Article

COMPARATIVE PREVALENCE OF ANTIMICROBIAL RESISTANCE IN COMMUNITY-ACQUIRED URINARY TRACT INFECTION CASES

Hitesh Bhatt[1]

[1]*Associate Professor, Department of Microbiology, Sudha Rustagi Dental College, Faridabad, Haryana, India*

Received *: 06/09/2025*
Received in revised form *: 17/10/2025*
Accepted *: 04/11/2025*

Corresponding Author:
Dr. Hitesh Bhatt,
Associate Professor, Department of Microbiology, Sudha Rustagi Dental College, Faridabad, Haryana, India.
Email: hbhattmicro@gmail.com

DOI: 10.70034/ijmedph.2025.4.258

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (4); 1445-1449

ABSTRACT

Background: Urinary tract infection (UTI) is the second most common bacterial infection worldwide after respiratory tract infections, contributing significantly to global morbidity and economic burden. The rise of antimicrobial resistance (AMR) among community-acquired uropathogens poses a major public health challenge, particularly in developing countries like India, where empirical antibiotic use is frequent. This study aimed to identify the predominant etiological agents of community-acquired UTIs and evaluate their antimicrobial resistance profiles among outpatients.

Materials and Methods: This prospective observational study included 200 patients aged 14–72 years presenting with symptoms suggestive of UTI at the Department of Microbiology, Medicheck Hospital, Faridabad. Midstream clean-catch urine samples were collected and processed within two hours of collection. Cultures showing significant bacteriuria ($>10^5$ CFU/mL) were considered positive. Identification was performed using standard microbiological methods. Antimicrobial susceptibility testing was done by the Kirby–Bauer disk diffusion method on Mueller–Hinton agar as per CLSI guidelines. Data were analyzed using SPSS version 26.0, with $p < 0.05$ considered statistically significant.

Results: Out of 200 urine samples analyzed, 82 (41%) were culture-positive. Females (56.1%) had a higher infection rate than males (43.9%). Escherichia coli was the most common pathogen (54.9%), followed by Enterococcus faecalis (17.1%) and Klebsiella pneumoniae (11%). High resistance was observed to ampicillin (96.3%), cefuroxime (78%), ciprofloxacin (68.3%), and gentamicin (60.9%), while amikacin exhibited the lowest resistance (15.9%), indicating its continued efficacy.

Conclusion: E. coli remains the predominant uropathogen in community-acquired UTIs, exhibiting extensive resistance to commonly used antibiotics. Amikacin showed the highest sensitivity and remains the most effective therapeutic option. The findings underscore the importance of regular surveillance of antimicrobial susceptibility patterns and adherence to antibiotic stewardship principles to guide empirical therapy and contain rising AMR.

Keywords: Urinary Tract Infection (UTI); Community-acquired infection; Antimicrobial resistance (AMR); Escherichia coli; Antibiotic susceptibility.

INTRODUCTION

Urinary tract infection (UTI) ranks as the most frequent bacterial infection encountered in clinical practice after respiratory tract infections. It represents a major global health concern due to its high morbidity and economic burden, with an estimated 150 million cases reported annually and an associated cost exceeding six billion US dollars worldwide.[1-3] UTI is defined as the presence of significant bacteriuria accompanied by urinary symptoms.[4] It may involve the lower tract alone or extend to affect both the upper and lower urinary systems. Several predisposing factors such as malnutrition, inadequate personal hygiene, and low

socioeconomic conditions have been linked to the increased risk of developing UTIs.[5]

The predominant causative organism is Escherichia coli (E. coli), followed by Enterococcus faecalis and Klebsiella pneumoniae, which together account for the majority of infections.[6] Although E. coli remains the leading uropathogen, recent studies indicate a shift in the distribution pattern of bacterial isolates responsible for UTIs.[7,8] The introduction of antibiotics has greatly improved the management of these infections; however, empirical treatment—often started before urine culture reports are available—has led to increasing antimicrobial resistance (AMR), particularly in community-acquired UTIs.[9] This issue is further compounded by the indiscriminate or repeated use of broad-spectrum antibiotics.

Data on resistance patterns of community-acquired uropathogens remain limited in the Indian context.[10,11] Given the regional variability in bacterial prevalence and drug susceptibility, it is essential that antimicrobial choices be guided not only by the most probable pathogen but also by current local resistance data. Regular surveillance of UTI-causing organisms and their antimicrobial susceptibility profiles is therefore crucial for rational antibiotic use and to mitigate the growing threat of AMR. In this context, the present study was designed to evaluate and compare the common etiological agents of UTIs among outpatients and to analyze their antimicrobial resistance trends across India.

MATERIALS AND METHODS

This prospective observational study included 200 patients (aged 14–72 years; both sexes) presenting with symptoms suggestive of urinary tract infection (UTI) at the Department of Microbiology, Medicheck Hospital, Faridabad. Patients were advised urine culture and sensitivity testing following clinical evaluation. Only those with significant bacteriuria (>10^5 CFU/mL) were included. Each participant provided a single midstream, clean-catch urine specimen for microbiological analysis.

Inclusion Criteria

- Patients aged 14–72 years of either sex.
- Outpatients presenting with clinical features suggestive of UTI (e.g., dysuria, frequency, urgency, suprapubic discomfort, flank pain, or fever).
- Culture-confirmed cases showing significant bacteriuria (>10^5 CFU/mL).
- Patients who provided informed consent for participation.

Exclusion Criteria

- Patients who had received antibiotic therapy within the preceding 48 hours.
- Samples showing mixed growth or contamination.
- Patients with indwelling urinary catheters or recent urinary tract instrumentation.
- Pregnant women and patients with known structural abnormalities of the urinary tract.
- Hospitalized or catheterized patients (to exclude hospital-acquired infections).

Sample Collection and Processing

Urine samples were collected in sterile containers under aseptic precautions and processed within two hours. Using a calibrated loop (0.001 mL), samples were inoculated on CLED, MacConkey, and Hichrome UTI agar plates and incubated aerobically at 37°C for 24–48 hours. Colonies were identified based on morphology, lactose fermentation, and chromogenic substrate utilization. Pure isolates were confirmed through subculture on nutrient agar and characterized using standard biochemical tests.

Antibiotic Sensitivity Testing: Antimicrobial susceptibility testing was performed by the Kirby–Bauer disk diffusion method on Mueller–Hinton agar as per Clinical and Laboratory Standards Institute (CLSI) guidelines.[12,13] Antibiotic discs used included Ampicillin (10 µg), Gentamicin (30 µg), Cefuroxime (30 µg), Amikacin (30 µg), and Ciprofloxacin (5 µg) (HiMedia Laboratories, India). Plates were incubated at 37°C for 24 hours, and inhibition zones were measured. Isolates were categorized as Sensitive (S), Intermediate (I), or Resistant (R) according to CLSI interpretive standards.

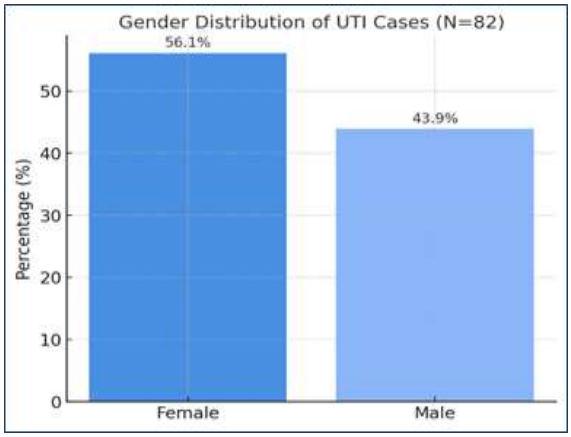
Statistical Analysis: Data were compiled in Microsoft Excel and analyzed using SPSS version 26.0. Descriptive statistics were expressed as frequencies and percentages. The Chi-square (χ^2) test, odds ratios (ORs), confidence intervals (CIs), and p-values were calculated. A p-value <0.05 was considered statistically significant.

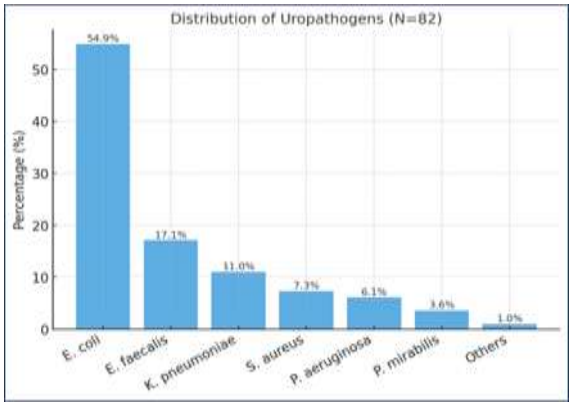
RESULTS

A total of 200 urine samples collected from clinically suspected cases of community-acquired urinary tract infection (CA-UTI) were analyzed. Of these, 82 samples (41%) showed significant bacteriuria and were culture-positive, while 118 samples (59%) were sterile or showed non-significant growth. UTI was more frequent among females (56.1%) than males (43.9%), indicating a clear female predominance in infection rate.

Table 1: Gender Distribution of UTI Cases (N = 82)

Gender	Frequency	Percentage (%)
Female	46	56.1
Male	36	43.9
Total	82	100





Bacteriological Profile: Among 82 culture-positive samples, Escherichia coli was the predominant pathogen (54.9%), followed by Enterococcus faecalis (17.1%), Klebsiella pneumoniae (11.0%), Staphylococcus aureus (7.3%), Pseudomonas aeruginosa (6.1%), and Proteus mirabilis (3.6%). Other isolates accounted for about 1% of cases.

Antimicrobial Resistance Pattern: Overall antimicrobial resistance (AMR) analysis revealed that ampicillin showed the highest resistance (96.3%), followed by cefuroxime (78%), ciprofloxacin (68.3%), and gentamicin (60.9%), while amikacin demonstrated the lowest resistance (15.9%), indicating it remains the most effective agent against community-acquired uropathogens.

Table 2: Distribution of Uropathogens in Culture-Positive Cases

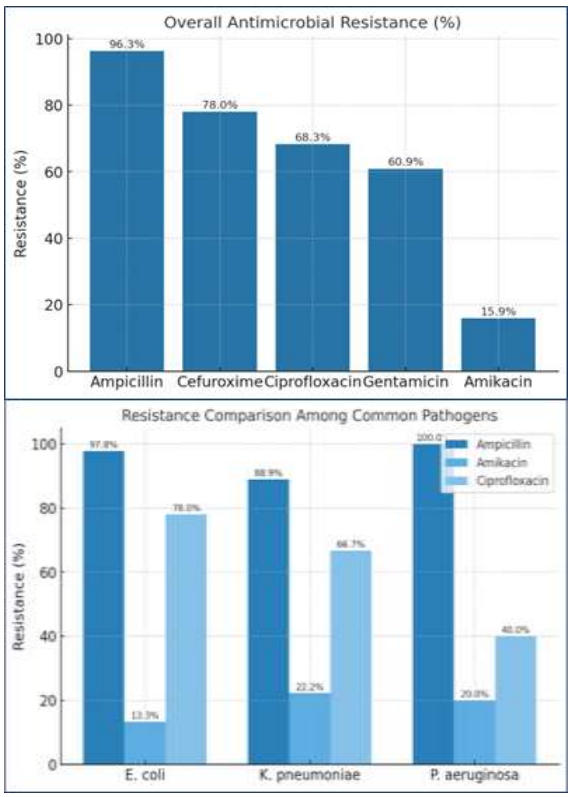
S. No	Organism	Frequency (N=82)	Percentage (%)
1	E. coli	45	54.9
2	E. faecalis	14	17.1
3	K. pneumoniae	9	11.0
4	S. aureus	6	7.3
5	P. aeruginosa	5	6.1
6	P. mirabilis	3	3.6
7	Others	1	1.0
Total		82	100

Table 3: Overall Antimicrobial Resistance Pattern of Uropathogens

Antibiotic	Resistant Isolates (n)	Resistance (%)
Ampicillin	79	96.3
Cefuroxime	64	78.0
Ciprofloxacin	56	68.3
Gentamicin	50	60.9
Amikacin	13	15.9

Table 4: Antibiotic Susceptibility of Major Uropathogens

Organism	Gentamicin (R%)	Ampicillin (R%)	Amikacin (R%)	Cefuroxime (R%)	Ciprofloxacin (R%)
E. coli (n=45)	64.4	97.8	13.3	82.2	78.0
E. faecalis (n=14)	57.1	96.4	21.4	71.4	64.3
K. pneumoniae (n=9)	55.6	88.9	22.2	77.8	66.7
S. aureus (n=6)	50.0	100.0	33.3	83.3	50.0
P. aeruginosa (n=5)	30.0	100.0	20.0	60.0	40.0
P. mirabilis (n=3)	80.0	100.0	10.0	90.0	60.0



Organism-Wise Susceptibility Profile: E. coli and P. mirabilis displayed the highest resistance to most commonly used antibiotics, particularly ampicillin and cefuroxime, but retained good sensitivity to amikacin. P. aeruginosa isolates exhibited higher susceptibility to gentamicin and amikacin.

Out of 200 analyzed samples, 82 were culture-positive, with E. coli emerging as the leading causative organism. High resistance was observed to ampicillin, cefuroxime, and ciprofloxacin, while amikacin retained the highest sensitivity across isolates. These findings underline the importance of periodic surveillance of uropathogens and their resistance patterns to guide appropriate empirical therapy.

DISCUSSION

This prospective study provides useful insights into the microbiological profile and antimicrobial resistance (AMR) patterns of uropathogens isolated from community-acquired urinary tract infections (CA-UTIs). Out of 200 urine samples analyzed, 82 (41%) showed significant bacteriuria. This positivity rate aligns with previous global findings and is comparable to that reported by Oladeinde et al. (39.7%) in a rural Nigerian cohort,[14] though higher than that observed in Aligarh, India (10.86%),[6] and slightly lower than the 49% positivity reported in other Indian studies.[15]

In our study, Escherichia coli emerged as the predominant uropathogen (54.9%), followed by Enterococcus faecalis (17.1%) and Klebsiella pneumoniae (11%). This distribution mirrors findings from several earlier reports,[16–19] reaffirming E. coli as the leading cause of CA-UTI across different populations. Similar trends were also reported in the multi-regional study by Gupta S who found E. coli to be the most frequent isolate (55.1%) followed by E. faecalis and K. pneumoniae, demonstrating consistent dominance of these pathogens in Indian settings.[1] Studies conducted worldwide consistently demonstrate that E. coli and K. pneumoniae remain the most frequently isolated uropathogens in cases of community-acquired urinary tract infection (CA-UTI).[20–22] The present study revealed a significant association between antibiotic efficacy and regional variation in resistance patterns. Therefore, routine surveillance of antimicrobial susceptibility among community isolates should be made an essential component of local and national disease monitoring programs to ensure effective treatment strategies and containment of resistance.

Our antimicrobial susceptibility analysis revealed alarmingly high resistance to commonly used antibiotics such as ampicillin (96.3%), cefuroxime (78%), ciprofloxacin (68.3%), and gentamicin (60.9%). In contrast, amikacin showed the least resistance (15.9%) and thus remains one of the most effective agents against uropathogens. These findings corroborate those of Gupta et al. (2014), who reported similar resistance trends among community isolates, with highest resistance to ampicillin and lowest to amikacin.[1]

The high resistance observed, particularly among E. coli, suggests that empirical use of ampicillin, cefuroxime, and ciprofloxacin in CA-UTI management may no longer be appropriate. E. coli isolates in this study demonstrated resistance rates of 97.8% to ampicillin, 82.2% to cefuroxime, and 78% to ciprofloxacin, indicating widespread dissemination of resistant strains in the community. This pattern reflects global AMR trends, where irrational antibiotic use and lack of antibiotic stewardship have fueled resistance development.[23] Similar findings have been reported from other developing nations, including Nepal and Vietnam, where easy over-the-counter availability of antibiotics, incomplete treatment courses, and self-medication are major contributing factors.[24–26]

The persistence of high AMR levels in community-acquired infections is a serious public health concern. Contributing factors include the widespread availability of antibiotics without prescription, non-compliance with treatment guidelines, self-medication, and the role of unqualified practitioners. Such practices increase selective pressure on bacterial populations, promoting resistant strains. Regular antimicrobial surveillance, public education, and enforcement of prescription regulations are urgently needed to mitigate the spread of resistance.

Overall, the present study emphasizes the need for periodic monitoring of AMR patterns among community-acquired uropathogens. Establishing regional AMR surveillance programs and integrating laboratory data into empirical treatment

guidelines are crucial steps toward rational antibiotic use. Continued local and national surveillance, as highlighted in the study by Gupta et al. (2014), will help maintain the efficacy of available antibiotics and guide clinicians in selecting the most appropriate empirical therapy.

CONCLUSION

This study highlights the predominance of Escherichia coli as the leading causative organism of community-acquired urinary tract infections, followed by Enterococcus faecalis and Klebsiella pneumoniae. A high level of antimicrobial resistance was observed against commonly used antibiotics such as ampicillin, cefuroxime, ciprofloxacin, and gentamicin, while amikacin remained the most effective drug. These findings emphasize the growing challenge of antimicrobial resistance among uropathogens in the community and underscore the urgent need for regular monitoring of local resistance patterns to guide empirical therapy.

Rational antibiotic use, periodic surveillance, and adherence to antibiotic stewardship policies are essential to preserve the efficacy of existing antimicrobial agents. Continuous education of healthcare professionals and the general public regarding appropriate antibiotic usage, along with stricter prescription control, can help curb the escalation of resistant urinary pathogens.

REFERENCES

1. 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 Sep;8(9):DC09-12.
2. Gonzalez CM, Schaeffer AJ. Treatment of urinary tract infection: What's old, what's new, and what works. World J Urol. 1999;17:372–82.
3. Arjunan M, Al-Salamah AA, Amuthan M. Prevalence and antibiotics susceptibility of uropathogens in patients from a rural environment, Tamilnadu. Am J Inf dis. 2010;6:29–33. [Google Scholar]
4. Zelikovic I, Adelman RD, Nancarrow PA. Urinary tract infections in children. An update. West J Med. 1992;157:554–61.
5. Ahmed SM, Avasara AK. Urinary tract infections (UTI) among adolescent girls in Karimnagar District, AP K.A.P STUDY. Indian J Pre Soc Med. 2008;39:12–15.
6. Akram M, Shahid M, Khan AU. Etiology and antibiotic resistance patterns of community acquired urinary tract infections in JNMC Hospital, Aligarh, India. Ann Clin Microbiol Antimicrob. 2007;6:6–11.
7. Omoregie R, Erebor JO, Ahonkhai I, Isobor JO, Ogefere HO. Observed changes in the prevalence of uropathogens in Benin City, Nigeria. NZJ Med Lab Sci. 2008;62:29–31.
8. Omoregie R, Eghafona NO. Urinary tract infection among asymptomatic HIV patients in Benin City, Nigeria. Br J Biomed Sci. 2009;66:190–93.
9. Tambekar DH, Dhanorkar DV, Gulhane SR, Khandelwal VK, Dudhane MN. Antimicrobial susceptibility of some urinary tract pathogens to commonly used antibiotics. Afr J Biotechnol. 2006;5:1562–65.
10. Biswas D, Gupta P, Prasad R, Sinha V, Arya M, Kumar A. Choice of antibiotic for empirical therapy of acute cystitis in setting of high antimicrobial resistance. Indian J Med Sci. 2006;60:53–58.
11. Kothari A, Sagar V. Antibiotic resistance in pathogens causing community acquired urinary tract infections in India: A multicentric study. J Infect. Dev Ctries. 2008;2:354–8.
12. Bauer AW, Kirby WM, Sherris JC, Turck M. Antibiotic susceptibility testing by a standardized single disk method. Am J Clin Pathol. 1966;45:493–96.
13. Clinical and Laboratory Standards Institute (CLSI). Performance standards for antimicrobial susceptibility testing: Nineteenth Informational Supplement. CLSI document M100-S19. Wayne; PA: USA. Clinical and Laboratory Standards Institute, 2009.
14. Oladeinde BH, Omoregie R, Olley M, Anunibe JA. Urinary tract infection in a rural community of Nigeria. N Am J Med Sci. 2011;3:75–77.
15. Orrett FA. Urinary tract infection in general practice in a rural community in south Trinidad. Saudi Med J. 2001;22:537–40. [PubMed] [Google Scholar]
16. García-Morúa A, Hernández-Torres A, Salazar-de-Hoyos JL, Jaime-Dávila R, Gómez-Guerra LS. Community-acquired urinary tract infection etiology and antibiotic resistance in a Mexican population group. Rev Mex Urol. 2009;69:45–48.
17. Sood S, Gupta R. Antibiotic resistance pattern of community acquired uropathogens at a tertiary care hospital in Jaipur, Rajasthan. Indian J Community Med. 2012;37:39–44.
18. Dias Neto JA, Martins AC, Tiraboschi RB, Domingos AL, Cologna AJ, Paschoalin, et al. Community acquired urinary tract infection: Etiology and bacterial susceptibility. Acta Cir Bras. 2003;18:33–36.
19. Khameneh ZR, Afshar AT. Antimicrobial susceptibility pattern of urinary tract pathogens. Saudi J Kidney Dis Transpl. 2009;20:251–53.
20. Selvakumar BN, Jasmine R. Antibiotic Susceptibility of ESBL-producing urinary isolates at a tertiary care hospital in Tiruchirapalli, South India. J Med Sci. 2007;7:443–46.
21. Bahadin J, Teo SS, Mathew S. Aetiology of community-acquired urinary tract infection and antimicrobial susceptibility patterns of uropathogens isolated. Singapore Med J. 2011;52:415–20.
22. Manjunath GN, Prakash R, Annam V, Shetty K. Changing trends in the spectrum of antimicrobial drug resistance pattern of uropathogens isolated from hospitals and community patients with urinary tract infections in Tumkur and Bangalore. Int J Biol Med Res. 2011;2:504–07.
23. Bano K, Khan J, Begum RH, Munir S, Akbar N, Ansari JA, et al. Patterns of antibiotic sensitivity of bacterial pathogens among urinary tract infections (UTI) patients in a Pakistani population. Afr J Microbiol Res. 2012;6:414–20.
24. Rao GG. Risk factors for the spread of antibiotic-resistant bacteria. Drugs. 1998;55:323–30.
25. Wachter DA, Joshi MP, Rimal B. Antibiotic dispensing by drug retailers in Kathmandu, Nepal. Trop Med Int Health. 1999;4:782–88.
26. Larsson M, Kronvall G, Chuc NT, Karlsson I, Lager F, Hanh HD, et al. Antibiotic medication and bacterial resistance to antibiotics: A survey of children in a Vietnamese community. Trop Med Int Health. 2000;5:711–21.