Volume 4, Issue 4, 2026

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

IDENTIFICATION OF MOST COMMON BACTERIAL PATHOGENS CAUSING URINARY TRACT INFECTION IN FEMALES IN LAHORE

Muhammad Ghous[*1], Muzamil Hussain[2], MS Rabia Butt[3], Syeda Iqra Batool Bukhari[4]

[*1,2]*Al Razi Institute, Lahore*
[3]*HOD OF Medical Laboratory Technology at Al Razi Institute*
[4]*lecturer, Al Razi Institute, Lahore*

[2]khalifamuzamil12@gmail.com, [3]rabiabutt@alrazi.edu.pk, [4]iqrabukhari229@gmail.com

DOI:https://doi.org/10.5281/zenodo.21065007

Keywords
urinary tract infection; uropathogens; Escherichia coli; antibiotic resistance; female patients; Lahore; Pakistan

Article History
Received: 25 February 2026
Accepted: 06 April 2026
Published: 21 April 2026

Corresponding Author: *
Muhammad Ghous

Abstract

Background: *Urinary tract infections (UTIs) are among the most prevalent bacterial infections in women, posing significant public health burdens globally. Identifying the dominant uropathogens at local levels is critical for guiding empirical antibiotic therapy and stewardship programs.*

Methods: *A cross-sectional descriptive study was conducted at the Central Diagnostic Laboratory, Mayo Hospital, Lahore. Midstream urine samples were collected from 228 female patients with clinical suspicion of UTI over a three-month period. Samples were cultured on CLED agar at 37°C for 24–48 hours. Bacterial identification was performed using Gram staining and biochemical tests. Antibiotic susceptibility was assessed by the Kirby-Bauer disc diffusion method on Mueller-Hinton agar.*

Results: *Escherichia coli was the predominant uropathogens, isolated from 118 samples (51.8%), followed by Klebsiella pneumoniae in 66 samples (28.9%) and Enterococcus faecalis in 44 samples (19.3%). Multidrug resistance (MDR) was detected in all three pathogens, with notable extended-spectrum beta-lactacase (ESBL) production in K. pneumoniae and vancomycin-resistant Enterococcus (VRE) patterns in select E. faecalis isolates.*

Conclusion: *E. coli remains the primary cause of female UTIs in Lahore, consistent with global trends. The significant co-prevalence of K. pneumoniae and E. faecalis, combined with MDR profiles, underscores the urgent need for continuous local surveillance and targeted antibiotic stewardship.*

INTRODUCTION

Urinary tract infections (UTIs) are characterized by the colonization and proliferation of microorganisms within the urinary tract and represent one of the most common bacterial infections encountered in both community and hospital settings (Flores-Mireles et al., 2015). Globally, UTIs affect more than 400 million individuals annually, with women disproportionately affected because of anatomical factors such as a shorter urethra and the close proximity of the urethral meatus to the anus and vaginal vestibule (Zeng et al., 2023). Approximately 50–60% of women experience at least one UTI during their lifetime, and recurrent infections occur in a substantial proportion of affected individuals, with recurrence rates reaching up to 80% within three months among women with previous infections (Foxman, 2014). Gram-negative bacteria, particularly *Escherichia coli*, account for approximately 70–80% of community-acquired UTIs (Flores-Mireles et al.,

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

2015). Other clinically significant uropathogens include *Klebsiella pneumoniae*, *Enterococcus faecalis*, *Proteus mirabilis*, and *Pseudomonas aeruginosa*, all of which contribute to both uncomplicated and complicated urinary tract infections (Bonkat et al., 2024; Flores-Mireles et al., 2015). The increasing prevalence of multidrug-resistant (MDR) uropathogens has become a major global public health concern, compromising the effectiveness of empirical antimicrobial therapy and emphasizing the need for continuous regional surveillance of bacterial pathogens and antimicrobial susceptibility patterns (Bonkat et al., 2024; World Health Organization, 2023).

Objectives

- For the purpose of identifying and isolating the bacterial pathogens that cause UTIs in female Lahore patients.
- To find out how common the top three bacterial infections that cause UTIs are in the community of women who were chosen.
- To contrast the results with local and national data on frequent female UTI bacteria.
- To offer information that help direct empirical therapy and improve antibiotic management in the treatment of female UTIs in Lahore.

Despite the growing burden of antimicrobial resistance in Pakistan, limited data are available regarding the distribution of bacterial uropathogens among females in Lahore, one of the country's largest metropolitan cities. Therefore, this study aimed to identify the most common bacterial pathogens causing urinary tract infections in females attending a tertiary care laboratory in Lahore and to evaluate their antimicrobial resistance profiles, thereby providing evidence to support appropriate empirical treatment and antimicrobial stewardship practices.

MATERIALS AND METHODS

Study Design and Setting

A cross-sectional descriptive study was conducted over three months at the Central Diagnostic Laboratory, Mayo Hospital, Lahore. Ethical approval was obtained from the institutional review board, and all patient data were anonymized to ensure confidentiality.

Participants

A total of 228 female patients across all age groups with clinical suspicion of UTI were enrolled. Sample size was calculated at a 90% confidence level ($Z = 1.645$), assuming a UTI prevalence of 70% and margin of error of 5%, yielding $n = 228$. Patients with mixed bacterial growth (indicative of contamination) and asymptomatic females were excluded.

Sample Collection and Processing

Midstream clean-catch urine samples were collected in sterile wide-mouthed containers following standard antiseptic precautions. All samples were processed within 1–2 hours of collection (or refrigerated at 2–8°C if delayed). Samples were inoculated onto CLED agar and incubated at 37°C for 24–48 hours. Bacterial identification was performed using Gram staining, colony morphology, and standard biochemical tests (catalase, oxidase, citrate).

Antibiotic Susceptibility Testing

Antibiotic susceptibility was determined by the Kirby-Bauer disc diffusion method on Mueller-Hinton agar, following standard guidelines. Antibiotics tested included ciprofloxacin, norfloxacin, gentamicin, ceftriaxone, imipenem, meropenem, nalidixic acid, fosfomycin, tetracycline, levofloxacin, cefepime, polymyxin B, tigecycline, and co-trimoxazole. Data were analyzed using SPSS version 27.

RESULTS

Sample Characteristics

All 228 urine culture reports were successfully analyzed. No missing observations were recorded for any bacterial isolate, ensuring complete data for descriptive analysis.

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

Table 3.1

Sample Size and Data Completeness (N = 228)

Variable	Valid (n)	Missing (n)
Escherichia coli	228	0
Klebsiella pneumoniae	228	0
Enterococcus faecalis	228	0

All bacterial variables contained complete observations without missing values, allowing analysis based on the entire study sample (N = 228).

Distribution of Bacterial Pathogens

Table 3.2

Frequency Distribution of Bacterial Pathogens Isolated from Urine Samples

Bacterial pathogen	Frequency (n)	Percentage (%)
Escherichia coli	118	51.8
Klebsiella pneumoniae	66	28.9
Enterococcus faecalis	44	19.3
Total	**228**	**100.0**

Among the 228 urine samples analyzed, *Escherichia coli* was the most frequently isolated bacterial pathogen (**51.8%**), followed by *Klebsiella pneumoniae* (**28.9%**) and *Enterococcus faecalis* (**19.3%**). These findings indicate that *E. coli* is the predominant causative organism of urinary tract infections among females in Lahore.

Identification of *Escherichia coli*

Table 3.3

Frequency of Escherichia coli in Urine Samples

Result	Frequency	Percentage (%)
Negative	110	48.2
Positive	118	51.8
Total	**228**	**100.0**

Out of 228 urine samples, **118 (51.8%)** were positive for *Escherichia coli*, whereas **110 (48.2%)** showed no growth of this organism. *E. coli* represented the most commonly isolated uropathogen in the present study.

Identification of *Klebsiella pneumoniae*

Table 3.4

Frequency of Klebsiella pneumoniae in Urine Samples

Result	Frequency	Percentage (%)
Negative	162	71.1
Positive	66	28.9
Total	**228**	**100.0**

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

A total of **66 (28.9%)** urine samples were positive for *Klebsiella pneumoniae*, while **162 (71.1%)** samples were negative. *K. pneumoniae* was identified as the second most common bacterial pathogen isolated from female UTI patients.

Identification of *Enterococcus faecalis*

Table 3.5

Frequency of *Enterococcus faecalis* in Urine Samples

Result	**Frequency**	**Percentage** (%)
Negative	184	80.7
Positive	44	19.3
Total	228	**100.0**

Among the 228 urine samples, **44 (19.3%)** were positive for *Enterococcus faecalis*, whereas **184 (80.7%)** were negative. This organism showed the lowest prevalence among the three bacterial pathogens identified.

Ranking of Bacterial Pathogens

Table 3.6

Ranking of the Most Common Bacterial Pathogens Causing UTIs

Rank	**Bacterial Pathogen**	**Frequency (n)**	**Percentage** (%)
1	*Escherichia coli*	118	51.8
2	*Klebsiella pneumoniae*	66	28.9
3	*Enterococcus faecalis*	44	19.3

Based on the frequency of isolation, *Escherichia coli* was the predominant bacterial pathogen causing urinary tract infections among females in Lahore, accounting for more than half of all isolates. *Klebsiella pneumoniae* ranked second, whereas *Enterococcus faecalis* was the third most frequently isolated organism.

DISCUSSION

Our findings confirmed *Escherichia coli* as the predominant uropathogen causing urinary tract infections (UTIs) among females in Lahore, accounting for **51.8%** of all isolates. This finding is consistent with previous national and international studies reporting that *E. coli* is responsible for approximately 50–70% of community-acquired UTIs (Flores-Mireles et al., 2015; Shaikh et al., 2020). The predominance of *E. coli* is largely attributed to its virulence factors, including adhesins, fimbriae, and biofilm-forming ability, which facilitate colonization of the urinary tract (Flores-Mireles et al., 2015). The prevalence of *Klebsiella pneumoniae* **(28.9%)** observed in this study is comparatively higher than the 11–23% reported in several South Asian studies (Akram et al., 2007; Dash et al., 2013). This regional variation may be associated with differences in antimicrobial prescribing practices, healthcare-associated transmission, and the organism's ability to acquire multidrug resistance through plasmid-mediated mechanisms and biofilm formation (Martin & Bachman, 2018). *Enterococcus faecalis* accounted for **19.3%** of all isolates, which falls within the range reported in previous epidemiological studies (Kline & Lewis, 2016). Although *E. faecalis* is generally considered a less frequent cause of urinary tract infections than Gram-negative bacteria, its intrinsic resistance to several antimicrobial agents, capacity for biofilm formation, and the emergence of vancomycin-resistant enterococci (VRE) have increased its clinical importance (Kline & Lewis, 2016).

Multidrug-resistant (MDR) strains were identified among all three major uropathogens. *Escherichia*

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

coli demonstrated resistance to several commonly prescribed antibiotics, while *Klebsiella pneumoniae* exhibited resistance patterns suggestive of extended-spectrum β-lactamase (ESBL) production. In addition, some *Enterococcus faecalis* isolates demonstrated resistance consistent with vancomycin-resistant enterococci (VRE). The increasing burden of antimicrobial resistance in Pakistan is likely associated with inappropriate antibiotic use, self-medication, inadequate infection control practices, and insufficient antimicrobial stewardship programs (World Health Organization, 2023; Aslam et al., 2021). These findings underscore the importance of routine urine culture and antimicrobial susceptibility testing to guide appropriate therapy instead of relying solely on empirical antibiotic treatment.

Conclusion

Escherichia coli is the predominant cause of female UTIs in Lahore (51.8%), followed by *K. pneumoniae* (28.9%) and *E. faecalis* (19.3%). The high prevalence of MDR strains across all three pathogens necessitates routine local microbiological surveillance, region-specific empirical treatment protocols, and robust antibiotic stewardship programmes. Early, culture-directed therapy remains the cornerstone of effective UTI management in this setting.

Limitations of the Study

The present study has several limitations. It was conducted at a single tertiary care laboratory over a relatively short study period, which may limit the generalizability of the findings to the wider population of Lahore and may not account for seasonal variations in pathogen distribution. Future multicentre studies with larger sample sizes and molecular characterization of resistance genes are recommended to better understand the epidemiology and antimicrobial resistance patterns of uropathogens in Pakistan.

Suggestions and Recommendations

Based on the study findings, routine urine culture and antimicrobial susceptibility testing should be encouraged to guide appropriate antibiotic therapy. Continuous surveillance of uropathogens and antimicrobial resistance, along with strengthened antibiotic stewardship programs, is essential to combat multidrug-resistant bacteria. Public awareness regarding UTI prevention and rational antibiotic use should be promoted. Future multicentre studies with larger sample sizes and molecular analysis of resistance mechanisms are recommended to validate and expand these findings.

References

Akmal, Z., Shahbaz, S., Rehman, W. U., et al. (2023). Antimicrobial susceptibility pattern of uropathogens in UTI patients of Punjab, Pakistan. *International Journal of Health Sciences, 6*(S8), 6811–6830.

Codelia-Anjum, A., et al. (2023). Enterococcal urinary tract infections: A review of pathogenicity, epidemiology, and treatment. *Antibiotics, 12*(4), 778. https://doi.org/10.3390/antibiotics12040778

Czajkowski, K., Broś-Konopielko, M., & Teliga-Czajkowska, J. (2021). Urinary tract infection in women. *Przegląd Menopauzalny (Menopausal Review), 20*(1), 40–47. https://doi.org/10.5114/pm.2021.105895

Glover, E. K., & Sheerin, N. S. (2023). Urinary tract infection. *Medicine, 51*(4), 239–243. https://doi.org/10.1016/j.mpmed.2023.01.006

Guerra, M. E. S., et al. (2022). *Klebsiella pneumoniae* biofilms and their role in disease pathogenesis. *Frontiers in Cellular and Infection Microbiology, 12*, 877995. https://doi.org/10.3389/fcimb.2022.877995

Jalil, M. B., & Al Atbee, M. Y. N. (2022). The prevalence of multiple drug-resistant *Escherichia coli* and *Klebsiella pneumoniae* isolated from patients with urinary tract infections. *Journal of Clinical Laboratory Analysis, 36*(9), e24619. https://doi.org/10.1002/jcla.24619

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Jawad, R., & Hira, C. (2023). Prevalence of urinary tract infection-causing pathogens among different subgroups of the local population. *Journal of Biosciences, 1*(2), 16–27.

Kandel, S., & Sapkota, K. (2025). Prevalence and antibiotic resistance patterns of bacteriuria in patients attending Bharatpur Hospital, Nepal. *Journal of Bharatpur Hospital, 1*(1), 18–23.

Mehboob, M., et al. (2021). Identification and characterization of urinary tract infectious bacteria and its antibiotic sensitivity. *Biomedical Research, 3*(3), 43–62.

Salm, J., et al. (2023). High frequency of *Enterococcus faecalis* in urinary tract infections in male outpatients. *BMC Infectious Diseases, 23*(1), 812. https://doi.org/10.1186/s12879-023-08812-4

Silva, A., Costa, E., Freitas, A., & Almeida, A. (2022). Revisiting the frequency and antimicrobial resistance patterns of bacteria implicated in community urinary tract infections. *Antibiotics, 11*(6), 768. https://doi.org/10.3390/antibiotics11060768

Turcu, F. L., et al. (2025). Recurrent urinary tract infections in female patients: A clinical review. *Medical Sciences, 12*(1), 5.