Section: Miscellaneous

Original Research Article

ASSOCIATION OF HOST FACTORS AND UROPATHOGENS AMONG PATIENTS ATTENDING A TERTIARY CARE HOSPITAL IN SINDHUDURG DISTRICT, MAHARASHTRA: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Urinary tract infections (UTIs) are among the most common bacterial infections encountered in clinical practice and are a significant contributor to morbidity, antibiotic use, and antimicrobial resistance. The distribution of uropathogens and their association with host-related risk factors vary across settings, necessitating region-specific data for effective management. The objective is to determine the association between selected host factors and uropathogens among patients with suspected UTI attending a tertiary care hospital in Sindhudurg District, Maharashtra.

Materials and Methods: A hospital-based cross-sectional analytical study was conducted during 2025 at SSPM Medical College and Research Centre, Padve, Sindhudurg. A total of 425 clinically suspected UTI patients were included using consecutive sampling. Data on socio-demographic characteristics, clinical presentation, and host factors such as diabetes mellitus, pregnancy, prior antibiotic use, recurrent UTI, catheterization, and recent hospitalization were collected using a structured proforma. Urine samples were processed using standard microbiological techniques. Data were analysed using descriptive statistics, chi-square test, and logistic regression. A p-value <0.05 was considered statistically significant.

Results: Out of 425 patients, 182 (42.8%) showed culture-positive UTI. Females constituted 66.6% of the study population. The most common uropathogen isolated was Escherichia coli (51.6%), followed by Klebsiella pneumoniae (17.6%) and Enterococcus spp. (9.9%). Culture positivity was significantly associated with female sex (p=0.012), age >60 years (p=0.041), diabetes mellitus (p=0.001), recurrent UTI (p<0.001), prior antibiotic use (p=0.028), catheterization (p<0.001), and recent hospitalization (p=0.003). Non-E. coli uropathogens were more frequently observed among patients with catheterization, diabetes mellitus, prior antibiotic use, and recent hospitalization. On multivariable analysis, catheterization (AOR 3.12), recurrent UTI (AOR 2.84), diabetes mellitus (AOR 2.21), and recent hospitalization (AOR 2.09) were independent predictors of culture-positive UTI.

Conclusion: UTIs in the present study were significantly associated with key host factors, particularly diabetes mellitus, recurrent UTI, catheterization, and healthcare exposure. While Escherichia coli remained the predominant pathogen, non-E. coli organisms were common among high-risk patients. Identification of host-risk profiles and local uropathogen patterns is essential for rational antibiotic therapy and strengthening antimicrobial stewardship in tertiary care settings.

Keywords: Urinary tract infection, uropathogens, host factors, Escherichia coli, antimicrobial resistance, tertiary care hospital, Maharashtra.

INTRODUCTION

Urinary tract infection (UTI) is one of the most common bacterial infections encountered in outpatient and inpatient clinical practice. It affects individuals across all age groups and contributes substantially to morbidity, laboratory workload, antibiotic prescription, hospital admission, and health-care expenditure. Clinically, UTI may present as asymptomatic bacteriuria, cystitis, pyelonephritis, catheter-associated UTI, complicated UTI, or urosepsis depending on the host profile and site of infection.[1,2]

The causative organisms of UTI vary according to patient characteristics and health-care exposure. Globally and in India, Gram-negative bacilli remain the predominant uropathogens, with Escherichia coli being the most frequently isolated organism, followed by Klebsiella pneumoniae, Proteus spp., Pseudomonas aeruginosa, and other Enterobacterales. Gram-positive organisms such as Enterococcus spp. and Staphylococcus saprophyticus, and fungal isolates such as Candida spp., are also encountered, particularly among hospitalized, catheterized, elderly, diabetic, or immunocompromised patients.[3,4]

Host factors play a central role in determining both susceptibility to UTI and the type of uropathogen isolated. Female sex, extremes of age, pregnancy, diabetes mellitus, urinary tract obstruction, renal calculi, recurrent UTI, prior antibiotic exposure, hospitalization, and urinary catheterization are well-recognized risk factors.[5,6] In women, anatomical and physiological factors increase the risk of ascending infection, while pregnancy predisposes to urinary stasis and asymptomatic bacteriuria. In elderly males, prostatic enlargement, urinary retention, comorbid illness, and catheter use increase the risk of complicated UTI.[2,7]

Diabetes mellitus is an important host factor because hyperglycaemia, glycosuria, impaired immune response, autonomic bladder dysfunction, and incomplete bladder emptying increase the risk of UTI and recurrent infection. Diabetic patients are also more likely to develop complicated UTI and infections due to resistant or non-E. coli organisms.[5,8] Similarly, catheterization alters the normal urinary tract defence mechanisms and promotes biofilm formation, thereby increasing the risk of catheter-associated UTI and infection with multidrug-resistant organisms.[6]

The public health importance of UTI has increased due to rising antimicrobial resistance among common uropathogens. The World Health Organization has highlighted reduced susceptibility among E. coli causing UTI to commonly used antibiotics such as ampicillin, co-trimoxazole, and fluoroquinolones.[9] Indian antimicrobial resistance surveillance reports also identify E. coli and Klebsiella pneumoniae among the major pathogens contributing to the national AMR burden.[10] This is clinically important because empirical treatment without culture guidance may lead to treatment failure, recurrent infection, prolonged hospital stay, and further selection of resistant organisms.

Although several studies have described the bacteriological profile of UTI, local data are essential because uropathogen distribution and host-risk patterns differ across regions, hospitals, patient groups, and antibiotic-use practices. Evidence from a tertiary care hospital in Sindhudurg district is particularly useful for guiding empirical treatment, strengthening laboratory-based surveillance, identifying high-risk patients, and supporting antimicrobial stewardship.

Therefore, the present study titled “Association of Host Factors and Uropathogens in a Tertiary Care Hospital, Maharashtra” was undertaken at SSPM Medical College and Research Centre, Padve, Sindhudurg District, Maharashtra, during 2025 to assess the association between selected host factors and uropathogens among patients suspected of UTI.

MATERIALS AND METHODS

A hospital-based cross-sectional analytical study was conducted during the year 2025 at SSPM Medical College and Research Centre, Padve, Sindhudurg District, Maharashtra. The study was designed to assess the association between selected host factors and uropathogens among patients clinically suspected of urinary tract infection.

The study population consisted of patients attending the outpatient departments, emergency services, and inpatient wards of the tertiary care hospital who were clinically suspected to have urinary tract infection and were advised urine culture and sensitivity testing. Patients of all age groups were considered eligible for inclusion. Written informed consent was obtained from adult participants, while consent for minors was obtained from parents or guardians.

Patients with improperly collected urine samples, contaminated or rejected samples, incomplete clinical records, and repeat samples from the same patient during the same episode of illness were excluded from the study. Consecutive sampling was used, and all eligible patients were enrolled until the required sample size was achieved.

The sample size was calculated using the formula $n = Z^2pq/d^2$, taking the expected prevalence as 50% to obtain the maximum sample size, with 95% confidence level and 5% absolute precision. The calculated sample size was 384. After adding 10% for incomplete records or non-response, the final sample size was rounded to 425 patients.

Data were collected using a predesigned and pretested structured proforma. Information regarding age, sex, residence, clinical symptoms, pregnancy status, diabetes mellitus, chronic kidney disease, recurrent UTI, prior antibiotic use, urinary catheterization, renal stone or urinary obstruction, and recent hospitalization was recorded. Clinical

symptoms such as dysuria, frequency, urgency, suprapubic pain, fever, flank pain, hematuria, vomiting, and altered sensorium were documented wherever applicable.

Urine samples were collected before initiation of antibiotics whenever possible. Clean-catch midstream urine samples were collected in sterile containers after explaining the correct collection procedure to the patients. In catheterized patients, urine was collected aseptically from the catheter sampling port and not from the urine collection bag. Samples were transported promptly to the microbiology laboratory for processing.

Urine culture was performed using standard microbiological techniques as per institutional laboratory protocol. Significant growth was interpreted based on standard colony count criteria. The isolated organisms were identified by colony morphology, Gram staining, biochemical reactions, and other routine microbiological methods. The uropathogens were further classified as Gram-negative bacteria, Gram-positive bacteria, and fungal isolates.

The main outcome variable was culture-positive urinary tract infection. The secondary outcome variables included type of uropathogen isolated and classification into Escherichia coli and non-Escherichia coli isolates. The independent variables included socio-demographic factors, clinical presentation, and host factors such as diabetes mellitus, pregnancy, recurrent UTI, prior antibiotic use, catheterization, recent hospitalization, chronic kidney disease, and urinary obstruction.

Data were entered in Microsoft Excel and analysed using appropriate statistical software. Categorical variables were expressed as frequencies and percentages. Continuous variables were expressed as mean with standard deviation or median with interquartile range depending on data distribution. The chi-square test or Fisher's exact test was used to assess the association between host factors and culture positivity. Logistic regression analysis was performed to identify independent predictors of culture-positive UTI. A p-value of less than 0.05 was considered statistically significant.

Ethical clearance was obtained from the Institutional Ethics Committee of SSPM Medical College and Research Centre, Padve, Sindhudurg District, Maharashtra. Confidentiality of participant information was maintained throughout the study, and data were used only for research purposes.

RESULTS

A total of 425 clinically suspected UTI patients were included. Of these, 182 showed significant growth on urine culture, giving a culture positivity rate of 42.8%.

Table 1: Socio-demographic profile of study participants

Variable	Frequency	Percentage
Total participants	425	100
Male	142	33.4
Female	283	66.6
Age <18 years	38	8.9
Age 18–40 years	156	36.7
Age 41–60 years	128	30.1
Age >60 years	103	24.3
Rural residence	276	64.9
Urban residence	149	35.1

Females constituted nearly two-thirds of the study population. The highest proportion of suspected UTI cases was observed in the 18–40 years age group.

Table 2: Distribution of host factors among study participants

Host factor	Frequency	Percentage
Diabetes mellitus	96	22.6
Pregnancy	42	9.9
Recurrent UTI	78	18.4
Prior antibiotic use	112	26.4
Urinary catheterization	58	13.6
Recent hospitalization	74	17.4
Chronic kidney disease	31	7.3
Renal stone/urinary obstruction	44	10.4

The common host factors observed were prior antibiotic use, diabetes mellitus, recurrent UTI, and recent hospitalization.

Table 3: Urine culture results

Culture result	Frequency	Percentage
Culture positive	182	42.8
Culture negative	229	53.9
Contaminated/rejected	14	3.3
Total	425	100

Significant bacteriuria was detected in 42.8% of clinically suspected cases.

Table 4: Spectrum of uropathogens isolated

Uropathogen	Frequency	Percentage
Escherichia coli	94	51.6
Klebsiella pneumoniae	32	17.6
Enterococcus spp.	18	9.9
Pseudomonas aeruginosa	14	7.7
Proteus spp.	10	5.5
Staphylococcus saprophyticus	6	3.3
Candida spp.	5	2.7
Others	3	1.7
Total	182	100

The most common uropathogen isolated was Escherichia coli, followed by Klebsiella pneumoniae and Enterococcus spp.

Table 5: Association between host factors and culture positivity

Host factor	Culture positive n (%)	Culture negative n (%)	p-value
Female sex	134 (47.3)	149 (52.7)	0.012
Age >60 years	52 (50.5)	51 (49.5)	0.041
Diabetes mellitus	55 (57.3)	41 (42.7)	0.001
Pregnancy	23 (54.8)	19 (45.2)	0.089
Recurrent UTI	48 (61.5)	30 (38.5)	<0.001
Prior antibiotic use	57 (50.9)	55 (49.1)	0.028
Catheterization	38 (65.5)	20 (34.5)	<0.001
Recent hospitalization	43 (58.1)	31 (41.9)	0.003

Culture positivity was significantly associated with female sex, age above 60 years, diabetes mellitus, recurrent UTI, prior antibiotic use, catheterization, and recent hospitalization.

Table 6: Association between host factors and type of uropathogen

Host factor	E. coli n (%)	Non-E. coli n (%)	p-value
Female sex	76 (56.7)	58 (43.3)	0.038
Diabetes mellitus	22 (40.0)	33 (60.0)	0.021
Catheterization	10 (26.3)	28 (73.7)	<0.001
Recent hospitalization	16 (37.2)	27 (62.8)	0.007
Prior antibiotic use	24 (42.1)	33 (57.9)	0.034
Recurrent UTI	26 (54.2)	22 (45.8)	0.614

Non-E. coli uropathogens were more frequently isolated among patients with catheterization, recent hospitalization, diabetes mellitus, and prior antibiotic exposure.

Table 7: Logistic regression analysis for predictors of culture-positive UTI

Variable	Adjusted Odds Ratio	95% CI	p-value
Female sex	1.72	1.08–2.75	0.022
Age >60 years	1.58	1.01–2.49	0.046
Diabetes mellitus	2.21	1.34–3.64	0.002
Recurrent UTI	2.84	1.65–4.89	<0.001
Prior antibiotic use	1.67	1.03–2.72	0.038
Catheterization	3.12	1.67–5.84	<0.001
Recent hospitalization	2.09	1.21–3.61	0.008

On multivariable logistic regression, catheterization, recurrent UTI, diabetes mellitus, recent hospitalization, female sex, age above 60 years, and prior antibiotic use were independent predictors of culture-positive UTI.

In the present study, 425 clinically suspected UTI patients were included, of whom 182 were culture positive, giving a culture positivity rate of 42.8%. Females constituted 66.6% of the study population. The highest proportion of suspected UTI cases was observed among patients aged 18–40 years.

Among the culture-positive cases, Escherichia coli was the predominant isolate, accounting for 51.6% of isolates. This was followed by Klebsiella pneumoniae in 17.6%, Enterococcus spp. in 9.9%, Pseudomonas aeruginosa in 7.7%, Proteus spp. in 5.5%, Staphylococcus saprophyticus in 3.3%, and Candida spp. in 2.7%.

Culture positivity was significantly associated with female sex, age above 60 years, diabetes mellitus, recurrent UTI, prior antibiotic use, urinary catheterization, and recent hospitalization. Non-E. coli uropathogens were more commonly isolated among patients with catheterization, diabetes mellitus, recent hospitalization, and prior antibiotic exposure.

On multivariable logistic regression, catheterization was the strongest independent predictor of culture-positive UTI, followed by recurrent UTI, diabetes mellitus, recent hospitalization, female sex, age above 60 years, and prior antibiotic use.

DISCUSSION

In the present study, culture positivity among clinically suspected UTI cases was 42.8%, indicating

that a substantial proportion of clinically suspected cases had microbiological confirmation. This finding supports the importance of urine culture, particularly in tertiary care settings where patients often present with recurrent symptoms, comorbidities, prior antibiotic exposure, or complicated UTI. Similar hospital-based studies have shown variable culture positivity because of differences in study population, prior antibiotic use, sample collection methods, and laboratory criteria.[11]

The present study found Escherichia coli as the predominant uropathogen, accounting for 51.6% of culture-positive cases, followed by Klebsiella pneumoniae, Enterococcus spp., Pseudomonas aeruginosa, and Proteus spp. This pattern was consistent with previous studies in which E. coli remained the leading organism causing UTI, followed by other Gram-negative bacilli and Gram-positive cocci.[11,12] The predominance of E. coli may be explained by its ability to colonize the periurethral area, adhere to uroepithelial cells, and ascend into the urinary tract.

Female sex was significantly associated with culture-positive UTI in this study. This finding was expected because women are anatomically more prone to ascending urinary infection due to a shorter urethra and proximity of the urethral opening to the perineal region. Hormonal changes, sexual activity, pregnancy, and postmenopausal changes may further increase susceptibility among women.[1,2]

Diabetes mellitus was significantly associated with culture positivity and also showed a higher proportion of non-E. coli uropathogens. Similar findings have been reported in diabetic patients, where impaired immunity, glycosuria, autonomic neuropathy, incomplete bladder emptying, and recurrent antibiotic exposure increase the risk of UTI and complicated infection.[13] In the present study, diabetic patients had more than two times higher odds of culture-positive UTI, suggesting that diabetes should be considered an important host factor while evaluating suspected UTI.

Recurrent UTI was one of the strongest predictors of culture positivity. Patients with recurrent UTI may have persistent colonization, underlying anatomical or functional urinary tract abnormalities, incomplete prior treatment, or infection with resistant organisms. Recurrent episodes also increase the probability of repeated antibiotic exposure, which may alter the normal flora and promote selection of resistant uropathogens.[3,9]

Urinary catheterization showed the strongest association with culture-positive UTI in the present study. Catheterized patients had higher odds of UTI and a greater proportion of non-E. coli organisms. This finding is biologically plausible because urinary catheters bypass natural host defence mechanisms and provide a surface for biofilm formation. Catheter-associated UTI is one of the most common healthcare-associated infections and is frequently linked with multidrug-resistant organisms.[14]

Recent hospitalization and prior antibiotic use were also significantly associated with culture-positive UTI and non-E. coli uropathogens. Hospital exposure increases contact with resistant organisms, while prior antibiotic use may suppress susceptible bacteria and allow resistant pathogens to emerge. These findings reinforce the need for culture-guided therapy and antimicrobial stewardship, especially in patients with healthcare exposure.[9,10]

The isolation of Klebsiella pneumoniae, Pseudomonas aeruginosa, Enterococcus spp., and Candida spp. among selected patients suggests that complicated and healthcare-associated UTI should not be managed only with the assumption of E. coli infection. Non-E. coli pathogens are more likely among elderly, diabetic, catheterized, hospitalized, and previously treated patients. Therefore, empirical antibiotic selection should be guided by patient risk profile and local antibiogram rather than uniform treatment for all suspected UTI cases.[14,15]

From a community medicine and public health perspective, the study highlights the importance of identifying high-risk host factors at the first point of care. Screening for diabetes, documentation of prior antibiotic use, catheter history, recurrent symptoms, pregnancy status, and recent hospitalization can help clinicians classify patients into uncomplicated and complicated UTI groups. This risk-based approach can reduce inappropriate antibiotic use, improve treatment outcomes, and support antimicrobial resistance containment.

The findings also have implications for hospital infection control. Catheter use should be minimized, aseptic catheter insertion should be ensured, catheter care bundles should be implemented, and daily review for catheter removal should be practiced. For diabetic and elderly patients, early diagnosis, glycaemic control, hydration, personal hygiene, and follow-up after treatment are important preventive strategies.

The present study had certain limitations. Being hospital-based, the findings may not represent the true community burden of UTI in Sindhudurg district. Prior antibiotic use may have influenced urine culture positivity. The study focused on host factors and uropathogen distribution; detailed molecular characterization of resistance mechanisms was not performed. Despite these limitations, the study provides useful local evidence from a tertiary care hospital in coastal Maharashtra and may help guide empirical treatment policy and antimicrobial stewardship.

Overall, the present study demonstrated that UTI was significantly associated with host factors such as female sex, older age, diabetes mellitus, recurrent UTI, prior antibiotic use, catheterization, and recent hospitalization. Escherichia coli remained the most common uropathogen, while non-E. coli organisms were more frequent among patients with complicated and healthcare-associated risk factors.

CONCLUSION

UTIs in the present study were significantly associated with key host factors, particularly diabetes mellitus, recurrent UTI, catheterization, and healthcare exposure. While Escherichia coli remained the predominant pathogen, non-E. coli organisms were common among high-risk patients. Identification of host-risk profiles and local uropathogen patterns is essential for rational antibiotic therapy and strengthening antimicrobial stewardship in tertiary care settings.

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