# To Determine the Profile of Community Acquired and Hospital Associated Urinary Tract Infections Pathogen and Their Susceptibility Pattern with Special Reference to MRSA, ESBL, MBLS and AMPCS

**Meet Gupta[1], Geeta Gupta[2], Gajendra Kumar Gupta[3], Charul Sahu[1]**

[1]Post Graduate Resident, Department of Microbiology, Santosh Medical College and Hospitals, Ghaziabad, Uttar Pradesh, India. [2]Professor, Department of Microbiology, Santosh Medical College and Hospitals, Ghaziabad, Uttar Pradesh, India. [3]Professor, Department of Community Medicine, Santosh Medical College and Hospitals, Ghaziabad, Uttar Pradesh, India

## Abstract

**Background:** Urinary tract infections are a significant health issue, ranking as the second most common hospital-acquired infection. The most frequently identified pathogens in urine samples associated with UTIs were E coli, Klebsiella spp., Proteus spp., Pseudomonas spp., and Staphylococcus spp. The pathogen is notorious for developing resistance quickly. Multi-drug-resistant isolates lead to increased morbidity and mortality. The aim is to study the profile of community-acquired and hospital-associated urinary tract infection pathogens and their susceptibility pattern with special reference to MRSA, ESBL, MBLs, and Amp Cs. **Material and Methods:** The current cross-sectional study was conducted at the Department of Microbiology at Santosh Medical College and Hospital in Ghaziabad, Uttar Pradesh, India. The study was conducted over 12 months, from January 2024 to December 2024. A total of 384 suspected UTI urine samples were received in the Department of Microbiology, and 246 were confirmed UTI cases. The samples were processed, and Microscopy, Culture, and standard biochemical tests identified uropathogens. Antibiotic testing was performed using the Kirby-Bauer disc diffusion method. Antibiotic discs were taken for GPC and GNB accordingly. **Results:** Overall, 246 cases (64.06%) were confirmed UTI cases. Out of 246 samples, 226 (91.86%) were community-acquired UTI, while 20 (8.13%) were hospital-associated UTI. E. coli was the most commonly isolated organism. The total number of gram-positive cocci isolated was 24, and the total number of gram-negative bacilli isolated was 207. The antibiotic susceptibility profile showed that vancomycin, linezolid, and levofloxacin were the most sensitive drugs for gram-positive cocci, and that colistin, meropenem, and imipenem were the most sensitive drugs for gram-negative bacilli. The prevalence of MRSA was 72.7%, ESBL 21.25%, MBL 7.2%, and AmpC 12.5%. **Conclusion:** The study showed that antibiotics such as Erythromycin, clindamycin, sulfamethoxazole, and gentamicin were ineffective against Gram-positive cocci, and that ampicillin, cefepime, nitrofurantoin, and sulfamethoxazole were ineffective against Gram-negative bacilli. The antimicrobial susceptibility testing profile identifies the drug of choice for treating UTI, so patients can be treated promptly and effectively in most cases.

**Keywords:** UTI, CA-UTI, Antibiogram, Antimicrobial Susceptibility test, Uropathogens.

## INTRODUCTION

Urinary tract infections (UTIs) are the second most prevalent hospital-acquired infections, accounting for 35 percent of all nosocomial infections. Approximately 10% of individuals experience urinary tract infections at some point in their lives. The issue of UTI affects both males and females of all ages, including neonates. The primary predisposing factors for UTIs include age, gender, lack of nutrition, poor socioeconomic status with inadequate hygiene, and functional and structural disorders of the urinary tract. The most frequently isolated pathogenic microorganisms in urine are Escherichia coli, Klebsiella species, Staphylococcus saprophyticus, Proteus spp., and Pseudomonas spp.[1]

Urinary tract infections are classified as uncomplicated or complicated, depending on the route of infection: ascending or hematogenous. In females, the ascending route is more common, and organisms originate from a faecal or vaginal source. Treatment of diseases is often complicated by the increasing prevalence of multidrug-resistant gram-positive cocci and gram-negative bacilli, which are a growing concern due to their association with higher morbidity, mortality, prolonged hospital stays, and rising health care costs.

MRSA is also associated with a high occurrence of complications, longer hospital stays, and duration of therapy.[2] AmpC and carbapenemases are the primary causes of multidrug resistance in Gram-negative bacilli, as they are emerging β-

lactamases (ESBLs). To prevent resistant UTIs and reduce hospital stays, it is necessary to detect MRSA, ESBLS, MBLs, and AmpC.[3]

## MATERIALS AND METHODS

The present cross-sectional study was conducted at the Department of Microbiology, Santosh Medical College and Hospital, Ghaziabad, Uttar Pradesh, India. The study was conducted over 12 months, from January 2024 to December 2024. Written informed consent was obtained from all participants in the study for the collection of urine samples from IPD and OPD in sterile containers. The samples were processed, and Microscopy, Culture, and standard biochemical tests identified uropathogens.

**Microscopy:** Wet mount preparation (to see pus cells and the number of bacteria per high-power field). Culture: samples were streaked on three different types of agar plates, Blood agar, MacConkey agar, and CLED agar. The culture plates were then incubated at 37°C for 18-24 hours. Bacterial counts were performed by counting colonies and multiplying the colony-forming units (CFU) by 1000 to determine the number of microorganisms per milliliter in the original specimen. The KASS Criteria were employed to determine the colony count in urine.

Hanging drop and Gram staining were done, followed by biochemical tests.

Colonies were sub-cultured into peptone water, and the following tests were performed: Coagulase test, Oxidase fermentation test, Catalase test, Oxidase test, Indole test, Methyl red test, Vogues Proskauer test, Simmons citrate utilization test, Urease test, triple sugar iron test, nitrate

reduction test, sugar fermentation test-glucose, lactose, sucrose, maltose, mannitol, xylose.[4,5]

Antibiotic testing is performed by the Kirby-Bauer disc diffusion method. Antibiotic discs were taken for GPC and GNB accordingly. For the detection of MRSA, Cefoxitin 30 micrograms is used (zone size less than < 21mm).[6] For Extended spectrum beta lactamases detection, cephalosporin with and without clavulanic acid was placed (zone- >5 mm larger than cephalosporin alone).[7] Detection of MBLs- Two 10-microgram imipenem disks were placed in an MHA plate, 1 plane and 2nd with EDTA (zone- ≥ 7 mm).[8] Detection of AMP C- cefotaxime and ceftazidime 30 micrograms were placed.[9,10]

## RESULTS

The study was a cross-sectional study conducted in the Department of Microbiology, Santosh Medical College. Ghaziabad for a period of twelve months from January 2024 to December 2024. The majority of UTI cases are found in younger Adults. The females constituted a slightly higher proportion of UTI cases (203, 52.9%) than males (181, 47.1%). Of 246 samples, 226 (91.86%) were community-acquired UTI, while 20 (8.13%) were hospital-acquired UTI. E. coli was the most commonly isolated organism. The total number of gram-positive cocci isolated was 24. Out of which 11 were Staphylococcus aureus, and 13 were Streptococcus spp. Out of 11 isolates of Staphylococcus aureus, 8 were MRSA, and 3 were MSSA. Out of 13 Streptococcus spp., 10 were Enterococcus faecalis, and 3 were Streptococcus agalactiae. Antibiotic susceptibility profile of gram-positive cocci response, Vancomycin and Linezolid both had 100% sensitivity.

**Table 1: Antibiotic Susceptibility profile for Gram-Positive Cocci (GPC)**

| Antibiotic | Sensitive | Intermediate | Resistant |
|---|---|---|---|
| Penicillin G | 76% | 6% | 18% |
| Ampicillin | 74% | 14.8% | 11.2% |
| Tigecycline | 80% | 4.9% | 15.1% |
| Levofloxacin | 88% | 7% | 5% |
| Erythromycin | 51% | 10.8% | 38.2% |
| Clindamycin | 62% | 7% | 31% |
| Vancomycin | 100% | 0% | 0% |
| Linezolid | 100% | 0% | 0% |
| Sulfamethoxazole | 71% | 8.6% | 20.4% |
| Amoxicillin + Clavulanic Acid | 50% | 45% | 15% |
| Gentamicin | 74% | 5.9% | 20.1% |
| Nitrofurantoin | 76% | 10% | 14% |
| Oxacillin | 50% | 7% | 43% |

The total number of gram-negative bacilli isolated was 207, out of which E. coli was the most common. Antibiotic susceptibility profile of gram-negative bacilli, colistin, meropenem, and imipenem was mostly sensitive to these drugs.

**Table 2: Antibiotic Susceptibility Profile for Gram-Negative bacilli (GNB)**

| Antibiotic | Sensitive | Intermediate | Resistant |
|---|---|---|---|
| Ampicillin | 31.7% | 14.3% | 54% |
| Amoxicillin-Clavulanic Acid | 43.2% | 33.8% | 23% |
| Piperacillin-Tazobactam | 64.1% | 18.8% | 17.1% |
| Ceftriaxone | 65% | 17.8% | 17.2% |
| Ceftazidime | 69% | 29% | 2% |
| Cefepime | 42.1% | 11.9% | 46% |
| Gentamicin | 80.1% | 13.9% | 6% |
| Amikacin | 94.3% | 2.2% | 3.5% |

| | | | |
|---|---|---|---|
| Ciprofloxacin | 53% | 29% | 18% |
| Tigecycline | 90% | 9% | 1% |
| Nitrofurantoin | 28% | 39% | 33% |
| Sulfamethoxazole | 56.2% | 17.8% | 26% |
| Meropenem | 97% | 0.2% | 2.8% |
| Imipenem | 94.2% | 2.8% | 3% |
| Levofloxacin | 83.1% | 4.9% | 12% |
| Tobramycin | 78% | 19% | 3% |
| Colistin | 99.7% | 0.3% | 0% |

Distribution of study subjects by resistance pattern (MRSA, ESBL, MBL, and AmpC) across organisms. In this study, MRSA resistance was observed only in 8 cases of Staphylococcus. ESBL resistance was found in 44 isolates, with E. coli being the most common (24), followed by Klebsiella (12) and Proteus (8). MBL resistance was observed in 15 cases, predominantly in E. coli (13) and Proteus (2). AmpC resistance was observed in 17 cases: E. coli (17), Klebsiella (5), and Proteus (4). This highlights the significant presence of multidrug-resistant strains among these organisms.

**Table 3: Distribution of study subjects according to resistance Pattern MRSA, ESBL, MBL, AmpC by organisms**

| Susceptibility | Organism | | | | Total |
|---|---|---|---|---|---|
| | E. coli | Proteus | Klebsiella | Staphylococcus | |
| MRSA | 0 | 0 | 0 | 8 | 8 |
| ESBL | 24 | 8 | 12 | 0 | 44 |
| MBL | 13 | 2 | 0 | 0 | 15 |
| Amp C | 17 | 4 | 5 | 0 | 26 |

## Discussion

In this study, 384 patients suspected of UTI were included. 384 samples were collected from IPD & OPD and processed to identify uropathogens by microscopy, culture, and biochemical tests, followed by antibiotic susceptibility testing using the Kirby-Bauer disc diffusion method. All processes were done as per the recommended guidelines. The most common age group affected is 21- 30 yrs (22.9%). Khan et al. (2023) reported similar age-related findings, noting a higher incidence of UTIs in the 21-30 yrs age group, which aligns with the present study's data. Younger Females were found to be most commonly affected in our study, similar to other studies.[11] this may be due to their lifestyle and more sexual activity in their age group and short urethra.[1] Rahman et al. (2023) also found that 60% of the UTI cases in their study were female patients, while only 40% were male, further corroborating the tendency for females to be more affected by UTIs.[12] Another study conducted in Bhubaneshwar found that UTI was more prevalent among people aged 60-69 years. E. coli was the most common among OPD, IPD, and ICU elderly patients.[13]

In our study, we found that 64.06% were culture-positive and 35.9% were culture-negative. The maximum number of cases was found in the medicine department, followed by the surgery and obstetrics and gynae departments. Out of 246 samples, 20 (8.1%) cases were hospital-acquired UTI, and 226 (91.8%) cases were community-acquired UTI. Out of 246 samples, 191 cases were symptomatic patients, and 55 cases were asymptomatic patients. E. coli was the most common organism isolated. Among symptomatic cases, 22.13% presented with increased frequency of urination, 20.3% with abdominal pain, and 19.5% had fever. In a study conducted by other researchers, fever was the most prevalent symptom (73%), and approximately one-third of the patients experienced dysuria, increased urinary frequency, or a change in the scent of their urine.[14] Nauman Khalid et al. 2023,[15] reported higher rates of hospital-acquired infections caused by E. coli (20%) and Klebsiella (15%), suggesting a more pronounced distinction between hospital- and community-acquired infections in their sample. Their findings contrast with the present study data, where E. coli and Klebsiella were more prevalent in community-acquired cases.[13]

The most sensitive drugs for the gram-positive cocci were Vancomycin and Linezolid, 100% effectiveness, followed by levofloxacin (88%), Tigecycline (80%), Penicillin G (76%), Nitrofurantoin (76%), Gentamicin (74%), and Ampicillin (74%). The most sensitive drugs for Gram-negative bacilli were: Colistin s(99.7%), followed by Meropenem (97%), Imipenem (94.2%), Amikacin (94.3%), Tigecycline (90%), Levofloxacin (83.1%), Gentamicin (80.1%), and Tobramycin (78%). Similar results were reported by Muzamil Khan et al in 2024 in their study.[16] In the present study, the prevalence of MRSA was 72.7% (8 out of 11 isolates), ESBL 21.25% (44 out of 207 isolates), MBL 7.2% (15 out of 207 isolates), and Amp C 12.5% (26 out of 207 isolates). Similar results were found by Gaurav Dalela et al. (2012). The overall prevalence of ESBL and Amp C β-lactamase, and the coexistence of the phenotype (ESBL + Amp sC β-lactamase) and MRSA in the urinary isolates were reported as 66.9%, 21.1%, 3.5%, and 42.4%, respectively.[17]

## Conclusion

The study showed that antibiotics such as Erythromycin, clindamycin, sulfamethoxazole, and gentamicin were ineffective against Gram-positive uropathogens. Antibiotics like ampicillin, cefepime, nitrofurantoin, sulfamethoxazole, amoxicillin, clavulanic acid, and piperacillin-tazobactam were not effective for uropathogens belonging to Gram-negative bacilli. MRSA, ESBL, MBL, and AmpC were more prevalent in isolated organisms belonging to Gram-positive cocci and Gram-negative bacilli. The antimicrobial susceptibility testing profile identifies

the drug of choice for treating UTI, so patients can be treated promptly and effectively in most cases.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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