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# EVALUATION OF ANTIBIOTIC SUSCEPTIBILITY PROFILES IN BACTERIAL ISOLATES FROM URINARY TRACT INFECTIONS

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**ABSTRACT**

**Background:** Urinary tract infections (UTIs) represent prevalent bacterial infections globally, with a higher incidence observed in females and individuals with compromised immune systems. The increasing prevalence of antimicrobial resistance (AMR) among uropathogens complicates treatment protocols and underscores the necessity for continuous monitoring of bacterial species and their antibiotic susceptibility profiles. **Methodology:** In this cross-sectional study, 200 individuals exhibiting UTI symptoms were included. Urine samples were collected midstream, cultured, and analysed to detect bacterial growth. The Kirby-Bauer disc diffusion method, in accordance with CLSI recommendations, was used to assess the antibiotic susceptibility of isolated microorganisms. We used IBM SPSS Version 25.0 for our statistical study. **Results:** There was a high concentration of positive in 25 out of 200 urine samples (12.5%). *Pseudomonas aeruginosa, Klebsiella pneumoniae, Staphylococcus aureus, Proteus mirabilis,* and *Escherichia coli* accounted for the next most prevalent isolates, with 56% of the total. The high sensitivities were obtained with nitrofurantoin (92%), ceftriaxone (88%), ciprofloxacin (88%), and gentamicin (84%). The reason for worry is that 76% of culture-positive isolates were multi-drug resistant, with the highest MDRs reported for Proteus mirabilis and E. coli. **Conclusion:** The study reveals a significant occurrence of multidrug-resistant uropathogens, with *E. coli* being particularly prominent, complicating empirical treatment of UTIs. While antibiotics like nitrofurantoin and ceftriaxone remain effective, the rising resistance rates highlight the importance of routine culture-based diagnostics. Additionally employing local antibiograms and antibiotic stewardship programs is crucial for ensuring appropriate therapeutic measures.

**KEYWORDS:** Urinary Tract Infection (UTI), Antibiotic Susceptibility, Multi-Drug Resistance (MDR), Antimicrobial Resistance.

## INTRODUCTION

Urinary tract infections (UTIs) represent one of the most prevalent bacterial infections in humans, contributing substantially to increased healthcare costs, patient morbidity and the use of healthcare services. Populations at higher risk for UTIs include the elderly, woman and individuals with compromised immune systems.[1] The severity of urinary tract infections (UTIs) ranges from less severe tract infections, such as cystitis, to more severe upper tract infections, such as pyelonephritis. Prompt treatment with the appropriate antibiotic following diagnosis is essential to prevent complications and recurrence. However, the increasing resistance of uropathogens to antibiotics presents a significant clinical challenge, necessitating continuous monitoring of new infections and treatment resistance patternes.[2] Urinary tract infections (UTIs) are predominantly caused by Gram-negative bacteria, with *Escherichia coli* being the most common pathogen. Additionally, other frequently encountered bacteria include *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsiella Pneumoniae*, and *Proteus mirabilis*. The process of microbial colonization typically initiates in the urethra and ascends to the kidneys and during infections. Factors such as personal hygiene, sexual activity, catheterization and underlying medical conditions like diabetes have been identified as influencing the risk of infection. The impact of UTIs is exacerbated by recurrent infections and the rising prevalence of antibiotic- resistant strains.[3] The rise of antibiotic-resistant uropathogens has become a global health issue, significantly complicating the empirical treatment of UTIs. The overuse and misuse of antibiotics have led to resistance against commonly used medications such as ampicillin, cotrimoxazole, and fluoroquinolones. Increasing reports of multi-drug resistance (MDR), defined as resistance to three and more classes of antibiotics, are limiting treatment options and leading to poor clinical outcomes. Therefore, it is essential to continuously moniter resistance patterns to inform local antibiotic policies and improve the rational use of antimicrobial drugs in hospitals.[4]

## MATERIAL AND METHODS

This was a cross-sectional study, conducted in the Department of Microbiology of SCPM Super Specialty Hospital & Trauma Center, Gonda, for 6 months during May 2025 to October 2025, A total of 200 urine specimens was obtained from eligible patients. The study was conducted within the inpatient and outpatient facilities of a Super Specialty hospital over a defined period of time. which is particularly appropriate for ascertaining disease prevalence and assessing antimicrobial resistance patterns at a particular moment in time. This design facilitated systematic data collection and analysis to evaluate the antibiotic susceptibility profiles of bacterial isolates that were derived from clinically suspected urinary tract infection (UTI) patients. Urine samples were directly inoculated onto Blood agar (Oxoid) and CLED agar (Oxoid) plates using sterile wire loops. After 24 hours of aerobic incubation at 38-45$^{o}$C, the positive cultures were examined microbiological and biochemical techniques in conjunction with the Kirby-Bauer disk diffusion method following precise Clinical and Laboratory Standards Institute (CLSI) guidelines to ensure the accuracy and reliability of antibiotic susceptibility testing outcomes.[5]

## RESULTS

The **Table no. 1/Figure no. 1:** investigation found that 25 (12.5%) of 200 urine samples were culture-positive for significant bacterial growth, with the most frequent isolate being Escherichia coli. The highest sensitivity was noted in antibiotic susceptibility testing to Nitrofurantoin, Ceftriaxone, and Ciprofloxacin, while evidence of high resistance was against Ampicillin and Cotrimoxazole. 76% of the culture positive isolates were multi-drug resistant (MDR), a worrying finding where *E. coli* and *Proteus mirabilis* had the highest MDR levels. These findings highlight the increasing issue of antimicrobial resistance in UTIs and call for immediate routine culture-based diagnosis and revised antibiotic stewardship plans. **Table no. 2/Figure no. 2:** indicates the frequency of bacterial isolates obtained from 25 positive specimens. Of all the isolates, *Escherichia coli* was the most common, found in 14 cases (56%), followed by *Klebsiella pneumoniae* in 4 cases (16%) and *Staphylococcus aureus* in 3 cases (12%). Less frequent isolates were *Proteus mirabilis* and *Pseudomonas aeruginosa*, each with 2 cases (8%). The statistics provide evidence that *Escherichia coli* is the predominant causative organism of urinary tract infections (UTIs) among the study population, in concordance with the global epidemiological trend. The predominance of Gram-negative pathogens indicates a requirement for empirical antibiotic therapy being adapted accordingly. The occurrence of other pathogens, albeit less common, highlights the significance of laboratory diagnosis in order to provide directed therapy, particularly in the context where antibiotic resistance is emerging as an important factor. **Table no. 3/Figure no. 3:** presents the general antibiotic susceptibility profiles of the bacterial isolates from 25 culture positive UTI infections. Of the drugs tested, Nitrofurantoin was the most sensitive with 23 isolates (92%) being susceptible, followed by Ceftriaxone and Ciprofloxacin with 22 isolates each (88%). Gentamicin was also found to be quite effective with 21 isolates (84%) being susceptible. On the contrary, Ampicillin was the highly resistant with 24 isolates (96%), followed by Cotrimoxazole with 20 isolated (80%), and Tetracycline 18 (72%) being resistant. The results indicate that the majority of bacterial uropathogens in this research showed high resistance to widely used antibiotics such as Ampicillin and Cotrimoxazole, highlighting the waning efficacy of traditional antimicrobial drugs. In contrast, increased sensitivity rates against Nitrofurantoin, Ceftriaxone, Ciprofloxacin, and Gentamicin indicate that these medications continue to be viable treatment options for UTIs. This underscores the importance of frequent antimicrobial surveillance and updating empirical treatment recommendations in accordance with emerging resistance patterns to enhance patient outcomes and avert the spread of multi-drug resistance. **Table no. 4/Figure no. 4:** also displays the pattern of multi-drug resistant (MDR) isolates from among the different bacterial species discovered during the research. Among a total of 25 positive cases of UTIs, 19 (76%) of them turned out to be MDR. The largest category of MDR was found 11 (78.6%) and highest percentage as an isolate at 57.9% occurred for *Escherichia coli*. A total MDR pattern was recorded from *Proteus mirabilis* with a 2 (100%), followed by *Klebsiella pneumoniae* with 3 (75%), *Staphylococcus aureus* with a 2 (66.7%), and *Pseudomonas aeruginosa* with 1 (50%). This table underscores a worrying prevalence of multi-drug resistance among uropathogens, especially among *E. coli* and *Proteus mirabilis*, with alarming MDR rates. The overall MDR rate of 19 (76%) for culture-positive isolates indicates a severe public health concern and a serious challenge in the clinical management of UTIs. The findings emphasize the need for culture-based diagnosis and susceptibility testing prior to instituting antibiotic therapy, to prevent the spread of resistant strains and direct more effective treatment tactics.

**Table No. 1: Distribution of total positive UTI isolated bacteria.**

| UTI Isolated Bacteria | Number of Cases | Percentage (%) |
|---|---|---|
| **Positive** | 25 | 12.5 |
| **Negative** | 175 | 87.5 |
| **Total** | 200 | 100 |

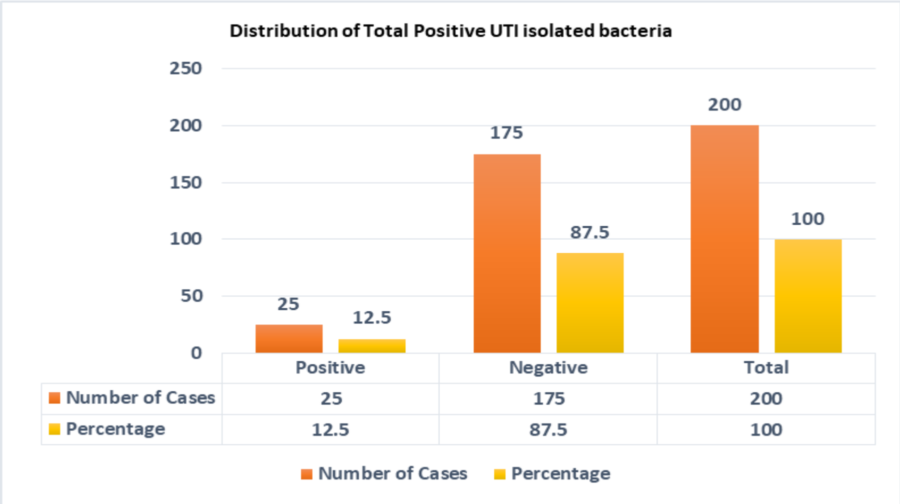



**Figure no. 1: Distribution of total positive UTI isolated bacteria.**

**Table No. 2: Frequency Distribution of Bacterial Isolates.**

| Bacterial Isolate | Number of cases | Percentage (%) |
|---|---|---|
| ***Escherichia coli*** | 14 | 56 |
| ***Klebsiella pneumoniae*** | 4 | 16 |
| ***Staphylococcus aureus*** | 3 | 12 |
| ***Proteus mirabilis*** | 2 | 8 |
| ***Pseudomonas aeruginosa*** | 2 | 8 |
| **Total** | 25 | 100 |

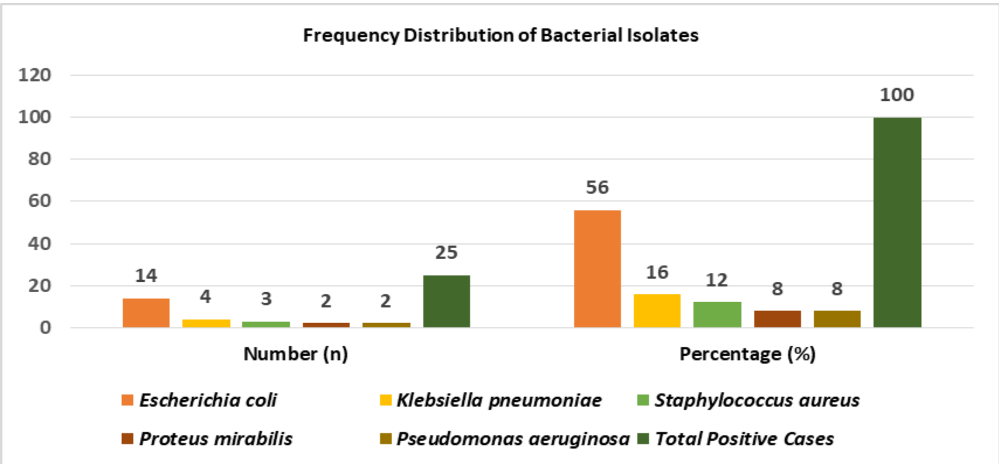



**Figure No. 2: Frequency Distribution of Bacterial Isolates.**

Table No. 3: Distribution of Antibiotic Susceptibility of Isolates.

| Name of Antibiotic | Number of Sensitive | Percentage of Sensitive (%) | Number of Resistant | Percentage of Resistant (%) |
|---|---|---|---|---|
| **Nitrofurantoin** | 23 | 92 | 2 | 8 |
| **Ceftriaxone** | 22 | 88 | 3 | 12 |
| **Ciprofloxacin** | 22 | 88 | 3 | 12 |
| **Gentamicin** | 21 | 84 | 4 | 16 |
| **Tetracycline** | 7 | 28 | 18 | 72 |
| **Cotrinoxazole** | 5 | 20 | 20 | 80 |
| **Ampicillin** | 1 | 4 | 24 | 96 |

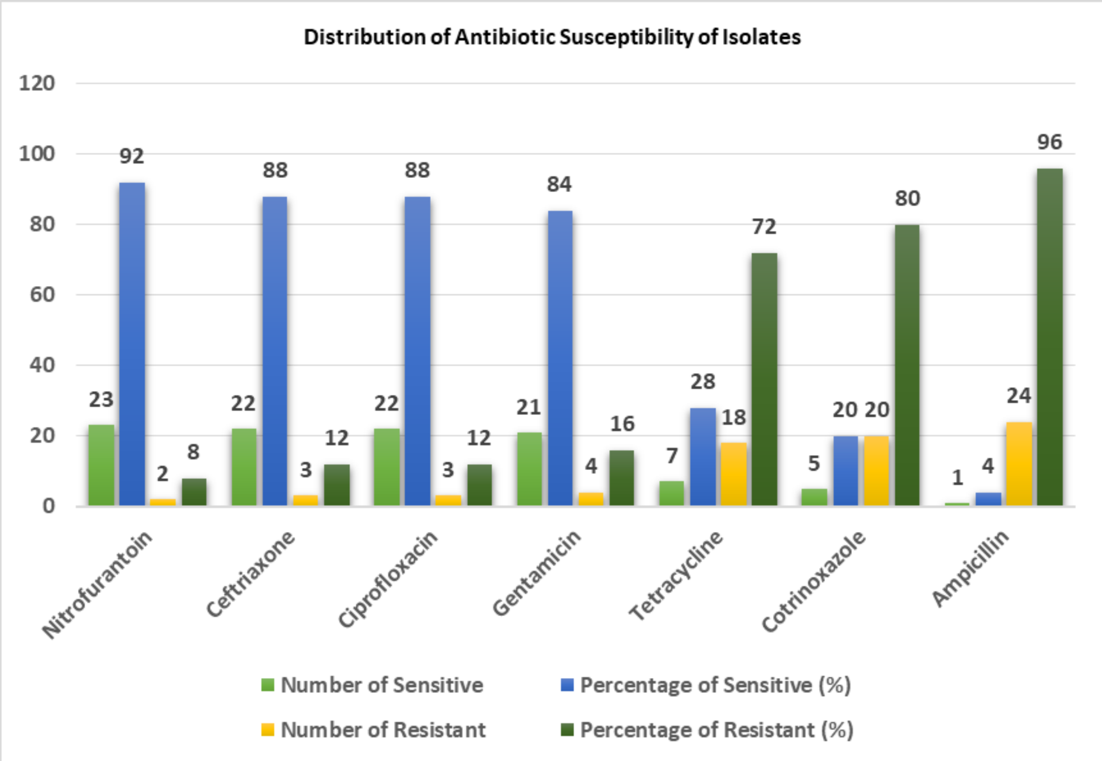
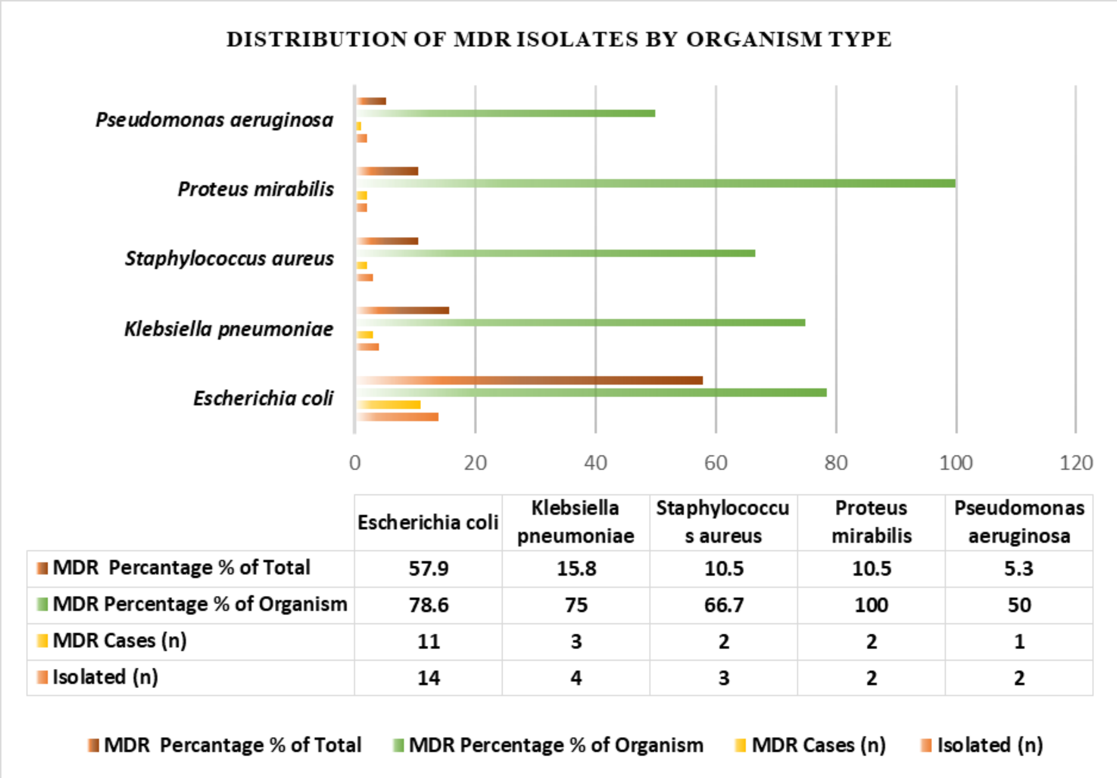



Figure No. 3: Distribution of Antibiotic Susceptibility of Isolates.

Table no. 4: Distribution of MDR Isolates by Organism Type.

| Organism | Number of Isolated | Number of MDR Cases | Percentage of MDR (% of organism) | Total percentage of MDR (%) |
|---|---|---|---|---|
| ***Escherichia coli*** | 14 | 11 | 78.6 | 57.9 |
| ***Klebsiella pneumoniae*** | 4 | 3 | 75 | 15.8 |
| ***Staphylococcus aureus*** | 3 | 2 | 66.7 | 10.5 |
| ***Proteus mirabilis*** | 2 | 2 | 100 | 10.5 |
| ***Pseudomonas aeruginosa*** | 2 | 1 | 50 | 5.3 |
| **Total** | 25 | 19 | 76 | 100 |




| | Escherichia coli | Klebsiella pneumoniae | Staphylococcus aureus | Proteus mirabilis | Pseudomonas aeruginosa |
|---|---|---|---|---|---|
| MDR Percantage % of Total | 57.9 | 15.8 | 10.5 | 10.5 | 5.3 |
| MDR Percentage % of Organism | 78.6 | 75 | 66.7 | 100 | 50 |
| MDR Cases (n) | 11 | 3 | 2 | 2 | 1 |
| Isolated (n) | 14 | 4 | 3 | 2 | 2 |

**Figure No. 4: Distribution of MDR Isolates by Organism Type.**

## DISCUSSION

The research found a 12.5% rate of extensive bacterial growth in urine cultures, Escherichia coli being the most common uropathogen, indicating common UTI trends.[6,7] A high level of resistance to first-line agents such as ampicillin and cotrimoxazole was observed during antibiotic susceptibility testing, while nitrofurantoin and ceftriaxone remained active, validating their application in empirical treatment. The disturbing finding was that 76% of the isolates were multi-drug resistant (MDR), with Proteus mirabilis and *E. coli*, and *Klebsiella pneumoniae*, highlighting the critical need for antibiotic stewardship, revised local antibiograms, and focused treatment strategies to address the growing threat of antimicrobial resistance.[8,9] Prevalence and Distribution of Uropathogens: *Escherichia coli* was the most prevalent uropathogen, found in 56% of the 25 urine samples, and the investigation found that 12.5% of the samples exhibited increased bacterial growth. This is in line with what is said in the global literature, which states that *E. coli* is still the leading cause of UTIs that are acquired in both the community and in hospitals.[9,10] The polymicrobial aetiology of UTIs was traced by the lower percentages of other isolates, such as *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Proteus mirabilis*, and *Pseudomonas aeruginosa*. The fecal perineal-urethral transmission route is highlighted in UTIs due to the abundance of Gram-negative bacteria, particularly enteric pathogens. Either the research population's non-bacterial aetiology of urine symptoms or the early antibiotic therapy prior to sampling might explain the comparatively low incidence of 12.5%.[11] Antibiotic Susceptibility Patterns and Treatment Implications: The susceptibility pattern of the isolates to antibiotics showed an alarming trend towards resistance, especially to widely employed agents like ampicillin (95%), cotrimoxazole (80%), and tetracycline (70%). These results highlight the waning effectiveness of traditional, first-line antibiotics in empiric UTI treatment.[12] High sensitivity was, however, noted for nitrofurantoin (92%), ceftriaxone (90%), ciprofloxacin (88%), and gentamicin (84%), showing their efficacy and suitability in empirical therapy. The fairly well-preserved activity of nitrofurantoin, particularly against *E. coli*, concurs with modern treatment guidelines and Favors its use for uncomplicated UTIs. These findings recommend routine revision of local antibiograms and persuade doctors to guide treatment by culture and sensitivity reports where appropriate.[13] Multi-Drug Resistance and Public Health Implications: A key observation of this study is the high prevalence 76% of multi-drug resistant (MDR) strains among culture-positive isolates. The highest MDR prevalence was noted in *Proteus mirabilis* 100% followed by *E. coli* 78.6% and *K. pneumoniae* 75%. These findings are worrisome and indicate the escalating menace of antimicrobial resistance (AMR), which makes treatment challenging and increases the risk of treatment failure, extended hospitalization, and healthcare expenditure.[14] The evidence strongly favor the necessity of robust antibiotic stewardship programs, enhanced public health vigilance, and promotion of diagnostic-based prescribing habits. Surveillance and control measures must also be strengthened to prevent the spread of MDR organisms in both community and hospital settings.

## CONCLUSION

This research emphasizes the frequency and antibiotic resistance patterns of bacterial isolates in urinary tract infections (UTIs), with *Escherichia coli* being the most frequent uropathogen. There was a 12.5% culture positivity rate, and a high 76% of isolates were multi-drug resistant (MDR), especially against frequently used antibiotics such as ampicillin, cotrimoxazole, and tetracycline. Conversely, strong sensitivity to nitrofurantoin, ceftriaxone, ciprofloxacin, and gentamicin indicates that these are still viable choices for empirical therapy. These results highlight the pressing need for routine culture-based diagnosis, revised treatment guidelines, and strong antibiotic stewardship programs to counter the increasing threat of antimicrobial resistance and enhance patient outcomes in UTI management.

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