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Original Research Article

Bacteriological profile and antibiotic sensitivity pattern of cases with urinary tract infection in tertiary care center, Pipariya, Vadodara, Gujarat

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Abstract

Background: One of the most common problems in both inpatient and outpatient settings is urinary tract infections (UTIs). It is crucial to continuously evaluate the pathogenic organisms and their antibiotic sensitivity due to the rise in antimicrobial resistance.

Aim & Objective: To determine the types of bacteria that cause urinary tract infections and evaluate the patterns of antibiotic resistance in patients in a tertiary care facility in Pipariya, Vadodara, Gujarat.

Materials and Methods: Patients having a clinical suspicion of UTIs were included in this observational study. Standard procedures were followed to collect urine samples, which were then processed for sensitivity testing and culture at the microbiology lab. According to CLSI recommendations, microorganisms and antimicrobial susceptibility were assessed using the automated Vitek Compact 2 system/ Kirby-Bauer disk diffusion technique (manual method).

Results: Out of the 200 urine samples that were examined, 53 (26.5%) had considerable bacteriuria, whereas the remaining 147 (73.5%) had either no growth, mixed bacterial growth, or no pathogenic bacteriuria. Gram-negative bacteria were identified from the majority of the culture-positive samples. 43.9% of the positive isolates were *E. coli*, with *Klebsiella pneumoniae (20.75%), Pseudomonas aeruginosa (11.32%), and Enterococcus spp. (9.43%), Acinetobacter spp. (7.55%)*, and other organisms, following in order of prevalence. The *E. Coli* isolates exhibited resistance to Ampicillin and Ciprofloxacin, but great sensitivity to Nitrofurantoin (92%), Imipenem (91%), and Amikacin (81%). Enterococcus and Staphylococcus aureus were among the gram-positive bacteria that were susceptible to Vancomycin, Linezolid, and Tigecycline.

Conclusion: The study underlines most common *E. coli* is as a uropathogen and how crucial local antibiotic susceptibility data are for directing empirical treatment. Using antibiotics sensibly is essential to halting the emergence of new resistance.

Keywords: Antibiotic Sensitivity pattern, Bacteriological profile, UTI.

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1. Introduction

One of the most prevalent problems that afflict people of all ages is urinary tract infection in Outdoor patients as well as indoor patients in Tertiary care centre. Catheterization in hospital also main cause for Urinary tract infection (UTI) in admitted patient in Tertiary care centre. From simple cystitis to severe pyelonephritis and urosepsis, infections can take many different forms.[1] Treatment and patient management are significantly hampered by the rising incidence of multidrug-resistant uropathogens.

The increasing trend of resistance in India has been exacerbated by the inappropriate use of antibiotics and inadequate infection control procedures. Clinicians can select appropriate empirical therapy and stop the spread of resistant strains by regularly monitoring uropathogens and their resistance profiles.[2] The purpose of this study was to evaluate the patterns of antibiotic susceptibility and bacterial profile in UTI cases that presented to a tertiary care hospital in Pipariya, Vadodara.

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2. Materials and Methods

2.1. Study design and setting

This was a observational study carried out in the Central Microbiology Laboratory of a tertiary care center in Pipariya, Vadodara, from January 2025 to March 2025.

2.2. Sample collection

Midstream clean-catch urine samples were collected in sterile containers from patients with suspected UTI symptoms. Samples were transported immediately and processed within 2 hours. In catheterized patients, urine should be collected from the sampling port of the catheter, not from the drainage bag, to avoid contamination. Clean the sampling port with an alcohol swab, then use a sterile syringe to withdraw urine and transfer it into a sterile container for testing. Always follow the aseptic technique throughout the entire procedure. Transfer the urine into a sterile container, label it, and promptly send it to the lab or refrigerate it if delayed. Aseptic technique is essential to avoid contamination.

2.2. Laboratory procedures

Standard microbiological methods (semi-quantitative approach) were used to perform urine cultures. Urine was cultured on MacConkey's agar, Nutrient agar, and Cystine Lactose Electrolyte Deficient (CLED) agar, respectively, and incubated for 18 to 24 hours at 37 °C. Using the conventional Kass criteria,[3] the urine culture results were classified as significant and inconsequential. For infection, a colony count of $\geq 10^5$ CFU/mL was deemed significant.

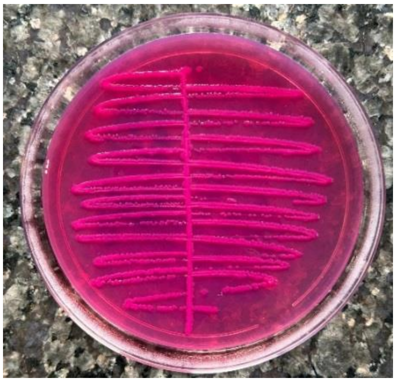

Figure 1: Showing Urine sample streak on MacConkey agar by semiquantitative method.

2.3. Antibiotic sensitivity testing

Organisms were identified and antibiotic sensitivity tests were performed as per Clinical and Laboratory Standards Institute (CLSI) guidelines. Vitek2 Compact system - VITEK2 GN (Gram Negative), VITEK2 GP (Gram Positive), and Antimicrobial Susceptibility Test (AST) cards were used for identification of organisms and antibiotic sensitivity test, respectively. Microsoft Excel was used for the entry and analysis of the data, During breakdown of the Vitek2 compact system Kirby-Bauer disk diffusion technique (manual method) for antibiotic sensitivity, and biochemical tests were done for identification.[4,5]

Figure 2: Showing antibiotic sensitivity testing.

3. Result

Showing out of 200 urine sample 121 sample are mid-stream urine and 79 urine sample from catheterized patients.

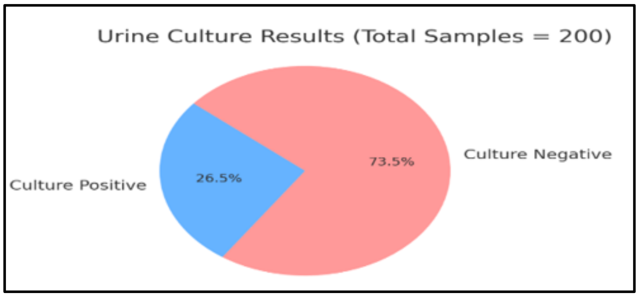

Figure 3: Shows a total of 200 urine samples out of 53(26.5%) culture-positive and 147(26.5%) culture-negative samples.

Table 1:

Type of Urine Sample	Percentage (%)	Number of Samples (n = 200)
Midstream Urine	60.4%	121
Catheterized	39.6%	79
Total	100%	200

3.1. CAUTI diagnosis among catheterized urine samples

CAUTI (Catheter-Associated Urinary Tract Infection) is diagnosed in patients who have had an indwelling urinary catheter for more than 2 calendar days and exhibit symptoms such as fever, suprapubic tenderness, or costovertebral angle pain. It requires a urine culture showing $\geq 10^5$ CFU/mL of no more than two species of organisms of infection**.**

Table 2:

Samples type	Number
Total Catheterized Samples	79
Culture-positive Catheterized Samples	19
CAUTI Cases Diagnosed	11
Percentage of CAUTI Cases	25.2%

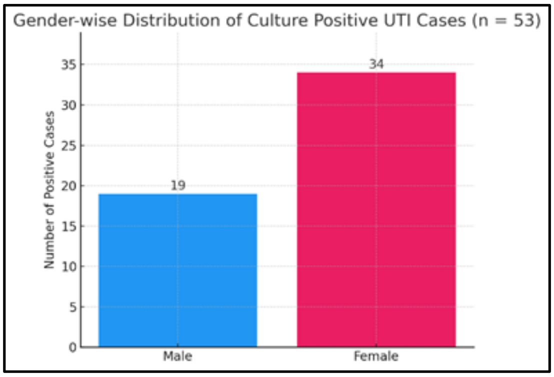

Figure 4: Gender-wise distribution of UTI-positive cases.

UTIs were observed in both males and females, with a female predominance, which is consistent with the anatomical and physiological predisposition of females to urinary infections. Urinary tract infections are more common in females due to their shorter urethra and its close proximity to the anus and vaginal opening, which facilitates the entry of bacteria into the urinary tract. Additionally, factors like sexual activity, hormonal changes, and hygiene practices contribute to the higher susceptibility in females.

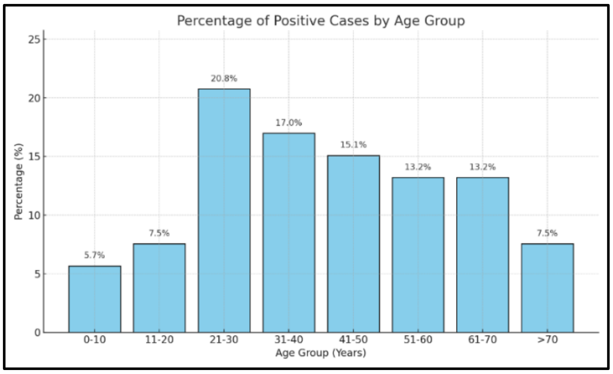

Figure 5: Age group-wise distribution of UTI-positive cases.

Distribution of UTI-positive cases varied across different age groups, with a slightly higher incidence noted among the age 21-30 year followed by the 31–40-year,41-50 year, less common >50 year, and <20-year age group.

Table 3: Frequency of bacterial isolates from urine samples (n = 53)

Organism	No. of Isolates	Percentage (%)
Escherichia coli	23	43.40%
Klebsiella pneumoniae	11	20.75%
Pseudomonas aeruginosa	6	11.32%
Enterococcus spp.	5	9.43%
Acinetobacter spp.	4	7.55%
Proteus spp.	2	3.77%
Staphylococcus aureus	2	3.77%
Total	53	100%

A total of 53 bacterial isolates were recovered from the culture-positive urine samples. The distribution of these isolates is detailed below:

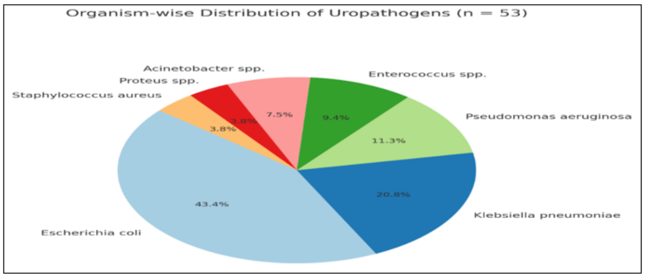

Figure 6: Organism wise distribution of uropathogens (n = 53)

From this data, Gram-negative organisms dominated, *E. coli* was the most frequent pathogen, followed by *Klebsiella pneumoniae*, indicating their central role in urinary tract infections. Non-fermenters such as *Pseudomonas* and *Acinetobacter* spp. were also notable, particularly in hospital-associated cases

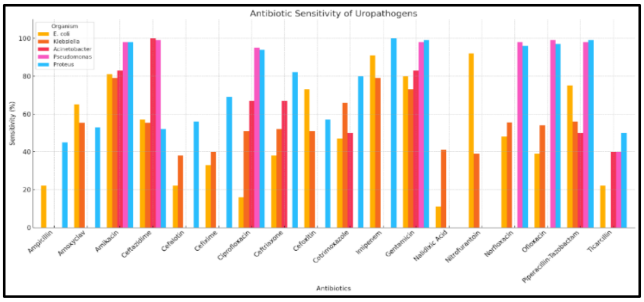

Figure 7: Gram-negative isolates and their susceptibility pattern to antibiotics (%)

3.2. Antibiotic susceptibility pattern – Gram-negative bacteria

The antibiotic sensitivity profiles of the major Gram-negative isolates are summarized below:

1. E. coli showed high sensitivity to Nitrofurantoin (92%), Imipenem (91%), Amikacin (81%), and Gentamicin (80%). However, resistance was notable against Ampicillin, Ciprofloxacin, and Cefixime.
2. Klebsiella pneumoniae demonstrated moderate susceptibility to Imipenem (79%) and Amikacin (79%), but resistance to several beta-lactams, including Cefalotin and Ceftazidime, was concerning.
3. Pseudomonas aeruginosa was sensitive to Piperacillin-Tazobactam (98%), Amikacin (98%), and Ofloxacin (99%), but exhibited high resistance to Cephalosporins.
4. Acinetobacter spp. showed considerable resistance overall, with better sensitivity to Amikacin (83%) and Gentamicin (83%).

The presence of multidrug-resistant organisms, particularly among non-fermenters, emphasizes the need for cautious empirical therapy and reliance on culture-directed treatment.

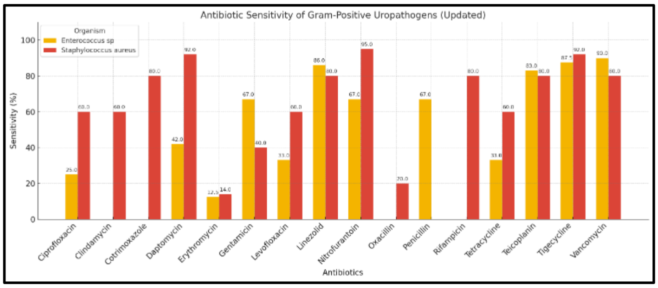

Figure 8: Gram-positive isolates and their susceptibility pattern to antibiotics (%)

3.3. Antibiotic Susceptibility Pattern – Gram-Positive Bacteria

For Gram-positive organisms, the following trends were observed:

1. Enterococcus spp. showed good sensitivity to Linezolid (86%), Nitrofurantoin (67%), Teicoplanin (83%), and Tigecycline (87.5%). Vancomycin resistance was minimal (90% sensitive).
2. Staphylococcus aureus isolates were 92% sensitive to Tigecycline, followed by Linezolid (80%), Rifampicin (80%), and Nitrofurantoin (95%). However, resistance to penicillin and oxacillin indicates the possible presence of MRSA.

These results underscore the continued relevance of newer generation antibiotics such as Linezolid and Tigecycline in managing Gram-positive UTI pathogens, especially in hospital settings.

4. Discussion

Urinary tract infections (UTIs) are a major cause of morbidity in both community and healthcare settings, affecting individuals of all ages and genders. The emergence of multidrug-resistant organisms and the inappropriate use of empirical antibiotics have added complexity to the treatment of UTIs. This study aimed to evaluate the bacteriological profile and antimicrobial resistance patterns among patients presenting with UTIs at a tertiary care center in Pipariya, Vadodara, Gujarat.

4.1. Prevalence of uropathogens

In the present study, *Escherichia coli* emerged as the predominant causative organism, accounting for 43.4% of all isolates. This is consistent with a wide body of literature, as *E. coli* has long been recognized as the most common uropathogen due to its ability to colonize the periurethral area and adhere to uroepithelial cells. Its pathogenicity as acending infection is attributed to various virulence factors, including fimbriae and adhesins.[6]

Following *E. coli*, the next most frequent pathogens identified were *Klebsiella pneumoniae* (20.75%), *Pseudomonas aeruginosa* (11.32%), and *Acinetobacter* spp. (7.55%). These organisms are frequently associated with hospital-acquired infections and are known to possess strong resistance mechanisms.[7] Other isolates included *Enterococcus* spp. and *Staphylococcus aureus*, which, although less frequent, remain clinically significant due to their resistance to commonly used antibiotics.

4.2. Antibiotic Resistance in Gram-Negative Isolates

The current findings revealed the growing resistance to antibiotics among uropathogens.[8] *E. coli* isolates showed high sensitivity to Nitrofurantoin (92%), Imipenem (91%), and Amikacin (81%), suggesting that these antibiotics are still effective in treating infections caused by this organism. However, significant resistance was noted against commonly prescribed antibiotics such as Ampicillin, Ciprofloxacin, and Nalidixic Acid.

Klebsiella pneumoniae isolates also showed moderate sensitivity to Amikacin (79%) and Gentamicin (73%) but were less responsive to beta-lactams and cephalosporins. This could be due to the production of extended-spectrum beta-lactamases (ESBLs), a phenomenon increasingly reported in Klebsiella strains. The resistance of *Klebsiella* to Carbapenems like Imipenem, though still relatively low in our study, should be closely monitored due to the emergence of carbapenemase-producing strains globally.[9]

Pseudomonas aeruginosa and *Acinetobacter* spp., both known for their intrinsic resistance to many antibiotic classes, displayed favourable sensitivity to Amikacin and Piperacillin-Tazobactam. However, resistance to cephalosporins and fluoroquinolones was prominent. These findings underscore the complexity of treating infections caused by non-fermenting Gram-negative bacilli, particularly in hospitalized or catheterized patients.

Proteus spp., though a minor isolate, showed high sensitivity to Gentamicin, Amikacin, and Imipenem, consistent with its generally favourable response to aminoglycosides and Carbapenems.[10]

4.3. Resistance in gram-positive organisms

The Gram-positive isolates identified included *Enterococcus* spp. and *Staphylococcus aureus*. *Enterococcus* isolates showed promising sensitivity to Linezolid (86%), Nitrofurantoin (67%), and Teicoplanin (83%). These antibiotics remain vital in managing infections caused by these organisms.[11]

Staphylococcus aureus isolates exhibited strong sensitivity to Tigecycline (92%) and Linezolid (80%), with resistance noted against Penicillin and Oxacillin, suggesting the potential presence of methicillin-resistant *S. aureus* (MRSA) strains. These findings are of concern, especially in nosocomial environments, where MRSA can spread rapidly and complicate treatment protocols.[12]

4.4. Comparative analysis with other studies

The resistance patterns observed in this study align with previously reported trends in India and other countries. Studies conducted in various regions, including urban tertiary care centers and rural hospitals, have shown rising resistance to fluoroquinolones and third-generation cephalosporins.[13] A study by Kothari et al. and another by Mehta et al. similarly observed that Nitrofurantoin and Imipenem retained high efficacy against uropathogens, particularly *E. coli*.[14]

Our findings reinforce the importance of Nitrofurantoin as a first-line treatment for uncomplicated lower UTIs, particularly in outpatient settings.[15] Carbapenems such as Imipenem should be reserved for more severe or complicated infections to preserve their effectiveness and delay resistance development.

CAUTI bundle care approach involves a set of evidence-based practices to prevent catheter-associated urinary tract infections. Key components include using catheters only when medically necessary, ensuring aseptic insertion, maintaining a closed drainage system, performing daily catheter care, and regularly assessing the need for catheter continuation or removal.

Clinical Implications and Recommendations

This study highlights the need for region-specific antibiograms to guide empirical therapy. Given the variations in resistance patterns across different geographical areas, reliance on international or national data alone may be inadequate. Clinicians must adapt treatment strategies based on real-time microbiological data to ensure effective management of UTIs.

The widespread resistance to fluoroquinolones and cephalosporins suggests that these drugs should no longer be used empirically unless supported by culture and sensitivity results.[16] The rational use of antibiotics is essential to limit the spread of multidrug-resistant organisms.

Furthermore, the study supports the implementation of antimicrobial stewardship programs and antibiotic policy at the institutional level. These programs can monitor prescribing practices, promote targeted therapy, and reduce the unnecessary use of broad-spectrum antibiotics.

5. Limitations of the Study

Although the study provides important insights, it is not without limitations. The sample size, though adequate for preliminary conclusions, may not fully represent the larger population. Additionally, molecular characterization of resistant strains was not performed, which could have added depth to the understanding of resistance mechanisms, particularly ESBL and carbapenemase production.

6. Conclusion

In conclusion, this study highlights a significant burden of bacterial UTIs in the region, with a clear shift toward resistant strains, especially among Gram-negative organisms. While Nitrofurantoin, Amikacin, and Carbapenems continue to be effective, resistance to fluoroquinolones and third-generation cephalosporins poses a serious challenge.

The findings advocate for continued monitoring, development of local antibiograms, rational prescribing practices, and the strengthening of antibiotic stewardship and infection control programs. Only through a comprehensive, multi-disciplinary approach can we effectively manage UTIs and cure the growing threat of antimicrobial resistance in patients with vaginitis.

7. Ethics Statement

This study was approved by the Institute's Ethics Committee, Sumandeep Vidhyapeeth University, Vadodara, India.

8. Informed Consent

Written informed consent was obtained from the participants before enrolling in the study.

9. Conflict of Interest

None.

10. Source of Funding

None.

11. Acknowledgments

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