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Bacteriological profile and antimicrobial susceptibility pattern of the commonest isolate in clinically diagnosed urinary tract infection among patients attending OPD in a tertiary care hospital

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Abstract

Background: Urinary tract infections (UTIs) are common bacterial infections, with *Escherichia coli* as the leading pathogen. Rising antimicrobial resistance poses challenges for effective management. This study investigates the bacteriological profile and antimicrobial sensitivity patterns of the commonest urinary isolates from UTI cases among the OPD patients attending a tertiary care hospital in Kolkata, India.

Materials and methods: A descriptive cross-sectional study was conducted at the Microbiology Department, Nil Ratan Sircar Medical College and Hospital, from July to August 2024. Urine samples from 1090 clinically suspected UTI cases were processed using standard microbiological techniques, including microscopy, culture, and biochemical identification. Antibiotic susceptibility testing followed Clinical and Laboratory Standards Institute (CLSI) guidelines.

Results: Significant bacteriuria was found in 144 (13.21%) samples, with a higher prevalence in females (58%) with the most affected age group being 13–45 years. Gram-negative bacteria accounted for 93% of isolates, with *Escherichia coli* (79%) as the predominant pathogen, followed by *Klebsiella pneumoniae* (11.1%). Gram-positive bacteria (6.9%) were mainly *Enterococcus faecalis*. Antibiotic susceptibility testing of *E.coli* revealed high sensitivity to fosfomycin (90.4%), colistin (89.7%), piperacillin-tazobactam (78.5%), and nitrofurantoin (85.2%), while resistance to cotrimoxazole and ampicillin was noted.

Conclusion: This study highlights the increase prevalence of UTIs among females, particularly in reproductive age groups. Escherichia coli remains the predominant pathogen in OPD patients, reflecting global trends. The observed resistance to commonly used antibiotics, such as cotrimoxazole and ampicillin, emphasizes the urgent need for local antimicrobial surveillance and stewardship programs. The emergence of extended-spectrum beta-lactamase (ESBL) producers among *Escherichia coli* (17.5%) and *Klebsiella pneumoniae* (21%) further complicates treatment strategies. Nitrofurantoin, fosfomycin, and piperacillin-tazobactam demonstrate significance efficacy and Nitrofurantoin being the first line of drug, is a viable options for empirical therapy. These findings underscore the importance of tailored antibiotic policies and the judicious use of antimicrobials to combat resistance and improve treatment outcomes.

INTRODUCTION

Urinary tract infections occurs when bacteria, which are pathogens that cause disease, enter the urinary tract as ascending infection through urethra from the perennial region, or as a descending infection from septicaemia. Infections of the kidneys, ureters, bladder, or urethra, which make up the urinary system, are referred to as urinary tract infections. A urinary tract infection (UTI) is caused by various microbes. There are two type of urinary tract infections, these are upper urinary tract infection (pyelonephritis) and lower urinary tract infection (cystitis, urethritis, prostatitis).

Even though a variety of microorganisms, such as viruses and fungi, can cause UTIs, bacteria are

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the major cause and account for over 95% of UTI occurrences. *Escherichia coli* is the pathogen that causes UTIs most frequently, accounting for almost 80% of cases.[1] Studies on UTIs in Kolkata indicate that *Escherichia coli* (*E. Coli*) is the most frequent correlated agent, with *Klebsiella* and *Pseudomonas spp*.[2] Numerous other studies have regularly demonstrated that *Escherichia coli* was the most common pathogen causing UTIs, accounting for a sizeable percentage of cases.[3,4,5,6]

In clinical practice, prescribers generally diagnose microbial infection on clinical judgment and prescribe antimicrobials on empirical basis, which often leads to the development of drug-resistant organisms.[7,8] Usually it took 3 to 4 days to get the microbiological report of urine culture and sensitivity testing. Commonly used antibiotics are ceftriaxone, cefixime, gentamicin, and ciprofloxacin. *Escherichia coli* has been shown to be 16.5% to 85% resistant to the regularly used antibiotics ceftriaxone, levofloxacin, ciprofloxacin, amoxicillin, and ampicillin.[9,10,11] A notable percentage of Escherichia coli isolates are classified as multidrug-resistant (MDR), with studies indicating rates of approximately 26%.[12] Additionally, ceftazidime -avibactam, aztreonam, clavulanic acid, ampicillin, amoxy-clav and piperacillin have been reported to be resistant against ESBL producing organisms.[13]

The present study attempts to identify the bacteria causing UTI among the outpatient in the present setting and determine the antibiotic-resistance patterns of the most common uropathogen isolated. This findings of the study will help in formulating guidelines for establishing a proper empirical therapy for UTIs while awaiting culture sensitivity report.

AIM

To determine the bacteriological profile and antimicrobial sensitivity pattern of urinary isolates of bacteria in clinically diagnosed patients with urinary tract infection attending the outpatient departments of a tertiary care hospital.

OBJECTIVES

- To identify the bacteria among urine samples from clinically suspected cases of urinary tract infections attending outpatient departments of a tertiary care hospital.
- To determine antimicrobial sensitivity of the isolates.

MATERIALS AND METHODS

Study type and design: The present study was a descriptive cross-sectional study.

Study Setting: The study was conducted at the department of Microbiology, Nil Ratan Sircar Medical College and Hospital, Kolkata.

Study Period: The study was undertaken between 01/07/2024 and 31/08/2024.

Study Population: Urinary samples from patients with suspected UTI attending the outpatient departments of the Nil Ratan Sircar Medical College.

Exclusion Criteria:

- Patients below the age of 12 years,
- Patients started on antibiotics prior collection of urine sample.

Study Procedure

Sample collection and processing: Appropriate sterile collection of mid-stream early morning urine samples was ensured from all patients. All the specimens were received in sterile, disposable universal containers. All the collected specimens were processed as early as possible. The CLSI guidelines advise urinalysis within two hours of sample collection avoids over growth of normal flora of lower urinary tract. If that was not possible, samples were kept at 4°C immediately after collecting the sample.[14]

Direct Microscopy: Urine samples were examined microscopically for significant pyuria, RBC, crystals and microbes present or not.

Standard loop method (semi quantitative method): When more than five pus cells/high power field (hpf) were detected in uncentrifuge, well mixed urine sample were detected for pyuria, significant bacteriuria was regarded as a sign of positive urine culture bacteriuria, which is the isolation of one or two pathogens with $>10^5$ CFU (colony forming units)/ml.[15]

Culture: Urine samples were inoculated on to CLED agar (cystine lactose electrolyte deficient medium), Mac Conkey agar and the culture plates were subjected to incubation at 37°C for overnight or 18-24 hrs. Gram staining, motility testing, oxidase and catalase tests, and colony morphology were used to identify the isolates. Following these initial testing techniques, various biochemical reactions were performed to further identify the organisms in accordance with accepted standards.[16] The standard KASS criteria were used to assess the culture results as significant. Significant bacteriuria was defined as an active urine infection with a growth of $\geq 10^5$ colony forming units/ml of uro-pathogens.[17,18]

Antibiotics used for E coli:

Nitrofurantoin (0.3mg), ampicillin (10 µg), Gentamycin (10µg), Piperacillin-tazobactam (75µg), Meropenem (10µg), Cefepime (30µg), Fosfomycine (200µg), Colistin (10µg), Ceftriaxone (30µg), Ciprofloxacin(5µg) and Trimetho-prim/sulfamethoxazole (5µg).

RESULT

Of the 1090 samples, organisms were detected in 13.2%. Of these 12.3% grew Gram negative organisms while 0.9% were gram positive. Out of 1090 positive cases 144 were from OPD patients.

Table 1 outlines the distribution of study subjects across different age groups based on the gender and the total number of positive samples identified. For the age group 0–1 year, there were 56 positive samples equally distributed between males (28) and females (28). In the 1–12 age group, 32 positive samples were evenly split between males and females. The 13–45 age group showed a higher prevalence in females (34 samples) compared to males (22 samples).

Among those aged above 45, there were 14 positive samples, with 8 from males and 6 from females. The overall distribution indicates a total of 144 positive samples, with 42% being males and 58% females.

Table 2 highlights the frequency and percentage of isolates among gram-negative and gram-positive bacteria identified in the study. Among gram-negative bacteria (134 isolates), *Escherichia coli* was the most common (73.6%), followed by *Klebsiella pneumoniae* (11.1%), and other species such as *Acinetobacter baumannii*, *Morganella morganii*, *Enterobacter cloacae complex*, *Pseudomonas aeruginosa*, and *Providencia stuartii*, each contributing to 1.4–2.8%. Among gram-positive bacteria (10 isolates), *Enterococcus faecalis* accounted for 4.2%, and *Staphylococcus aureus* contributed 2.8%. The total number of isolates was 144.

Table 3 describes the susceptibility of *Escherichia coli* isolates to various antibiotics, expressed as percentages. The highest sensitivity was observed for Fosfomycin (90.4%) and Colistin (89.7%), followed by Nitrofurantoin (85.2%) and Piperacillin-tazobactam (78.5%). Sensitivity to Ampicillin-sulbactam was 75.5%, while Meropenem and Ceftriaxone showed moderate efficacy (56.6% and 70.8%, respectively). Lower sensitivity was seen for Ciprofloxacin (32.7%) and Cotrimoxazole (30.7%). These results provide insight into the effective antibiotics against *Escherichia coli* in the study population.

DISCUSSION

Understanding current uro-pathogen patterns and their susceptibility to different antibiotics is crucial for the proper empirical treatment of UTIs, among the patients attending the OPD with the symptoms. Various studies have demonstrated shifting patterns of susceptibility from diverse locations over time.[21,22] Our study showed a high prevalence of UTI in females (58%) than in males (42%) which correlates with other findings reported by Gonzalez et al and Orrett.[23,24] UTI is more common in females because of shorter urethra and urethra is more proximal to anus so that coliforms enter and colonize inside urethra.[21,24]

Out of 1090 urine samples, 144 (13.21%) were found to be culture positive. *Escherichia coli* 106 (79.10 %) was the predominant uropathogen which is in concordance with the other studies.[25,26] Enterobacteriaceae have several factors responsible for their attachment to the uroepithelium. *Klebsiella pneumoniae* was the second most common organism isolated. A study by Prakash et al, reported an increase in *Klebsiella pneumoniae* causing UTI.[27]

The gram-negative bacteria were showing maximum sensitivity towards fosfomycin and piperacillin-tazobactam followed by nitrofurantoin, amikacin (65.7%) and gentamicin (63%). According to Kaushik et al, the gram-negative bacteria showed maximum sensitivity to nitrofurantoin (95.5%), amikacin (75.5%) and gentamicin (65.5%).[25] The least sensitive antibiotic among the gram-negative bacteria in our study was ampicillin/sulbactum (21.1%) followed by cotrimoxazole (49.5%). In a study done by Sundaramurthy et al, after beta-lactum antibiotics, fluoroquinolones were the least effective drugs followed by cotrimoxazole.[28]

We observed 17.5 % of the *Escherichia coli* and 21% of *Klebsiella pneumoniae* to be ESBL producers. In our study, both cefotaxime-clavulanic acid and ceftazidime-clavulanic acid identified ESBL producers equally, whereas in other studies cefotaxime-clavulanic acid identified a greater number of ESBL producers compared to ceftazidime-clavulanic acid.[29,30,31] Some studies have isolated enterococcus species as the commonest gram-positive bacteria causing UTI followed by cons.[32,33] The prevalence of different bacteria and their antibiotic resistance vary not only from place to place but also from institute to institute and this can be due to different health care settings, different antibiotic protocols and study population.

The high prevalence of UTIs in women aged 13 to 45 years is concerning since it can be difficult to cure infections caused by different drug-resistant bacteria during this reproductive stage. It has been shown that UTI pathogens, particularly *Escherichia coli*, are producing more ESBL. Because ESBL-producing bacteria complicate treatment policies, every healthcare system must have adequate antimicrobial surveillance.

CONCLUSION

The most prevalent bacteria that cause UTIs vary by location, as does their pattern of antibiotic susceptibility. Therefore, it was crucial that this study be carried out in our facility. We observed that the most frequent cause of UTIs was Escherichia coli, which was followed by *Klebsiella pneumoniae.* E coli showed high sensitivity to Fosfomycin, Colistin, Nitrofurantoin, Piperacillin-tazobactam and Ampicillin-sulbactam. Moderate sensitivity was seen with Meropenem and Ceftriaxone while low sensitivity was seen for Ciprofloxacin and Cotrimoxazole.

CONFLICT OF INTEREST

Not Declared

FUNDING

The study was not funded.

Figure 1: Organisms isolated from urine of patients with clincally suspected UTI (n= 1090)

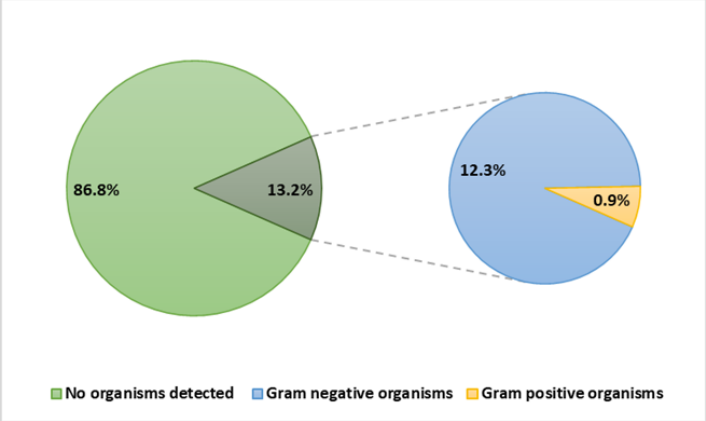


Table 1: Age group distribution of all the study subjects (n=144)

Age group (year)	Number of positive sample		
	Total	Males	Females
0-1	56 (100)	28 (50)	28 (50)
1 - 12	32 (100)	16 (50)	16 (50)
13 - 45	42 (100)	22 (20)	34 (80)
> 45	14 (100)	8 (57)	6 (43)
Total	**144 (100)**	**60 (42)**	**84 (58)**

Table 2: Distribution of gram negative bacteria (n=144)

Gram stain	Isolates	Frequency	Percentage
Gram negative bacteria (n=134)	*Escherichia coli*	106	73.6
	Klebsiella pneumonia	16	11.1
	Acinetobacter baumannii	4	2.8
	Morganella morganii	2	1.4
	Enterobactor cloacae complex	2	1.4
	Pseudomonas aeruginosa	2	1.4
	Providencia stuartii	2	1.4
Gram positive bacteria (n=10)	*Enterococcus faecalis*	6	4.2
	Staphylococcus aureus	4	2.8
Total		**144**	**100.0**

Table 3: More common antibiotic pattern (n=106)

Bacteria	Nitrofurantoin	Ampicillin sulbactam	Gentamicin	Piperacillin tazobactam	Meropenem	Cefepime	Fosfomycin	Colistin	Ceftriaxone	Ciprofloxacin	Cotrimoxazole
Escherichia coli	85.2	75.5	66.5	78.5	56.6	37.2	90.4	89.7	70.8	32.7	30.7

Figure 2: AST in MH agar

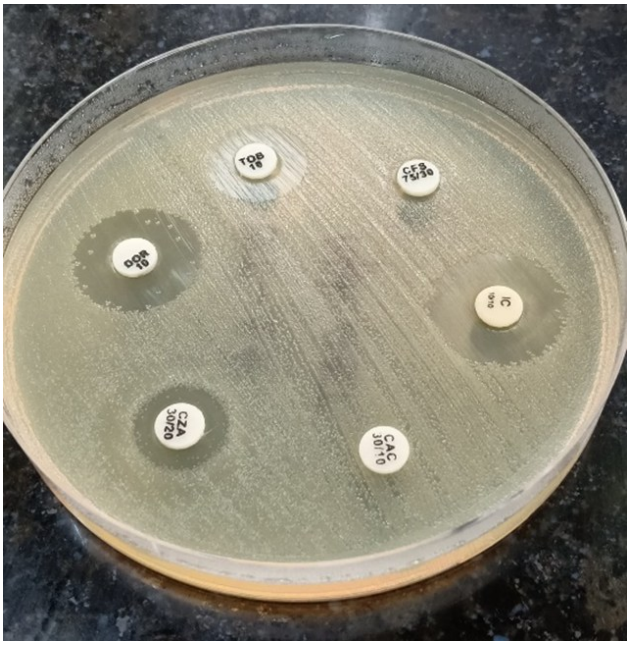
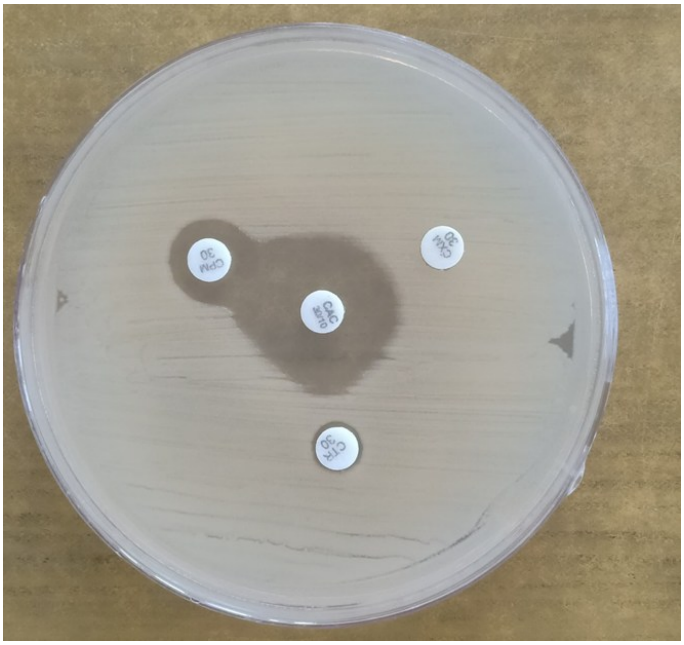


Figure 3: ESBL detection



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