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EPIDEMIOLOGICAL CHARACTERISTICS, CLINICAL PRESENTATION, AND RISK FACTORS ASSOCIATED WITH ESBL PRODUCING UROPATHOGENS IN URINARY TRACT INFECTIONS AT A TERTIARY CARE CENTRE

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ABSTRACT

Background: Urinary tract infections (UTIs) are common bacterial infections with variable epidemiological patterns, clinical presentations, and bacterial etiologies. Understanding these patterns is essential for accurate diagnosis and appropriate antimicrobial therapy.
Aim: To evaluate the epidemiological characteristics, clinical presentation, and risk factors associated with ESBL-producing uropathogens in patients with suspected UTIs.
Materials and Methods: A total of 400 urine samples were collected from patients with suspected UTIs. Samples were processed using standard microbiological techniques for bacterial isolation and identification. Demographic details, clinical manifestations, and relevant risk factors were documented. Antimicrobial susceptibility testing was performed using the Kirby–Bauer disk diffusion method.
Results: Of 400 urine samples, 304 (76.0%) showed significant bacterial growth, while 96 (24.0%) showed no significant growth. Females constituted 296 (74.0%) patients, and males accounted for 104 (26.0%). The predominant age group was 21–40 years (210; 52.5%). Most patients were outpatients (248; 62.0%), while 152 (38.0%) were hospitalized. Dysuria was the most common symptom (314; 78.5%), followed by increased urinary frequency or urgency (297; 74.2%), suprapubic pain (168; 42.0%), and fever (117; 29.2%). Among culture-positive samples, Enterobacteriaceae accounted for 258 (84.8%) isolates. *Escherichia coli* predominated (157; 60.9%), followed by *Klebsiella pneumoniae* (70; 27.1%), *Proteus* species (21; 8.1%), and *Enterobacter* species (10; 3.9%). Other isolates included *Staphylococcus*, *Pseudomonas*, and *Enterococcus* species.
Conclusion: Culture positivity was high, particularly among females and patients aged 21–40 years. Dysuria was the leading symptom, and *E. coli* was the predominant uropathogen. Routine urine culture, susceptibility testing, and local surveillance are essential for guiding appropriate treatment and antimicrobial stewardship.

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INTRODUCTION

Globally, infections caused by Enterobacteriaceae have a significant role in both mortality and morbidity [1]. The administration of antibiotics as part of empirical therapy is considered both the cause of increasing drug resistance and the solution of infections [2]. However, the development of drug resistance to such medicines has evolved into a major health issue globally [3]. Antimicrobial resistance, especially in Gram negative bacilli is a growing public health concern [4]. The large percentage of Enterobacteriaceae is due to their being naturally occurring inhabitants of a human gastrointestinal (GI) tract, and the illnesses they cause result from being forced out of that environment. They can cause a variety of diseases, such as wound infections, septicemia, and lower respiratory tract infections (LRTIs) [5]. Infections caused by Multidrug-resistant (MDR) Enterobacteriaceae pose a significant public threat due to their association with high mortality rates. One of the most common bacterial infections in both community and hospital settings is Urinary Tract Infection (UTI). UTIs are a serious public health issue in India, where they greatly increase hospital admissions and outpatient morbidity [6,7].

Antimicrobial resistance, especially in Gram negative bacilli is a growing public health concern. Treatment options for the multi-drug-resistant strains are limited due to paucity of newer antimicrobials in the pipeline. Infections with antimicrobial resistant strains lead to longer duration of hospital stay, increased cost of health care and contribute to higher rates of morbidity and mortality [8].

However, the development of drug resistance to such medicines has evolved into a major health issue globally [9]. The Centre for Disease Control and Prevention (CDC), United States of America (USA), believes infections caused by carbapenem-resistant Enterobacteriaceae (CRE) to be an urgent concern to public health because they are being reported more often across the world [100].

Today, ESBL producers have been recognized as the mainstay causes of hospital and community-acquired infections globally. Isolates that express ESBL phenotypes and hydrolize the beta lactam antibiotics are often multi-drug resistant (MDR) [11-13].

MATERIALS AND METHODS

The present Research was carried out in the Department of Biochemistry at Index Medical College, Hospital & Research Centre, Indore (M.P.), over the period from July 2023 to December 2026. All the samples are taken from the OPD and IPD of Index Medical College, Indore (M.P).

A total of 400 urine samples from patients with clinically suspected UTI were included in the study. Samples were received from outpatient and inpatient services.

Inclusion criteria:

- Patients aged 13–65 years.
- Clinically suspected UTI cases.
- Patients willing to participate and provide a urine sample.

Exclusion Criteria:

- Patients below 10 or above 65 years.
- Patients unwilling to participate.
- Improper, leaking, contaminated, or inadequate urine specimens.

Sample Collection and Biochemical Analysis

Clinical specimens will be collected aseptically following standard microbiological procedures. The samples will be cultured on CLED agar, MacConkey agar and Blood agar plates and incubated aerobically at 37°C for 18–24 hours. Bacterial isolates will be identified on the basis of colony morphology, Gram staining characteristics, and standard biochemical tests including indole, citrate, urease, triple sugar iron (TSI), and motility tests. Detection of Beta-lactamase Production Screening for Extended Spectrum Beta-Lactamase (ESBL) production will be performed using the disk diffusion method with cefotaxime (30 µg) and ceftazidime (30 µg). Antimicrobial Susceptibility Testing Antimicrobial susceptibility testing will be performed by the Kirby–Bauer disk diffusion method on Mueller-Hinton agar, and the results will be interpreted according to the latest Clinical and Laboratory Standards Institute (CLSI) guidelines. The antibiotics will be tested included beta-lactams (ampicillin, cefotaxime, ceftazidime, ceftriaxone), carbapenems (imipenem, meropenem), aminoglycosides (gentamicin, amikacin), fluoroquinolones (ciprofloxacin, levofloxacin), and other agents such as cotrimoxazole and nitrofurantoin.

Statistical Analysis

The result of the data will be analyzed using the software SPSS. The descriptive analysis will be represented by the values in mean, percentages and standard deviation. While the inferential analysis will include the use of statistical tests including linear regression to represent the correlation. The coefficient of correlation (r) between various parameters studied will be calculated to find out the correlation of these parameters in UTI patients.

RESULT

Of the 400 urine samples examined, 304 (76.0%) showed significant bacterial growth, while 96 (24.0%) showed no significant growth. Females constituted 296 (74.0%) of the study population, and males accounted for 104 (26.0%). (Table 01/Figure 01).

The mean age of patients was 37.57 ± 13.39 years, with majority of patients belonged to the 21–40 years age group, comprising 210 (52.5%) patients. This was followed by the 41–60 years age group, which included 125 (31.2%) patients. Patients aged 10–20 years accounted for 42 (10.5%) cases, whereas 23 (5.7%) patients belonged to the 61–65 years age group. (Chart no.2)

Most patients were from the outpatient department (248; 62.0%), while 152 (38.0%) were hospitalized. (Graph no.1)

A history of recurrent UTI was documented in 120 (30.0%) patients. An indwelling urinary catheter was present in 60 (15.0%) patients, while 40 (10.0%) patients had a history of urinary instrumentation.

Among the associated comorbidities, diabetes mellitus was the most frequently recorded condition, being present in 180 (45.0%) patients. Hypertension was documented in 157 (39.2%) patients.

Dysuria was the most frequently reported symptom (314; 78.5%), followed by increased urinary frequency or urgency (297; 74.2%), suprapubic pain (168; 42.0%), and fever (117; 29.2%).

The presence of ESBL-producing Enterobacteriaceae in urinary tract infections was significantly associated with several clinical and behavioral factors.

Patients with an indwelling urinary catheter accounted for 35 isolates (32.7%), which was also significantly associated with ESBL production ($p < 0.001$). Recurrent UTI history was present in 37 patients (34%), showing a moderate but significant association ($p = 0.018$). No statistically significant association was observed with diabetes mellitus or gender alone, although females comprised a higher absolute number of ESBL infections (82/107, 76.6%) compared to males (25/107, 23.4%). These findings indicate that catheterization, and recurrent infections are important risk factors for acquiring ESBL producing organisms, highlighting the need for judicious antibiotic use and careful management of indwelling catheters (Table 02)

Table 01: Gender wise distribution of cases

Gender	Female	Male	Total
Nos.	296	104	400
Percentage (%)	74	26	100

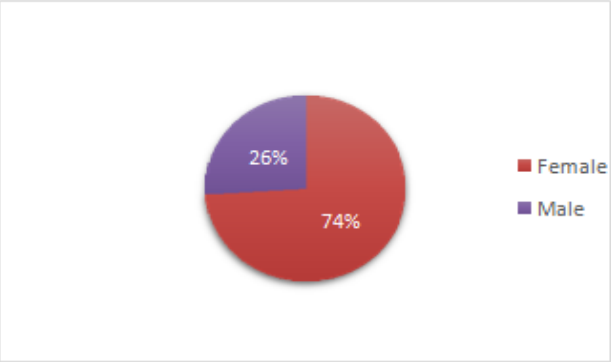

Figure 01: Distribution (in %) of Genders

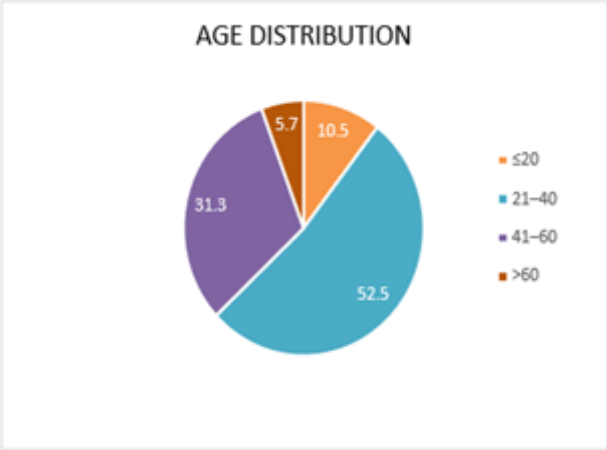

Figure 02: Age (%) Wise Distribution of Patients

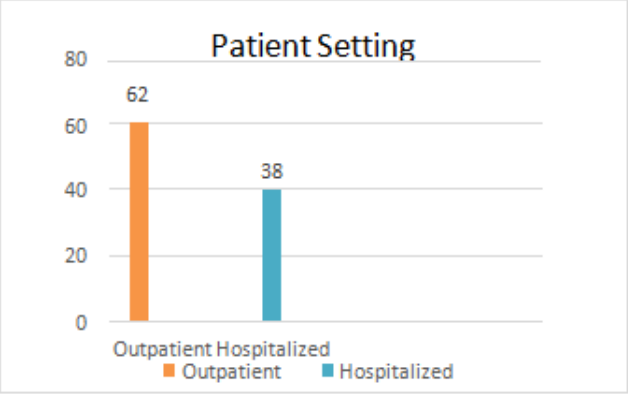

Figure 03: Patient Settings in Percentage (%)

Table 02: Risk factors associated with ESBL producing Enterobacteriaceae in urinary tract infection patients

Risk Factor	ESBL Positive (n)	Percentage (%)	p-value
Recurrent UTI	37	34.0	0.018
Indwelling catheter	35	32.7	0.001
Urinary tract instrumentation	9	8.4	NS
Diabetes mellitus	28	26.0	NS

DISCUSSION

Gouse Basha Sheik et al, 388 (49.7%) came out to be positive for UTI isolates. Among them 231 (29.6%) isolates recovered were found to be Enterobacteriacea. Among Enterobacteriacea 150 (64.9%) isolates were producing beta lactamases and 81 (35.1%) isolates were non-beta lactamases. The risk factors in Beta lactamase isolates were found to be long term hospital stay 134(89.3%), urinary catheter 125(83.3%), ICU stay 109(72.7%), prior antibiotic use within 3 months 98(65.3%), obstructive uropathy 74(46.7%), renal disease/renal transplant 68(45.3%). The frequency of ESBL, CTX M, AmpC, ESBL with Carbapenems, OXA and MBL were higher in catheterized patients as compared to non-catheterized patients [14].

Muhammad Muqaddas Mustafai et al, A majority of participants (58.3%) in the current study were living in urban areas. A total of 227 (59.1%) patients were hospitalized. Furthermore, 26.04% of the patients were determined to be suffering from infections with Enterobacteriaceae. Escherichia coli was the most prevalent (9.1%) isolate overall, followed by Klebsiella pneumoniae (8.07%), Acinetobacter baumannii (2.6%), Pseudomonas aeruginosa (3.1%), Enterobacter cloacae (1.3%), Proteus spp. (1.3%), and Morganella spp. (0.5%). The studied patients were suffering from urinary tract infections (48.6%), blood stream infections (32.2%), wounds infection (11.9%), and respiratory infections (7.03%), confirmed with bacterial cultures. The resistance against carbapenems was seen in 31.4% of E. coli isolates, 25.8% in K. pneumoniae, 50% in P. aeruginosa, 25% in A. baumannii, and 20% in E. cloacae isolates [15].

CONCLUSION

The study demonstrated a high culture positivity rate among patients with suspected UTIs, with a predominance of female patients and individuals aged 21-40 years. Dysuria was the most common clinical manifestation, and E. coli was the predominant uropathogen, followed by K. pneumoniae. These findings highlight the importance of routine urine culture and bacterial identification for the effective diagnosis and management of UTIs. Local epidemiological and microbiological data may help inform empirical treatment decisions and antimicrobial stewardship practices.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this study.

FINDING

Nil

AUTHOR CONTRIBUTION

All authors are contributed equally.

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