

Original Research Article

ANTIBIOTIC SUSCEPTIBILITY PROFILE OF ESCHERICHIA COLI ISOLATES FROM URINE SAMPLES FROM A TERTIARY CARE CENTER

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Received : 16/07/2026
Received in revised form : 14/08/2026
Accepted : 29/08/2026

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DOI: 10.70034/ijmedph.2026.3.870

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 5640-5643

ABSTRACT

Background: Escherichia coli is a predominant organism causing urinary tract infection. Escherichia coli is a Gram-negative Enterobacteriaceae known for its drug resistance. This survey, conducted over one year, shows that 43% of UTI cases were caused by Escherichia coli. It not only causes urinary tract infection, but also other intestinal infections and systemic infections such as pneumonia, sepsis and peritonitis. A UTI caused by Escherichia coli will eventually progress to cystitis and pyelonephritis. Therefore, it is necessary to treat Escherichia coli with appropriate antibiotics. The prevalence of antimicrobial-resistant bacteria has become a global threat, limiting therapeutic options. This current cross-sectional study focuses the antibiotic susceptibility pattern of Escherichia coli in urinary samples in a tertiary health care setup.

Materials and Methods: 118 strains of Escherichia coli were collected, and strain isolation was done using Blood agar and CLED agar in the Department of Microbiology, Madha Medical College. Standard biochemical test was carried out. The antibiotic susceptibility testing was done using Kirby Bauer disc diffusion method. The zone size was measured and interpreted according to the CLSI guidelines.

Results: The predominant gender affected were female because of many anatomical reasons such as short urethra. The vast majority of sample obtained was from General medicine and Obstetrics & Gynecology department. The highest resistance pattern was shown to Ampicillin (94%), cefuroxime (82%), cefotaxime (82%), cefazolin (78%) etc.

Conclusion: The study concludes by stating the importance of use of right antibiotic at right time. The study also highlights the importance of usage of fosfomycin and regards it as a safer antibiotic comparing to the other antibiotics.

Keywords: Urinary tract infection, antimicrobial resistance, Escherichia coli, Antibiotics.

INTRODUCTION

The most important discoveries of the 20th century are antibiotics, which have saved millions of lives from bacterial infections.

The term 'antibiotics' is a mere accident, discovered by Sir Alexander Fleming, who isolated the first known antibiotic, penicillin, derived from a mold called *Penicillium rubens*.^[1] Antibiotic resistance is a major threat in the 21st century, which needs to be addressed urgently, as there is the emergence of superbugs such as extended-spectrum β -lactamase

producers (ESBL), carbapenem-resistant Enterobacterales (CRE), etc.^[2]

Antibiotic resistance can be a result of chromosomal gene mutations, acquisition of foreign DNA through horizontal Gene Transfer (HRG) coding for resistance determinants, efflux pumps, etc, which has developed due to irrational use of antibiotics over the years. The spread and emergence of AMR because of antimicrobial use in livestock feed has been the major contributing factor. This has become the silent pandemic over recent years, which raises concerns about future treatment strategies. This also indicates

that the globe is in need of novel antibiotics or future steps such as phage therapy.^[1]

Urinary tract infections are said to be the most common bacterial infections, representing a severe health problem. It has been reported that Urinary tract infections are caused by a particular strain called uropathogenic *Escherichia coli*. Complications such as pregnancy, diabetes mellitus, hospital-acquired infection (HAI), renal failure, urinary tract obstruction, recent urinary tract instrumentation, presence of a stent or urinary catheter or nephrostomy tube, anatomic or functional abnormality of the urinary tract, renal transplantation, and immunosuppression can worsen the situation of persons with UTIs.

Escherichia coli is a Gram-negative bacillus belonging to the family of Enterobacteriaceae. Virulence factors of uropathogenic *Escherichia coli* include proteins, hemolysins, fimbrial adhesions, iron acquisition systems, specific lipopolysaccharides and capsule types that are lacking in commensal *E. coli* strains. *Escherichia coli* affects the perineal area, which further causes cystitis by ascending through the urethra and reaching the bladder. If left untreated, the kidney will be damaged, resulting in pyelonephritis. After involving the kidney, they breach the endothelial lining and enter the bloodstream, causing bloodstream infections and sepsis.^[3]

Objective of the study: To determine the antibiotic susceptibility patterns of *Escherichia coli* isolates acquired from urine samples in this healthcare facility.

Inclusion criteria:

Escherichia coli isolated from clinically suspected urinary samples with a colony count of >10⁵ CFU/ml (Significant bacteriuria). Colonies <10³ CFU/ml are also considered significant if the patient is suffering from renal failure, is in critical condition or has undergone transplantation and based on other clinical indication.

Exclusion criteria:

Urine samples with mixed bacterial growth; insignificant colonies (<10³ CFU/ML) are not considered for this study.

MATERIALS AND METHODS

This Cross-sectional study conducted in Department of Microbiology, Madha Medical College, Chennai over a period of one year, from January 2024 to December 2024. All the urine samples were routinely subjected to culture on Mac-Conkey agar and CLED agar by semi-quantitative loop method, where the specimen is streaked using a calibrated loop of 0.01 ml, incubated at 37 degrees Centigrade overnight. After preliminary findings of presence of Gram-negative bacteria by Gram staining, Standard biochemical test was done to confirm the *E. coli* isolates. The antibiotic susceptibility testing was

done by Kirby Bauer disc diffusion method on Mueller Hinton agar with commercially available antibiotic discs in accordance to CLSI guidelines. The antibiotics used were ampicillin (10 µg), cefazolin (30 µg), cefotaxime (30 µg), piperacillin tazobactam (100/ 10 µg), gentamicin (10 µg), amikacin (30 µg), fosfomycin (200 µg), ciprofloxacin (5 µg), trimethoprim-sulfamethoxazole [25(23.75/1.25) µg], tetracycline (30 µg), nitrofurantoin (300 µg), cefuroxime (30 µg), cefepime (30 µg), aztreonam (30 µg), imipenem (10 µg), meropenem (10 µg).

RESULTS

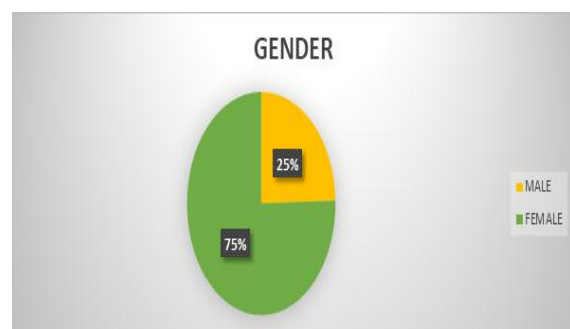
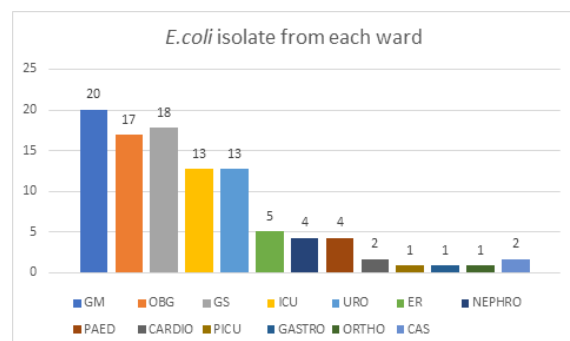


Figure 1: showing the incidence among the predominant gender.

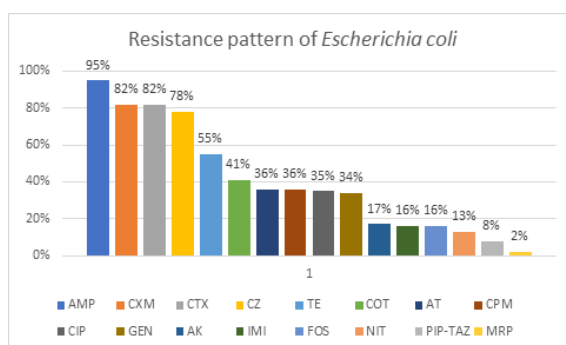
[Figure 1] picturizes that 2/3rd of the gender affected due to *Escherichia coli* is female. Whereas the 1/3rd population of the target population is male.



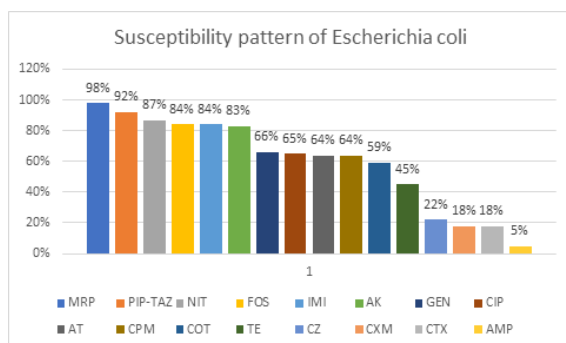
[Figure 2] shows the isolation of *E. coli* isolates from various wards. Most of the strains were isolated from General medicine followed by Obstetrics & Gynaecology and General surgery.



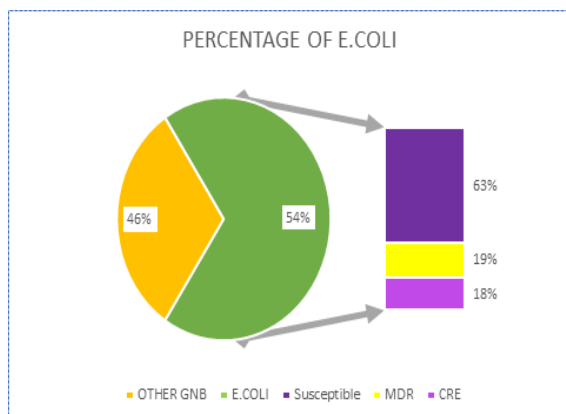
[Figure 3 & 4] illustrating the picture of antimicrobial susceptibility testing done by Kirby Bauer disk diffusion method



[Figure 5] showing the highest antibiotic resistance rate of *Escherichia coli*



[Figure 6] shows the highest antibiotic susceptibility rates of *Escherichia coli*.



[Figure 7] represents pie of bar chart, where the pie chart shows the ratio of *Escherichia coli* to other pathogens in the year 2024. Among various isolates, *Escherichia coli* (54%) charts to be in the highest proportion in the year 2024. The bar chart shows susceptible strains, MDR and CRE strains.

In the year 2024, the total no. of urinary isolates is 264 (GNB=226; GPC=38). Among the 226 Gram negative isolates, 118 strains were isolated to be *Escherichia coli*. 63% of the strains are susceptible to most of the antibiotics. Whereas, 19% of the strains are multidrug resistant and the rest 18% strains are resistant to carbapenems.

At least resistance to more than three group of antibiotics such as fluorquinolones, aminoglycosides and cephalosporins are considered to be MDR resistant strains.^[4]

DISCUSSION

Among the reported bacterial infections, UTI are the most common infection. The predominant gender suffering with UTI is female because of the anatomical reasons. Females have a shorter urethra than males, making them more susceptible to contact with infective fomites. The adult female urethra is roughly around 3-4 cm in length with a wider lumen and the male urethra measures approximately 18-20 cm in length with a narrow lumen. In addition, the male urethra is divided into two parts and has protective layers. The penile urethra is surrounded by a layer called corpus spongiosum, and the fossa navicularis is surrounded by the glans penis.^[5]

The other reasons include that the female urethra opens into vulvar vestibule, an area which is particularly prone to infections. The infection further increases due to sexual activity and use of excess intimate products breaching down the protective normal flora. Caesarean sections and perioperative catheterizations are also key factors for women to get urinary tract infections very easily. The risk of infections increases with age.^[6]

Like the current study, another study has proven that females are being affected by urinary tract infections than male patients. According to the study conducted by Alameer et al, the vast majority of urine- positive cultures for *Escherichia coli* were obtained from female patients.^[7]

In this study, 19% of *Escherichia coli* strains were multidrug resistant. Multidrug resistance is a current threat to present and future. The multidrug-resistant mechanism of the organism is due to several factors such as efflux pumps, enzymatic activation, target modification, horizontal gene transfer, etc. It has been found that *Escherichia coli* has a troubling pattern of antimicrobial resistance towards first-line oral antibiotics such as ampicillin, co-trimoxazole, and ciprofloxacin.

According to Ravi et al, a similar resistance pattern was observed across tertiary care centres in Saudi Arabia, East Africa and South east Asia due to widespread empirical antibiotic use, self-medication and unregulated access to antibiotics.^[8] In contrast, resistance to nitrofurantoin and fosfomycin remains low, suggesting the effectiveness of these antibiotics in uncomplicated lower urinary tract infections. Resistance to cephalosporins and fluoroquinolones indicates the global emergence of MDR clones and horizontal gene transfer of resistant elements, such as beta-lactamases and fluoroquinolone-resistant plasmids. Fosfomycin is well suited for MDR isolates as it inhibits cell wall formation by its unique chemical structure, mechanism of action and low chromosomal mutations.^[9]

Our study is recorded with 18% carbapenem resistant strains. According to the Yohe Doi, the treatment options for Carbapenem resistant strains includes polymyxin group of drugs such as colistin and polymyxin B. According to Yohe Doi, the treatment

options for carbapenem-resistant strains include polymyxin group of drugs such as colistin and polymyxin B. But use of polymyxins is widely limited because of toxicities such as neurotoxicity and nephrotoxicity. Therefore, other choices would include meropenem-varobactam, imipenem-cilastatin-relebactam etc.^[10-18]

CONCLUSION

A successful antimicrobial therapy for UTI is a challenging task because of other key components. Even though meropenem is susceptible to most of the strains, it cannot be used for all patients because it is a broad-spectrum antibiotic and shall be recommended to be used as an empirical therapy for sepsis and septic shock or unless and until the isolated strain is an ESBL producer.

Nitrofurantoin is a good option, but recent reports show that prolonged use of nitrofurantoin has the risk of causing irreversible drug-induced interstitial lung disease (DI-ILD), by acting upon parenchymal cells of the lungs (11). Fosfomycin seems to be a safer drug to use for both complicated & uncomplicated urinary tract infections (UTI), because it is prescribed for *Escherichia coli*. Therefore, a clear antibiotic policy in every tertiary care centre can combat UTI with a well-planned bundle care approach. The "culture of cultures" framework directly addresses the critical need to obtain microbiological cultures before initiating empirical antimicrobial therapy. This dual-layered strategy involves systematically tracking microbiological culture reports to guide precise antibiotic de-escalation and fostering a collaborative workplace environment where diverse clinical and diagnostic perspectives are integrated into patient-centred care.

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