Original Research Article

# Prevalence and antibiotic susceptibility pattern of Escherichia coli isolated from urine samples in patients attending a tertiary care hospital, Chennai

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## Abstract

**Background**: Escherichia coli *(E.coli)*is one of the commonest cause of urinary tract infections. The drug resistance to many of the common antibiotics in use, has been alarming in the urinary E. coli isolates. **Objective**: To study the prevalence of E.coli in urinary tract infections and to study their antibiotic susceptibility pattern of the isolates. **Material and Methods:** This study was conducted in a tertiary care hospital in Chennai over a period of 4 months. A total of 3408 urine samples were processed for bacterial culture using standard methods. E.coli isolates were further confirmed by standard microbiological and biochemical methods. Antibiotic susceptibility of the E.coli isolates were carried out by Kirby Bauer disc diffusion method. **Results:** A total of 102 E.coli isolates were obtained from the urine specimen and were screened for the antibiotic susceptibility pattern. E.coli isolates were highly susceptible to imipenem (100%) and nitrofurantoin (96%). High degree of resistance was seen to antibiotics like ampicillin, amoxycillin clavulanic acid, cefazolin and cotrimoxazole, ciprofloxacin and cefotaxime. **Conclusion:** Our results give the data about the antibiotic susceptibility pattern of the Escherichia coli isolates in this locality. This will help in the choice of the appropriate antibiotics for treatment of the infections.

**Keywords:** Escherichia coli, Urinary tract infection, Antibiotics, Resistance

## Introduction

Urinary tract infection (UTI) is a common infectious disease, affecting 150 million people each year worldwide. The causative organisms of UTI includes both Gram-negative and Gram-positive and certain fungi [1]. Urinary tract infection may present with symptoms or may be asymptomatic. However, both the types of infection must be treated as soon as possible or may lead to complications [2]. Gram negative bacteria are among the common organisms isolated from the urine samples of patients with urinary tract infections [3]. Though the causative is of varied origin, 95% of cases are of bacterial origin only. *E. co li* is the most common bacteria responsible for the majority of the infections [2,4,5]. It is an important cause of community-acquired urinary tract infections (70–95%) as well as nosocomial UTIs (50%), and responsible for world wide morbidity [6]. Hence early diagnosis and treatment plays a key role in decreasing the morbidity. This makes the selection of appropriate Antimicrobial therapy an important step to treat as well to prevent the spread of resistance [7].

In the recent years, Emergence of antibiotic resistance is becoming a major health threat. Many studies with E.coli strains showing antibiotic resistance has also been reported. According to the Centre for Disease Control and Prevention (CDC), multi-drug resistance (MDR) is defined as the organism showing non-susceptibility to at least one antimicrobial agent in three

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or more of the antimicrobial categories [8]. MDR bacteria are suspected to be the major cause of the treatment failure of infectious diseases leading to high morbidity and mortality [9,10]. Regular monitoring of antibiotic susceptibility is essential for rational management of the infections and to battle the widespread occurrence of multidrug resistant E.coli. The rates of drug resistance to the commonly prescribed drugs vary widely worldwide.

Thus, investigating the prevalence, causative agents and their antibiotic susceptibility pattern is fundamental for appropriate management of the UTI and improving the efficacy of the empirical treatment. Hence, this study is aimed at determining the prevalence and resistance pattern of E.coli isolates causing UTI.

## Materials and Methods

The study was conducted at Sree Balaji Medical College & Hospital, Chrompet, Chennai for a period of 4 months from march 2017 to June 2017. Institutional ethical clearance was obtained.

A total of 3408 midstream urine samples were collected in a wide mouthed sterile container from all the patients with clinical symptoms suggestive of urinary tract infections, who have not received any antibiotic therapy in the previous two weeks.

The patients with no symptoms suggestive of UTI at the time of sample collection and with history of recent antibiotic usage were excluded from the study. Patients suffering from renal disorders, HIV positivity and who were on corticosteroid therapy were also excluded from the study. All the urine samples were cultured within half an hour of sampling. Then, the bacterial pathogens were isolated and tested for antibiotic susceptibility pattern.

**Bacterial isolation and identification:** All samples were inoculated by surface streak procedure on Mac-Conkey agar and Blood agar plates by semiquantitative method using calibrated loops. The plates were incubated aerobically at 37°C for 24 hours, and for 48 hours in case no growth was observed after 24 hours. A specimen was considered significant for UTI in the light of the number of yielded colonies (>$10^5$cfu/mL) and the cytology of the urine through microscopic detection of bacteriuria and PMNs (8 leukocytes/mm3).

However, lower colony counts associated with significant pyuria or low PMN count associated with significant colony counts was considered and analyzed in the light of the clinical picture and the patient's immunological status. Bacterial identification was based on standard culture and biochemical characteristics of isolates. Gram-negative bacteria were identified by standard biochemical tests. Escherichia coli isolates were diagnosed based on the cultural characteristics, Gram stain findings, motility test and biochemical reactions name indole, citrate, oxidase, H2S production, lactose fermentation, urease hydrolysis, etc.

**Susceptibility testing**: Antimicrobial susceptibility of Escherichia coli isolates was tested by the disk diffusion Kirby Bauer method according to Clinical Laboratory Standards Institute (CLSI) recommendations, using Mueller–Hinton agar. Antimicrobial agents tested were ampicillin, amoxicillin–clavulanicacid, ciprofloxacin, gentamicin, piperacillintazobactum, cotrimoxazole, imipenem, nitrofurantoin, cefazolin, cefotaxime, ceftriaxone, amikacin (all disks were chosen as per the CLSI recommendations) [7]. A standard inoculum adjusted to 0.5 Mcfarland was swabbed on the Muller Hinton agar and the antibiotic discs were placed and incubated at $37^0$ C for 24 hours. ATCC reference E.coli strain (25922) was used as control.

The data obtained from the study were entered and analysed using SPSS windows version 14.0 software. Pearson's Chi square test was used to find significance of the results. The p value <0.05 is considered statistically significant.

## Results

A total of 3408 urine samples were included in the present study. Escherichia coli was isolated from 102 of the total urine samples (30%). The E.coli isolates were found to be highly susceptible to antibiotics like imipenem, piperacillin tazobactam, nitrofurantoin, amikacin. They showed lesser susceptibility to antibiotics like ampicillin, amoxycillin clavulanic acid, cefazolin, cotrimoxazole, etc.

The antibiotic susceptibility pattern of the E.coli isolates were shown in the Table.

**Antibiotic susceptibility pattern of *Escherichia coli* isolates:**

| | No. of Susceptible E.coli isolates N = 102 | Percentage of susceptible isolates (%) | No. of Resistant Isolates | Percentage of resistant isolates |
|---|---|---|---|---|
| Ampicillin | 13 | 13 | 89 | 87 |
| Amoxycillin clavulanic acid | 16 | 16 | 86 | 84 |
| Ciprofloxacin | 45 | 44 | 57 | 56 |
| Gentamicin | 73 | 72 | 29 | 28 |
| Cotrimoxazole | 31 | 30 | 71 | 70 |
| Nitrofurantoin | 98 | 96 | 4 | 4 |
| Cefazolin | 27 | 27 | 75 | 73 |
| Cefotaxime | 52 | 51 | 50 | 49 |
| Piperacillin tazobactam | 95 | 93 | 7 | 7 |
| Imipenem | 102 | 100 | 0 | 0 |
| Amikacin | 90 | 88 | 12 | 12 |
| Ceftriaxone | 55 | 54 | 47 | 46 |

## Discussion

Urinary tract infections are one of the common bacterial diseases affecting the people worldwide. Urinary tract infection is a broad term which is commonly referred to as the presence of microbial pathogens within the urinary tract and it can be symptomatic or asymptomatic, complicated or uncomplicated. UTI occurs by invasion and multiplication of the microbial pathogens in the urinary tract. Effective management of UTI commonly depends on the identification of the etiological agent causing the infection and selection of appropriate antibiotic to effectively battle the organism.

Many organisms are encountered for causing the urinary tract infections. Escherichia coli is one of the common organisms causing UTI. E.coli accounts for more than 50% of the UTI cases [11,12]. In the present study, E.coli was isolated in 30% of the total urine samples. This could be due to variation in the sample size and the studies might be based on retrospective analysis. E.coli has been widely associated with various clinical conditions. Karlowsky et al reported that the pathogenic E.coli isolates are at higher risk of developing resistance [13].

Treatment of UTI is often empirical and antibiotic therapy is based on the susceptibility pattern of the isolated organisms in culture. Antibiotics are generally used to kill or inhibit the growth of microorganisms. However, irrational and high uncontrolled antibiotic usage has led to the emergence of antibiotic resistance among the urinary pathogens. The prevalence of antibiotic resistance is on the rise worldwide.

Antibiotic resistance in E.coli isolates is increasing day by day making it a major health issue. Hence it is very essential to determine the resistance pattern in E.coli isolates for proper management plans. The resistant pattern of E.coli isolates can vary by regions. High degree of antibiotic resistance was observed in the E.coliisolates in the current study. 80-90% of E.coli were resistant to ampicillin (87%) and amoxycillin-clavulanic acid (84%). This emphasises the cautious use of these antibiotics in UTIs. In different parts of the country, resistance of *E. coli* to penicillin group of antibiotics have been on higher side and is increasing day by day. In a study by Aibinu et al, 100% of the E. coliisolates were resistant to ampicillin [14]. Similar reports have been documented by Sabir et al and Aziz et al [15,16].

High degree of resistance (70 – 80%) was observed to antibiotics like cefazolin and cotrimoxazole. Percentage of resistance to cotrimoxazole (70%) in our study is similar to another study reported from Nigeria [17].

Contrast to our study, Urinary isolates in few other studies showed a lesser degree of resistance to cotrimoxazole [18,19]. Cotrimoxazole resistance was

reported in 30% of the isolates in a study by Oteo et al [18] and 27% of the isolates in another study by Alos et al [19]. Previously, Cotrimoxazole was one of the active drugs of treatment in UTI cases. But many of the previous studies and our study indicates that this drug is no longer an effective drug against uropathogens [18,19].

50 – 60% of E.coli isolates in our study were resistant to ciprofloxacin and cefotaxime. In contrast, studies by Akinjogunla et al and Akingbade O et al, reported low percentage of resistance to ciprofloxacin and cefotaxime [20,21].

Resistance to other beta-lactam antibiotics such as cefotaxime was also very high rendering many of these cephalosporins inefficient for empirical prescription to treat urinary tract infections. Previous studies have also shown very high antibiotic resistance in *E. coli* against cephalosporins and penicillins [16,22]. Lesser degree of resistance was observed to gentamicin and amikacin (28% and 12%) which is in consistent with the study by Sabir et al (12.7%)[15].

In the current study, E.coli isolates showed a good susceptibility to gentamicin (72%). Quinolones, especially ciprofloxacin have been used for *E. coli* infections in recent past. In the present study, E.coli isolates showed a high degree of resistance to fluoroquinolones. Similar results have been reported in another study by Mavroidi et al. [23].

We found that the E.coli isolates were highly susceptible to imipenem (100%) and nitrofurantoin (96%). Similar results have been reported by Sumera et al [15]. In many previous studies, Nitrofurantoin is found to be reasonably effective against E.coli (24,25,26). Also, nitrofurantoin is more advantageous because of its oral usage. Meropenem, imipenem, amikacin are found to have good sensitivity. Hence, these drugs can be reserved for critical conditions and when first line drugs are found to be resistant.

The high degree of resistance of E.coli isolates in this study can be attributed to the widespread and indiscriminate use of antibiotics in current clinical practice. Inorder to avoid treatment failure and spread of mutant strains, knowledge about the resistant pattern of the E.coli isolates in the locality will be helpful to select appropriate antibiotics. Further, Organisms emerge as resistant strains when the patient doesnot maintain antibiotic dose regimen eventually leading to nosocomial and community acquired infections.

## Conclusion

In conclusion, Escherichia coli isolates from urinary tract infections have showed resistance to many of the routine antibiotics in our study. This information may directly influence the choice of empirical antibiotic therapy for UTI. Multidrug resistant uropathogenic E. coli is an expanding public health threat. Misuse of antimicrobials contributes to increase in bacterial resistance which has led to increase in treatment failure, morbidity & mortality. This study provides information regarding the prevalence and antibiotic susceptibility pattern of the urinary E.coli isolates which will be helpful for the clinicians to select appropriate antibiotics for empiric therapy. Knowledge about the etiologic agents or UTI and their antibiotic resistance pattern in specific geographical locations may help the clinicians to choose appropriate antibiotic for empirical treatment. The antibiotic resistance patterns observed in this study emphasises the need for close monitoring and appropriate prescription of antibiotic after culture and sensitivity results. Infection control measures, active surveillance and antimicrobial stewardship is highly needed to reduce the multi drug resistance in bacteria. As resistance is becoming more widespread, prudent use of antimicrobials is imperative. To prevent the spread of the resistant bugs, it is critically important to have surveillance programs for the detection of drug resistance & have strict antibiotic policies.

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