

Isolation and Antibiotic Susceptibility Pattern of *Escherichia coli* from Urinary Tract Infections in a Tertiary Care Hospital of North Eastern Karnataka

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Abstract

Introduction: Clinical management of the urinary tract infections (UTI) is influenced by the antimicrobial vulnerability patterns. **Objective:** The study aimed to analyse the resistance pattern of the *Escherichia coli* (*E. coli*) causing UTI in patients over a period of 4 years from 2012 to 2015. **Materials and Methods:** 1000 samples from patients suspected of having urinary tract infections were collected and processed for culture and antimicrobial drug susceptibility as per the routine microbiological techniques. **Results:** Of the total 1000 samples, 395 cases were culture-positive for *E. coli*. These isolates were tested for antibiotic susceptibility by disk diffusion method. Of the total 395 *E. coli* isolates, 170 (43%) were multi drug resistant (MDR). The isolates showed high level of resistance to Ampicillin (82.53%), Cefuroxime (72.41%), Amoxicillin-clavulanic acid (71.90%), Ceftriaxone (66.58%), Ciprofloxacin (65.82%) and Cefepime (57.47%). The isolates were sensitive to Imipenem (96.71%), Nitrofurantoin (92.41%), Amikacin (90.89%), Chloramphenicol (85.82%), Piperacillin-tazobactam (80.76%), Gentamicin (59.24%), Aztreonam (54.43%) and Norfloxacin (53.67%). **Conclusion:** We conclude that a significant number of the urinary tract infections in our study subjects were caused by multiple drug resistant *E. coli*. The sensitivity pattern showed a continued decline from 2012 to 2015, with Imipenem being currently the most effective antibiotic.

Keywords: *Escherichia coli*, multidrug resistant, therapy, urinary tract infection

INTRODUCTION

Urinary tract infection (UTI) can be caused by Gram-negative bacteria such as *Escherichia coli*, *Klebsiella* species, *Enterobacter* species, and *Proteus* species. *E. coli* is the most common organism causing both community as well as hospital-acquired UTI,^[1] often leading to serious secondary health issues.^[2] Different factors such as age, gender, immunosuppression, and urological instrumentation can affect prevalence of UTI.^[3] Detection of UTI causing pathogens and analyzing resistance pattern of these pathogens to commonly prescribed antibiotics in the clinical practice is essential and helpful in improving the efficacy of empirical treatment.^[4] UTI caused by multidrug-resistant (MDR) *E. coli* increases the cost of treatment, morbidity, and mortality, especially in developing countries like India.^[5,6] The resistance rate of uropathogenic *E. coli* to various antibiotics has been reported as beta-lactams (57.4%), co-trimoxazole (48.5%), quinolones (74.5%), gentamicin (58.2%), amikacin (33.4%),

cefuroxime (56%), and nalidixic acid (77.7%).^[2,7-10] However, these antibiotic sensitivity patterns may vary in different geographical locations. Hence, here, we aimed to isolate *E. coli* and study the antibiotic sensitivity profile from patients with UTIs from a tertiary care hospital of North Karnataka, India.

MATERIALS AND METHODS

Sample collection

The study was performed from the year 2012–2015 to investigate symptomatic and asymptomatic UTI among patients attending OPD of Bidar Institute of Medical Sciences

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(BRIMS) Teaching Hospital, Bidar, Karnataka, India. One thousand patients complaining of burning micturition and other associated illness were included in this study. A clean-catch midstream urine sample was collected in a sterile wide mouth container labeled with information on the patients age, sex, and brief clinical history. The samples were transported immediately to the laboratory, Department of Microbiology, BRIMS, Bidar and processed for culture and antimicrobial drug susceptibility as per the routine microbiological techniques. Semi-quantitative urine culture using a calibrated loop was used to isolate bacterial pathogens on blood and MacConkey agar as per the recommendations of Kass.^[11] The plates were incubated at 37°C for 24 h and further incubated for 48 h in culture (growth) negative cases. Following this, the isolates were identified by standard biochemical tests, and diagnosis of UTI was made when pathogens were present at a concentration of at least 10⁵ colony-forming unit (CFU)/ml of urine. Isolates other than *E. coli* were not considered for this study.

Antibiotic sensitivity testing

Antibiotic sensitivity testing was done on Mueller-Hinton agar by Kirby–Bauer disc diffusion method^[12] using following antibiotic discs (HiMedia, Mumbai) ampicillin (AMP 10 mcg), amikacin (AK 30 mcg), amoxicillin-clavulanic acid (AMC 30 mcg), aztreonam (AT 30 mcg), ceftriaxone (CTR 30 mcg), cefuroxime (CXM 30 mcg), cefepime (CPM 30 mcg), ciprofloxacin (CIP 5 mcg), chloramphenicol (C 30 mcg), gentamicin (GEN 10 mcg), imipenem (IPM 10 mcg), nitrofurantoin (NIT 300 mcg), norfloxacin (NX 10 mcg), and piperacillin-tazobactam (PIT 100/10 mcg) as per CLSI guidelines.^[13]

Statistical analysis

Statistical software package SPSS version 16 (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp) was used to analyze the data. Age, gender, organisms causing UTI, and its antibiotic sensitivity and resistance were included as variables in the model.

RESULTS

Among 1000 samples tested, 39.5% (395) samples showed growth of *E. coli* with colony count of over 10⁵ CFU/ml of urine. Of the total 395 *E. coli* isolates, 170 (43%) were MDR. The isolates showed high level of resistance to ampicillin (82.53%), cefuroxime (72.41%), amoxicillin-clavulanic acid (71.90%), ceftriaxone (66.58%), ciprofloxacin (65.82%), and cefepime (57.47%) and were sensitive to imipenem (96.71%), nitrofurantoin (92.41%), amikacin (90.89%), chloramphenicol (85.82%), piperacillin-tazobactam (80.76%), gentamicin (59.24%), aztreonam (54.43%), and norfloxacin (53.67%).

Seventy-two *E. coli* positive samples were isolated in the year 2012 and were analyzed for the antibiotics sensitivity and resistance pattern among the patients of different age group as shown in Figure 1. The age group of 0–9 showed the highest

resistance to two isolates for CPM, CIP, and C and sensitivity to three isolates for AMP, AK, GEN, IPM, NIT, and NX. The age group of 10–19 showed the highest resistance to five isolates for AMP and sensitivity to six isolates for AK, IPM, and NIT. Age group of 20–29 showed the highest resistance to 28 isolates for AMP and sensitivity to 24 isolates for IPM. Age group of 30–39 showed the highest resistance to 13 isolates for AMP, CTR, and CPM and sensitivity to 15 isolates for IPM. The age group of 40–49 showed the highest resistance to six isolates for AMP and sensitivity to five isolates for AK and NIT. The age group of 50–59 showed the highest resistance to three isolates for CIP and sensitivity to three isolates for AT, C, IPM, and NIT. Age group >60 years showed the highest resistance to six isolates for AMC, CXM, and CIP and sensitivity to six isolates for AMP, AK, C, IPM, and NIT. The maximum isolates were both sensitive and resistant in the 20–29 age group.

In the year 2013, 133 isolates were analyzed for the antibiotic sensitivity pattern among the patients of different age group as shown in Figure 2. The age group of 0–9 showed the highest resistance to isolates for AMP, AMC, and CXM and sensitivity to six isolates for AK, CTR, CPM, CIP, C, GEN, IPM, NIT, PIT, and NX. Age group of 10–19 showed the highest resistance to 23 isolates for AMP and sensitivity to 27 isolates for AK, PIT, and NIT. Age group of 20–29 showed the highest resistance to 38 isolates for AMP and sensitivity to 40 isolates for IPM and NIT. Age group of 30–39 showed the highest resistance to 21 isolates for CXM and sensitivity to 26 isolates for NIT. Age group of 40–49 showed the highest resistance to six isolates for AT, CXM, and CIP and sensitivity to seven isolates for AK, C, IPM, PIT, and NIT. Age group of 50–59 showed the highest resistance to eight isolates for AMC and CXM and sensitivity to eight isolates for AK. Age >60 years showed the highest resistance to 16 isolates for AMP and sensitivity to 19 isolates for NIT. In this year also, maximum isolates were both sensitive and resistant in the 20–29 age group.

In the year 2014, 75 isolates were analyzed for the antibiotic sensitivity pattern among the patients of different age group as shown in Figure 3. The age group of 0–9 showed the highest resistance to one isolates for AT, CIP, and GEN and sensitivity to nine isolates for AMP, AK, AMC, CTR, CXM, CPM, C, IPM, NIT, PIT, and NX. Age group of 10–19 showed the highest resistance to 15 isolates for AMP and sensitivity to 17 isolates for C and IPM. Age group of 20–29 showed the highest resistance to 19 isolates for AMP and sensitivity to 21 isolates for NIT. Age group of 30–39 showed the highest resistance to 11 isolates for CXM and sensitivity to 13 isolates for AK, C, and IPM. Age group of 40–49 showed the highest resistance to four isolates for AMP and sensitivity to four isolates for AK, C, and IPM. Age group of 50–59 showed the highest resistance to five isolates for AMP, AT, CTR, and CXM and sensitivity to five isolates for AK, C, and NIT. Age group of >60 years showed the highest resistance to five isolates for AMP and AMC and sensitivity to six isolates for AK and IPM. Again in this year also, maximum isolates were both sensitive and resistant in the 20–29 age group.

In the year 2015, 54 isolates were analyzed for the antibiotics sensitivity pattern among the patients of different age group as shown in Figure 4. The age group of 0–9 showed the highest resistance to seven isolates for C and sensitivity to nine isolates for AK, IPM, and PIT. Age group of 10–19 showed the highest resistance to seven isolates for AMP and sensitivity to eight

isolates for IPM. Age group of 20–29 showed the highest resistance of twenty isolates for AMP and CXM and sensitivity to 23 isolates for IPM. Age group of 30–39 showed the highest resistance to five isolates for AMP and CXM and sensitivity to five isolates for AK and IPM. Age group of 40–49 showed the highest resistance to single isolate except AK, C, GEN,

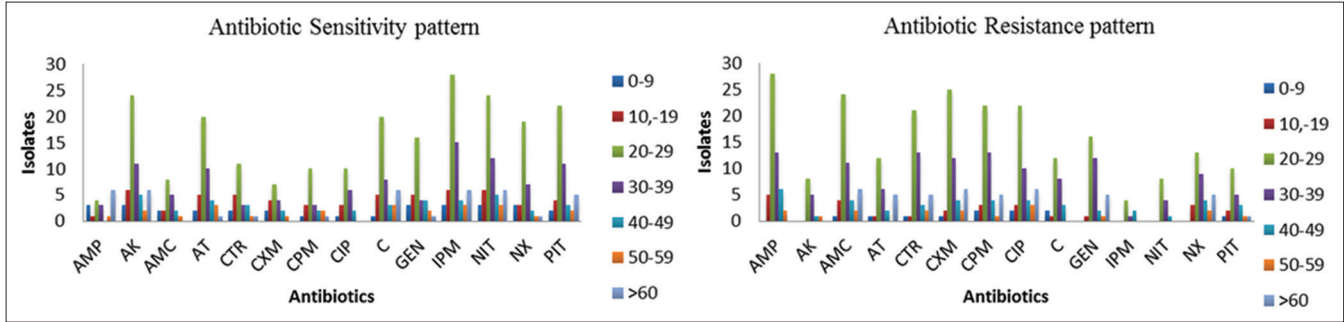


Figure 1: Antibiotic sensitivity and resistance pattern of *E. coli* isolates in the year 2012 in different age groups

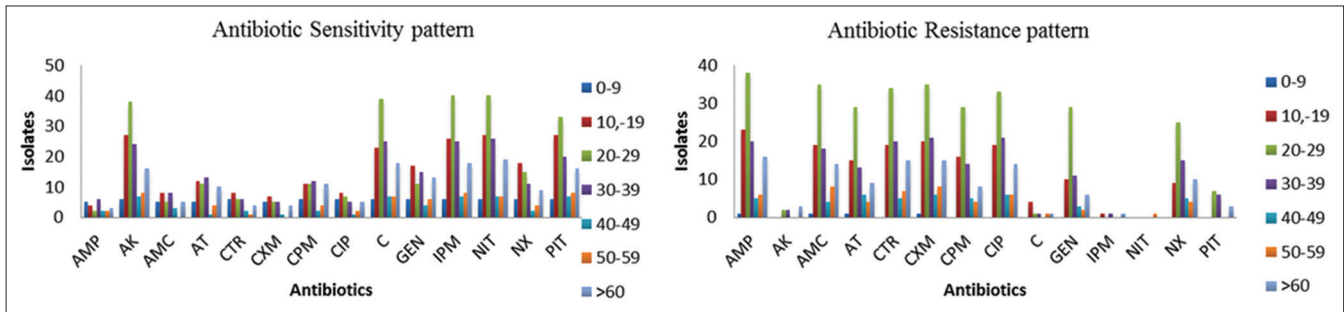


Figure 2: Antibiotic sensitivity and resistant pattern of *E. coli* isolates in the year 2013 in different age groups

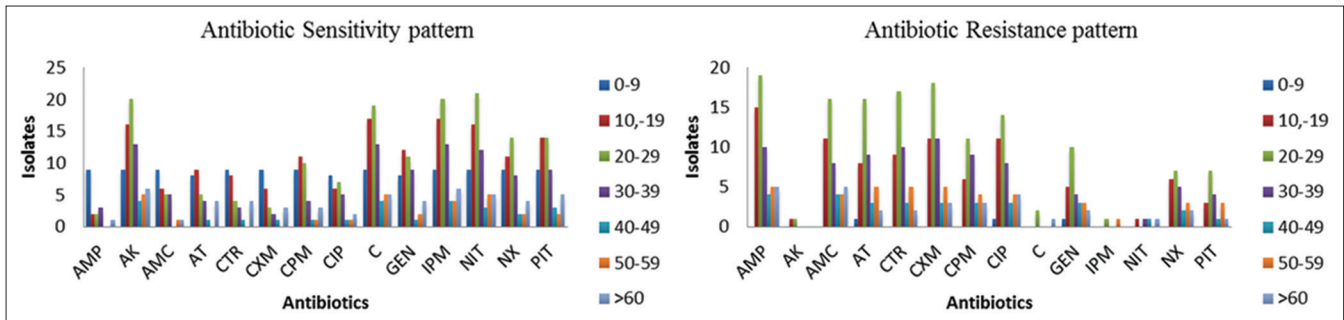


Figure 3: Antibiotic sensitivity and resistant pattern of *E. coli* isolates in the year 2014

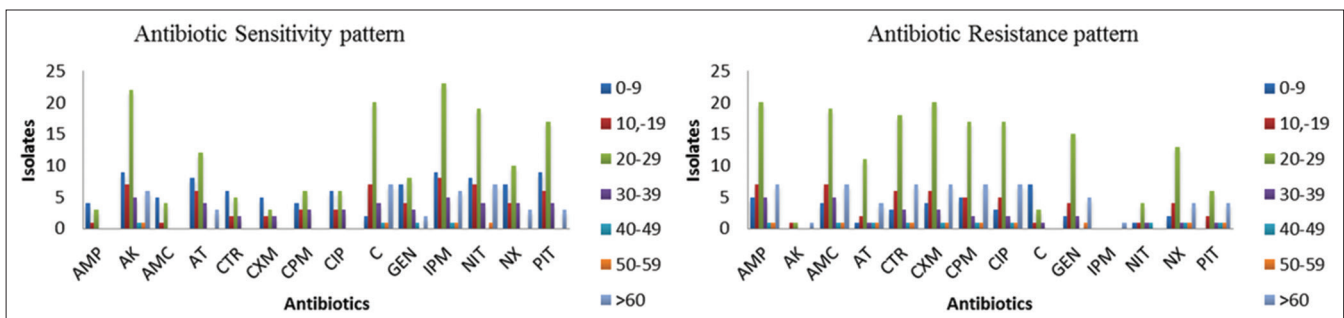


Figure 4: Antibiotic sensitivity and resistant pattern of *E. coli* isolates in the year 2015

and IPM and sensitivity to single isolate for AK, C, GEN, and IPM. Age group of 50–59 showed the highest resistance to single isolate except AK, C, IPM, and NIT and sensitivity to single isolate for AK, C, IPM, and NIT. Age group >60 years showed the highest resistance to seven isolates for AMP, CTR, CXM, CPM and CIP and sensitivity to seven isolates for C and NIT. The 20–29 age group showed the maximum isolates both sensitive and resistant to the antibiotics.

In the year 2015, 61 *E. coli* were isolated from pregnant women and were analyzed for the antibiotics sensitivity pattern among different age groups as shown in Figure 5. The age group of 10–19 showed the highest resistance to ten isolates for AMP and sensitivity to ten isolates for IPM, NIT, and PIT. Age group of 20–29 showed the highest resistance to 34 isolates for AMP and sensitivity to 35 isolates for IPM. Age group of 30–39 showed the highest resistance to nine isolates for AMP and sensitivity to nine isolates for IPM. Age group of 40–49 showed the highest resistance to single isolate for AMP, AMC, and CPM and sensitivity to single isolate except AMP, AMC, and CPM. The 20–29 age group showed both sensitive and resistant to the maximum isolates.

Our findings indicate that MIC of *E. coli* to AMP and CXM has increased and also the resistance to other antibiotics has increased with increase in MIC. Resistance to antibiotics AMP and CXM was more common among 20–29 years age group in all the years studied. The infection rate was higher in female patients (81.26%) and in the 20–29 age group [Figure 6].

DISCUSSION

UTIs are the most frequent infection in women often caused by bacteria. *E. coli* UTI caused by the MDR *E. coli* has increased in the current years probably due to the increasing and irrational use of antibiotics. The distribution of species and their susceptibility to antibiotics vary with time and place.^[14] *E. coli* was the most predominant species isolated in our study population. The isolates were tested for 14 different antibiotics and showed resistance to fluoroquinolones and other commonly used antibiotics to treat UTI which was similar to the studies conducted by Akram *et al.*^[15] and Aypak *et al.*^[16] in other parts of India. Our study also monitored the year-wise

sensitivity pattern of *E. coli* isolates to the antibiotics. In the year 2012, the isolates were more sensitive to the most of the antibiotics compared to 2015. The carbapenems could be the promising antibiotics which showed only sensitive in the year 2015. Formation of films by bacteria inside the bladder leads to recurrent infections and also increases the possibility of MDR strain causing UTI.^[17,18] Studies from India have reported *E. coli* as one of the most common organisms causing UTI.^[15,19,20] In the year 2006, Biswas *et al.* studied the prevalence of antimicrobial resistance among urinary isolates in Uttaranchal, India, and in this study, *E. coli* was isolated from 67.5% samples and more than 35% isolates showed resistant to commonly used antibiotics to treat UTI.^[21] Eshwarappa *et al.* studied the clinico-microbiological profile of UTI in South India. Their study also revealed that *E. coli* was the most common organism causing UTIs with extended spectrum beta-lactamase which recorded least resistance against carbapenems (3.9%) and a high resistance to commonly used antibiotics, which is of significant concern for future options in treating these infections.^[22] Pregnant women are more susceptible to UTI because of increased urinary content of amino acids, vitamins, and other nutrients, which encourage the persistence of infection. Manjula *et al.* studied the incidence and prevalence of UTI among pregnant women in Karnataka and found that 49.4% had UTI, and *E. coli* was the predominant pathogen isolated.^[23] The present study revealed the infection rate due to *E. coli* in pregnant women of North Karnataka region and their resistant pattern to different antibiotics.

CONCLUSION

We conclude that significant numbers of the UTI are caused by MDR *E. coli*. The antimicrobial resistance patterns of the causes of UTI are highly variable, and continuous surveillance of trends in resistance patterns of uropathogens is necessary. The treatment of UTI by antimicrobial agents needs to be strongly promoted by *in vitro* susceptibility testing to evade advance spread of antimicrobial resistance in patients and eventual development of MDR. This is the first study conducted in North Karnataka which helps further researchers to keep monitoring on the ever-changing trend in the antibiotic susceptibility pattern of *E. coli* isolates in this

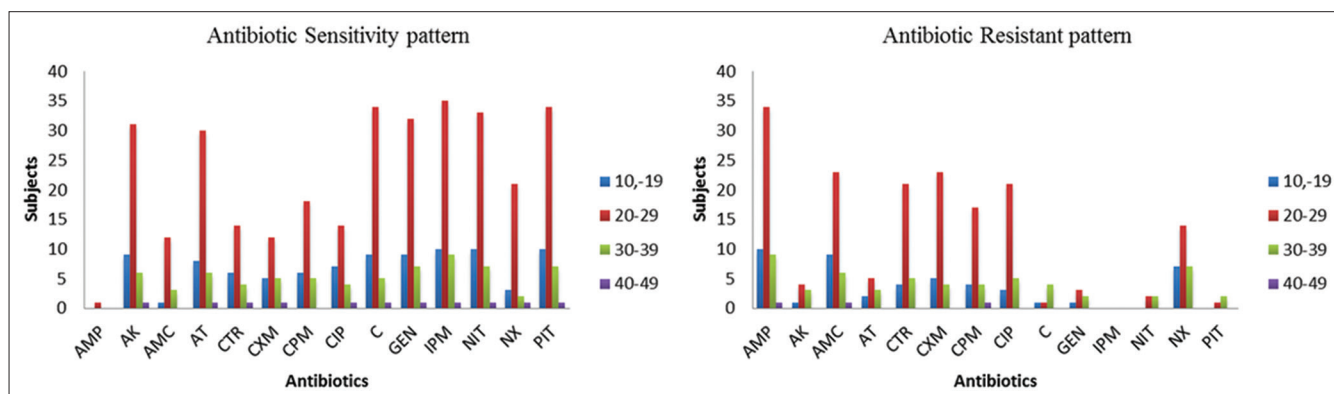


Figure 5: Antibiotic sensitivity and resistant pattern of *E. coli* isolated from pregnant women in the year 2015(P)

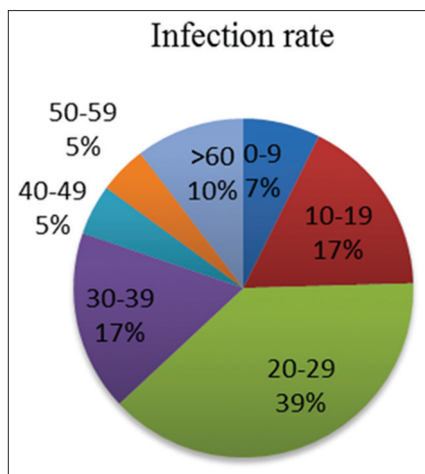


Figure 6: Percentage of infection rate in age group

region and facilitates evidence-based judicious antibiotic use policy to treat UTI.

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Conflicts of interest

There are no conflicts of interest.

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