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Antimicrobial resistance pattern in *Escherichia coli* causing urinary tract infection among inpatients

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***Background & objectives*: Recent studies suggest an increasing antimicrobial resistance among *Escherichia coli* causing urinary tract infection (UTI). We undertook this study to know the resistance pattern of *E. coli* causing UTI in patients admitted to a tertiary care hospital in north India, and to know the treatment given and response of the patients.**

***Methods*: The details of *E. coli* grown from urine samples and their antibiotic sensitivity pattern were collected from the laboratory registers and the patient details were collected from the case records. The urine samples received were processed using standard methods and antibiotic susceptibility was done by Kirby-Bauer disk diffusion test.**

***Results*: Of the total 311 *E. coli* isolates, 119 (38.2%) were isolated from in-patients, which were considered for the study. Of these 119 *E. coli* isolates, 91 (76.51%) were multi drug resistant (MDR). The isolates showed high levels of resistance to ampicillin (88.4%), amoxicillin-clavulanic acid (74.4%), norfloxacin (74.2%), cefuroxime (72.2%), ceftriaxone (71.4%) and co-trimoxazole (64.2%). The isolates were sensitive to amikacin (82.6%), piperacillin-tazobactum (78.2%), nitrofurantoin (82.1%) and imipenem (98.9%). Ceftriaxone was most commonly used for empirical therapy for UTI among inpatients in our hospital. Of the 93 cases of UTI due to MDR *E. coli*, 73 improved on treatment and 12 worsened, which were referred to higher centres.**

***Interpretation & conclusions*: Our study showed that 76.5 per cent of *E. coli* isolates from urine samples of inpatients were MDR. Diabetes, chronic renal disease and catherization were some of the risk factors associated. The high rate of resistance could be because only inpatients were included and the increased usage of cephalosporins in our hospital for empirical therapy.**

Key words Antimicrobial resistance - *Escherichia coli* - MDR - therapy - UTI

Urinary tract infection (UTI) can be caused by Gram-negative bacteria such as *Escherichia coli*, *Klebsiella* species, *Enterobacter* species, *Proteus* species and Gram-positive bacteria like *Enterococcus* species, and *Staphylococcus saprophyticus. E. coli* is the most common organism causing both community as well as hospital acquired UTI[1]. Studies from various parts of India have shown occurrence of high rates of antimicrobial resistance among *E coli.* The resistance rates of uropathogenic *E. coli* to various antibiotics have

been reported as beta-lactams (57.4%), co-trimoxazole (48.5%), quinolones (74.5%), gentamicin (58.2%), amikacin (33.4%), cefuroxime (56%), nalidixic acid (77.7%)[1-5]. UTI due to multi drug resistant (MDR) *E. coli* increases the cost of treatment, morbidity and mortality especially in developing countries like India[6,7]. This study was undertaken to know the resistance pattern of *E. coli* causing UTI in patients admitted to a hospital in Puducherry, south India. Further analysis was done to identify the associated risk factors and data were also collected regarding the treatment given.

Material & Methods

This hospital record based cross-sectional study was conducted in a 750 bedded tertiary care centre located in Puducherry, south India. The analysis was done on all *E. coli* isolates obtained from urine samples among hospital inpatients, admitted during the period of August 2011 to July 2012. All the inpatients with UTI at the time of admission or acquired during their stay in the hospital were included in the study. Ethical clearance for the study was obtained from the institutional ethics committee.

Urine culture was done by standard loop method, a semi-quantitative method. The organisms isolated from urine culture were identified by standard methods[1]. The antibiotic sensitivity test was done on Mueller-Hinton agar by Kirby-Bauer disc diffusion test as per Clinical and Laboratory Standard Institute (CLSI) guidelines[8]. The isolates were tested for ampicillin (10 µg), cefuroxime (30 µg), ceftriaxone (30 µg), norfloxacin (10 µg), nitrofurantoin (300 µg), amoxicillin-clavulanic acid (10/20 µg), co-trimoxazole (1.25/23.75 µg), cefepime (30 µg), ciprofloxacin (5 µg), amikacin (30 µg), piperacillin-tazobactam (100/10 µg) and imipenem (10 µg) (Hi-media, Mumbai). An isolate was considered as MDR if found resistant to three or more antimicrobials belonging to different classes/ groups of antimicrobials.

The data regarding the urine culture and sensitivity pattern were obtained from the Microbiology laboratory registers. The patients' details were collected from case sheets in the Medical Records Department and wards.

Proportions were used to study the resistance pattern of *E. coli* and to study the association of risk factors in UTI due to MDR *E. coli*.

Results & Discussion

A total of 2941 urine samples were received for culture and sensitivity during the study period.

Table I. Proportion of the uropathogens among the urinary isolates

Organism	No (%)
E. coli	311 (56.8)
Klebsiella species	79 (14.4)
Pseudomonas species	46 (8.4)
Enterococcus species	40 (7.3)
Staphylococcus species	22 (4.02)
Citrobacter species	22 (4.02)
Providencia species	15 (2.7)
Proteus species	6 (1.1)
Candida species	6 (1.1)
Total	547

Among these, 547 samples (18.5%) yielded significant bacteriuria; 2323 samples (79.1%) showed no growth and 74 samples (2.4%) showed mixed growth.

The various organisms isolated from urine culture are shown in Table I. *E. coli* was the commonest accounting for 56.8 per cent of the uropathogens. Of the 311 *E. coli* isolates, 119 (38.2%) were isolated from 119 inpatients (age range on 6 months-80 yr) and hence were included in the analysis.

The isolates were sensitive to amikacin (82.6%), piperacillin-tazobactum (78.2%), nitrofurantoin (82.1%) and imipenem (98.9%); 91 of 119 (76.5%) *E. coli* isolates were multi drug resistant. The sensitivity to ampicillin, cefuroxime, ceftriaxone, norfloxacin, ciprofloxacin varied from 11-25 per cent.

During the analysis it was observed that empirical therapy was started in 80 cases. In 42 cases ceftriaxone was used, in 20 ciprofloxacin, in seven cases norfloxacin and in the remaining few ampicillin, amoxicillin, cephalexin and doxycycline were used.

Of the 91 patients with UTI due to MDR *E. coli*, 73 (80.2%) patients improved after the treatment, whereas 12 (13.2%) worsened with the treatment and hence were referred to higher centres. Four patients were discharged at request and two left the hospital against medical advice. No deaths were observed in the study.

The most common risk factor associated with MDR *E. coli* were diabetes mellitus (19 patients, 28.7%) followed by renal pathologies (14 patients, 21.2%) like nephrotic syndrome, chronic renal disease, hydroureteronephrosis (HUN), and posterior urethral

Table II. Comparison of resistance patterns of uropathogenic *E. coli* in various studies from India and other parts of the world

Author	Country	Year	Aminopenicillin	Ciprofloxacin	Cotrimoxazole	Nitrofurantoin
Colodner *et al*[12]	Israel	2001	66	6	26	1
Gupta *et al*[13]	India	2002	74	38	70	12
Farrell *et al*[14]	UK	2003	48.7	2.3	---	3.7
Andrade *et al*[15]	Latin America	2006	53.6	21.6	40.4	6.6
Biswas *et al*[16]	India	2006	63.6	35.1	40.3	9.3
Garcia *et al*[17]	Spain	2007	58.7	22.7	33.8	5.7
Akram *et al*[4]	India	2007	----	69	76	80
Kothari & Sagar[3]	India	2008	85.3	72	74	24.4
Present study	India	2012	88.4*	75	64.2	17.9

*Ampicillin used in the present study belongs to aminopenicillin group

valve. The other risk factors were catheterisation (9, 13.6%), renal calculi (6, 9.1%); 39 of 91 patients did not have any risk factors.

Formation of biofilms inside the bladder causes recurrent infections and also increases the chance of MDR strain causing UTI[9,10]. Studies from India have reported. *E. coli* as one of the commonest organisms causing UTI[2-4]. In our study also *E. coli* was the commonest organism followed by *Klebsiella* species.

In our study, 76.5 per cent isolates of *E. coli* were MDR. This is quite high when compared to other studies. Prevalence of MDR *E. coli* was about 52.9 per cent in a study done by Hasan *et al*[2] in a tertiary care Indian hospital and 7.1 per cent in a study done by Sahm *et al*[11] in the USA. A study by Mathai *et al*[5] in southern India has showed that 8.4 per cent of commensal *E. coli* were MDR[5].

The antimicrobial sensitivity pattern of the *E. coli* isolates in our study was similar to previous studies done in India. The comparison of resistance patterns of uropathogenic *E. coli* in various studies is shown in Table II[3,4,12-17].

In 21 cases though the clinical picture was not UTI, the culture grew MDR *E. coli.* This could be due to improper collection of the mid-stream urine sample or there could have been a delay in transporting the sample to the laboratory which might have given a false positive culture report. The limitations of the study were that it included only the inpatients, as a result of which the resistance rates could be high. The study did not test for ESBLs and genotyping of the resistance genes was not done.

To conclude, this study showed high resistance among uropathogenic *E. coli* to ampicillin, cephalosporins, and fluoroquinolones. The increased occurrence of UTI due to MDR *E. coli* could be due to increased prevalence of MDR strains in the community.

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