Indian J Med Res 136, November 2012, pp 842-849

Antibiotic resistance pattern among common bacterial uropathogens with a special reference to ciprofloxacin resistant *Escherichia coli*

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Received November 23, 2010

***Background & objectives*: The resistance of bacteria causing urinary tract infection (UTI) to commonly prescribed antibiotics is increasing both in developing as well as in developed countries. Resistance has emerged even to more potent antimicrobial agents. The present study was undertaken to report the current antibiotic resistance pattern among common bacterial uropathogens isolated in a tertiary care hospital in south India, with a special reference to ciprofloxacin.**

***Methods*: A total of 19,050 consecutive urine samples were cultured and pathogens isolated were identified by standard methods. Antibiotic susceptibility was done by Kirby Bauer disk diffusion method. The clinical and demographic profile of the patients was noted.**

***Results*: Of the 19,050 samples, 62 per cent were sterile, 26.01 per cent showed significant growth, 2.3 per cent showed insignificant growth and 9.6 per cent were found contaminated. Significant association (*P*<0.001) of prior use of antibiotics in males, UTI in adults, gynaecological surgery in females, obstructive uropathy in males and complicated UTI in females with the occurrence of UTI with ciprofloxacin resistant *Escherichia coli* was noted. Significant association was noted in females with prior antibiotics, with prior urological surgery and in males with prior complicated UTI. There was no significant association with diabetes mellitus with the occurrence of UTI with ciprofloxacin resistant *E. coli.* Fluoroquinolone resistance was found to increase with age.**

***Interpretations & conclusions*: Ciprofloxacin resistance has emerged due to its frequent use. This resistance was seen more in the in-patients, elderly males and females. Also the resistance to other antibiotics was also high. Increasing antibiotic resistance trends indicate that it is imperative to rationalize the use of antimicrobials in the community and also use these conservatively.**

Key words Ciprofloxacin - *Escherichia coli* - minimum inhibitory concentration - urinary tract infection

Urinary tract infections (UTIs) are amongst the most common infections encountered in clinical practice[1]. The commonest bacterial agent involved in causation of UTIs is *Escherichia coli*, being the principal pathogen both in the community as well as in the hospital[2,3].

The treatment of UTIs varies according to the age of the patient, sex, underlying disease, infecting agent and whether there is lower or upper urinary tract involvement. Trimethoprim/sulphamethoxazole is the recommended drug for the treatment of UTIs in settings where the prevalence of resistance is <10-20 per cent and ciprofloxacin is recommended where this resistance is >20 per cent, according to the Infectious Diseases Society of America (IDSA) guidelines[4,5]. The other agents used in the treatment of UTI include fluoroquinolones, cephalosporins and other β-lactams with or without β-lactamase inhibitors, nitrofurantoin[4,5]. Recently, several studies have revealed increasing trends of resistance to many antimicrobials including the fluoroquinolones[6-8]. The increase in bacterial resistance to fluoroquinolone is multifactorial[9-13]. With the increasing trend of antibiotic-resistance in *E. coli*, the management of urinary tract infections is likely to become complicated with limited therapeutic options.

The present study was undertaken to assess the current antibiotic resistance pattern in the common uropathogens isolated in a tertiary care hospital in south India with a special emphasis on ciprofloxacin. Since *Escherichia coli* is the predominant pathogen, the study was focused on it. Further, risk assessment was also performed to determine the factors responsible for the emergence of ciprofloxacin resistance in *E. coli*.

Material & Methods

Study site: The study was carried out in the department of Microbiology, Jawaharlal Institute of Postgraduate Institute Medical Education & Research (JIPMER), Puducherry, India, during March 2008 to April 2009. This was an analysis of data generated from the records of consecutive urine samples received in the laboratory during the study period. Only the initial sample of an individual received was included to avoid duplication. Analysis of the data was carried out focussing on the age, gender, whether admitted or not, whether received prior antibiotic therapy, any surgical or gynaecological intervention performed in the recent past, and any history of urinary tract infection in the past. The antibiotic susceptibility data of all isolates were also reviewed and analyzed.

Samples received included mid-stream clean catch urine, suprapubic aspirate, urine collected from Foley's catheter and from the nephrostomy tube under sterile precautions, in patients who had undergone percutaneous nephrostomy. Samples were processed and isolates were identified as per standard methods[14]. All urine samples were inoculated onto cysteine lactose electrolyte deficient (CLED) medium (Himedia, Mumbai, India) using a calibrated loop (volume-0.005 ml) and were incubated for 18-24 h at 37˚C.Wet mount preparations were also made from all urine samples to look for pus cells and epithelial cells. Depending upon the number of the colonies grown on the CLED medium, the interpretations of urine culture were made as insignificant (<50 colonies), doubtful significance (>50 - <500 colonies) and significant (≥500 colonies) with due clinical correlation as per recommendations[14,15]. The antibiotic susceptibility testing of the isolated bacteria was carried out by the Kirby Bauer method[15,16].

Determination of minimum inhibitory concentration (MIC): The MIC testing was performed as per guidelines[15,16]. The MIC interpretive standards for the susceptibility categories were as per the recommended breakpoints by the Clinical Laboratory Standards Institute (CLSI) for ciprofloxacin[16]. Ciprofloxacin hydrochloride was obtained from Hi-media (Mumbai, India). The antibiotic was dissolved in sterile distilled water as per the recommendations. The antibiotic was used immediately after reconstitution. The different concentrations of the drug analyzed were 0.5 to 256 μg/ml[15,16]. ATCC *E. coli* 25922 was inoculated on each plate as the growth control. The growth control was read first followed by the MICs of the test strains[15,16].

Statistical analysis: The chi-square test or Fisher's exact test was used to compare different groups. Relative risk and odds ratio were determined to compare the risk factors in the different groups of interest (UTI due to ciprofloxacin resistant *E. coli* and UTI due to *E. coli*). Statistical softwares GraphPadInStat3 software (GraphPadInc, San Diego, USA) and SPSS 16.0 (SPSS Inc, Chicago, Illinois, USA) were used to analyse the data.

Results

Data from a total of 19,050 consecutive urine samples were included in the study. Of these, 11,811 (62%) were sterile, 4956 (26.01%) showed significant growth, 438 (2.3%) showed insignificant growth and 1828 (9.6%) were found contaminated. Wet mount microscopy for presence of bacteria or pus cells in significant amount per field had sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of 83, 58, 44 and 89 per cent, respectively in detecting infections.

Of the 4956 culture positives, *E. coli* was the most common (59%) isolate. (Table I). The percentage

Table I. Organisms causing urinary tract infection (UTI) in relation to different host characteristics

Host Characteristics	*Escherichia coli* (2671)	*Ciprofloxacin resistant E. coli* (1951)	*Citrobacter spp* (78)	*Enterobacter spp* (93)	*Klebsiella pneumoniae* (551)	*Pseudomonas* (355)	*Acinetobacter spp* (416)	*Staphylococcus spp* (166)	*Enterobacter faecalis* (455)	*Providencia spp* (16)	*Morganella morgannii* (52)	*Proteus mirabilis* (61)	*P.vulgaris* (3)	*P.penne-ri* (11)	*Aeromonas spp* (7)	*Streptococcus spp* (20)	*S.marcescens* (1)
Male	1190 (44.55)	925 (47.4)	36 (46.1)	44 (47.3)	181 (32.8)	163 (45.9)	130 (31)	76 (45)	209 (45)	7 (43.75)	28 (53.8)	43 (70.4)	3 (100%)	11 (100%)	2 (26.5%)	13-	
Female	1481 (55.44)	1026 (52.5)	34 (43.5)	39 (41.9)	261 (47.3)	168 (46.8)	246 (59)	70 (42)	171 (37)	9 (56.25)	24 (46.15)	18 (29.5)	0 (0%)	0 (0%)	5 (71.4%)	16 (80%)	1 (100%)
Children	406 (15.20)	153 (7.84)	8 (10.2)	10 (10.7)	109 (19.7)	24 (6.7)	40 (9.6)	20 (12%)	75 (16.4)	3 (18.75)	9 (17.3)	15 (24.5)	0 (0%)	0 (0%)	1 (14.2%)	1 (5%)	0
Prior antibiotics use	356 (13.32)	182 (9.32)	25 (32)	40 (43)	194 (35.2)	96 (27)	84 (20)	35 (21)	119 (26)	9 (56.25)	17 (32.69)	29 (47.5)	2 (66.6%)	3 (27.2%)	5 (71.4%)	6 (30%)	0
Urology surgery	180 (6.75)	93 (4.76)	6 (7.6)	8 (8.6)	38 (6.8)	39 (10.9)	17 (4)	5 (3)	2 (4.6)	6 (37.5)	10 (19.23)	11 (18)	2 (66.6%)	2 (18.18%)	2 (28.7%)	2 (10%)	0
Gynaecology surgery	176 (6.58)	36 (1.84)	5 (6.4)	10 (10.7)	59 (10.7)	41 (11.5)	49 (11.7)	10 (6)	24 (5.2)	1 (6.25)	7 (13.46)	5 (8.1)	0 (0%)	0 (0%)	1 (14.2%)	0 (0%)	0
Obstructive uropathy	429 (16)	243 (12.45)	26 (33.3)	9 (9.6)	55 (9.9)	96 (27)	3 (0.7)	35 (21)	97 (21.3)	0 (0)	17 (32.69)	7 (11.4)	0 (0%)	3 (27.2%)	2 (28.7%)	4 (20%)	0
Diabetes mellitus	41 (1.5)	25 (1.28)	2 (2.5)	0	8 (1.4)	10 (2.8)	4 (0.9)	6 (3.6)	13 (2.8)	0 (0)	0 (0)	0 (0)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0
UTI (pyelonephritis, recurrent UTI, pyonephrosis)	1502 (56.2)	1343 (68.83)	44 (56.4)	70 (75.2)	301 (54.6)	126 (35.4)	173 (41.5)	102 (61.4)	248 (54)	9 (56.25)	25 (48%)	22 (36)	3 (100%)	6 (54.5%)	3a (42.85%)	4 (20%)	1 (100%)
Neurogenic bladder	0	0	0	0	8 (1.4)	0	0	0	0	0 (0)	0 (0)	0 (0)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0

Values in parentheses represent percentages

Table II. Antibiotic susceptibility pattern of the Gram-negative isolates (% resistance)

Antibiotics	*E. coli* n=2671	*K. pneumoniae* n=551	*Pseudomonas* spp n=355	*Proteus* spp n=75	*Enterobacter* spp n=93	*Citrobacter* spp n=78	*Acinetobacter* spp n=416	*M. morganii* N=52	*Providencia spp* n=16	*Aeromonas spp* n=7	*S. marcescens* n=1
Ceftriaxone	1618 (60.5)	327 (59.3)	-	-	59 (78.67)	34 (43.58)	-	26 (50%)	13 (81.25%)	4 (57.14%)	0
Ceftazidime	1526 (57.1)	311 (56.4)	158 (44.5)	41 (54.67)	44 (47.31)	32 (41.02)	250 (60)	19 (36.53%)	11 (68.75%)	3 (42.85%)	0
Gentamicin	1592 (59.6)	337 (61.1)	204 (57.4)	41 (62.67)	55 (59.1)	38 (48.71)	287 (68.9)	21 (40.38%)	10 (62.5%)	4 (57.14%)	0
Nitrofurantoin	720 (26.9)	323 (58.6)	-	-	55 (59.1)	30 (38.46)	-	-	-	3 (42.85%)	1 (100%)
Meropenem	264 (9.8)	100 (18.15)	169 (47.6)	18 (24)	11 (11.83)	12 (15.38)	11 (11.83)	8 (15.38%)	1 (6.25%)	4 (57.14%)	0
Ciprofloxacin	1951 (73.04)	302 (54.8)	209 (58.8)	47 (54.67)	48 (51.6)	36 (46.15)	255 (61.2)	31 (59.61%)	9 (56.25%)	4 (57.14%)	0
Amikacin	621 (23.2)	158 (28.6)	149 (41.9)	31 (41.34)	27 (29.03)	21 (26.92)	244 (58.6)	244 (58.6%)	11 (68.75%)	1 (14.28%)	0
Ampicillin	2153 (80.6)	-	-	59 (78.67)	71 (76.34)	38 (48.71)	-	-	14 (87.5%)	4 (57.14%)	0

Values in parentheses represent percentages

of *Klebsiella pneumoniae*, *Acinetobacter* spp, *Pseudomonas* spp, *Staphylococcus* spp, *Enterococcus faecalis* was higher in patient females and patients with history of prior treatment with antibiotics, compared to the rest. In addition to these isolates, the percentage of *Proteus* spp was more in males, especially in cases with prior history of antibiotics administration (Table I).

Seventy three per cent of all *E.coli* isolates were found to be resistant to ciprofloxacin.Ciprofloxacin resistance was comparatively less among the other Gram-negative uropathogens like *Pseudomonas* spp, *Proteus* spp and *K. pneumoniae* as mentioned (Table II). Resistance to the aminoglycosides amikacin and gentamicin was also considerable especially among isolates of *Acinetobacter* spp with as many as 68.9 per cent of all *Acinetobacter* isolates showing resistance to gentamicin and 58.6 per cent to amikacin. The percentage of isolates of *E. coli* resistant to ampicillin was found to be as much as 80.6 per cent.

The rates of resistance among Gram-negative uropathogens to third generation cephalosporins like ceftriaxone and ceftazidime were high. Ceftriaxone resistance were seen in 60.5 and 59.3 per cent of all isolates of *E. coli* and *K. pneumoniae.* Resistance to ceftazidime among the Gram- negative non-fermenters was also considerable. 60 per cent of all *Acinetobacter* isolates and 44.5 per cent of all *Pseudomonas* spp isolates were found to be resistant to ceftazidime (Table II). Compared to the other Gram-negative uropathogens, resistance to the urinary antiseptic nitrofurantoin was comparatively less among isolates of *E. coli.*

Amongst the Gram-positive isolates, *Enterococcus faecalis* was the most commonly isolated organism with 3.2 per cent resistance to vancomycin. Amongst the *Streptococcus* spp, 3 (15%) were identified as *S. agalactiae*, which were isolated from antenatal women and were sensitive to all the antimicrobial agents. Substantial number of *Staphylococcus* [109 (65.6%)] and *Streptococcus* [11 (55%)] isolates were resistant

Table III. Antibiotic susceptibility pattern of the Gram-positive isolates

Organism	Interpretation	Antibiotics tested						
		Ciprofloxacin	Nitrofurantoin	Vancomycin	Oxacillin	Penicillin	Tetracycline	Ampicillin
Staphylococcus spp (n=166)	Resistant	109 (65.6)	15 (9)	9 (5.4)	95 (45.1)	141 (84.9)	-	-
Streptococcus spp (n=20)	Resistant	11 (55)	5 (25)	-	-	-	9(45%)	10(50%)
Enterococcus faecalis (n=455)	Resistant	268 (58.9)	191 (41.9)	15 (3.2)	-	-	295 (64.8%)	202 (44.3%)

to ciprofloxacin. Resistance to nitrofurantoin was comparatively more amongst the *Enterococcus* spp (Table III).

Our findings indicate that prior antibiotic therapy especially flouroquinolone therapy and post-operative patients of gynecological surgeries, were significant risk factors for the emergence of fluoroquinolone resistant *E. coli* (Table IV) .The difference between the resistance patterns amongst the inpatients (IP) and the outpatients (OP) was very minimal and no significant difference (*P*=0.0981) was noted between the two groups (Tables V and VI). But, there was a significant difference (*P*=0.0058) noted between the IP and the OP groups particularly in the age group of 19 to 25 yr with UTI due to ciprofloxacin resistant *E. coli*. Though *E. coli* was the commonest organism associated with UTI in both the IP and OP patients, there were many other unusual isolates like *Psuedomonas* spp which were isolated both from the OP patients (Table VII).

A total of 150 consecutive isolates of *E. coli* were subjected to MIC determination. Of these, 137 were ciprofloxacin resistant while 23 were sensitive. MIC_{50} was found to be between 32 and 64 µg/ml, while MIC_{90} was determined to be at 128 µg/ml for ciprofloxacin. It was noted that 5 of 150 (3.33%) isolates had MIC at 256 µg/ml, 106 (70.67%) had MIC at 64 µg/ml,

Table IV. Risk factors with respect to occurrence of UTI due to ciprofloxacin resistant *E. coli*

Risk factors	Chi-square	Odds ratio (95%CI)	Relative Risk (95%CI)
Female vs male	*P*=0.0578	1.122 (0.9980 to1.261)	1.064 (0.9991 to 1.133)
Adults vs children	*P*<0.0001	2.224 (1.828 to 2.704)	1.091 (1.069 to 1.114)
Female vs prior antibiotic use	*P*=0027	1.355 (1.114 to 1.648)	1.053 (1.020 to 1.088)
Male vs prior antibiotic use	*P*<0.001	1.520 (1.247 to 1.854)	1.086 (1.045 to 1.127)
Female vs uro-surgery	*P*=0.0332	1.341 (1.031 to 1.744)	1.028 (1.004 to 1.054)
Male vs uro-surgery	*P*=0.0029	1.504 (1.155 to 1.960)	1.046 (1.017 to 1.076)
Female vs gynaesurgery	*P*<0.001	3.387 (2.346 to 4.890)	1.081 (1.059 to 1.103)
Male vs obstructive uropathy (chronic prostatitis, prostatic hypertrophy)	*P*=0.0006	1.372 (1.147 to 1.642)	1.077 (1.034 to 1.123)
Female vs diabetes mellitus	*P*=0.7112	1.136 (0.6865 to 1.880)	1.003 (0.9907 to 1.016)
Male vs diabetes mellitus	*P*=0.4129	1.275 (0.7695 to 2.112)	1.0007 (0.9925 to 1.022)
Female vs neurogenic bladder	Cannot be commented upon as no isolates of *E. coli* was obtained from cases with Neurogenic bladder in our study population		
Male vs neurogenic bladder			
Female vs complicated UTI	*P*<0.001	0.7748 (0.6952 to 0.8635)	0.8723 (0.8227 to 0.9244)
Male vs complicated UTI	*P*=0.0165	0.8693 (0.7763 to 0.9735)	0.9226 (0.8343 to 0.9849)

Table V. Distribution of the cases with UTI due to ciprofloxacin resistant *E. coli* as a function of age, gender and inpatient/outpatient status

Age (yr)	Inpatient (IP)		Outpatient (OP)	
	(Male)	(Female)	(Male)	(Female)
0-5	10	12	15	13
6-10	17	18	24	11
11-18	23	19	25	24
19-25	110	230	48	49
Upto 40	99	189	134	77
Upto 60	80	174	136	100
>60	50	55	154	65
Total N=1951/ 2671 (73.04) Male: N=925 (47.4) Female: N=1026 (52.5)	389 (19.9)	697 (35.7)	536 (27.4)	339 (17.3)

Values in parentheses represent percentages

58 (38.66%) at 32 µg/ml, 37 (24.66%) at 16 µg/ml, 26 (17.33%) had MIC at 8 µg/ml and 23 (15.33%) had MIC at 4 µg/ml. The resistance pattern varied in different age groups. In the 0-5 years group, it was noted that (10 out of 150) 6.6 per cent isolates of *E. coli* were ciprofloxacin resistant whereas the number of isolates resistant to ciprofloxacin in the 6-10 and 10-18 yr groups was equal *i.e.* (7 of 150) 4.6 per cent. In the adults, in the age group of 19-25 yr, the resistance was noted in (32 out of 150) 21.3 per cent. In the age group of >25 yr up to 40 yr, the resistance was found to be (39 out of 150) 26 per cent and in the age group of >40 up to 60 yr, the resistance was found to be 27 (18%). In the elderly (>60 yr), the resistance was found to be 18.6 per cent (28 out of 150).

Discussion

Ciprofloxacin and ofloxacin are the most extensively used fluoroquinolones for the treatment of UTIs.

This study showed that *E. coli* was the commonest pathogen causing complicated and uncomplicated UTI as described previously[1-3]. There are several organisms known to cause UTIs, including *P. aeruginosa, S. saprophyticus, S.epidermidis, Enterococcus* spp, *P. mirabilis, Klebsiella* spp., *Citrobacter* spp, *etc.* as reported by earlier workers[17,18]. This study also demonstrates (Table VII) the emergence of *E. faecalis* and the non-fermenters *Acinetobacter* spp and *Pseudomonas* spp as major uropathogens especially in the patients admitted in the hospitals, more so in the intensive care units. Such findings have been documented elsewhere[5-16,19-22]. The percentage of isolates of *E.coli* resistant to ampicillin was found to be as much as 80 per cent in our set up. Such high levels of resistance to ampicillin have been quoted by many other studies from different parts of India. Gupta *et al*[23] in a study from the northern part of the country reported 76 per cent resistance to *E.coli* isolates for ampicillin. A more recent study from Karnataka reported a resistance rate of 80.6 per cent for ampicillin[24].

Our MIC results showed that fluoroquinolone resistance increased significantly with patient's age. An MIC of 256 µg/ml was noted in the age group of >60 yr of age. There could be two explanations for this. Firstly, as a consequence of frequent exposure to fluoroquinolones resulting from the treatment of repeated infections in elderly leads to increase in MIC of fluoroquinolone[19]. Secondly, unlike urinary tract infections (UTIs) in females, UTIs in males are frequently complicated and are more likely to require prolonged antimicrobial therapy, especially in the elderly, potentially explaining the fluoroquinolone the higher MIC[25,26]. Moreover, fluoroquinolones are

Table VI. Distribution of the cases with UTI due to *E. coli* as a function of age, gender and inpatient/outpatient status

Age (yr)	Inpatient		Outpatient	
	(Male)	(Female)	(Male)	(Female)
0-5	43	75	69	27
6-10	26	46	44	20
11-18	25	28	24	11
19-25	115	256	93	125
Upto 40	101	258	176	137
Upto 60	86	229	162	145
>60	66	59	160	65
Male: N=1190 (44.55) Female: N=1481 (55.44) Total N=2671	462 (17.29)	951 (35.60)	728 (27.25)	530 (19.88)

Values in parentheses represent percentages

Table VII. Distribution of the various organisms in the inpatients and the outpatient groups

Organism (N)	Inpatient		Outpatient	
	Male n=462	Female n=951	Male n=728	Female n=530
E. coli (2671)	389 (19.9)	687 (25.7)	536 (27.4)	339 (17.3)
Klebsiella pneumoniae (551)	88 (2.5)	171 (4.9)	224 (6.5)	68 (1.9)
Proteus spp (75)	18 (24)	10 (13.34)	36 (48)	9 (12)
Citrobacter spp (78)	21 (26.92)	20 (25.64)	22 (28.20)	15 (19.23)
Enterobacter spp (93)	24 (25.80)	49 (52.68)	12 (12.90)	8 (8.60)
Pseudomonas spp (355)	96 (27.04)	132 (37.18)	80 (22.53)	47 (13.23)
Acinetobacter spp (416)	129 (31)	204 (49.03)	37 (8.89)	46 (11.05)
Staphylococcus spp (166)	46 (27.71)	37 (22.28)	39 (23.49)	44 (26.50)
Enterococcus spp (455)	142 (31.20)	155 (34.06)	99 (21.75)	59 (12.96)
Streptococcus spp (20)	1 (5)	2 (10)	8 (40)	9 (45)
Serratia marcescens (1)	1 (100)	-	-	-
Aeromonas spp (7)	1 (14.28)	3 (42.85)	2 (28.5)	1 (14.28)
Providencia spp (16)	6 (37.5)	6 (37.5)	2 (12.5)	2 (12.5)
Morganella morganii (52)	20 (38.4)	7 (13.4)	10 (19.2)	15 (28.8)

Values in parentheses represent percentages

used to treat chronic prostatitis, even though these do not all readily penetrate the prostate[19,27,28]. Such doses of fluoroquinolones produces "sub-inhibitory concentration effects" which leads to the selection of mutants exhibiting resistance. All the elderly males, from whom the resistant isolates with high MIC were obtained, had prostatitis. In isolates from children below 18 yr, the MIC was 4 µg/ml. Amongst the cases with MIC >4 µg/ml, 14.6 per cent had obstructive uropathy, 6.6 per cent had undergone uro-surgery, 13.3 per cent had undergone gynaecological procedures, 22 per cent had indwelling catheter, and 28 per cent had history of prior antibiotic therapy.

The emergence of resistance for fluoroquinolones is multifactorial[7,17,19,20]. Resistance to ciprofloxacin has emerged in a variety of genera of the family *Enterobacteriaceae*[27,28]. Apart from the notable resistance of *E. coli* to ciprofloxacin, other organisms were also found to be resistant to ciprofloxacin especially *K. pneumoniae*, *Citrobacter* spp, *Pseudomonas* spp, *Acinetobacter* spp, *Proteus* spp and *Enterobacter* spp, *Staphylococcus* spp, and *E. faecalis*. Also, fluoroquinolone resistance in *E. coli* has emerged particularly in patients with urinary tract infections who have received fluoroquinolone prophylaxis[5-12]. An association between the increase in quinolone prescriptions and an increase in bacterial resistance has been reported from several countries[5-8,12]. Usually, the prevalence of fluoroquinolone resistance is related to the intensity of antibiotic use[5]. Resistance rates for ciprofloxacin against uncomplicated UTI pathogens were reported as 0-14.7 per cent in the ECO-SENS Project, 2.5 per cent in the USA and 1.2 per cent in outpatients in Canada[2,7,8].

In conclusion, the present results in increasing antibiotic resistance trends in UTI patients indicate that it is imperative to rationalize the use of antimicrobials and to use these conservatively.

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