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Prevalence and antimicrobial susceptibility pattern of *Escherichia coli* in hospital acquired and community acquired patients related to urinary tract infection in India

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ABSTRACT

There is a dearth of information regarding to prevalence and antimicrobial susceptibility pattern of *E. coli*, a most common cause of nosocomial infections, in community and hospital acquired urinary tract infections. The antibiotic resistant pattern against *E. coli* varies when isolated from different sources. This study was carried out with an objective to isolate *E. coli* from male and female patients infected with hospital and community acquired UTI. The isolates were subjected to five different antibiotic categories comprising 18 antibiotics. On the basis of antibiotic resistance profiling MAR index was calculated. Prevalence of UTI was found 69.17% which was high in hospital (56.63%) than community settings (43.37%). Females were found more susceptible to UTI than males in both settings. Prevalence of *E. coli* was found 61.45% among all isolates. Carbepenems showed highest sensitivity against *E. coli* isolated from UTI patients. The highest MAR indices were 0.8 (3.57%) and 0.7 (8.69%) of *E. coli* isolated in hospital and community settings. The present study suggests that females are highly susceptible to UTI in both community and hospital settings as well as the occurrence of *E. coli* were also found high in female patients. *E. coli* showed resistance against commonly prescribed antibiotics.

INTRODUCTION

Bacteria causing urinary tract infection (UTI) is the most common infection found in developing countries like India where proper sanitization is not considered adequately. It has been reported that more than 150 million people are affected by UTI globally (Stamm and Norrby, 2001) and it has also been estimated that about 30,000 UTI patients are treated in clinical wards from 6 million patients that are visited for UTI globally per year, particularly infants (Winberg *et al.*, 1975), pregnant women (Cunningham and Lucas, 1994), eldery of both sexes (Ruben *et al.*, 1995) as well as patients with spinal cord injuries, indwelling catheters (Biering-Sorensen *et al.*, 2001), diabetes (Ronald and Ludwig, 2001), multiple sclerosis (Metz *et al.*, 1998), acquired immune deficiency (Evans *et al.*, 1995) and underlying urological abnormalities (Maji *et al.*, 2013). UTI is the third most common infection found in India (Bano *et al.*, 2012) which affects the people of all age group and found in both out-patients and in-patients. This continuously increasing incidence of UTI adversely affects the socioeconomic life of individuals and also leads to the consumption of antibacterial drugs in large amount (Dada-Adegbola and Muili, 2010). The most common causes of UTI are poor personal hygiene, pregnancy, urinary tract obstruction, long time catheterization, urethral reflex, spermicidal contraception, sexual intercourse and a history of UTIs (Manges *et al.*, 2008; Nahar *et al.*, 2010). Acute and uncomplicated UTI are most commonly found in women (Warren *et al.*, 1999; Hooton *et al.*, 2004; Huang and Stafford, 2002) and it has been estimated that more than 60% women have UTI at least once in their life time (Foxman, 2002; Foxman *et al.*, 2000). It has also been reported that the rate of causing UTI is 10.57% higher in sexually active females and teenage girls than males and the most common bacteria involved are *Escherichia coli* (32.8%), *Klebsiella pneumonia* (22.4%) and *Staphylococcus aureus* (15.1%) (Kumar *et al.*, 2002). *E. coli*, the most common bacteria found in UTI infection, causes 75-90% uncomplicated UTI (Ejrnaes *et al.*, 2006), however, the estimated rate of causing UTI by *Staphylococcus saprophyticus* in younger women is 5-15% (Widerstrom *et al.*, 2007).

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Another study performed on 100 preoperative urine samples of the Urolithiosis cases in India reported that *E. coli* was the predominant bacteria found with 32.25% and 21.73% frequency in pre-operative urine samples and stone culture respectively (Solanki and Golechha, 2001). Other than *E. coli*, *Enterococci* and other gram negative rods have also been found in some cases of UTI (Darbro *et al.,* 2009). UTI accounts the commonest nosocomial infection and estimated approximately 35% of all nosocomial infection (Hvidberg *et al.,* 2000) and also been estimated that the implication of *E. coli* in UTI infection is about 80-85% (Nicolle, 2002). The widespread and easily availability of antibiotics make the UTI not easily diagnosed disease. Global research data on UTI showed that the pathogens involved in causing UTI are continuously developed resistance against commonly used conventional drugs and to newer more potent antimicrobial agents (Rajan and Prabavathy, 2012). This alarming situation arises due to the frequent misuse of antibiotics, inadequate doses and easily availability of antimicrobials (Tamberkar *et al.,* 2006; Okeke *et al.,* 2000; Lamikanra and Ndep, 1989; Okeke *et al.,* 1999). The antibiotic resistance makes UTI treatment more complicated which necessitates the careful use of antibiotics along with the formulations of new one (Hasan *et al.,* 2007). So, the aim of the present study is to compare the frequency and susceptibility pattern of antimicrobial drugs against *E. coli* isolate from patients related with hospital and community acquired urinary tract infection. This study is important for clinicians in order to facilitate the empiric treatment of patients. Moreover, the data would also helpful for the authorities to formulate antibiotic prescription policies.

MATERIAL AND METHODS

Study Design

In our study, we selected two groups of patients - community acquired (out-patients) and hospital acquired (in-patients) for the isolation of *E. coli*. The group of community acquired comprised the urine of patients who have their first visit to hospital. These patients were not admitted in any hospital either at least during last one year or at all. Hospital acquired group comprised the urine or catheterized urine of hospitalized patients who have developed UTI at least after 72 hours of admission. All urine samples were collected from clean catch midstream method. It was noticed to discontinue all antibiotics 72 hr prior to urine collection for culture and sensitivity. Urine samples were delivered to the laboratory within 1hr and processed within 24 hr from collection. Total 120 early morning midstream urine samples of patients, which comprises 62 from hospital acquired and 58 from community acquired, were collected. Out of 62 urine samples of hospitalized patients, comprises 34 were from male and 28 from female. Total 58 community acquired urinary samples comprises 27 from males and 31 from females patients. Verbal informed consent was obtained from all patients prior to specimen collection. The ethical approval was obtained for the study and subjected to the hospital administration.

Isolation and Identification

A standard loop technique was used for the isolation, in which 0.01 mL of urine was inoculated on Blood agar, MacConkey's agar and incubated at 37°C for 24 hr and extended up to 48 hr in cases of negative growth. All positive samples were rechecked by collecting second urine samples to rule out contaminations. The number of colonies was counted for the diagnosis of urinary tract infection which was defined based on significant bacterial colony count of $\geq 10^5$ CFU/ mL. The organisms were identified by general biochemical tests such as catalase, oxidase, Triple Sugar Iron agar (TSI), citrate utilization (Simmon's citrates medium), urease (Christensen's Urea Agar), indole, motility, H_2S production (Sulphide Indole Motility Medium), esculin hydrolysis, and sugar fermentation tests. All culture media were provided by Himedia Laboratories Pvt. Ltd., India. The isolated uropathogens were stored at -70°C until further analysis.

Antimicrobial susceptibility testing

Antibiotic susceptibility testing against isolates was performed according to Kirby Bauer's method (Hua *et al.,* 2004) and interpreted as per Clinical and Laboratory Standards Institute (CLSI) recommendations (CLSI, 2005). The antibiotic discs (Himedia, India) used were Imepenem (10µg), Meropenem (10µg), Ciprofloxacin (5µg), Tobramycin (10µg), Moxifloxacin (5µg), Ofloxacin (5µg), Sparfloxacin (5µg), Levofloxacin (5µg), Ceftazidime (30µg), Amikacin (30µg), Nitrofurantoin (300µg), Netillin (30µg), Nalidixic acid (30µg), Cephotaxime (30µg), Co-Trimoxazole (25µg), Gentamicin (10µg), Ceftrixone (5µg), Gatifloxacin (30µg).

Standard strain of *E. coli* (MTCC 1559) was used routinely in this study as control. Each experiment repeated in triplicate, mean and standard error mean was calculated by Microsoft Office Excel for Windows version 2007.

Multiple Antibiotic Resistance (MAR) Indexing

Multiple antibiotic resistance index (MAR) was calculated for each test isolate as recommended by Krumperman (Krumperman, 1983). The formula used was a/b where 'a' represents the number of antibiotics to which the isolate is resistant and b represents the total number of antibiotics to which the isolate was exposed.

The higher values of MAR index from 0.2 represents that the isolate is originated from high risk sources where antibiotics are frequently used, however, the lower values of MAR than 0.2 represents that the isolate originates from the sources where antibiotics are seldom or newer used.

STATISTICAL ANALYSIS

The student t-test for paired samples was used to compare in-resistance versus out-resistant and in-sensitive versus out-sensitive against isolates with Statistical Package for Social Sciences (SPSS®) software, Inc. 233 South Wacker Drive, 11th

Floor Chicago, Illinois 60606-6412, USA for Windows, version 20. Susceptibility was calculated as percentages with 95% confidence intervals and a *p*-value of <0.05 was considered to be statistically significant.

RESULTS AND DISCUSSION

Out of 120 urinary samples of hospital acquired (in-patients) and community acquired (out-patients) patients only 83 (69.17%) showed positive results for UTI. However, the prevalence of UTI was found more (56.63%) in hospitalized patients than in community acquired patients (43.37%). The female patients were found to more susceptible for both hospital acquired (61.71%) and community acquired (63.89%) UTI, than males which showed 38.29% and 36.11% positive cases of hospital and community acquired UTI respectively (Table 1).

The overall prevalence of *E. coli* was found 61.45% in total 83 Gram negative isolates from positive sample of urine. Total 28 *E. coli* (54.90%) were found in hospitalized patients (in-patients) and 23 (45.10%) were found in the positive urine samples from patients of community acquired (out-patients) UTI. The high prevalence of *E. coli* was found more in females both in hospital acquired (71.43%) and community acquired (60.87%) than males as 28.57% and 39.13% *E. coli* were found in hospital and community acquired UTI in males respectively (Table 2).

Tobramycin was found the most resistant drug in 91.30% isolated *E. coli* from out-patients followed by Nalidixic acid (86.96%) and 82.61% each for Cefotaxime and Co-trimaxazole, however, Amikacin and Imipenem was found the most susceptible drugs each in 95.65% cases against isolated *E. coli* from out-patients followed by Meropenem (91.30%) and Nitrofurantoin (82.61%). In in-patients all 28 isolated *E. coli* (100%) were found resistant against Tobramycin followed by Nalidixic acid (92.86%) and Cefotaxime (89.29%), however, Imipenem was found 100% sensitive against all isolated *E. coli* from in-patients followed by Meropenem (96.43%) and Amikacin (92.86%) (Table 3). The calculated *p*-value was lower than 0.05 in paired t tests performed on in-resistant versus out-resistant, however, there was no significant difference was found in in-sensitive versus out-sensitive pathogens as the p value was greater than 0.05 in this case. The *p*-value for the in-resistant vs. out-resistant variables was found p=0.000 and for in-sensitive vs. out-sensitive variable the p value was p=0.246 at 95% level of confidence intervals.

The results for the means of the zones of clearance around the antibiotics for the isolated *E. coli* from out-patients (community acquired) and in-patients (hospital acquired) on Muller Hinton agar are shown in tables 4 and 5 respectively. The multiple antibiotic resistance (MAR) index was calculated from table 4 and 5 for out and in-patients UTI isolates which suggests that almost all the tested *E. coli* exhibited multiple antibiotic resistance. The MAR index ranges from 0.16 to 0.77 for out-patients and 0.33 to 0.83 for in-patients (Figure 1 and 2). There was only 1 (4.35%) *E. coli* isolate found from 23 isolates in community acquired UTI which showed <0.2 MAR index and only 3 (13.04%) isolates were showed the MAR index equal to 0.2, however, there was no *E. coli* was found in hospital acquired UTI which showed ≤0.2 MAR index. All the 28 isolates of *E. coli* from hospital acquired UTI showed >0.2 MAR index from which 1 (3.57%) isolate showed the maximum MAR index of 0.8 (Figure 3).

The increasing resistance of pathogens against commonly used antimicrobial drugs is a serious issue and a major clinical problem to treating diseases. The rate of resistance among pathogens varies from time to time and from place to place (Gales *et al.,* 2001). Although UTI is the most common disease in India, it is not always possible to perform bacteriological studies and antimicrobial susceptibility testing for the treatment in small clinical centers which ultimately arises as a source of inappropriate prescription of antimicrobial drugs that leads to the development of resistance against antimicrobials in bacterial population. Even the hospitals or clinical centers where these tests are performed, the antimicrobial therapy started earlier before the arrival of reports and the changes are made for the prescribed drugs afterward, if required.

This type of medical treatment is far better in many ways as the delays are more common in many bacteriological and antimicrobial assays, however, for the initial antibiotic treatments it is necessary to acquired knowledge about the sensitivity pattern of the bacterial pathogens causing UTI in a specific local area. In the present study it was found that the females are more susceptible to urinary tract infection than males in both community acquired UTI (53.45%) and in hospital acquired UTI (54.84%). The findings are correlated with other reports (Foxman *et al.,* 2000; Oluremi *et al.,* 2011; Mohsin and Siddiqui, 2010; McGregor *et al.,* 2013).

One report indicated that the office visits for UTI was twice high in women than men (Schappert, 1999). In our study the prevalence of *E. coli* was found high in female patients of both had hospital acquired (71.43%) and community acquired (60.87%) UTI. These results are supported by other studies which reported that the *E. coli* was the predominant bacteria in causing urinary tract infection (Ruman Mowla et. al., 2011; Tambekar et al, 2006; Inaoba and Obanibi, 2006; Akhatar Khan *et al.,* 2002). Other reports showed the different rate of occurrence of *E. coli* in UTI patients as it was 75.5%-87.0% reported in USA (Ghedira *et al.,* 2004; Mangiarotti *et al.,* 2000) and 68.69%-83% in general population of India (Rayan *et al.,* 1978). These variations may be due to different life style, hygienic conditions, availability of education, inadequate water availability and different geographical conditions. Both Carbepenems used in the study were found to be most sensitive drugs against *E. coli* isolated from out and in-patients followed by Aminogygloside: Amikacin. Imipenem and Amikacin each showed 95.65 % sensitivity followed by Meropenem (91.30%) in out-patients whereas Imipenem was found 100% sensitive against all *E. coli* isolates from in-patients followed by Meropenem (96.43%) and Amikacin (92.86%).

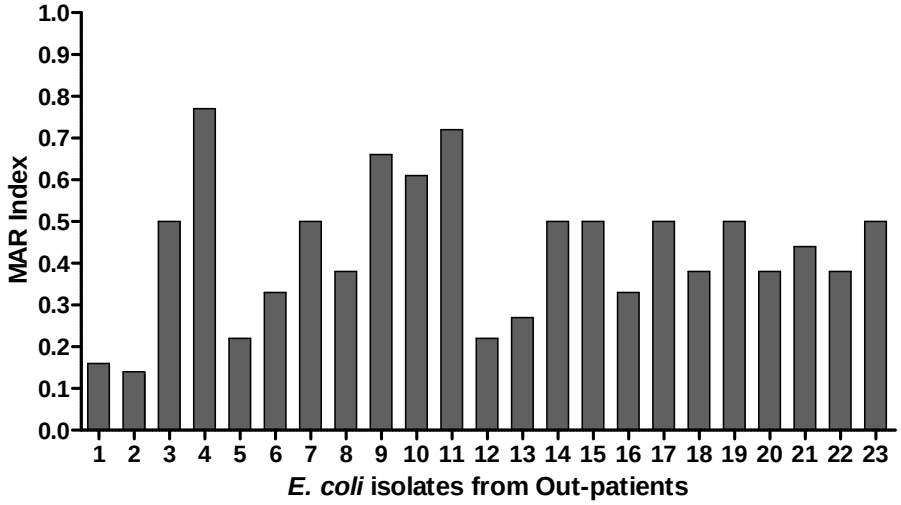

Fig. 1: MAR (Multiple Antibiotic Resistance) indices of isolated *E. coli* from Out-patients.

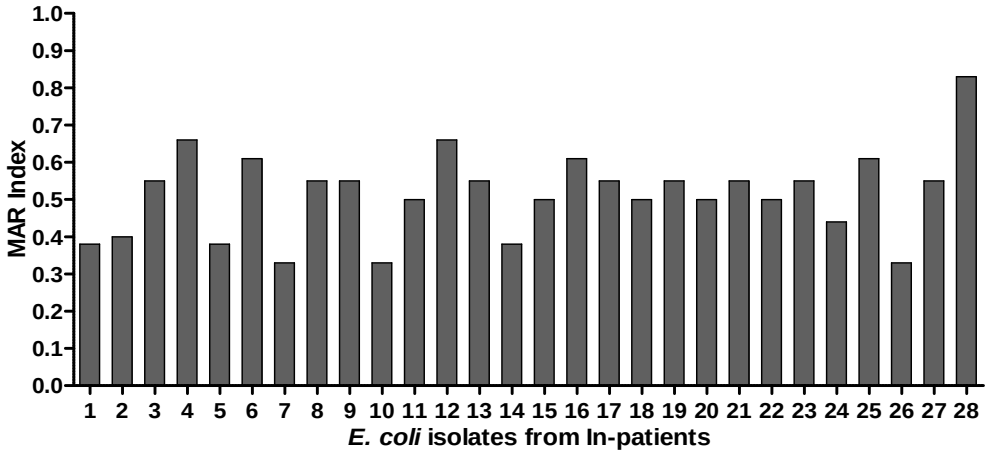

Fig. 2: MAR (Multiple Antibiotic Resistance) indices of isolated *E. coli* from In-patients.

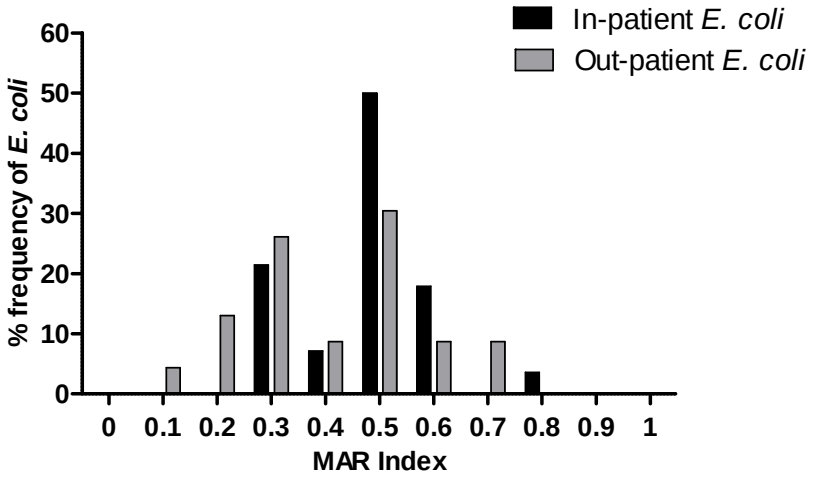

Fig. 3: Multiple antibiotic resistance (MAR) indices of *E. coli* isolated from in and out-patients.

These antibiotic susceptibility results correlate with other studies (Alipourfard and Nili, 2010; Mangaiarkkarasi *et al.,* 2013). Another study conducted in India showed that Meropenem was highly sensitive against Gram negative bacilli whereas Cephalosporin showed highest resistance against gram negative rods (Goel *et al.,* 2009).

In other study, Meropenem and Imipenem was found 98% and 100% sensitive respectively against highly resistant gram negative bacilli (Jolly-Guiller *et al*., 2010).

A study done in King Fahd Hospital, Saudi Arabia showed that meropenem was 95.8% sensitive followed by Amikacin (93.7%) and Imipenem (91.71%) against Extended spectrum β lactamase producing *E. coli* (Al-Zahran and Akhtar, 2005). The multiple antibiotic resistances (MAR) index data showed that almost all isolated *E. coli* from out and in-patients were multi drug resistance. The range of MAR index of isolated *E. coli* from out-patients and in-patients was 0.1 to 0.7 and 0.1 to 0.8 respectively. The highest percentage of *E. coli* (30.43%) showed 0.5 MAR index in out-patients and 50% in in-patients. These results differ from other study done in Pakistan in which highest percentage of *E. coli* (43.1%) showed 0.7 MAR index (Riaz *et al.,* 2011).

Increasing antibiotic resistance by pathogenic microorganisms was emerging as a serious issue globally for the treatment of infectious diseases (Tenover and Hugles, 1996; Tamberkar *et al.,* 2006). The pattern of increasing antibiotic resistance of UTI pathogens has been published by many authors during the recent years which indicate the importance and necessity of the performance of antibiotic tests on regular basis and prior to treating infectious disease like UTI.

Table. 1: Prevalence and distribution of hospital acquired (in-patients) and community acquired (out-patients) UTI in male and female.

	Urine samples (N=120)							
	In-patients (N=62)				**Out-patients (N=58)**			
	Male		**Female**		**Male**		**Female**	
	N	%	N	%	N	%	N	%
Total Samples	28	45.16	34	54.84	27	46.55	31	53.45
Samples Positive for UTI	In-patients (N=47; 56.63%)				Out-patients (N=36; 43.37%)			
Prevalence	18	38.29	29	61.71	13	36.11	23	63.89

N= Number; %= Percentage

Table. 2: Prevalence and distribution of isolated *E. coli* in in-patients and out-patients.

	***E. coli* (N=51)**							
	In-patients (N=28; 54.90%)				**Out-patients (N=23; 45.10%)**			
	Male		**Female**		**Male**		**Female**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Prevalence	8	28.57	20	71.43	9	39.13	14	60.87

N= Number; %= Percentage

Table. 3: Overall number and percentage (%) of susceptibility to the antimicrobial agents among 51 isolates of *E. coli* in Out-patients and in-patients.

Antimicrobial class	**Antimicrobial agents**	**Out-patients *E. coli* (N=23)**						**In-patients *E. coli* (N=28)**					
		R		**I**		**S**		**R**		**I**		**S**	
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Quin.	Cf	16	69.57	0	0	7	30.43	20	71.43	0	0	8	28.57
	Mo	13	56.52	4	17.39	6	26.09	16	57.14	2	7.14	10	35.72
	Of	9	39.13	1	4.35	13	56.52	12	42.86	2	7.14	14	50.00
	Sc	8	34.78	3	13.04	12	52.18	11	39.29	0	0	17	60.71
	Le	5	21.74	2	8.69	16	69.57	8	28.57	1	3.57	19	67.86
	Na	20	86.96	0	0	3	13.04	26	92.86	0	0	2	7.14
	Gf	6	26.09	1	4.35	16	69.56	20	71.43	0	0	8	28.57
Amn.	Tb	21	91.30	0	0	2	8.70	28	100	0	0	0	0
	Ak	1	9.35	0	0	22	95.65	1	3.57	1	3.57	26	92.86
	Ge	15	65.22	2	8.69	6	26.09	19	67.86	1	3.57	8	28.57
Cep[3]	Ca	17	73.91	1	4.35	5	21.74	22	78.57	2	7.14	4	14.29
	Ce	19	82.61	1	4.35	3	13.04	25	89.29	1	3.57	2	7.14
	Ci	9	39.13	4	17.39	10	43.48	17	60.71	4	14.29	7	25.00
Carb.	Im	1	9.35	0	0	22	95.65	0	0	0	0	28	100
	Mr	2	8.70	0	0	21	91.30	1	3.57	0	0	27	96.43
Others	Nf	3	13.04	1	4.35	19	82.61	8	28.57	2	7.14	18	64.29
	Nt	1	4.35	4	17.39	18	78.26	5	17.86	3	10.71	20	71.43
	Co	19	82.61	0	0	4	17.39	23	82.14	0	0	5	17.86

Key: Quin.= Quinolones; Amn.= Aminoglycosides; Cep[3]= III generation cephalosporin; Carb.= Carbenicillin; Cf= Ciprafloxacin; Mo= Moxifloxacin; Of= Ofloxacin; Sc= Sparfloxacin; Le= Levofloxacin; Na= Nalidixic acid; Gf= Gatifloxacin; Tb= Tobramycin; Ak= Amikacin; Ge= Gentamycin; Ca= Ceftazidime; Ce= Cefotaxime; Ci= Ceftrixone; Im= Imipenem; Mr= Meropenem; Nf= Nitrofurantoin; Nt= Netellin; Co= Co-trimaxazole; R= Resistant; I= Intermediate; S= Sensitive; N= Number; %=Percentage

Table. 4: Mean [± standard error] zones of clearance (mm) around tested antibiotics for 23 isolated *E. coli* causing community acquired UTI.

	Antibclass	Quin.							Amn.		
	Antib	Cf	Mo	Of	Sc	Le	Na	Gf	Tb	Ak	Ge
	Rng. (in mm)	(16-20)	(20-21)	(13-15)	(16-18)	(16-18)	(14-18)	(15-17)	(13-14)	(15-16)	(13-14)
E. coli isolates	1	25.3±0.35	11.47±0.24	18.83±0.12	24.87±0.13	32.2±0.15	27.3±0.40	14.37±0.18	22.47±0.33	29.6±0.38	20.13±0.09
	2	12.83±0.17	20.67±0.35	11.87±0.45	14.47±0.24	27.47±0.33	14.53±3.29	26.1±0.21	10.93±0.48	27.6±0.38	10.00±0.00
	3	24.27±0.63	27.97±0.03	12.23±0.18	12.2±0.11	21± 0.11	13.03±0.14	12.7±0.36	12.4±0.06	30.5±0.5	9.03±0.55
	4	9.2±0.62	16.00±0.00	21.07±0.07	28.87±0.13	10.23±0.14	10.00±0.00	28.03±0.67	12.07±0.29	9.63±0.86	11.4±0.35
	5	29.77±0.43	30.47±0.24	10.1±0.06	11.07±0.07	28.67±0.38	26.43±0.23	20.93±0.07	26.87±0.18	21.00±0.00	18.67±0.34
	6	27.87±0.13	28.63±0.37	26.73±0.27	17.5±0.26	22.57±0.29	12.07±0.23	20.27±0.27	9.33± 0.67	23.77±0.38	13.00±0.00
	7	10.9±0.46	18.37±0.37	30.33±0.38	26.97±0.03	10.13±0.58	11.7±0.40	11.43±0.43	10.43±0.72	29.77±0.38	19.53±0.32
	8	31.53±0.53	19.97±0.03	7.2±0.2	28.53±0.27	23.37±0.18	8.73±0.73	25.9±0.058	11.83±0.22	20.2±0.2	8.3±0.65
	9	13.00±0.00	12.43±0.23	14.07±0.07	13.17±0.2	11±0.00	7.4±0.4	29.43±0.34	10.87±0.13	18.43±0.43	11.23±0.14
	10	12.03±0.52	10.87±0.09	18.00±0.00	19.47±0.33	12.03±0.54	10.4±0.4	22.37±0.23	9.1±1.05	26.8±0.15	9.9±0.46
	11	10.4±0.4	8.13±0.58	16.8±0.15	19.83±0.09	10.47±0.26	11.63±0.26	14.00±0.00	10.7±0.35	24.1±0.21	7.9±0.47
	12	25.43±0.32	21.53±0.29	9.53±0.31	22.93±0.07	26.73±0.18	29.00±0.00	21.37±0.23	7.33±0.33	21.73±0.367	22.03±0.26
	13	23.43±0.23	31.23±0.28	12.00±0.00	16.4±0.21	29.4±0.4	11.63±0.37	21.83±0.46	11.00±0.00	29.00±0.00	26.97±0.03
	14	12.17±0.22	14.1±0.1	21.97±0.20	20.43±0.26	16.97±0.03	13.17±0.17	10.00±0.00	9.4±0.70	26.77±0.14	10.00±0.00
	15	14.57±0.32	12.97±0.03	19.2±0.15	11.47±0.26	21±0.00	10.0±0.00	24.3±1.06	10.4±0.71	27±0.11	8.00±0.00
	16	12.2±0.2	18.47±0.47	11.23±0.14	26.93±0.07	29.93±0.12	8±0.00	29.00±0.00	9.17±1.09	24.77±0.14	28.3±0.65
	17	13.1±0.15	21.53±0.53	27.53±0.29	10.57±0.35	20.47±0.24	12.47±0.24	11.9±0.45	9.00±0.00	24.1±0.06	11.23±0.14
	18	11.07±0.07	14.97±0.49	7.1±0.1	28.33±0.34	26.57±0.35	11.73±0.47	27.43±0.43	11.77±0.41	29.5±0.32	14.00±0.00
	19	12.2±0.2	13.17±0.49	17.87±0.13	18.97±0.03	18.3±0.21	10.4±0.4	25.00±0.00	7.33±0.33	30.23±0.18	12.63± 0.24
	20	8.87±0.87	17.00±0.00	20.00±0.00	21.37±0.18	22.33±0.20	9.1±0.67	21.63±0.73	9.17±1.09	28.97±0.03	11.87±0.45
	21	10.63±0.33	28.1±0.21	16.7±0.21	11.43±0.34	25.57±0.32	11.5±0.40	27.00±0.00	10.00±0.00	24.8±0.40	8.33± 0.67
	22	11.33±0.32	27.8±0.65	8.47±0.24	17.27±0.14	21.37±0.37	12±0.00	16.63±0.33	9.1±0.66	20.83±0.12	11.00±0.00
	23	8.67±0.88	11.3±0.18	18.8±0.2	8.93± 0.49	26.93±0.07	10.93±0.48	23.57±0.34	8.00±0.00	27.07±0.12	9.9±0.40

Table. 4: Continued..

	Antibclass	Cep[3]			Carb.		Others		
	Antib	Ca	Ce	Ci	Im	Mr	Nf	Nt	Co
	Rng. (in mm)	(15-17)	(18-20)	(14-20)	(14-15)	(14-15)	(15-16)	(13-14)	(11-15)
E. coli isolates	1	26.9±0.21	29.03±0.09	11.33±0.38	26.8±0.15	26.17±0.12	27.7±0.35	21.23±0.18	20.33±0.28
	2	11.00±0.00	15.00±0.00	15.00±0.00	22.17±0.09	27.43±0.23	29.37±0.37	20.4±0.26	23.5±0.32
	3	10.63±0.26	14.23±0.14	17.03±0.03	22.93±0.33	25.9±0.1	29.67±0.18	23.33±0.28	7.93±0.52
	4	10.03±0.52	9.47±0.73	10.37±0.42	28.13±0.24	11.00±0.00	10.63±0.41	9.9±0.47	8.67±0.29
	5	8.03±0.61	19.00±0.00	19.00±0.00	21.7±0.30	25.33±0.18	29.97±0.26	19.6±0.32	10.53±0.32
	6	9.93±0.48	11.63±0.33	10.00±0.00	23.47±0.26	23.33±0.28	27.23±0.34	14.00±0.00	9.33±0.28
	7	11.00±0.00	13.00±0.06	27.13±0.18	28.33±0.38	29.4±0.35	21.53±0.39	19.2±0.15	10.43±0.22
	8	8.33±0.67	14.00±0.00	29.00±0.00	27.63±0.33	21.43±0.23	20.73±0.38	17.57±0.28	10.4±0.35
	9	9.33±0.67	13.13±0.18	11.9±0.45	10.00±0.00	23.5±0.32	23.3±0.3	21.73±0.38	7.8±0.46
	10	9.57±0.49	11.07±0.12	10.8±0.40	22.23±0.12	27.43±0.43	10.17±0.73	23.47±0.26	8.4±0.35
	11	11.00±0.00	15.13±0.24	9.8±0.90	29.1±0.21	10.6±0.37	11.5±0.35	27.83±0.42	10.5±0.26
	12	12.83±0.18	11.00±0.00	26.67±0.34	23.3± 0.15	25.77±0.18	23.1±0.15	13.17±0.12	27.4±0.35
	13	8.00±0.58	28.13±0.18	29.37±0.42	23.63±0.35	27.43±0.26	15.00±0.00	21.53±0.32	8.00±0.58
	14	27.73±0.38	14.00±0.00	11.07±0.54	23.4±0.21	29.33±0.38	27.13±0.41	23.23±0.34	9.23±0.18
	15	12.00±0.00	12.23±0.45	28.33±0.38	27.63±0.33	21.63±0.33	24.6±0.30	25.33±0.18	7.77±0.38
	16	16.00±0.00	27.07±0.18	26.7±0.3	21.3±0.3	26.77±0.18	26.93±0.23	27.43±0.26	10.5±0.26
	17	25.67±0.34	15.9±0.06	11.00±0.00	27.7±0.35	22.00±0.51	24.47±0.33	23.13±0.18	9.33±0.28
	18	11.00±0.00	12.00±0.00	26.9±0.06	27.67±0.34	23.4±0.21	27.6±0.29	25.37±0.23	26.03±0.03
	19	10.57±0.35	15.97±0.32	10.2±1.10	23.03±0.03	25.73±0.38	29.23±0.12	29.33±0.28	9.5±0.40
	20	23.47±0.2	10.00±0.00	26.07±0.18	22.00±0.00	27.43±0.26	28.33±0.28	13.3±0.3	9.73± 0.40
	21	11.3±0.3	9.33±0.67	17.00±0.00	21.67±0.34	29.07±0.18	21.2±0.2	27.7±0.36	10.7±0.38
	22	24.03±0.09	14.13±0.18	29.00±0.34	21.37±0.20	21.5±0.26	21.67±0.34	14.4±0.26	8.07±0.54
	23	11.53±0.32	11.53±0.32	26.93±0.07	27.1±0.21	25.1±0.11	22.87±0.18	21.77±0.41	8.77±0.41

Antib.=Antibiotics; Rng.=Range; Quin.=Quinolones; Amn.=Aminoglycosides; Cep[3]=III generation Cephalosporin; Carb.=Carbepenems; Cf=Ciprofloxacin; Mo=Moxifloxacin; Of=Ofloxacin; Sc=Sparfloxacin; Le= Levofloxacin; Na= Nalidixic acid; Gf= Gatifloxacin; Tb= Tobramycin; Ak= Amikacin; Ge= Gentamycin; Ca= Ceftazidime; Ce= Cefotaxime; Ci= Ceftrixone; Im= Imipenem; Mr= Meropenem; Nf= Nitrofurantoin; Nt= Netellin; Co=Co-trimaxazole.

Table. 5: Mean [± standard error] zones of clearance (mm) around tested antibiotics for 28 isolated *E. coli* causing hospital acquired UTI.

	Antib class	Quin.						
	Antib	Cf	Mo	Of	Sc	Le	Na	Gf
	Rng. (in mm)	(16-20)	(20-21)	(13-15)	(16-18)	(16-18)	(14-18)	(15-17)
E. coli isolates	1	12.5± 0.26	10.37± 0.32	10.37± 0.27	11.4± 0.30	29.47± 0.29	11.5± 0.29	21.5± 0.26
	2	27.13± 0.18	29.2± 0.11	11.37± 0.27	21.57± 0.32	26.9± 0.06	10.37± 0.23	12.47± 0.26
	3	10.47± 0.26	14.4± 0.26	9.03± 0.58	20.23± 0.18	21.53± 0.29	21.3± 0.15	28.63± 0.32
	4	12.47± 0.26	16.5± 0.32	11.7± 0.38	14.33± 0.20	12.33± 0.18	13.87± 0.47	10.5± 0.29
	5	10.37± 0.18	30.57± 0.24	25.97± 0.26	27.43± 0.24	29.33± 0.18	10.63± 0.32	13.43± 0.21
	6	9.00± 0.55	12.23± 0.18	14.2± 0.14	23.43± 0.26	24.47±0.26	10.3± 0.21	10.27± 0.14
	7	14.47± 0.26	20.27± 0.21	21.47± 0.26	12.33± 0.18	30.4± 0.23	13.47± 0.26	27.63± 0.32
	8	7.97± 0.53	27.63± 0.32	12.63± 0.32	23.47± 0.29	14.47± 0.24	11.37± 0.27	11.37± 0.27
	9	12.53± 0.32	12.43± 0.26	23.57± 0.29	27.6± 0.30	27.63± 0.32	29.3± 0.25	12.47± 0.24
	10	11.27± 0.27	11.63± 0.32	24.57± 0.32	29.07± 0.12	25.43± 0.26	10.37± 0.27	13.43± 0.26
	11	10.7± 0.30	23.4± 0.23	11.0± 0.23	23.37± 0.20	23.4± 0.35	13.43± 0.26	23.6± 0.30
	12	10.57± 0.28	12.23± 0.18	24.57± 0.38	21.33± 0.17	10.63± 0.31	11.77± 0.39	11.5± 0.29
	13	12.4± 0.21	21.4± 0.23	14.17± 0.22	10.5± 0.29	24.23±0.18	10.43± 0.22	10.47± 0.26
	14	11.5± 0.40	27.67± 0.34	10.43± 0.22	11.33± 0.24	24.4± 0.26	13.4± 0.21	13.23± 0.12
	15	10.4± 0.30	11.37± 0.27	27.23± 0.34	26.47± 0.29	29.83± 0.09	12.8± 0.42	23.37± 0.20
	16	7.27± 0.27	16.53± 0.27	29.47± 0.29	11.27± 0.18	10.53± 0.29	11.33± 0.18	10.47± 0.29

E. coli isolates	**17**	28.97± 0.09	14.5± 0.29	10.4± 0.21	23.3± 0.25	27.33± 0.28	10.47± 0.26	11.27± 0.27
	18	27.13± 0.18	26.53± 0.27	27.27± 0.14	13.6± 0.30	14.14± 0.26	11.5± 0.26	13.23± 0.34
	19	8.87± 0.45	14.53± 0.27	9.83± 0.44	23.33± 0.28	27.47± 0.29	11.7± 0.38	25.33± 0.18
	20	24.47± 0.24	27.3± 0.35	27.63± 0.32	13.63± 0.32	12.4± 0.21	10.47± 0.24	10.83± 0.60
	21	11.4± 0.21	12.5± 0.26	26.33± 0.28	21.6± 0.30	29.37± 0.32	11.63± 0.37	12.57± 0.42
	22	23.1± 0.15	27.8± 0.42	8.83± 0.44	19.9± 0.06	30.43± 0.26	10.53± 0.29	11.83± 0.46
	23	11.67± 0.34	16.1± 0.15	25.23± 0.18	11.6± 0.30	12.63± 0.32	12.3± 0.17	25.9± 0.49
	24	27.223± 0.28	27.33± 0.28	9.77± 00.39	21.43± 0.26	27.3± 0.25	10.5± 0.26	12.73± 0.37
	25	10.67± 0.28	12.43± 0.21	25.33± 0.18	13.1± 0.21	16.4± 0.23	11.63± 0.32	12.4± 0.23
	26	29.2± 0.25	29.57± 0.29	27.63± 0.32	24.5± 0.89	27.33± 0.28	11.47± 0.26	23.43± 0.26
	27	28.223± 0.18	11.37± 0.32	9.37± 0.32	12.47± 0.29	29.6± 0.30	13.17± 0.22	11.8± 0.42
	28	11.4± 0.30	16.27±0.32	27.43± 0.34	29.43± 0.26	11.33± 0.24	12.47± 0.26	11.27± 0.63

Table. 5: …..

	Antibclass	**Amn.**			**Cep[3]**			**Carb.**		**Others**		
	Antib	**Tb**	**Ak**	**Ge**	**Ca**	**Ce**	**Ci**	**Im**	**Mr**	**Nf**	**Nt**	**Co**
	Rng.(in mm)	**(13-14)**	**(15-16)**	**(13-14)**	**(15-17)**	**(18-20)**	**(14-20)**	**(14-15)**	**(14-15)**	**(15-16)**	**(13-14)**	**(11-15)**
E. coli isolates	**1**	10.37± 0.18	20.33± 0.20	20.3± 0.17	21.53± 0.32	29.2± 0.31	27.33± 0.28	28.33± 0.18	28.67± 0.28	27.33± 0.28	25.07± 0.12	10.57± 0.35
	2	12.53± 0.29	23.63± 0.33	10.87± 0.47	10.53± 0.29	13.1± 0.15	11.27± 0.18	25.33± 0.17	28.47± 0.32	29.63± 0.32	27.03± 0.14	20.33± 0.29
	3	10.63± 0.37	28.07± 0.12	13.4± 0.23	10.43± 0.26	14.2± 0.15	10.53± 0.29	22.9± 0.06	26.93± 0.03	12.47± 0.26	10.43± 0.29	10.87± 0.47
	4	11.5± 0.26	27.23± 0.26	8.73± 0.37	8.6± 0.30	10.93± 0.48	10.77± 0.41	29.53± 0.29	25.43± 0.26	29.1± 0.15	21.67± 0.34	22.87± 0.47
	5	11.7± 0.43	23.43± 0.26	27.13± 0.35	12.43± 0.26	12.43± 0.26	17.37± 0.23	21.4± 0.26	29.8± 0.42	23.5± 0.26	23.4± 0.23	10.77± 0.39
	6	11.67± 0.34	27.57± 0.28	10.73± 0.37	11.5± 0.25	12.53± 0.35	12.9± 0.06	27.63± 0.31	24.00± 0.58	11.17± 0.22	14.47± 0.26	8.83± 0.44
	7	10.7± 0.36	29.1± 0.26	8.87± 0.59	27.37± 0.23	14.4± 0.26	29.4± 0.23	24.5± 0.26	31.37± 0.27	21.53± 0.29	28.77± 0.18	26.93± 0.07
	8	12.43± 0.26	30.5± 0.26	11.37± 0.27	11.77± 0.39	13.67± 0.33	15.23± 0.12	21.77± 0.39	25.67± 0.34	15.47± 0.24	27.6± 0.35	8.47± 0.47
	9	11.67± 0.40	15.47± 0.24	10.5± 0.26	16.4± 0.23	12.67± 0.34	11.43± 0.34	23.13± 0.18	21.67± 0.37	10.63± 0.32	10.73± 0.37	10.67± 0.35
	10	11.77± 0.41	27.8± 0.40	28.63± 0.27	21.63± 0.37	28.23± 0.34	10.4± 0.30	27.77± 0.39	26.57± 0.38	22.63± 0.27	21.67± 0.34	23.07± 0.18
	11	10.5± 0.29	23.43± 0.26	10.63± 0.32	10.43± 0.29	12.33± 0.18	13.47± 0.37	29.23± 0.34	28.93± 0.29	22.4± 0.21	25.03± 0.14	9.47± 0.74
	12	12.17± 0.17	26.37± 0.23	9.00± 0.58	11.33± 0.24	14.57± 0.35	28.87± 0.09	26.87± 0.09	28.63± 0.31	12.6± 0.30	11.37± 0.27	10.47± 0.33
	13	12.5± 0.32	24.73± 0.38	9.43± 0.72	11.5± 0.26	13.4± 0.23	12.4±0.26	24.6± 0.35	30.2± 0.11	29.17± 0.12	29.4± 0.21	10.5± 0.26
	14	10.83± 0.44	23.13± 0.18	23.4± 0.21	24.8± 0.40	12.7± 0.36	24.57± 0.32	23.33± 0.28	23.53± 0.32	21.6± 0.38	24.57± 0.32	220.3± 0.14
	15	10.67± 0.40	20.43± 0.26	10.33± 0.24	12.5± 0.26	19.4± 0.21	11.47± 0.33	21.73± 0.38	30.83± 0.09	11.37± 0.27	14.47± 0.26	7.93± 0.52
	16	10.43± 0.26	21.77± 0.39	11.73± 0.38	13.3± 0.25	11.73± 0.38	17.33± 0.24	20.57± 0.42	24.5± 0.26	5.27± 0.22	27.1± 0.1	7.83± 0.46
	17	12.43± 0.26	23.43± 0.26	11.4± 0.23	16.33± 0.28	16.3± 0.25	13.03± 0.09	23.17± 0.22	21.43± 0.26	7.7± 0.36	11.63± 0.33	10.6± 0.35
	18	12.83± 0.42	27.57± 0.28	24.47± 0.24	13.6± 0.30	14.3± 0.3	27.3± 0.25	24.9± 0.06	25.7± 0.35	0.53± 0.29	25.00± 0.06	10.77± 0.49
	19	11.37± 0.18	29.27± 0.22	12.63± 0.32	12.43± 0.26	12.43± 0.22	11.47± 0.24	28.57± 0.38	27.37± 0.23	9.07± 0.17	21.4± 0.21	9.23± 0.62
	20	10.63± 0.32	21.63± 0.32	11.3± 0.35	11.57± 0.32	10.83± 0.42	19.23± 0.12	21.5± 0.26	21.67± 0.34	2.8± 0.15	23.43± 0.26	7.9± 0.51
	21	10.73± 0.35	30.4± 0.21	27.3± 0.3	11.4± 0.26	15.47± 0.24	12.67± 0.34	19.9± 0.06	20.5± 0.26	2.43± 0.22	14.5± 0.26	10.5± 0.26
	22	11.53± 0.32	25.23± 0.28	12.43± 0.22	12.43± 0.26	10.47± 0.24	10.73± 0.37	23.5±0.26	27.8± 0.40	7.03± 0.14	29.33± 0.28	8.33± 0.28
	23	10.33± 0.24	23.3± 0.15	10.53± 0.29	13.3± 0.3	10.47± 0.24	24.5± 0.26	24.8± 0.11	24.00± 0.55	4.8± 0.11	23.1± 0.15	8.77± 0.38
	24	10.43± 0.26	30.73± 0.37	26.73± 0.18	10.5± 0.36	14.47± 0.26	13.13± 0.18	27.00± 0.52	25.00± 0.06	7.03± 0.14	21.57± 0.32	10.5± 0.26
	25	10.8± 0.41	24.47± 0.26	8.37± 0.37	12.4± 0.26	13.23± 0.34	10.73± 0.37	29.83± 0.44	23.3± 0.15	2.57± 0.34	23.9± 0.06	8.67± 0.34
	26	10.83± 0.42	25.33± 0.20	10.6± 0.35	11.73± 0.38	12.47± 0.24	27.23± 0.28	21.6± 0.30	25.23± 0.34	1.7± 0.38	23.1± 0.15	10.6± 0.35
	27	10.37± 0.23	28.43± 0.29	24.27± 0.14	11.9± 0.45	11.73± 0.38	10.4± 0.30	29.73± 0.18	28.77± 0.18	9.3± 0.25	27.23± 0.28	7.63± 0.33
	28	11.53± 0.32	10.53± 0.29	11.3± 0.15	11.47± 0.33	12.6± 0.35	11.53± 0.29	20.7± 0.43	12.63± 0.37	0.63± 0.37	11.37± 0.27	10.27± 0.18

CONCLUSION

The present study concluded that the females were more prone to UTI than males in both community and hospital settings and the most responsible causing agent of UTI i.e., *E. coli* was also found in high percentages in female patients related to both hospital and community settings. The organism developed resistance against many commonly used antibiotics. In most of the cases people are not aware about the disease and increasing resistance of pathogens against antimicrobials against and remain without proper laboratory investigations and treatment. So, large scale monitoring is urgently required from centers in the Meerut city to look at the similar data and to identify predisposing factors for urinary pathogens with antibiotic resistance. In this regards local policies for the choice of first-line oral antibiotic treatment for UTI patients should be reviewed every three years or so according to local resistance rate.

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