

## Prevalence of urinary tract infections and current scenario of antibiotic susceptibility pattern of bacteria causing UTI

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### Abstract

**Introduction:** Urinary tract infection (UTI) is one of the most prevalent diseases affecting people of all age groups i.e. from neonate to geriatric age group. Widespread use of antibiotics has led to the emergence of resistant microorganisms. As the antibiogram of the microorganisms are frequently changing hence the present study was done to analyze the recent antibiotic sensitivity pattern of uropathogens in urinary tract infection.

**Materials and Methods:** In present study is a retrospective analysis of culture results of urine samples, was conducted at Microbiology department of tertiary health care hospital in Mumbai. The age & sex of patients, the organism isolated and also the antimicrobial susceptibility profiles were collected from the laboratory registers using a standard data collection form.

**Results:** The overall prevalence of UTI was 33.54% of which 66.78% were females and 33.22% were from males. High prevalence was observed in females as compared to males (2:1). Though the overall prevalence was high in old aged (>45 years) patients, in females high prevalence was seen among middle-aged (31 to 45 years) patients and in male high prevalence was seen among old age (>45 years) patients. From total 584 uropathogens, *E.coli* (53.77%) was the commonest isolate causing UTI followed by *Klebsiella pneumoniae* (27.40%). The most effective antimicrobial agents in our study were Meropenem, gentamicin, Nitrofurantoin and Cotrimoxazole whereas higher resistance was observed among Fluoroquinolones, Amoxicillin and third generation Cephalosporins, these are the drugs which are commonly given empirically for UTI.

**Conclusion:** As drug resistance among bacterial pathogens is vary with time to time regular surveillance and monitoring is necessary for giving updated information to physician for most effective empirical treatment of UTIs.

**Keywords:** Urinary tract infection, Prevalence, Antibiotics resistance, Uropathogens.

### Introduction

Urinary tract infection (UTI) is one of the most prevalent disease affecting people from all age groups including neonate and geriatric age groups. Every year about 150 million people are being diagnosed with urinary tract infection worldwide. Each and every woman has a lifetime risk of developing UTI is 60%; by contrast, men have a lifetime risk of only 13%.<sup>1</sup>

Clinically, UTI is divided into two categories, uncomplicated and complicated. Uncomplicated UTI mostly affects healthy individuals with no structural or neurological urinary tract abnormalities; which includes cystitis and pyelonephritis. Complicated UTI is due to the factors that compromise the urinary tract, which include urinary obstruction, neurological disease causing urinary retention, renal failure, renal transplantation, pregnancy and the presence of foreign bodies such as calculi, indwelling catheters or other drainage devices.<sup>2</sup>

Females are more susceptible to UTI as compared to males due to the short length of urethra, absence of prostatic secretion, pregnancy and easy contamination of the tract with faecal flora.<sup>3</sup>

*E. coli* is most common organism causing UTI which accounts for up to 90% of cases. *P. mirabilis*, *Klebsiella* species, *P. aeruginosa* and *Enterobacter species* are less frequent offenders. Gram-positive organisms are less common which includes Group B

*Streptococcus*, *S. aureus*, *S. saprophyticus* and *S. haemolyticus*.<sup>4</sup>

Currently UTI is mostly managed empirically without urine culture or susceptibility testing this may lead to the frequent misuse of antibiotics. The antimicrobial susceptibility data of UTI-causing microorganisms is variable it changes from time to time and from place to place. Most commonly UTIs are treated empirically; in that case the criteria for the selection of antimicrobial agents should be determined on the basis of the most likely pathogen and its expected resistance pattern in that geographic area. Hence, the periodic monitoring of etiologic agents of UTI and their resistance pattern in the community is very essential.

The aim of the study is to determine the age wise and sex wise prevalence of UTI and to analyze the recent sensitivity pattern of Uropathogens in the management of UTI which may help and guide the Medical Practitioners to carry out empirical treatment.

### Materials and Methods

**Study Design:** The Present study is a retrospective study on UTI in which analysis of urinary culture results are done. This study, conducted at the Microbiology department of a tertiary health care hospital in Mumbai. The age, sex, the organism isolated and the antimicrobial susceptibility profiles were

collected from the records. The data were entered into Excel for analysis and statistical analysis was done.

**Culture and Identification:** Urine specimens were collected in sterile wide mouth glass container as per the standard operating procedures. Urine samples were plated using calibrated wire loops (0.001 ml) on Cystine Lactose Electrolyte-Deficient (CLED) medium, MacConkey agar and blood agar and then incubated aerobically at 37 °C for 24 h. From positive cultures, isolates were identified according to the standard operating procedures. An isolate was considered significant if urine cultures having colony count  $\geq 10^5$  CFU/ml.<sup>5</sup>

**Antimicrobial Susceptibility Tests:** Antimicrobial susceptibility tests were done as per Kirby-Bauer disk diffusion method.<sup>6</sup> The antimicrobial agents tested were: Nitrofurantoin (300 µg), Azithromycin (15 µg), Gentamicin (10 µg), Ciprofloxacin (5 µg), Norfloxacin (10 µg), Trimethoprim-Sulphamethoxazole (co-trimoxazole) (1.25-23.75µg), Ceftriaxone (30 µg) and Amoxicillin (10 µg), Amoxicillin-Clavulanic Acid, Tetracycline (30 µg), Cefepime (30µg), Meropenem (10 µg). Resistance data were interpreted according to Clinical laboratory Standards Institute (CLSI).<sup>7</sup> Approval taken from medical Bhatia hospital Medical Research Society.

**Results**

A total of 1741 cases of symptomatic UTI were studied in one year, among these, no infectious etiology was found in 1157 (66.46%).

The overall prevalence of UTI was found to be 33.54% (584/1741). Total 584 urine samples showed

the significant bacterial growth, 194 (33.22%) samples from males and 390 (66.78%) from female patients (Table 1). In females high prevalence was seen among middle-aged (31 to 45 years) patients and in male high prevalence was seen among old age (>45 years) patients (Table 1).

There was not any significant seasonal variation in the prevalence of infection. However, maximum cases occurred in the hot-humid summer, in the months of April to September (Fig. 1).

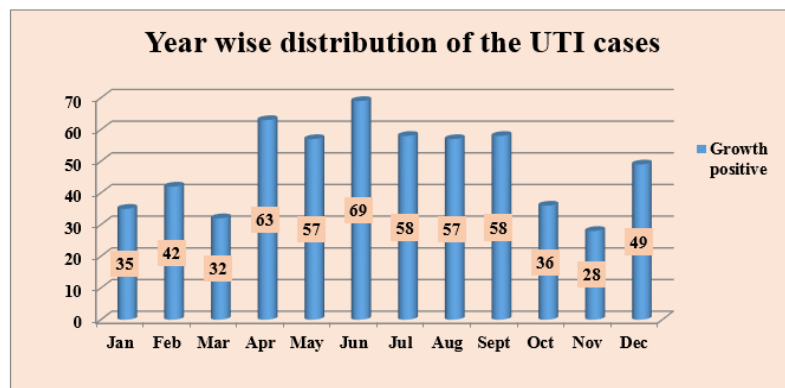
From total 584 uropathogens, *E.coli* (53.77%) was the commonest isolate causing UTI. The second most prevalent isolate was *Klebsiella pneumoniae* (27.40%) followed by *Pseudomonas aeruginosa* (8.56%), *Proteus* spp. (4.79%), *Enterobacter* spp. (1.71%), *Staphylococcus aureus* (1.54%) (Fig. 2).

Fig. 3 is representative of overall antibiotic sensitivity pattern of urinary bacterial isolates. Gentamicin, Nitrofurantoin and Sulphamethoxazole/Trimethoprim (Co-Trimoxazole were found to be agents with high sensitivity of various uro-pathogens. Other antibiotics with higher sensitivity were Tetracycline & Meropenem. Overall susceptibility of organisms showed considerable resistance to Ampicillin, Fluoroquinolones and Ceftriaxone with low susceptibilities ranging from 20-30%. However, Gentamicin (59.58%), Nitrofurantoin (52.91%) and Sulphamethoxazole/Trimethoprim (Co-Trimoxazole) (49.49%) showed relatively good susceptibility, thus providing a better option for treatment.

Percentage sensitivity of organism to antimicrobial agents is given in Table 2.

**Table 1: Age and sex prevalence of UTI**

Age	Male		Female		Total	
	No.	%	No.	%	No.	%
<18 years	21	3.59	7	1.20	28	4.79
18 to 30 years	12	2.05	57	9.76	69	11.81
31 to 45 years	16	2.74	184	31.51	200	34.24
>45 years	145	24.83	142	24.32	287	49.14
<b>Total</b>	<b>194</b>	<b>33.21</b>	<b>390</b>	<b>66.79</b>	<b>584</b>	<b>100.00</b>



**Fig. 1: Year wise distribution of the UTI cases**

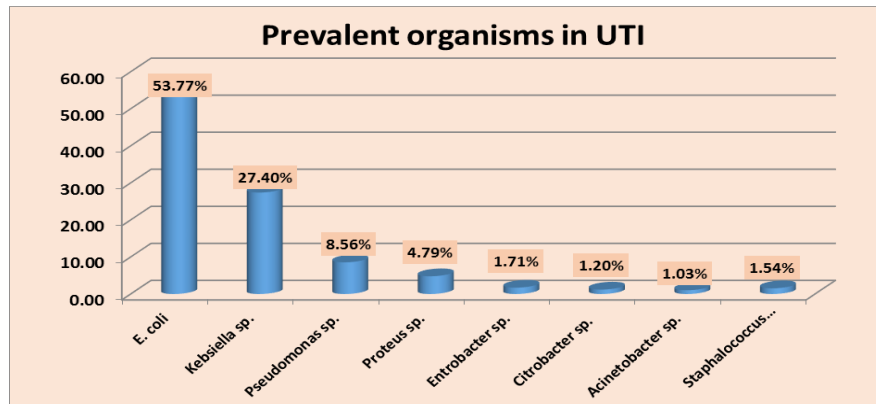


Fig. 2: Prevalent organisms in UTI

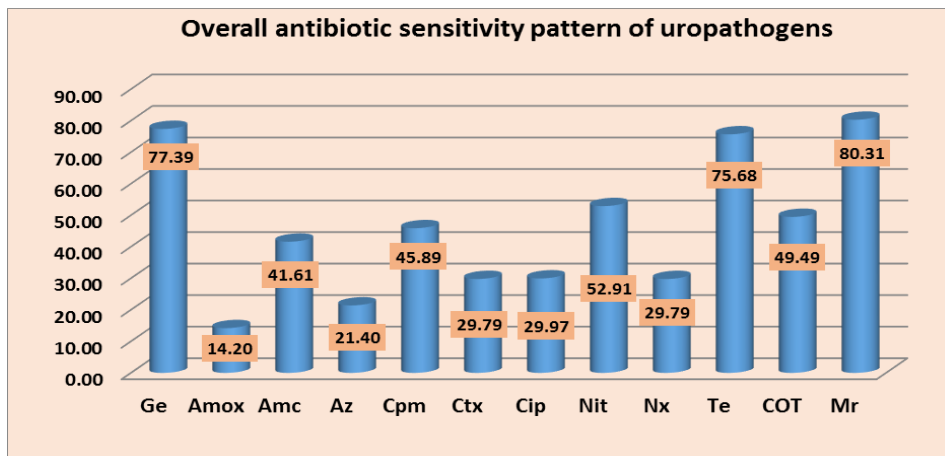


Fig. 3: Overall antibiotic sensitivity pattern of uropathogens

Ge= Gentamicin; Amox= Amoxicillin; Amc = Amoxicillin- Clavulanic Acid; Az= Azithromycin ; Cpm= Cefepime ; Ctx = Ceftriaxone; Cip = Ciprofloxacin; Nit = Nitrofurantoin; Nx=Norfloxacin; Te= Tetracycline; COT=Sulphamethoxazole/Trimethoprim (Co-Trimoxazole); Mr = Meropenem

Table 2: Percentage distribution of drug sensitivity of uropathogens

Antibiotics	E. coli (314)		Klebsiella Pneu. (160)		Pseudomonas a. (50)		Proteus Sp. (28)		Enterobacter sp. (10)		Acinetobacter sp. (6)		Staph. Aureus (9)	
	No	% S	No	% S	No	%S	No	% S	No	% S	No	% S	No	% S
Ge	285	90.76	109	68.13	16	32.00	27	96.43	6	60.00	5	83.33	4	44.44
Amox	56	17.83	12	7.50	0	0.00	13	46.43	0	0.00	0	0.00	2	22.22
Amc	162	51.59	59	36.88	0	0.00	15	53.57	1	10.00	4	66.67	2	22.22
Az	68	21.66	37	23.13	3	6.00	9	32.14	2	20.00	5	83.33	1	11.11
Cpm	135	42.99	84	52.50	17	34.00	20	71.43	6	60.00	4	66.67	2	22.22
Ctx	102	32.48	42	26.25	7	14.00	17	60.71	1	10.00	4	66.67	1	11.11
Cip	94	29.94	48	30.00	9	18.00	13	46.43	5	50.00	4	66.67	2	22.22
Nit	250	79.62	51	31.88	0	0.00	0	0.00	2	20.00	6	100.00	0	0.00
Nx	89	28.34	50	31.25	9	18.00	14	50.00	5	50.00	4	66.67	3	33.33
Te	119	37.90	48	30.00	0	0.00	0	0.00	5	50.00	5	83.33	4	44.44
Cot	169	53.82	86	53.75	0	0.00	21	75.00	5	50.00	5	83.33	3	33.33
Mr	302	96.18	113	70.63	13	26.00	27	96.43	6	60.00	6	100.00	2	22.22

Ge= Gentamicin; Amox= Amoxicillin; Amc = Amoxicillin- Clavulanic Acid; Az= Azithromycin; Cpm= Cefepime; Ctx = Ceftriaxone; Cip = Ciprofloxacin; Nit = Nitrofurantoin; Nx=Norfloxacin; Te= Tetracycline; COT=Sulphamethoxazole/Trimethoprim (Co-Trimoxazole); Mr = Meropenem

**Discussion**

UTI is a one of the most common diseases diagnosed worldwide. Availability of new antimicrobials has improved the management of UTIs.

However, the management of UTI infections has been jeopardized by increase in emergence of antimicrobial drug resistance.

The prevalence of UTI was found to be 33.54% in this study correlating to the prevalence rate of UTI with other studies from India done by M. Dash et al<sup>8</sup> and M. Mehta et al<sup>9</sup> showing prevalence of 34.5% and 36.68% respectively. However the higher prevalence was seen in a study by Devanand et al (53.82%).<sup>10</sup>

Our study showed a high prevalence of UTI in females (66.78%) than in males (33.22%) which correlate with findings from other studies which revealed that the frequency of UTI is greater in females as compared to males.<sup>10-14</sup> The reason behind this high prevalence of UTI in females is due to close proximity of the urethral meatus to the anus, shorter urethra, sexual intercourse, incontinence, and bad toilet.<sup>10</sup> However, higher incidence was observed in middle age females and old age males may be due to prostate disease in males are responsible for the increase in the incidence of UTI above 45 years. Similar observation being reported by Smita S et al<sup>11</sup> and Devanand et al.<sup>10</sup>

In the present study the overall occurrence of UTI recorded was highest among the elderly ( $\geq 48$  years, 49.5%) compared to young and middle age patients (18 to 30 years, 12.5%; 31 to 45, 33.5%).<sup>10-11</sup>

In present study, the Gram negative bacilli contribute to 98.50% of the total bacterial isolates while Gram positive cocci constituted 1.50%. *Escherichia coli* (53.77%) was found to be the most common gram negative bacteria causing UTI. This result is consistent with reports from other studies by Devanand et al,<sup>10</sup> Smita et al,<sup>11</sup> Agbawa et al<sup>12</sup> Mulugeta et al,<sup>13</sup> Asrat Aglu et al,<sup>14</sup> Arghya Das et al,<sup>15</sup> Ahmed Naeem et al<sup>16</sup> where 42.58%, 61.84%, 63.3%, 60.29%, 53.69%, 34.1% cultures grew *E. coli* respectively; and it was most frequent pathogen causing UTI in all these studies. Other isolated bacteria from UTI cases in this study were *K. pneumonia* (27.4%), *P. aeruginosa* (8.56%), *Proteus* spp. (4.79%), *Enterobacter* spp. (1.71%) and *S. aureus* (1.54%). These results also correlate with other studies in which *Klebsiella* spp. was reported as the second most frequently isolated organism in UTI.<sup>10,13,16</sup> Higher incidence of gram negative bacteria, related to Enterobacteriaceae, in causing UTI has many factors which are responsible for their attachment to the uroepithelium such as they are able to colonize in the urogenital mucosa with adhesins, pili, fimbriae, and P-1 blood group phenotype receptor.<sup>10</sup>

The most effective antimicrobial agents in said study were *Meropenem*, *Gentamicin*, *Nitrofurantoin* and *Cotrimoxazole* showing percentage susceptibility 80.31%, 59.58%, 52.91% and 49.49% respectively (Fig. 3). Higher resistance was observed among Fluoroquinolones, Amoxicillin and third generation *Cephalosporins* showing percentage susceptibility of 29.79%, 14.20% and 29.79% respectively. Study by Ahmed Naeem et al<sup>16</sup> has reported highest sensitivity to Gentamicin (92.3%) followed by Imipenem (90.2%) and less sensitivity was shown to Cefotaxime. Arghya

Das et al<sup>15</sup> in his study observed highest resistance to Ampicillin, fluoroquinolones and ceftriaxone whereas Gentamicin and Nitrofurantoin were the antibiotics to which organisms were most sensitive.

In this study, it was observed that the susceptibility of the isolates to the tested antibiotics differed with the species. Of the *E. coli* isolates (53.77%) showed resistance to the commonly used antibiotics. The highest sensitivity was shown by Gentamicin (90.76%), *Meropenem* (96.8%) followed by *Nitrofurantoin* (79.62%). High resistance to antibiotics shown by *Klebsiella*. *Klebsiella* showed highest sensitivity to Gentamicin is 68.13% and *Meropenem* is 70.63%.

In present study overall sensitivity is observed to be very low. Antimicrobial resistance is a very huge problem throughout the world. Periodic assessment of *in vitro* susceptibility pattern of urinary pathogens serves as a guide for antibiotic therapy, as these organisms exhibit resistance to many first-line drugs used for UTI infection. In order to prevent resistance to antibiotics, appropriate therapy as per bacterial sensitivity pattern needs to be initiated.

This retrospective study is based on the results of routine microbiological tests carried out in 2017. Due to the nature of the retrospective analysis, we couldn't trace patient's clinical settings. Thus the study did not consider the features such as inpatient and outpatients, catheterized and non-catheterized patients.

## Conclusion

As drug resistance among bacterial pathogens is changing with time and place, regular surveillance and monitoring is very essential to provide physicians updated information on most effective empirical treatment of UTIs. Empirical antibiotic choice in treatment of UTI should be based on the knowledge of local prevalence of causative micro-organisms and their antibiogram and not on universal guidelines.

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