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

Pritam Pardeshi

Consultant Microbiologist, Dept. of Microbiology, Bhatia Hospital, Mumbai, Maharashtra, India

*Corresponding Author: Email: dr.pritampardeshi@gmail.com

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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, Uropathogenes.
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 ≥10⁵ CFU/ml.⁵

**Antimicrobial Susceptibility Tests:** Antimicrobial susceptibility tests were done as per Kirby-Bauer disk diffusion method.⁶ The antimicrobial agents tested were: Nitrofurantoin (300 μg), Azithromycin (15 μg), Gentamicin (10 μg), Ciprofloxacin (5 μg), Norfloxacin (10 μg), Trimethoprim-Sulphamethoxazole (cotrimoxazole) (1.25-23.75 μg), Ceftriaxone (30 μg) and Amoxicillin (10 μg), Amoxicillin-Clavulanic Acid, Tetracycline (30 μg), Cefepime (30 μg), Meropenem (10 μg). Resistance data were interpreted according to Clinical laboratory Standards Institute (CLSI).⁷ 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-Trimpoxazole 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-Trimpoxazole) (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 No. | Male % | Female No. | Female % | Total No. | Total % |
|----------------|----------|--------|------------|----------|-----------|---------|
| <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   |
| Total          | 194      | 33.21  | 390        | 66.79    | 584       | 100.00  |

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

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Fig. 2: Prevalent organisms in UTI

Fig. 3: Overall antibiotic sensitivity pattern of uropathogens

Ge= Gentamicin; Amox= Amoxycillin; Amc = Amoxycillin-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 | Pseudomonas a. (50) | Proteus | Entrobacter sp. (10) | Acinetobacter sp. (6) | Staphylococcus aureus (9) |
|-------------|---------------|------------|----------------------|---------|----------------------|-----------------------|-------------------------|
|       | 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= Amoxycillin; Amc = Amoxycillin-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\textsuperscript{8} and M. Mehta et al\textsuperscript{9} showing prevalence of 34.5% and 36.68% respectively. However the higher prevalence was seen in a study by Devanand et al (53.82%).\textsuperscript{10}

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.\textsuperscript{10,14} 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.\textsuperscript{10} 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\textsuperscript{11} and Devanand et al.\textsuperscript{10}

In the present study the overall occurrence of UTI recorded was highest among the elderly (≥48 years, 49.5%) compared to young and middle age patients (18 to 30 years, 12.5%; 31 to 45, 33.5%).\textsuperscript{10,11}

In present study, the Gram negative bacilli contribute to 98.50% of the total bacterial isolates while Gram positive cocci constituted 1.50%. \textit{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.\textsuperscript{10} Smita et al,\textsuperscript{11} Agbawa et al\textsuperscript{12} Mulugeta et al,\textsuperscript{13} Asrat Aglu et al,\textsuperscript{14} Arghya Das et al,\textsuperscript{15} Ahmed Naeem et al\textsuperscript{16} where 42.58%, 61.84%, 63.3%, 60.29%, 53.69%, 34.1% cultures grew \textit{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 \textit{K. pneumonia} (27.4%), \textit{P. aeruginosa} (8.56%), \textit{Proteus} spp. (4.79%), \textit{Enterobacter} spp. (1.71%) and \textit{S. aureus} (1.54%). These results also correlate with other studies in which \textit{Klebsiella} spp. was reported as the second most frequently isolated organism in UTI.\textsuperscript{10,13,16} 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.\textsuperscript{10}

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 \textit{Cephalosporins} showing percentage susceptibility of 29.79%, 14.20% and 29.79% respectively. Study by Ahmed Naeem et al\textsuperscript{16} has reported highest sensitivity to Gentamicin (92.3%) followed by Imipenem (90.2%) and less sensitivity was shown to Cefotaxime. Arghya Das et al\textsuperscript{15} 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 \textit{E. coli} isolates (53.77%) showed resistance to the commonly used antibiotics. The highest sensitivity was shown by Gentamicin (90.76%), Meropenum (96.8%) followed by Nitrofuratoin (79.62%). High resistance to antibiotics shown by \textit{Klebsiella}. \textit{Klebsiella} showed highest sensitivity to Gentamicin is 68.13% and Meropenum 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 \textit{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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References
1. R Nalini, J Ezhil Ramya. Recent Sensitivity Pattern of \textit{Escherichia Coli} in Urinary Tract Infection. \textit{RRJMB}, 2014;3(3).
2. Ana L. Flores-Mireles, Jennifer N. Walker. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. \textit{Nat Rev Microbiol}. 2015;13(5):269–284.
3. Singh Randhir K, Dewasy Bijoylakshmi. Prevalence of antibiotic sensitivity pattern of uropathogens in patients of different age-groups from western region of Nepal. \textit{International Journal of Medical Research & Health Sciences}. 2016;5(9):1-7.
4. KY Loh, N Sivalingam. Urinary Tract Infections in Pregnancy. \textit{Malaysian Family Physician} 2007; Volume 2, Number 2.
5. Cheesbrough, M. (2005). District Laboratory Practice in Tropical Countries Part 1, second edition. Cambridge University Press, Cambridge UK, 105–115.

6. Bauer AW, Kirby WMM, Sherris JC, Turck M. Antibiotic susceptibility testing by standard single disc method. *Am J Clin Pathol.* 1966;45:493-496.

7. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing; 27th informational supplement. Wayne, PA: Clinical and Laboratory Standards Institute; 2017.

8. M. Dash, S. Padhi, I. Mohanty, P. Panda, and B. Parida. Antimicrobial resistance in pathogens causing urinary tract infections in a rural community of Odisha, India. *Journal of Family and Community Medicine.* 2013;20(1):20–26.

9. M. Mehta, S. Bhardwaj, and J. Sharma. Screening of urinary isolates for the prevalence and antimicrobial susceptibility of Enterobacteria other than *Escherichia coli.* *International Journal of Life Science and Pharma Research.* 2013;3(1):100–104.

10. Devanand Prakash and Ramchandra Sahai Saxena. Distribution and Antimicrobial Susceptibility Pattern of Bacterial Pathogens Causing Urinary Tract Infection in Urban Community of Meerut City, India. ISRN Microbiology, Volume 2013, Article ID 749629, 13 pages.

11. Sood S, Gupta R. Antibiotic resistance pattern of community acquired uropathogens at a tertiary care hospital in Jaipur, Rajasthan. *Indian J Community Med.* 2012;37:39–44.

12. Agbagwa O. E, Ifeanacho Emeka J. U. The Prevalence of UTI Pathogens in Urine Specimen Obtained from a Hospital in Rivers State Nigeria. *Journal of Microbiology Research.* 2015;5(5):143-148.

13. Mulugeta Kibret, Bayeh Abera. Prevalence and antibiogram of bacterial isolates from urinary tract infections at Dessie Health Research Laboratory, Ethiopia. *Asian Pac J Trop Biomed.* 2014;4(2):164-168.

14. Asrat Agalu Abejew, Ayele A Denboba. Prevalence and antibiotic resistance pattern of urinary tract bacterial infections in Dessie area, North-East Ethiopia. *BMC Research Notes.* 2014;7:687.

15. Arghya Das and Tuhina Banerjee, Prevalence of Urinary Tract Infections and Susceptibility Pattern of Uropathogens in Women of Reproductive age Group from North India. *Journal of Advances in Medicine.* 2015;4(1-2).

16. Ahmad Naeem Sajed, Uzma Batool. Prevalence of urinary tract infections and their antibiotic sensitivity in tertiary care hospital Lahore. *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS).* 2014;13(12)Ver. II,57-61.

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