ORIGINAL RESEARCH PAPER
Volume - 9 | Issue - 6 | June - 2020 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

# PREVALENCE OF MDR PATHOGENS AMONG URINARY TRACT INFECTIONS AND ITS EPIDEMIOLOGY

Microbiology

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## ABSTRACT

**Introduction:** Urinary tract infections are one of the most common types of infections during OP visits. The present study is focused on etiology of urinary tract infections and its antibiotic susceptibility pattern in this region. **Materials and Methods:** A prospective observational study has been undertaken for one year at Department of Microbiology. A total of 145 culture positive urine samples were assessed by Microbiological diagnosis. **Results:** Predominant pathogen isolated among UTI patients was Esherichia coli i.e., 40% followed by Klebsiella pneumoniae (20.6%), Pseudomonas aeruginosa (10.3%). Out of 129 gram negative isolates, 47 (36.4%) showed multidrug resistant pattern. Out of 8 Staphylococcus aureus isolates 2 (25%) were MRSA. Out of 5 coagulase negative staphylococcus 1 (20%) was MRCoNS. **Conclusion:** Microbiological diagnosis and accurate treatment is necessary to lessen resistance problem in the community. Regular surveillance and antimicrobial stewardship programme will definitely help clinicians to choose antibiotic for empirical therapy.

## KEYWORDS

Antibiotic susceptibility testing, Urinary tract infections

## INTRODUCTION

Infection in any part of your urinary system comes under urinary tract infection (UTI). Most of the Urinary tract infections occur in lower urinary tract usually in the bladder or urethra, but fatal consequences occurs when UTI involves Kidney. Recurrent or long lasting kidney infections can cause permanent damage, and some sudden kidney infections can be life threatening.

Urinary tract infections are classified clinically as uncomplicated and complicated UTIs. Uncomplicated UTIs occurs in healthy individuals without structural or neurological urinary tract abnormalities. Complicated UTIs are defined as UTIs associated with factors that compromise the urinary tract or host defense including urinary obstruction, urinary retention.

Urinary tract infections are one of the most common types of infections during OP visits. These infections are much more common in female than in male, the reason behind this might be unhygienic practices, short urethra, sexual intercourse, post-menopausal status [1].

In 2007, in the united states UTIs accounts for around 0.5 million visits and 2-3 million emergency department visits [2,3].

UTIs are caused by bacteria, fungi as well as by certain viruses occasionally. Bacterial etiology is the most common factor of UTIs. Escherichia coli is the most common bacteria responsible for this infection. Other bacteria involved in UTI are Klebsiella pneumonia, Staphylococcus saprophyticus, Enterococcus faecalis, Group B streptococci, Proteus mirabilis, Pseudomonas aeruginosa, Staphylococcus aureus etc.,

The present study is focused on etiology of urinary tract infections and its antibiotic susceptibility pattern in this region. This will help clinicians to assess common pathogen, its sensitivity to antibiotics and multidrug drug resistance and to start empirical therapy based on this epidemiological data.

## MATERIALS AND METHODS

A prospective observational study has been undertaken for one year at Department of Microbiology, Government Medical College, Anantapuram. This study has been conducted on all midstream clean catch urine samples received during study period from urinary tract infection suspected patients. Most of the samples we have received (February 2019 to November 2019) from urology and general medicine department. A total of 145 culture positive urine samples were included in this study.

After receiving sample, it was immediately processed for culture and sensitivity according to CLSI guidelines. Hi Media Laboratories products were being used at our lab for culture and sensitivity. The samples were inoculated on Nutrient Agar, Blood Agar, Macconkey agar plates and inoculated aerobically at 370C for 24 hours. After 24 hours of inoculation, colonies were examined and identified by Biochemical reactions and other tests according to CLSI guidelines. Sterile precautions have taken while processing samples.

Antibiotic susceptibility testing (AST) was done on Muller Hinton Agar by modified Kirby bauer disk diffusion method using clinical and laboratory standard institute guidelines (CLSI) [20]. Antibiotic disks used for Gram positive organisms testing were penicillin (10U), gentamicin (10µg), amikacin (30µg), ciprofloxacin (5 µg), erythromycin (5µg), clindamycin (2µg), cotrimoxazole (1.25 µg/23.75 µg), cefoxitin (30 µg), linezolid (30 µg), vancomycin (30µg) and teicoplanin (30µg), amoxyclav(30 µg). Gram negative isolates antibiotics were: amoxyclav (30 µg), piperacillin+tazobactum (100/10 µg), ceftazidime(30 µg), ceftriaxone (30 µg), cefipime (30 µg), imipenem (10 µg), Ceftazidime+clavulanic acid (30/10 µg), meropenem (10 µg), amikacin (30 µg), tigecycline (15 µg). Standard Quality Control strains were used as a part of testing. Multi Drug testing was done for all strains isolated according to CLSI guidelines.

Data entered into spread excel sheet on daily basis, results evaluated and tabulated. Statistical analysis of descriptive variables was expressed in the form of numbers, percentages.

## RESULTS

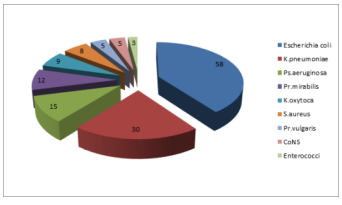
A total of 145 culture positive urinary tract infected patients were studied. Female preponderance was noted, it was 67.5%; female and male ratio was 2.085:1. Majority of the population affected were in the age group of 20-39 years i.e., 69.7% followed by ≥50 years of age i.e., 24.8%.

**Table 1.Age and Sex distribution of urinary tract infected population**

| Age in years | Male | % | Female | % | Total | % |
|---|---|---|---|---|---|---|
| 1-10 | 2 | 1.3 | 2 | 1.3 | 4 | 2.7 |
| 10-19 | 2 | 1.3 | 5 | 3.4 | 7 | 4.8 |
| 20-29 | 12 | 8.2 | 36 | 24.8 | 48 | 33.1 |
| 30-39 | 8 | 6.2 | 34 | 23.4 | 42 | 28.9 |
| 40-49 | 5 | 3.4 | 7 | 4.8 | 12 | 8.2 |
| ≥50 | 18 | 12.4 | 14 | 9.6 | 32 | 24.8 |
| | 47 | 36.4 | 98 | 67.5 | 145 | 100 |

Predominant pathogen isolated among UTI patients was Esherichia coli i.e., 40% followed by Klebsiellapneumoniae (20.6%), Pseudomonas aeruginosa (10.3%).

**Fig 1. Various pathogens isolated from urine samples of UTI patients**



Out of 129 gram negative isolates, sensitivity shown as 100% colistin, 96.8% tigecycline, 96.1% amikacin, 91.4% Nitrofurantoin, 79.06% norfloxacin, 77.5% ofloxacin, 63.5% meropenem, 60.4% piperacillin+tazobactum.

**Table 2.Antibitotic susceptibility pattern of gram negative isolates**

| Antibiotics | Sensitive | % | Intermediate | % | Resistant | % |
|---|---|---|---|---|---|---|
| Nitrofurantoin | 118 | 91.4 | 5 | 3.8 | 6 | 4.6 |
| Norfloxacin | 102 | 79.06 | 2 | 1.5 | 25 | 19.3 |
| Amoxycillin | 23 | 17.8 | 4 | 3.1 | 102 | 79.06 |
| Amoxyclav | 75 | 58.1 | 6 | 4.6 | 48 | 37.2 |
| Cefixime | 57 | 44.1 | 8 | 6.2 | 64 | 49.6 |
| Ceftriaxone | 62 | 48.06 | 4 | 3.1 | 63 | 48.8 |
| Piperacillin -tazobactum | 78 | 60.4 | 6 | 4.6 | 45 | 34.8 |
| Ofloxacin | 101 | 77.5 | 3 | 2.3 | 25 | 19.3 |
| Amikacin | 124 | 96.1 | 2 | 1.5 | 3 | 2.3 |
| Meropenem | 82 | 63.5 | 8 | 6.2 | 39 | 30.2 |
| Tigecycline | 125 | 96.8 | 2 | 1.5 | 2 | 1.5 |
| Colistin | 129 | 100 | 0 | 0 | 0 | 0 |

Out of 16 gram positive isolates, teicoplanin, vancomycin sensitive among 100% isolates, nitrofurantoin, norfloxacin, piperacillin-tazobactum, ofloxacin, amikacin, meropenem were sensitive for 80% of isolates, Amoxyclav, cefixime, ceftriaxone showed sensitive to around 60% isolates and amoxycillin sensitivity noted in 25% of isolates.

**Table 3. Antibiotic susceptibility pattern of gram positive isolates**

| Antibiotics | Sensitive | % | Intermediate | % | Resistant | % |
|---|---|---|---|---|---|---|
| Nitrofurantoin | 13 | 81.2 | 0 | 0 | 3 | 18.7 |
| Norfloxacin | 14 | 87.5 | 1 | 6.2 | 1 | 6.2 |
| Amoxycillin | 4 | 25 | 0 | 0 | 12 | 75 |
| Amoxyclav | 11 | 68.7 | 1 | 6.2 | 3 | 18.7 |
| Cefixime | 10 | 62.5 | 0 | 0 | 6 | 37.5 |
| Ceftriaxone | 10 | 62.5 | 0 | 0 | 6 | 37.5 |
| Piperacillin -tazobactum | 13 | 81.2 | 0 | 0 | 3 | 18.7 |
| Ofloxacin | 14 | 87.5 | 0 | 0 | 2 | 12.5 |
| Amikacin | 14 | 87.5 | 1 | 6.2 | 1 | 6.2 |
| Meropenem | 13 | 81.2 | 0 | 0 | 3 | 18.7 |
| Teicoplanin | 16 | 100 | 0 | 0 | 0 | 0 |
| Vancomycin | 16 | 100 | 0 | 0 | 0 | 0 |

Out of 129 gram negative isolates, 47 (36.4%) showed multidrug resistant pattern. Out of 8 Staphylococcus aureus isolates 2 (25%) were MRSA. Out of 5 coagulase negative staphylococcus 1 (20%) was MRCoNS.

**DISCUSSION**

Urinary tract infections are one of the most common bacterial infections. Incidence of UTI reported were high, but not accurate; as few number of cases which are mild infections are remained undiagnosed.

Out of 145 UTI patients, 48 (33.1%) were in the age group of 20-29 years, 42 (28.9%) were 30-39 years of age, 32 (24.8%) were ≥50 years of age, 12 (8.2%) belongs to 40-49 years, 7 (4.8%) were 10-19 years and remaining 4 (2.7%) patients were 1-10 age group. 98 (67.5%) were female and 47 (36.4%) were male among UTI cases with ratio of 2.085:1 as per this study.

Many of the studies documented incidence of Urinary tract infections is highest among the middle age group persons (20-40 years) [4-6]. There were statistical differences observed in the age, sex, area of residence, stage of pregnancy and marital status of the study UTI population [1,2]. In similar to this study, Getenet Beyene et al [5], Martin Odoki et al [6] reported female preponderance , it was 64.9% and 65.9% respectively. It is a well-known fact that females are most commonly affected when compared to males among urinary tract infected patients. Various reasons behind this are short urethra of female, urethral opening situated beneath anal opening, low intake of water among females, unhygienic measures due to poverty etc.

Our study is similar to Ruhi Khan Study [7] from North India, reported Escherichia coli is a predominant pathogen followed by Klebsiella pneumoniae.

**Table 4. Pathogens isolated from UTI samples of various studies**

| Articles | Year of the study | Escherichia coli (%) | K.Pneumoniae (%) | Ps.aeruginosa (%) | Pr.mirabilis (%) | K.oxytoca (%) | S.aureus (%) | Pr.vulgaris (%) | CoNS (%) | Enterococcus spp. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Current Study | 2019 | 40 | 20.6 | 10.3 | 8.2 | 6.2 | 5.5 | 3.4 | 3.4 | 2.06 |
| Martin Odoki et al [6] | 2019 | 41.9 | 11.6 | - | 3.5 | 7.0 | 31.4 | 1.2 | - | 3.5 |
| Angus N Oli et al [4] | 2017 | 28.5 | - | 20.5 | - | - | 28.0 | - | - | - |
| Tibyangye J [8] | 2015 | 61.1 | 5.9 | 1.4 | - | - | 14.9 | - | - | 5.6 |
| Ruhi Khan [7] | 2015 | 52.4 | 12.3 | 1.8 | 5.3 | - | 4.0 | - | 5.3 | 6.9 |
| Waisman et al [9] | 1999 | 76 | 6 | 6 | - | - | - | - | 3 | 6 |

Martin Odoki et al [6] did study on diabetic individuals in Uganda suffering from UTI. Angu N Oli [4] did a study in Nigeria; they reported salmonella species among UTI patients of 22.8%. Tibyangye J et al [8] reported Morganella species isolation of 4.8%, Citrobacter species of 2.9%, Acientobacter of 1.4%, Enterobacter species of 1.4% pathogens along with above mentioned organisms among UTI patients.

A Study from Kathmandu [10], Western Nepal [11] and North American and European material [12] showed prevalence of Escherichia coli as 81.3%, 59.4%, 47% and 36% and reported as predominant pathogens. Most of the studies documented most common pathogen isolated is Escherichia coli followed by Enterobacteriaceae members. These are major aerobic organism residing in the intestine and is the most commonly reported cause of UTI [13,14] being a common faecal contaminant. Due to the short urethra of females and closeness of the female anus and the vagina to the urethra, the organism is most likely to be inoculated into the urethra during the process of anal cleaning after defecation and during sexual intercourse. The predominance of Escherichia coli in cases of UTI is also supported by other researchers [15,16].

A study done in children with catheter associated urinary tract infection documented Staphylococcus aureus was second most predominant pathogen [17]. Few other studies also mentioned Staphylococcus as second reported isolates from UTI patients [18,19]. In this study, out of 129 gram negative isolates, 90% isolates were sensitive to Nitrofurantoin, amikacin, tigecycline, colistin. Norfloxacin and ofloxacin were sensitive to 70% isolates. Amoxyclav, piperacillin-tazobactum, meropenem showed sensitive in more than 50% isolates, cefixime, ceftriaxone showed sensitive to around 45% isolates and amoxycillin sensitivity noted in 17% of isolates. Out of 16 gram positive isolates, teicoplanin, vancomycin sensitive among 100% isolates, nitrofurantoin, norfloxacin, piperacillin-tazobactum, ofloxacin, amikacin, meropenem were sensitive for 80% of isolates, Amoxyclav, cefixime, ceftriaxone showed sensitive to around 60% isolates and amoxycillin sensitivity noted in 25% of isolates.

In similar to this study, few studies from Iran [20], Ethiopia [18,19] showed good sensitivity of UTI isolates to nitrofurantoin, gentamicin and ceftriaxone. Dash et al [21] also reported that nitrofurantoin was

the most effective drug against gram-positive uropathogen. Angus N Oli et al [4] reported that the most promising drugs for UTI management are Meropenem, aztreonam, azithromycin. Getenet Beyene et al [5] stated that both Escherichia coli and Klebsiella pneumoniae were shown 100% susceptibility to ciprofloxacin and 100% resistance to amoxicillin. All pathogens isolated from UTI samples have shown least resistance to ceftriaxone, gentamycin and chloramphenicol. Staphylococcal isolates showed 100% resistance to ampicillin and 66.7% to amoxicillin. Sudheendra Ramesh Kulkarni et al [22] reported out of 395 Escherichia coli isolates, 96.7% Imipenem, 92.4% Nitrofurantion, 90.8% Amikacin, 85.8% Chloramphenicol, 80.7% Piperacillin-tazobactum, 59.2% Gentamicin, 54.4% Aztreonam and 53.6% Norfloxacin and showed high resistance to Ampicillin (82.5%), Cefuroxime (72.4%), Amoxycillin-clavulanic acid (71.9%), Ceftriaxone (66.5%), Ciprofloxacin (65.8%) and Cefepime (57.4%).

Out of 129 gram negative isolates, 47 (36.4%) showed multidrug resistant pattern. Out of 8 Staphylococcus aureus isolates 2 (25%) were MRSA. Out of 5 Coagulase negative staphylococcus 1 (20%) was MRCoNS in this study. Syed Suhail Ahmed et al [23] reported <50% of Escherichia coli isolates, <50% and <30% of Klebsiella pneumoniae and Proteus mirabilis respectively showed multidrug resistance.

Most of the commonly used oral drugs, lower antibiotics are resistance to UTI isolates and also in some cases higher antibiotics like penems, fluoroquinolones are also showing resistance to isolated pathogens. Clinicians are facing major problem due to antimicrobial resistance. Clinicians need to focus more on microbiological diagnosis, to avoid emergence of antimicrobial resistance. Even, Escherichia coli which are a most common pathogen of UTI also expressing many resistance genes; this may cause widespread health problem. It is difficult to control once bacteria acquires resistance genes; prior to that it is optimize to follow infection control guidelines and hospital antimicrobial policy. In developing countries like India, education is a must and foremost regarding antibiotic policy, infection control practices to clinicians and regarding proper hygienic practices, regular intake of water to community will surely to decrease antimicrobial resistance among UTI pathogens.

## CONCLUSION

Most of common pathogens isolated among patients attending our hospital were Escherichia coli, Klebsiella pneumoniae. High sensitivity has shown to Nitrofurantoin, amikacin, norfloxacin, ofloxacin. Meropenem and piperacillin+tazobactum also showed promising results to UTI isolates. Microbiological diagnosis and accurate treatment is necessary to lessen resistance problem in the community. Regular surveillance and antimicrobial stewardship programme will definitely help clinicians to choose antibiotic for empirical therapy.

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