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# Antibiotic Susceptibility of Organisms Causing Urinary Tract Infection in Patients Presenting to a Teaching Hospital

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## ABSTRACT

**Background:** Urinary tract infections (UTI) are common. It causes severe morbidity and mortality, and it is important to know the causative organisms in the hospital and community for optimum management of UTI.

**Methods:** This is a prospective hospital based study to identify the organisms causing UTI and their antibiotic susceptibility. Consecutive patients presenting with symptoms of UTI had their clean catch midstream urine analysed. Antibiotic susceptibility was tested by Kirby-Bauer's disc diffusion method as described by National Committee for Clinical Laboratory Services (NCCLS) guidelines.

**Results:** Out of 1726 patients, 549 (31.8%) showed bacterial growth.Escherichia coli wasmost common (72.5%), followed by Klebsiellapneumoniae(11.3%), Staphylococcus aureus(3.1%), coagulase negative Staphylococcal species (2.7%) and others (10.1%). There was a female dominance of 3.2:1 compared tomales,except in the 61 and above age range.Infections were most common in young adults (21-30 years). The most effective antibiotic was Nitrofurantoin followed by Norfloxacin, Ciprofloxacin and Ofloxacin. Some isolates were resistant to Norfloxacin, Ampicillin, Cotrimoxazole and Ciprofloxacin.

**Conclusions:** The most common causative organism for UTI was Escherichia coli, and the best first line antibiotic was Nitrofurantoin. Organisms are developing resistance to antibiotics such as Norfloxacin, Ampicillin and Ciprofloxacin.

**Keywords:** a ntibiotic, organism, UTI

## INTRODUCTION

Urinary tract infection (UTI) is a term applied to a variety of clinical conditions, ranging from asymptomatic presence of bacteria in the urine to severe infection of the kidney with resultant sepsis.[1] It is a common medical problem and is responsible for notable morbidity among young and sexually active women.[2,3] [3]It has been shown that at least 80% of uncomplicated cystitis and pyelonephritis are due to *Escherichia coli (E. coli)*, with most of the pathogenic strains belonging to the O serogroups.[4] Other less common uropathogens include *Klebsiella*, *Proteus*, and *Enterobacter* spp. and *Enterococci*.[1]

The gold standard for identification of UTI is culture of urine for specific bacteria followed by antibiogram testing.This study looks at the common organisms causing urinary tract infections and at the various antibiotic sensitivity and resistance patterns in a tertiary hospital.

## METHODS

This was a prospective study conducted at Nepal Medical College Teaching Hospital (NMCTH), Kathmandu, between January and October 2011, which included both inpatient and outpatient patients. Patients who had history or symptoms suggestive of UTI were sent for

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urine culture and sensitivity. The study included 1726 consecutive patients who had their urine cultured for bacterial growth and for antibiotic sensitivity patterns. The urine collected was clean catch midstream urine in a wide-mouthed sterile container according to instructions given. The samples were subjected to standard bacterial culture of Blood andMacConkey'sagar plates using flame sterilized nichrome wire loop (internal diameter of 4mm holding 0.01ml). The plates were observed for bacterial growth after 18 hours incubation at 37°C. The bacteria were identified by colony characters, Gram's reaction and biochemical properties. Bacterial colonies more than $10^5$colony forming units (CFU)per ml of urine were significant. These were subjected to antibiogram testing by Kirby-Bauer's disc diffusion method using Mueller Hintonagar as described by NCCLS.[5]The data collected was analysed with IBM SPSS 19 software using frequency and cross-tabulation for bacteria involved, bacterial growth and antibiotic sensitivity and resistant patterns.

## RESULTS

Out of1726 patients whose urine was cultured for bacterial growth,1006 (58.3%) did not show any bacterial growth. Some patients had contamination (2.7%) or growth of either normal skin (6.8%) or vaginal flora (0.4%). Bacterial growth was found in the urine culture of 549 (31.8%) patients. Females were more commonly affected than males with a ratio of 3.2:1. *E. coli* infections were the highest in number with 301 (75.6%) cases in the females compared with 97 (24.4%) in the male.In elderly males over 61 years ofage *E. coli* infections were more common than females (18.6% compared with 5.7%)(Figure 1).

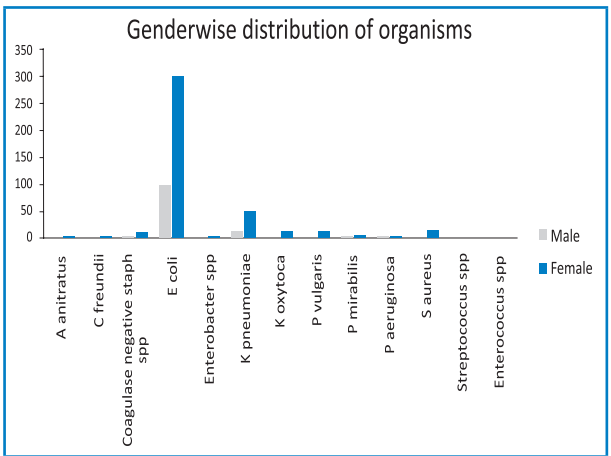


**Figure 1. Relationship between parasitic density and percentage sensitivity.**

Age group 21 to 30 years had highest number of UTI with 183 cases(33.3%). This was followed by the 31 to 40 years with 122 cases (22.2%) (Table 1).

**Table 1: Age wise distribution of organisms causing UTI**

| Organisms | Age in years | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | 1-10 | 11-20 | 21-30 | 31-40 | 41-50 | 51-60 | 61-95 | |
| A anitratus | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 4 |
| C freundii | 0 | 0 | 1 | 2 | 1 | 1 | 1 | 6 |
| Coagulase negative Staph spp | 0 | 2 | 4 | 2 | 2 | 3 | 2 | 15 |
| E coli | 6 | 38 | 130 | 94 | 51 | 31 | 48 | 398 |
| Enterobacter spp | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 4 |
| K pneumoniae | 1 | 7 | 25 | 9 | 5 | 6 | 9 | 62 |
| K oxytoca | 1 | 0 | 4 | 3 | 5 | 0 | 0 | 13 |
| P vulgaris | 0 | 2 | 7 | 1 | 2 | 0 | 1 | 13 |
| P mirabilis | 0 | 1 | 1 | 0 | 2 | 0 | 4 | 8 |
| P aeruginosa | 0 | 0 | 1 | 4 | 2 | 0 | 0 | 7 |
| S aureus | 0 | 2 | 8 | 4 | 1 | 1 | 1 | 17 |
| Streptococcus spp | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Enterococcus spp | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Total | 8 | 53 | 183 | 122 | 73 | 42 | 68 | 549 |

*E. coli* was the most common organism (72.5%), followed by *Klebsiella pneumoniae*(*K. pneumoniae*) (11.3%) and *Staphylococcus aureus* (*S. aureus*) (3.1%). Other less common isolates were *Acinetobacteranitratus*(0.7%), *Citrobacter freundii* (1.1%) and *Enterobacter* species (0.7%) (Figure 2).

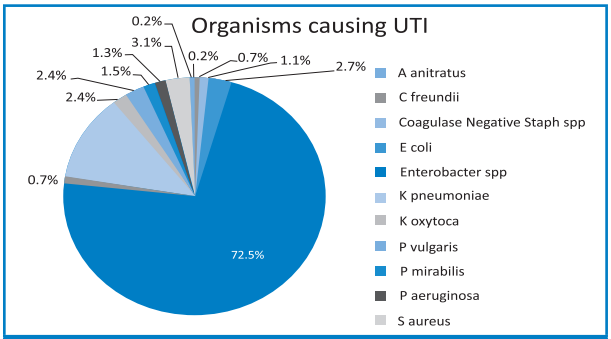


**Figure 1. Relationship between parasitic density and percentage sensitivity.**

Nitrofurantoin was the most sensitive antibiotic followed by Norfloxacin, Ciprofloxacin and Ofloxacin.*E. coli* was most sensitive to Nitrofurantoinin 77.8% cases,compared with Norfloxacin (65.5%)and Ciprofloxacin (57.2%). Ciprofloxacin was more sensitive against *K. pneumoniae in*42 cases (67.7%),followed by Norfloxacin (66.1%) and Nitrofurantoin (62.9%)(Table 2).

Bacteria were found to be most resistant to Norfloxacin followed by Ampicillin, Cotrimoxazole and Ciprofloxacin. *E. coli* were most resistant to Norfloxacin (48.1%), followed by Ampicillin (42.9%) and Ciprofloxacin (36.8%). However, *E. coli* was only resistant to Nitrofurantoin in

3.5%. *K.pneumoniae* was most resistant to Norfloxain (45.8%)followed by both Ampicillin?and Amoxicillin (33.3%). Here also *K. pneumoniae* isolates were only resistant to Nitrofurantoin in 8.3% (Table 3).

**Table 2: Antibiotic sensitivities to all organisms cultured**

| Antibiotics | Responses | |
|---|---|---|
| | N | Percent |
| Cefotaxime | 96 | 3.4% |
| Ceftriaxone | 157 | 5.6% |
| Nalidixic Acid | 46 | 1.6% |
| Ceftazidime | 33 | 1.2% |
| Meropenem | 17 | 0.6% |
| Ampicillin | 37 | 1.3% |
| Imipenem | 33 | 1.2% |
| Piperacillin/Tazobactam | 27 | 1.0% |
| Ofloxacin | 277 | 9.9% |
| Ciprofloxacin | 326 | 11.7% |
| Nitrofurantoin | 408 | 14.6% |
| Norfloxacin | 353 | 12.6% |
| Amikacin | 121 | 4.3% |
| Cephalexin | 20 | 0.7% |
| Amoxicillin | 90 | 3.2% |
| Cloxacillin | 3 | 0.1% |
| Cotrimoxazole | 133 | 4.8% |
| Tobramycin | 123 | 4.4% |
| Gentamicin | 223 | 8.0% |
| Cefixime | 131 | 4.7% |
| Azithromycin | 120 | 4.3% |
| Erythromycin | 8 | 0.3% |
| Chloramphenicol | 10 | 0.4% |
| Total | 2792 | 100.0% |

**Table 3: Antibiotic resistance to all organisms cultured**

| Antibiotics | Responses | |
|---|---|---|
| | N | Percent |
| Cefotaxime | 43 | 2.9% |
| Ceftriaxone | 89 | 6.0% |
| Nalidixic Acid | 91 | 6.1% |
| Ceftazidime | 36 | 2.4% |
| Meropenem | 3 | 0.2% |
| Aztreonam | 3 | 0.2% |
| Ampicillin | 178 | 11.9% |
| Piperacillin/Tazobactam | 11 | 0.7% |
| Ofloxacin | 98 | 6.6% |
| Ciprofloxacin | 147 | 9.8% |
| Doxycycline | 1 | 0.1% |
| Nitrofurantoin | 30 | 2.0% |
| Norfloxacin | 199 | 13.3% |
| Amikacin | 12 | 0.8% |
| Cephalexin | 40 | 2.7% |
| Amoxicillin | 126 | 8.4% |
| Cloxacillin | 8 | 0.5% |
| Cotrimoxazole | 150 | 10.0% |
| Tobramycin | 28 | 1.9% |
| Gentamicin | 47 | 3.1% |
| Cefixime | 113 | 7.6% |
| Azithromycin | 20 | 1.3% |
| Erythromycin | 19 | 1.3% |
| Chloramphenicol | 3 | 0.2% |
| Total | 1495 | 100.0% |

## DISCUSSION

Urinary tract infections patients presenting with had culture positive rate of 49%, which was similar to another study, but higher than a recent study with 24.9% positive cultures.[6,7] A study done previously in this institution had a low positive culture (21.8%), compared to another tertiary centre in Kathmandu (42.8% to 44.5%).[8,9] This suggests the majority who have symptoms or signs of UTI may not have culture positive infections. A significant number of samples were contaminated or had normal vaginal or skin flora (10%). This may reflect poor personal hygiene or the inability of the patient to follow instructions. As suggested by the literature there was a female preponderance except in the elderly age group (more than 69 years) which showed a high male percentage.[6, 7,10] The cause of urinary tract infections in elderly male may be because of conditions leading to bladder outflow obstruction.

Young adults (21 to 50 years) were commonly affected with UTI, which was similar to a study done by Al Benwan, *et al*.[11] UTI was most prevalent in the sexually active age groups with females affected more.

In this study *E. coli* (72.5%) was the predominant organism, which is similar to other studies; however, in one study *Klebsiella* was dominant, which may reflect the local flora.[7, 10-15] Similar figures are found in various other studies, with the percentage of infections due to *E. coli*varying from 68.7% to 72.8%.[7, 12]A previous study in this institution ten years ago showed 77.5% of bacterial isolates to be *E. coli*.[8] The second most common organism isolated *K. pneumonia* (11.2%)in this study was different from the study done previously in this institute which showed *Proteus* species.[8] In other studies *Enterobacter* species was the second largest group, but some studies showed similar results as ours.[7, 16-18] Studies also showed various other organisms following *E. coli*, they are*Streptococcus agalactiae*,*S. aureus* (coagulase positive), *Enterococci*, *Proteusmirabilis* and *Pseudomonas aeruginosa*.[6, 11, 13, 19-22]

The study also looked at antibiotic sensitivity and resistance patterns to the micro-organisms isolated. Knowledge about local microbiological patterns is essential for rationalizing both prophylaxis and treatment regimens.[23] Since gram negative organisms predominate, antibiotics effective against these should be used in the hospital and community. Nitrofurantoin showed the greatest effectiveness against *E. coli* isolates, which was different from the study done in this institution previously which showed Ciprofloxacin.[8] This shows a shift in antibiotic susceptibility of *E. coli*, similar to a study done by Kashanian, *et al*, which could be due to the misuse of antibiotics which are easily available over the counter.[24] A lack of hospital policy may also add to this problem. *K. pneumonia* was most sensitive to Ciprofloxacin but other antibiotics including Nitrofurantion were effective, and similar susceptibility

to Nitrofurantoin was shown by *S.aureus*. The study showed that Nitrofurantoin, followed by Norfloxacin and Ciprofloxacin were the most effective antibiotics when susceptibility was tested.

However, bacterial isolates showed the greatest resistance to Norfloxacin, including *E. coli*. Similarly the bacteria including *E. coli* showed a high degree of resistance against Ampicillin, Cotrimoxazole and Ciprofloxacin. The high degree of resistance of *E. coli* isolates to Ciprofloxacin is similar to findings in other studies also.[12,24,25] This is significant as Ciprofloxacin is probably the drug most prescribed empirically for urinary tract infections.[11] A review of the antibiotic policy for treating urinary tract infections is necessary and this will need interaction between the various departments. A common policy is needed taking the local flora into account and to prevent the development of resistant strains. The drug of choice according to the study is Nitrofurantion because most isolates are susceptible to it and resistance is low. This is in line with the study done by Kashanian J, *et al*.[24]The study suggests Nitrofuranto in has to be considered as a first line treatment in cases of urinary tract infections particularly those due to *E. coli*. The other antibiotics although having good sensitivity patterns also have more isolates resistant to them.

## CONCLUSIONS

The majority of patients presenting with symptoms suggestive of UTI may not have culture positive infections. *E. coli* remains the predominant organism responsible for UTI in young adults, more commonly in females presenting to our hospital. Nitrofurantoinwas the most sensitive antibiotic, but organisms are developing resistance to antibiotics like Ciprofloxacin and Norfloxacin. It is recommended that such studies be done to identify the most common bacteria responsible for UTI, and also to formulate an antibiotic policy.

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