

## Study of Bacterial Pathogens in Urinary Tract Infection and their Antimicrobial Sensitivity Pattern

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### Abstract

**Background:** Urinary tract infection (UTI) is one of the most common bacterial infections in Bangladesh. Antimicrobial agents are used for its treatment. The increase in antibiotic resistance among uropathogens is a global problem. **Objective:** This study was designed to find out the prevalence of UTI, its causative agents and their antimicrobial susceptibility patterns among suspected patients of UTI attending Dhaka Dental College Hospital, Dhaka. **Methodology:** This cross-sectional study was carried out in Dhaka Dental College Hospital, Dhaka during the period of November 2014 to May 2017. Clinically diagnosed cases of UTI irrespective of age and sex from out-patient department and in-patient department were selected for the purpose of the study. For culture, the urine samples were inoculated on 5% sheep blood agar and MacConkey's agar media using calibrated loop following standard bacteriological technique. After the incubation period, the plate were examined for bacterial pathogen. The disk diffusion method (Kirby Bauer's) was used to determine the antimicrobial susceptibility of isolates. Standard inoculums were inoculated on Mueller-Hinton agar and incubated at 37°C for 24 hours. **Result:** Ninety three urine samples were studied. Among the 93 samples most of them were in the age group of 21 to 30 years. Out of 93 samples, 26 (27.95%) samples were found culture positive. *Escherichia coli* (92.30%) was found to be the predominant organism. Regarding antimicrobial sensitivity pattern *Esch. coli* was found to be most sensitive to Imipenem (100%), Amikacin (87.5%), and Nitrofurantoin (83.33%). **Conclusion:** In conclusion young aged female are commonly suffering from UTI and *Escherichia coli* is the most common isolated bacteria. [Bangladesh Journal of Infectious Diseases, December 2017;4(2):40-44]

**Keyword:** Urinary tract infection (UTI); causative agents; susceptibility; antimicrobial agents

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## Introduction

Urinary tract infection is the most common bacterial infection accounting for 25.0% of all infections<sup>1</sup>. It is one of the most important causes of morbidity and also the second most common cause of hospital visit<sup>1</sup>. It is estimated that about 35% of healthy women suffer from symptoms of UTI at some time in their life. Urinary tract infection is caused mainly by normal bowel flora-principally *Escherichia coli*, responsible for  $\geq 75\%$  of cases. Other Gram negative Enterobacteriaceae, Gram positive *Enterococcus faecalis* and *Staphylococcus saprophyticus* are responsible for remainder of UTI<sup>2</sup>. Urinary tract infection is more common in women than in men though male over the age 60 years with prostatic hypertrophy are the exceptions<sup>3</sup>. Women are more prone to UTI than men because urethra is much shorter and closer to the anus in female<sup>4</sup>.

The aim of a microbiology laboratory in the management of UTI is to diagnose accurately and timely. Aim also includes appropriate antimicrobial sensitivity testing to reducing morbidity<sup>5</sup>. Development of resistant strain is a common problem in antimicrobial chemotherapy. Frequency of resistance to antibiotics and drug is directly linked to consumption of antibiotic<sup>6</sup>. Due to improper use of antibiotic the prevalence of antimicrobial resistance among urinary pathogens has been increasing worldwide<sup>7-8</sup>. Therapeutic decision to treat UTI should be based on accurate, up-to-date antimicrobial susceptibility pattern. Accurate and timely diagnosis, along with early initiation of appropriate antibiotic therapy has great potential to minimize the risk of poor outcome. It also reduces chronicity & drug resistance, thus reduces patient's sufferings and financial expenditure<sup>9</sup>. For this reason, knowledge of the etiological agents of UTI and their antimicrobial resistance patterns in a specific geographical location may aid the clinicians in choosing the appropriate antimicrobial empirical treatment. Thereby the study was undertaken to find out the most frequent etiologic agents responsible for UTI. Also to evaluate the antibiotic susceptibility pattern to the most common isolated organisms in order to facilitate better treatment and management of UTI.

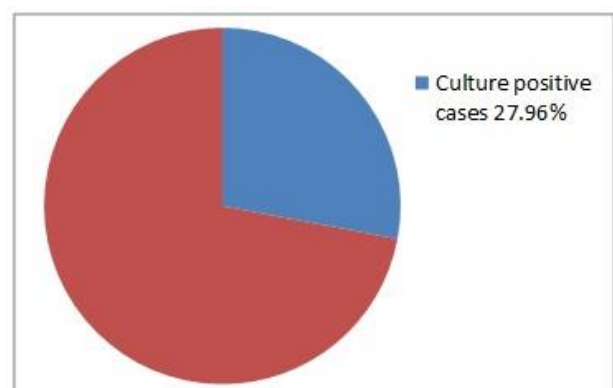
## Methodology

This cross-sectional study was carried out in Dhaka Dental College Hospital, Dhaka during the period of November 2014 to May 2017. Clinically diagnosed cases of UTI irrespective of age and sex from out-patient department and in-patient

department were selected for the purpose of the study. Total 93 samples were collected during this study period. For collection of urine sample, patients were advised to collect a clean catch mid-stream urine specimen in a sterile, wide mouth leak proof container supplied by the laboratory. Guideline for proper specimen collection was given to all patient. For culture, the urine samples were inoculated on 5% sheep blood agar and MacConkey's agar media using calibrated loop following standard bacteriological technique and incubated at 37° C for 24 hours. After the incubation period, the plate were examined for bacterial pathogen. Pure bacterial colony counting  $\geq 10^5$  bacteria/ml were considered as significant and was subjected to identification based on colony characters and biochemical test<sup>10</sup>. The disk diffusion method (Kirby Bauer's) was used to determine the antimicrobial susceptibility of isolates. Standard inoculums were inoculated on Mueller-Hinton agar and incubated at 37°C for 24 hours. Antimicrobial susceptibility and resistance was determine with the help of NCCLS. Following antimicrobial drugs were used for the sensitivity study amoxiclav, cotrimoxazole, cefuroxime, cephalexin, piperacillin, ceftriaxone, ciprofloxacin, levofloxacin, nalidixic acid, nitrofurantoin, imipenem and amikacin.

## Results

In this study, 26(27.96%) samples out of 93 were showed urine culture positive (Figure I). Out of 93 patients, 70(75.27%) were female and 23(24.73%) were male.



**Figure I:** shows the results of urine culture

Among 23 urine samples collected from males, 3 samples (13.05%) were urine culture positive and 70 urine samples collected from females, 23(32.86%) samples were culture positive (Table 1).

**Table 1: Sex distribution of culture positive cases among study population (n=93)**

Gender	Growth		Total
	Positive	Negative	
Male	3(13.05%)	20(96.95%)	23(100.0%)
Female	23(32.86%)	47(67.14%)	70(100.0%)
<b>Total</b>	<b>26(27.96%)</b>	<b>67(72.04%)</b>	<b>93(100.0%)</b>

The highest prevalence of UTI was found in females and the age group was 21 to 30 years (Table 2).

**Table 2. Distribution of cases of UTI causing in different age groups (n=93)**

Age Group	Number	Percentage
≤ 10 years	09	9.67
11 to 20 years	05	5.37
21 to 30 years	30	32.25
31 to 40 years	16	17.20
41 to 50 years	13	13.97
51 to 60 years	14	15.05
>60 years	06	6.45
<b>Total</b>	<b>93</b>	<b>100.0</b>

Among the 26 culture positive cases 24(92.30%) samples showed growth of *Esch. coli*. Other 2 organisms were *Pseudomonas spp.* and *Staph. saprophyticus* (Table 3).

**Table 3: Isolation of Different Organisms among Culture Positive Cases (n=26)**

Bacterial Pathogens	Frequency	Percentage
<i>Escherichia coli</i>	24	92.30
<i>Pseudomonas spp.</i>	1	3.85
<i>Staph. saprophyticus</i>	1	3.85
<b>Total</b>	<b>26</b>	<b>100.0</b>

Regarding sensitivity pattern, it was found that *Esch. coli* was 100.0% sensitive to imipenem followed by amikacin and nitrofurantoin which was 87.5% and 83.33% respectively (Table 4).

## Discussion

UTI is a common clinical problem. Epidemiological UTI accounts for seven million office visits and one million emergency department visits, resulting in 100,000 hospitalizations yearly, making them the most common bacterial infections in outpatient and emergency department setting<sup>11</sup>. Financially, the estimated annual cost of UTI is significant, at approximately 1.6 billion US dollar<sup>11</sup>.

**Table 4: Antimicrobial sensitivity pattern of *Escherichia coli***

Antibiotics	<i>E. coli</i> (24)	
	Sensitive	Resistant
Cefuroxime	06(25)	18(75)
Cotrimoxazole	11(45.83)	13(54.16)
Levofloxacin	15(62.5)	09(37.5)
Ceftriaxone	11(45.83)	13(54.16)
Ciprofloxacin	16(66.66)	08(33.33)
Nalidixic acid	05(20.84)	19(79.16)
Nitrofurantoin	20(83.33)	04(16.66)
Cephalexin	00(00)	24(100)
Imipenem	24(100)	00(00)
Piperacillin	10(41.66)	14(58.33)
Amikacin	21(87.5)	03(12.5)
Amoxiclav	06(25)	18(75)

Figures in parentheses represent percentage

It is stated that UTI is predominantly a disease of the female due to a short urethra & its proximity to anal opening<sup>4</sup>. In this study higher prevalence of UTI in female (32.86%) compared to that of male (13.05%) was observed which was resembled with that reported by Yasmeen et al<sup>13</sup>. The prevalence of UTI varies according to sex and age<sup>14</sup>. It has been usually observed that UTI most commonly occurs in the female and up to one-third of all women experience a UTI at some point during their lifetime<sup>15</sup>.

In the present study, regarding age and sex distribution, majority of the cases are in the age group of 21 to 30 years (32.25%), which is similar with reports showed by Zakaria et al<sup>13</sup> and Yasmeen et al<sup>12</sup>. The high incidence of UTI at this age might be due to their initial exposure to sex or related improper personal hygienic practice.

In this study, out of 93 urine specimen, 26 (27.96%) showed significant bacterial growth. The frequency is close to the incidence reported by Bashar et al<sup>16</sup> and Rahman et al<sup>17</sup> respectively. However, this study differs from the study done by Yasmeen et al<sup>12</sup> and Ahmed and Avasarala<sup>18</sup>. They reported lower frequency of UTI which was 20.0% and 12.0% respectively. Higher frequency of UTI is reported by Akhter et al<sup>19</sup>, Akter et al<sup>20</sup> and Zakaria et al<sup>13</sup>.

The most common uropathogen in this study was *Esch. coli*. Out of 26 urine culture positive cases, 24(92.30%) were *Esch. coli*. The reason of the highest rate of *Esch. coli* is that they are normal fecal flora and uropathogen strains of *Esch. coli* have an adherence factor called P fimbriae or pili,

which mediate the attachment of *Esch. coli* to uroepithelial cells<sup>21</sup>. Other investigators<sup>12,19,22-23</sup> also reported higher association of *Esch. coli*. Study conducted in 2014 in Pakistan shows the prevalence of *Esch. coli* is 80.0%<sup>24</sup>.

Antibiotic resistance among uropathogens has become a public health concern in Bangladesh. The pattern of antimicrobial resistance of the microorganisms causing UTI vary in their susceptibility to antimicrobials from place to place & from time to time. In this study *Esch. coli* was found to be most sensitive to imipenem (100%). Amikacin (87.5%) and nitrofurantoin (83.33%). It was also found that *Esch. coli* was most resistant to commonly used oral drugs like cephalexin (100.0%), nalidixic acid (79.16%), cefuroxime (75.0%) and cotrimoxazole (54.16%), which is consistent with other study<sup>25,28</sup>. The results were also supported by another study done by Sanjida et al<sup>25</sup> where the susceptibility rate to amikacin and imipenem remained between 93.0 to 100%. These finding also correlates with the study done by Akhter et al<sup>19</sup> of Bangladesh. They observed 90.3% sensitivity to imipenem and 88.8% sensitivity to nitrofurantoin. Sharmin et al<sup>26</sup> reported similar sensitivity pattern of *Esch. coli* to imipenem (98.9%) which is similar with the present study but different observation for sensitivity is reported for amikacin, which is 70.0%. In another study done in King Fahad Hospital, Saudi Arabia in 2005, 91.71% sensitivity to imipenem and 93.7% sensitivity to amikacin is observed, which is similar with the present study<sup>27</sup>. The low resistance rate detected for these antimicrobials may be due to their uncommon use in the empirical treatment of UTI, and the use of these antimicrobials only in hospitalized patient's according to culture results.

Increasing drug resistance is a great concern to common bacterial infections including UTI. Still antimicrobial agents like amoxicillin, cotrimoxazole, nalidixic acid, ciprofloxacin are in place to treat many Gram positive and gram negative bacterial infections including UTI in many underdeveloped and developing countries including Bangladesh. Unfortunately all these agents were found to have unacceptable range of antimicrobial activity to uropathogens isolated in our settings. This findings is alarming in regards to the choice of effective therapeutic options in the treatment of UTI. Ciprofloxacin was once considered to be the drug of choice for uncomplicated and complicated UTI but due to its irrational use, this broad spectrum drug has lost its efficacy not only in UTI but to other common infections too. However, various studies in Bangladesh have reported high

resistance rate to this antimicrobial agent; Majumder et al<sup>28</sup> reported in 70.11% and Ahmed et al<sup>29</sup> reported in 66.0%. In this present study, it was observed that 66.66% *Esch. coli* was sensitive to ciprofloxacin. This finding is supported by another study<sup>25</sup> where the susceptibility rate was 60.55%. Reason of these variations might be due to the fact that with passage of time ciprofloxacin is becoming more sensitive, cause may be due to registered physician are not prescribing this drug empirically. Whereas Mazzulli<sup>30</sup> from Canada and Farrel et al<sup>31</sup> from UK, reported that only 1.8-2.3% of *Esch. coli* were resistant to ciprofloxacin. Reason might be due to rational use of drugs in their country and these drugs are not easily available. Resistance rate of Ceftriaxone (56.16%) in the present study is supported by the other studies<sup>25,32,33</sup>.

Antibiotic abuse due to easy availability & practicing incomplete antibiotic regimen due to poverty has considerably promoted the dissemination of multidrug resistant bacteria. The Highest percentages of resistance of *Esch. coli* causing UTI were found against oral drugs like cephalexin (100.0%), nalidixic acid (79.16%) and cotrimoxazole (54.16%) and had lower resistance against less commonly used drugs like imipenem, amikacin in the present study.

## Conclusion

UTI is more prevalent among female and the most predominant uropathogen is *Esch. coli*. The prevalence of antimicrobial resistance among microorganisms that cause UTI is increasing worldwide and is a major factor in selecting antibiotics for treatment. Regular monitoring is required to establish reliable information about susceptibility pattern of urinary pathogens for optimal empirical therapy of patients with urinary tract infection. The emergence and spread of resistance can be reduced through appropriate and careful use of antimicrobial agents and increasing awareness among the population about the hazards of inappropriate antimicrobial use through public health education campaign.

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