Investigation of Urine Samples for Isolation, Identification and Antibiotic Susceptibility Analysis of Bacterial Pathogens from Suspected Urinary Tract Infected Patients of Bangladesh

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Authors’ contributions
This work was carried out in collaboration between all authors. Authors TA, KF, MAKP and SN designed the study. Author MRA managed the experimental process and analyses of the raw data. Author TA wrote the protocol and the first draft of the manuscript. Authors MEU, SP and TF managed the literature searches. All authors read and approved the final manuscript.

Article Information
DOI: 10.9734/BJMMR/2016/28576

ABSTRACT
Urinary tract infection (UTI) is the most common community-acquired bacterial infection affecting people of all age groups and both sexes.

Aims: This study was performed to isolate bacterial pathogens usually cause community-acquired uncomplicated UTI and to evaluate their sensitivity against 9 different antibiotics.

Place and Duration of Study: This study was conducted in Department of Microbiology, Jessore

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Medical College and Hospital of Bangladesh during the period from November, 2015 to February 2016.

**Methodology:** One hundred and fifty urine samples were collected from patients who were suspected of having UTI. Pathogenic bacteria were isolated and identified using conventional cultural and biochemical methods. Kirby-Bauer disc diffusion method on Mueller Hinton agar media was used for the determination of sensitivity of the positive isolates to commonly prescribed antibiotics. Statistical Package for Social Sciences (SPSS) software, version 20 was used for statistical analysis.

**Results:** Our research showed that *Escherichia coli* was the most common causative agent of UTI (50.68%), followed by *Pseudomonas* species (17.81%), *Streptococcus* species (13.70%), *Staphylococcus aureus* (10.96%), *Klebsiella* species (4.11%) and *Proteus* species (2.74%). The number of Gram-negative bacteria (75.34%) was higher than the Gram-positive bacteria (24.66%). In this study, UTI was more prevalent in females (84.93%) in comparison to males (15.07%). Antimicrobial susceptibility results for *E. coli* are as follows: Cefixime (94.59%), Cephalexin (91.89%), Azithromycin (89.19%), Ciprofloxacin (83.78%), Co-trimoxazole (81.08%), Gentamycin (75.68%), Amikacin (51.35%), Amoxicillin (21.62%) and Nalidixic acid (8.10%). More than 90% of the isolated uropathogens were susceptible to Cefixime (94.52%), Cephalexin (94.52%) and Azithromycin (93.15%) and less than 20% were susceptible to Nalidixic acid (13.69%).

**Conclusion:** Among the uropathogens, *E. coli* (50.68%) was the most predominant bacteria in both gender and different age groups. Cefixime (94.52%), Cephalexin (94.52%) and Azithromycin (93.15%) were the most effective drugs and Nalidixic acid (13.69%) was the least effective drug for the treatment of UTI.

**Keywords:** Uropathogens; *Escherichia coli*; antibiotic; antimicrobial susceptibility.

### 1. INTRODUCTION

Urinary tract infection (UTI) is one of the most common life threatening and community acquired bacterial infection with a high rate of morbidity and financial cost [1-3]. UTI involves bacterial infections on one or more parts of urinary system and it usually occurs after bacteria overcome the natural host defence mechanism [4]. When infections occur in the lower urinary tract, it is known as a bladder infection or cystitis and infections in the upper urinary tract is known as kidney infection or pyelonephritis [5]. Cystitis is usually associated with the urgency of urination, dysuria, pyuria, irritation of urinary tract, uncomfortable pressure, bloody urine which may have a strong smell and tiredness [6]. A kidney infection includes fever and flank pain as well as the symptoms of cystitis [5].

Though multiple species of microorganisms can be responsible for UTI, the vast majority of UTI is caused by Gram-negative *E. coli*, a common member of *Enterobacteriaceae* family, accounts for 75.0-90.0% of all UTI in both inpatients and outpatients [7]. Other members of the *Enterobacteriaceae* family that cause UTI are *Pseudomonas* species, *Proteus* species, *Klebsiella* species, and *Citrobacter* species. Among the Gram-positive organisms, the most common bacteria that frequently encountered are group B *Streptococci, Staphylococcus aureus* and *Staphylococcus saprophyticus*.

In case of uncomplicated urinary tract infection, nonresident infectious organisms invade structurally and functionally normal urinary tract and in complicated UTI, infections occur in patients with structurally and functionally abnormal urinary tract or both [8]. Nonresident infectious organisms include potential urinary pathogens from the bowel, or in some cases from the vagina of women as a result of sexual activity [8]. After colonization to the perirethral mucosa, organisms ascend to the bladder through the urethra and in some cases to the kidney through the ureter [8]. Antimicrobial secretions, polymorphonuclear cells, and Tamm-Horsfall glycoprotein of host inhibit bacterial adherence to the bladder mucosal wall [9]. But the uropathogens use different virulence factors and mechanisms to colonize and infect the urinary tract. In uncomplicated urinary tract infection, uropathogenic *E. coli* is the most common pathogens that have the enhanced virulence factor such as adhesins and fimbriae (pili), which help to bind to specific receptors of the uroepithelium [10].

Uncomplicated UTI is more commonly occurs in female because of the anatomical predisposition or urothelial mucosa adherence to the
mucopolysaccharide lining or other host factors [11]. However, recent studies suggest that, uncomplicated UTI may also occur in men because of insertive anal intercourse or lack of circumcision or having sexual partner with vaginal colonization with uropathogenic microorganisms or lack of immunity [12-14]. Majority of UTIs don’t cause any threat to the lives and irreparable damage. However, when the kidneys are involved, there is a risk of serious tissue damage with prevalence of bacteremia [15].

Clinical signs, symptoms and urinalysis results are important for the diagnosis of UTI. Results from urine culture play vital role in the diagnosis of UTI by determining the identity of infecting bacteria and their antimicrobial susceptibility [1,16]. Only a few studies have been documented about the susceptibility pattern of community-acquired UTI pathogens in different countries of the world [17–19]. However, there is no such information about the etiology and susceptibility patterns of community-acquired UTI pathogens in Jessore city of Bangladesh. Therefore, the present study was carried out to detect bacteria as etiological agents of community-acquired uncomplicated UTI and to determine their antimicrobial susceptibility pattern from urine samples of patients attending Jessore Medical College and Hospital of Bangladesh.

2. METHODS AND MATERIALS

2.1 Study Area and Study Population

Present study was conducted between November, 2015 to February, 2016 in Department of Microbiology at Jessore Medical College and Hospital, Bangladesh. Urine samples were collected from 150 patients attending outpatients departments (OPDs) who were suspected of having UTI and referred to Jessore Medical College and Hospital for urine culture. Among the 150 urine samples, 75 samples were collected from female and another 75 samples were collected from male. Patients in the age range from 0 to 80 years were included in our study. The study was conducted after taking ethical approval from the hospital administrations.

2.2 Sample Processing

Samples for urine culture were processed within an hour of sample collection. A loopful urine sample was inoculated on Cystine-Lactose-Electrolyte Deficient (CLED) agar, blood agar and MacConkey agar by using sterile 4.0 mm platinum wired calibrated loop. The plates were incubated for 24 hours at 37°C in aerobic condition. After 24 hours, plates which showed no growth were further incubated for 24 hours at the same condition. When a single organism produced colony of $\geq 10^5$ cfu/ml, then it was considered as positive sample for UTI [20].

2.3 Isolation and Identification of Bacterial Isolates

Bacteria were isolated and identified on the basis of standard culture and biochemical profiles of the isolates. Identification of Gram-negative bacteria were done by standard biochemical tests [21]. On the other hand, identification of Gram-positive microorganisms were done with the corresponding laboratory tests such as catalase, coagulase, CAMP test for Streptococcus species, mannitol test for Staphylococcus aureus [22]. The isolated strains were sub-cultured in nutrient agar slants and maintained as pure culture for further study.

2.4 Antimicrobial Susceptibility Testing

Disk diffusion method was used for testing of antimicrobial susceptibility of isolates on Mueller-Hinton agar medium according to Clinical and Laboratory Standards Institute (CLSI) recommendations [23]. Antimicrobial agents used for the study were Cefixime (5 µg), Cephalexin (30 µg), Ciprofloxacin (30 µg), Gentamycin (10 µg), Amikacin (30 µg), Amoxicillin (30 µg), Co-trimoxazole (1.25/23.75 µg), Azithromycin (15 µg) and Nalidixic acid (30 µg).

Pure culture of bacteria was grown on nutrient agar media by streaking method. Then suspension was made in normal sterile saline by taking a single colony. The turbidity of the suspension was then adjusted to a McFarland 0.5 standard (3×10^8 cfu/ml). A sterile non toxic cotton swab was dipped into the standardized suspension and the swab was then streaked over the entire surface of the Mueller Hinton agar plates to obtain uniform inoculum. After 3 to 5 minutes, the discs were applied by using a sterile forcep and pressed down gently into the agar. Then the plates were incubated at 37°C for 24 hours. After 24 hours, the zones of inhibition were measured and interpreted by following the recommendations of the criteria of the Clinical
and Laboratory Standards Institute (CLSI) [23]. E. coli (ATCC 25922), S. aureus (ATCC 25923), and P. aeruginosa (ATCC 27853) were used as quality control strains in our study.

### 2.5 Statistical Analysis

Chi square test was conducted to find out the significant difference between male and female patients in relation to the prevalence of isolated uropathogens. The frequency of the positive samples of each agent as a function of gender and age groups was also analyzed by Chi square test. At 95% level of confidence interval and a $P$ value of <0.05 was considered as statistically significant. The statistical analysis was performed by the Statistical Package for Social Sciences (SPSS) software, version 20.

### 3. RESULTS

Out of 150 urine samples, 73 (48.67%) samples were found positive for bacterial infection. The number of isolated Gram-negative bacilli was 55 (75.34%) and Gram-positive cocci was 18 (24.66%). From female, 62 (84.93%) positive isolates were identified and 11 (15.07%) positive isolates from male. Our study showed that prevalence of uropathogens was more common in females than males. However, the Chi square ($\chi^2$) test results showed that there was no significant variations ($P > 0.05$) between female and male in relation to the prevalence of the isolated bacterial pathogens at 95% confidence interval level ($\chi^2 = 2.544; \text{degree of freedom } = 5; P = 0.7698$) (Table 1).

The most prevalent uropathogen was E. coli (50.68%) (Table 1). The second isolate was Pseudomonas species (17.81%), followed by Streptococcus species (13.70%), Staphylococcus aureus (10.96%), Klebsiella species (4.11%) and Proteus species (2.74%).

The highest isolates 29 (39.73%) was found within age group 21-30 years followed by 17 (23.29%) and 11 (13.70%) isolates from age 31-40 years and 11-20 years respectively (Table 2). E. coli was higher in percentage than other bacteria in both female and male. Patients within age group 11-50 years were found most susceptible for E. coli (Table 3). Klebsiella species, Pseudomonas species, and Proteus species were found more commonly in the age ranged between 21-40 years (Table 3). On the other hand, the distribution of Streptococcus species and Staphylococcus aureus were found to be the most frequent in age group 61-70 and 51-60 years respectively (Table 3). However, Data from statistical analysis showed that there were no significant variations in the prevalence of each isolated bacterial pathogens between the female and male of different age groups at 95% confidence interval level (degree of freedom= 7, $P > 0.05$) (Table 3).

#### Table 1. Distribution of isolated uropathogens according to patient’s gender

| Etiological agent        | No. of isolate (%) | Female (%) (n= 62) | Male (%) (n= 11) | Chi square ($\chi^2$) value | $P$ value |
|--------------------------|--------------------|--------------------|------------------|---------------------------|-----------|
| E. coli                  | 37 (50.68)         | 33 (53.23)         | 4 (36.36)        | 2.544                     | 0.7698    |
| Pseudomonas species      | 13 (17.81)         | 10 (16.13)         | 3 (27.27)        | 2.544                     | 0.7698    |
| Klebsiella species       | 3 (4.11)           | 2 (3.23)           | 1 (9.09)         | 2.544                     | 0.7698    |
| Proteus species          | 2 (2.74)           | 2 (3.23)           | 0                | 2.544                     | 0.7698    |
| Streptococcus species    | 10 (13.70)         | 8 (12.90)          | 2 (18.18)        | 2.544                     | 0.7698    |
| Staphylococcus aureus    | 8 (10.96)          | 7 (11.29)          | 1 (9.09)         | 2.544                     | 0.7698    |

#### Table 2. Frequency of isolated bacteria according to patient age

| Age   | Female (%) (n= 62) | Male (%) (n= 11) | Total (n= 73) |
|-------|--------------------|------------------|---------------|
| 0-10  | 1 (1.61)           | 1 (9.09)         | 2 (2.74)      |
| 11-20 | 7 (11.29)          | 3 (27.27)        | 10 (13.70)    |
| 21-30 | 25 (40.32)         | 4 (36.36)        | 29 (39.73)    |
| 31-40 | 14 (22.58)         | 3 (27.27)        | 17 (23.29)    |
| 41-50 | 6 (9.68)           | 0                | 6 (8.22)      |
| 51-60 | 3 (4.84)           | 0                | 3 (4.11)      |
| 61-70 | 5 (8.06)           | 0                | 5 (6.85)      |
| 71-80 | 1 (1.61)           | 0                | 1 (1.37)      |
The antimicrobial susceptibility test showed that, *E. coli* was susceptible to Cefixime (94.59%), Cephalexin (91.89%), Azithromycin (89.19%), Ciprofloxacin (83.78%), Co-trimoxazole (81.08%) and moderate level of susceptible to Gentamycin (75.68%), Amikacin (51.35%) and least susceptible to Amoxicillin (21.62 %) and Nalidixic acid (8.10%) (Table 4).

The second uropathogen *Pseudomonas* species was susceptible to Cephalexin (100%) followed by Cefixime (92.31%), Azithromycin (92.31%), Ciprofloxacin (84.62%), Gentamycin (76.92%) and moderately susceptible to Amikacin (53.85%), and least susceptible to Co-trimoxazole (46.15%), Amoxicillin (38.46%) and Nalidixic acid (15.38%).

*Klebsiella* species was 100% susceptible to both Cephalexin and Azithromycin and 66.67% susceptible to Cefixime, Amikacin followed by 33.33% susceptible to Ciprofloxacin, Gentamycin, Amoxicillin, Co-trimoxazole and Nalidixic acid.

*Proteus* species was 100% susceptible to Cefixime, Cephalexin and Azithromycin and least susceptible to Ciprofloxacin (50%) and Gentamycin (50%). Also, *Streptococcus* species and *Staphylococcus aureus* were 100% susceptible to Cefixime and Azithromycin and 20% and 25% susceptible to Nalidixic acid respectively.

In overall, the uropathogens were highest susceptible to Cefixime (94.52%), Cephalexin (94.52%) and Azithromycin (93.15%) and lowest susceptible to Nalidixic acid (13.69%) (Table 5).

4. DISCUSSION

Urinary tract infection (UTI) is the most frequent community-acquired infection in the world. It is an extremely common cause of morbidity and mortality in developing countries like Bangladesh. This may be associated with lack of proper research, faulty diagnostic procedures, abuse of chemotherapeutic agents and little or no preventive measures. Generally, in almost all cases of UTI, antimicrobial treatment is started before the availability of results from microbiological tests. Therefore, it is important to obtain local and national data about the pathogens causing uncomplicated UTI and their antimicrobial susceptibility pattern. Results from region-specific surveillance studies provide additional information about causative agents and their antimicrobial susceptibility pattern and serve as a basis to develop national guidelines for the empirical treatment of UTI [24].

Detection of bacterial pathogens causing uncomplicated UTI and their antimicrobial susceptibility pattern has been demonstrated in this study. Our study showed that females (84.93%) are more prone to UTI than males (15.07%). Similar results were found in other studies performed in Turkey (82.3% female, 17.7% male), Kenya (64% female, 36% male), and Iran (76% female, 24% male) [24-28]. The incidence of urinary tract infections is far more frequent in women due to shorter and wider urethra, hormonal changes which affect the adherence of bacteria to mucosa, trauma of urethra during sexual intercourse. Besides, women lack the prostatic fluids which have bactericidal effects, usually secreted from male [28-29].

The results showed that the organisms isolated from urine samples were *E. coli*, *Pseudomonas* species, *Klebsiella* species, *Proteus* species, *Streptococcus* species and *Staphylococcus aureus*. Also, the most frequent causative agent of UTI was found to be *E. coli* (50.68%) in both sex groups. This result is consistent with other study conducted in Dhaka, the capital of Bangladesh where *E. coli* (59%) was found as the primary etiological agent of UTI [30]. Our report was higher than reports conducted in India and Southwest Ethiopia, where *E. coli* was 31.5% and 33.3% respectively. However, our report is lower than report carried out in Russia where *E. coli* (85.9%) was also found as predominant isolate [31-33].

Our research showed that Gram-negative bacilli (75.34%) are more commonly associated with UTI than Gram-positive cocci (24.66%). This data is consistent with other study conducted in Iran where prevalence of Gram-negative and Gram-positive bacteria was 85.6% and 9.3% respectively [20].

Present study revealed that patients in the age group 21-30 years were more susceptible (39.72%) to UTI. The factors of this increasing incidence of UTI in young age are associated with high sexual activity, recent use of a diaphragm with spermicide and a history of recurrent UTIs etc. [34-35].
### Table 3. Distribution of uropathogens in relation to gender and age of patients

| Etiological agent | Gender        | Age     | P value |
|-------------------|---------------|---------|---------|
|                   | Female (%)    | Male (%)|         |
| E. coli           | 0 (13.51)     | 1 (2.70)| 0.3679  |
|                   | 14 (37.84)    | 2 (5.41)|         |
|                   | 8 (21.62)     | 1 (2.70)|         |
|                   | 3 (8.11)      | 0       |         |
|                   | 1 (2.70)      | 0       |         |
|                   | 1 (2.70)      | 0       |         |
|                   | 1 (2.70)      | 0       |         |
| Pseudomonas species | 0 (0)       | 1 (2.70)| 0.9975  |
|                   | 6 (46.16)     | 2 (15.38)|        |
|                   | 2 (15.38)     | 1 (7.69)|         |
|                   | 0            | 0       |         |
|                   | 0            | 0       |         |
| Klebsiella species | 0 (0)        | 6 (33.33)| 0.9979  |
|                   | 2 (15.38)     | 1 (7.69)|         |
|                   | 1 (33.33)     | 0       |         |
|                   | 0            | 0       |         |
| Proteus species   | 1 (50)        | 0       |         |
|                   | 0            | 0       |         |
| Strepococcus species | 1 (10)    | 2 (20)  | 0.9106  |
|                   | 1 (10)        | 1 (10)  |         |
|                   | 0            | 0       |         |
|                   | 0            | 0       |         |
| Staphylococcus aureus | 0 (0)     | 1 (12.50)|         |
|                   | 1 (12.50)     | 1 (12.50)|        |
|                   | 1 (12.50)     | 2 (25)  |         |
|                   | 1 (12.50)     | 0       |         |

### Table 4. Susceptibility rates of bacteria isolated from urine culture to nine different antibiotics

| Etiological agent | % Susceptibility rates of isolated bacteria to commonly used antibiotics |
|-------------------|-------------------------------------------------------------------------|
|                   | CFM | CEP | CIP | GEN | AMK | AMC | COT | AZM | NA |
| E. coli (n=37)    | 35 (94.59)| 34 (91.89)| 31 (83.78)| 28 (75.68)| 19 (51.35)| 8 (21.62)| 30 (81.08)| 33 (89.19)| 3 (8.10)|
| Pseudomonas species (n=13) | 12 (92.31)| 13 (100)| 11 (84.62)| 10 (76.92)| 7 (53.85)| 5 (38.46)| 6 (46.15)| 12 (92.31)| 2 (15.38)|
| Klebsiella species (n=3) | 2 (66.67)| 3 (100)| 1 (33.33)| 1 (33.33)| 2 (66.67)| 1 (33.33)| 1 (33.33)| 3 (100)| 1 (33.33)|
| Proteus species (n=2) | 2 (100)| 2 (100)| 1 (50)| 1 (50)| 0 (0)| 0 (0)| 0 (0)| 2 (100)| 0 (0)|
| Strepococcus species (n=10) | 10 (100)| 10 (100)| 8 (80)| 6 (60)| 7 (70)| 5 (50)| 4 (40)| 10 (100)| 2 (20)|
| Staphylococcus aureus (n=8) | 8 (100)| 7 (87.5)| 6 (75)| 3 (37.5)| 6 (75)| 5 (62.5)| 2 (25)| 8 (100)| 2 (25)|

n = Number of isolates; CFM, Cefixime; CEP, Cephalexin; CIP, Ciprofloxacin; GEN, Gentamycin; AMK, Amikacin; AMC, Amoxicillin; COT, Co-trimoxazole; AZM, Azithromycin; NA, Nalidixic acid
The antimicrobial susceptibility test demonstrated that *E. coli* was susceptible to Cefixime (94.59%), Cephalexin (91.89%), Azithromycin (89.19%), Ciprofloxacin (83.78%), Co-trimoxazole (81.08%), Gentamycin (75.68%) and Amikacin (51.35%). This result is in agreement with other studies where it was found that susceptibility of *E. coli* was 75% to Cefixime [36-37], 89% to Azithromycin [37], and 85% to Ciprofloxacin [37]. In a study, Enrico Magliano et al. found susceptibility of *E. coli* to Amikacin (99.6%) and Gentamycin (91%) [38], which was higher than our findings and another study conducted by Bhuwan Khatri et al. [36] where they found 52.4% susceptibility to Co-trimoxazole which was lower than our result.

### Table 5. Overall uropathogens sensitivity to antibiotics (%)

| Antibiotic       | Susceptibility n(%) | Resistant n(%) |
|------------------|---------------------|----------------|
| Cefixime         | 69 (94.52)          | 4 (5.48)       |
| Cephalexin       | 69 (94.52)          | 4 (5.48)       |
| Ciprofloxacin    | 58 (79.45)          | 15 (20.55)     |
| Gentamycin       | 49 (67.12)          | 24 (32.88)     |
| Amikacin         | 41 (56.16)          | 32 (43.84)     |
| Amoxicillin      | 24 (32.88)          | 49 (67.12)     |
| Co-trimoxazole   | 43 (58.90)          | 30 (41.09)     |
| Azithromycin     | 68 (93.15)          | 5 (6.85)       |
| Nalidixic acid   | 10 (13.69)          | 63 (86.30)     |

*Pseudomonas* species were susceptible to Cephalexin (100%), Cefixime (92.31%), Azithromycin (92.31%), Ciprofloxacin (84.62%), Gentamycin (76.92%) and were least susceptible to Nalidixic acid (15.38%). Similar results were also recorded from studies conducted in Italy (Gentamycin 68%) and India (Ciprofloxacin 95%, Gentamycin 53.85%, Nalidixic acid 20%) [38-40].

Furthermore, *Klebsiella* species showed highest susceptibility to Cephalexin (100%) and Azithromycin (100%) which is similar to a study conducted by Forouzan Moinzadeh Zahra arab and Amir Banazadeh in Iran where they found 100% susceptibility to Cephalexin [41] and less than 50% susceptibility to Ciprofloxacin, Gentamycin, Amoxicillin, Co-trimoxazole and Nalidixic acid. Low level of susceptibility to Ciprofloxacin (20.69%), Gentamycin (40%), Amoxicillin (31%), Co-trimoxazole (20.3%) and Nalidixic acid (34.48%) were recorded in various part of the world which also support our study [40,42,43].

*Proteus* species, *Streptococcus* species, and *Staphylococcus aureus* were susceptible to Cefixime (100%), Cephalexin (87.5% to 100%), Azithromycin (100%), Ciprofloxacin (50% to 80%) and Gentamycin (37.5% to 60%). Similar findings were also reported in India by Devanand Prakash and R. S. Saxena where *Proteus* species showed 64.29% susceptibility to Ciprofloxacin and 71.43% to Gentamycin [40]. Besides, Shalini et al. recorded susceptibility of *Staphylococcus aureus* to Ciprofloxacin (77.8%) and Gentamycin (55.55%) which also support our findings [39].

Antimicrobial susceptibility test inferred that in overall more than 80% of the uropathogens were susceptible to Cefixime, Cephalexin, Azithromycin as well as more than 50% were susceptible to Ciprofloxacin and Gentamycin (Table 5). It was also observed that 32.88% isolates were susceptible to Amoxicillin and 13.69% to Nalidixic acid. A study conducted by Shalini et al. in India where susceptibility to Ciprofloxacin, Gentamycin and Amoxicillin were found 73.43%, 63.64% and 22.38% respectively, these results are very close to our findings [39].

Susceptibility to Cephalexin (56.3%), Ciprofloxacin (53.6%), Gentamycin (50.9%) and Nalidixic acid (19.4%) was also recorded in another study conducted in India by S. Manikandan et al. [31]. Besides, Devanand Prakash and R. S. Saxena found 51.04% susceptibility to Ciprofloxacin and 66.67% to Gentamycin which also support our findings [44]. The least susceptibility of first generation Quinolone such as Nalidixic acid indicated that these drugs were overused for the treatment of UTI [45] or were used generally in animals feed which ultimately resulted in resistant to uropathogens [46].

This study has several inherent limitations. All of the urine samples in the study were collected from Jessore Medical College and Hospital, Jessore, Bangladesh. Samples from other hospitals located in Jessore city were not included in this study. The results obtained from this analysis might appear with some variation in comparison to results obtained from other regions of the country. The small sample size was a major constraint to convey meaningful outcomes by statistical analyses. Therefore, a prospective design of longitudinal study involving larger sample from different hospitals may provide more detail insight of bacterial pathogens causing UTI and their prevalence in different age groups of both male and female patients. The identification of different bacterial pathogens was done based on various conventional
biochemical tests. However, parallel molecular detection could provide extra strength in our findings.

5. CONCLUSION

Our study confirmed that *E. coli*, *Pseudomonas* species, *Klebsiella* species, *Proteus* species, *Streptococcus* species and *Staphylococcus aureus* are common pathogens usually associated with UTI. Results from different age groups of both genders revealed that female are more frequently infected with UTI than males. Cefixime, Cephalexin and Azithromycin could be of drug choice for community-acquired uncomplicated UTI and to control antimicrobial resistance, the physicians should prescribe antibiotics only after performing antibiogram.

CONSENT

All authors declare that written informed consent was obtained from the patients for publication of this case report and accompanying images.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethical committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 declaration of Helsinki.

ACKNOWLEDGEMENTS

The authors wish to express heartfelt gratitude and appreciation to administrations of Jessore Medical College and Hospital for granting permission for sample collection from UTI patients and for providing the necessary facilities to carry out this research work. The authors are also thankful to all the OPDs physicians and technical staffs of hospital laboratories who directly and indirectly contributed to the completion of this work.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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