*Original Article*

# Pattern of Bacteria Causing Urinary Tract Infection and their Antibiotic Susceptibility Profile among the Female at a Teaching Hospital

Rahman NMW[1], Afrin S[2], Islam MB[3], Islam Z[4], Begum IA[5], Hossain MA[6]

**Abstract:**
*Urinary tract infection (UTI) is one of the most common types of bacterial infection. Area-specific monitoring studies aimed to gain knowledge about the type of pathogens responsible for UTIs and resistance pattern of the causative agents may help clinicians to choose correct treatment regimen. So, the present study was aimed to investigate the pattern of bacteria causing urinary tract infections and their antibiotic susceptibility profile among the female who were attending both in and out patient departments at Z. H. Sikder Women's Medical College & Hospital during April to June, 2012. Out of 150 clinical samples of urine collected, 47 (31.33%) showed significant bacterial growth. The most common pathogens isolated were Escherichia coli (30, 63.82%), Acinetobacter spp. (8, 17.02%), Coagulase-Negative Staphylococci. (4, 8.51%), Pseudomonas spp. (3, 6.38%) and Klebsiella spp. (2, 4.25%). Members of the Enterobacteriaceae were 100% sensitive to Imipenem while they were found variably resistance to other commonly used antibiotics. The clinicians should use Imipenem selectively in cases of unresponsiveness to commonly used antibiotics.*

**Introduction:**
Acute urinary tract infections (UTI) are one of the most common bacterial infections among women presenting to primary care, with an annual incidence of 7% for all ages of women peaking at 15-24 years and women older than sixty five[1]. Approximately one third of all women have had at least one physician-diagnosed UTI by the age of 26 years[2]. Urinary tract infection (UTI) is one of the most important causes of morbidity in the general population, and is the second most common cause of morbidity among hospital visitors. Moreover, UTI was found as the most common cause of nosocomial infection among hospitalized patients[3]. Recurrent UTI are common and can lead to irreversible damage to the kidneys, resulting in renal hypertension and renal failure in severe cases[4]. In the community, women are more prone to develop UTI. It has been observed that about 20% of the women experienced a single episode of UTI during their lifetime, and 3% of women had more than one episode of UTI per year[5]. Pregnancy also makes the women more susceptible to the infection[6]. Catheter-associated UTI is a trenchant problem with about 10% of the patients developing bacteriuria[7].

It is universally accepted that UTI can only be ascertained on the basis of microscopy and microbial culture of urine[8]. Although empirical treatment of UTI is most cost-effective, prescribing without confirmation of diagnosis contributes to the growing problem of resistance against uropathogens in primary care[9].

Urinary tract infection (UTI) is one of the most common types of bacterial infection and because of its high incidence; it is responsible for an enormous aggregate burden of morbidity, mortality and increased health care costs[10]. UTIs result in approximately eight million physician visit and more than 1,00,000 hospital admissions per year in the US[11].

[1] Dr. NM Wahidur Rahman, Associate Professor, Department of Microbiology, Z. H. Sikder Women's Medical College, Dhaka.
[2] Dr. Samia Afrin, Assistant Professor, Department of Microbiology, Z. H. Sikder Women's Medical College, Dhaka.
[3] Dr. Md. Badrul Islam, Associate Professor, Department of Microbiology, Dhaka National Medical College, Dhaka.
[4] Dr. Md. Zakirul Islam, Associate Professor, Dept. of Pharmacology & Therapeutics, Eastern Medical College, Comilla.
[5] Dr. Ismat Ara Begum, Associate Professor, Dept. of Biochemistry, Popular Medical College, Dhaka.
[6] Prof. Dr. Md. Afzal Hossain, Professor, Department of Microbiology, Z. H. Sikder Women's Medical College, Dhaka.

**Address of Correspondence:** Dr. NM Wahidur Rahman, Associate Professor, Department of Microbiology, Z. H. Sikder Women's Medical College, Dhaka, Bangladesh. Mobile: +8801816736995, Email: alvi_dr2000@yahoo.com

As Bangladesh is a poor, agro based country and most of the people are illiterate and not enough conscious about hygiene, so UTI is a common problem for them and its treatment is expensive for them as well. The high consumption of often inappropriately prescribed antibiotics combined with crowding, multiple pathology and frequent use of invasive devices, is a major factor contributing to high level resistance. Random and extensive use of broad spectrum of antibiotics contributed to changes in the microbiological and antibiotic susceptibility patterns of pathogens isolated from UTI. To provide appropriate treatment, physicians need to know local patterns of microbial susceptibility and proper drug selection for cost effectiveness[12].

Studies from India, Bangladesh and Nepal have reported an increased resistance of the urinary pathogens to commonly used antibiotics[13-15]. Any information from similar studies are not available in the Z. H. Sikder Women's Medical College & Hospital which is situated in one corner of Dhaka city. This teaching hospital is surrounded by different slum area like Rayer bazar basti, Babu bazar basti, Bou bazar basti where most of the people have been living in lower socioeconomic condition. Mostly this group of people comes to the outpatient department of this Medical College for seeking health care. Hence, this study was undertaken to find out the frequency and antibiotic susceptibility pattern of urinary pathogens isolated from urine samples of suspected cases of UTIs at Z. H. Sikder Women's Medical College & Hospital.

**Methodology**:
This cross sectional study was conducted from April to June 2012 in the Department of Microbiology at Z. H. Sikder Women's Medical College & Hospital. A total 150 Urine samples were collected from patients who attended both in and outdoor patient departments and also who were clinically suspected to have UTI.

All urine samples were inoculated in Blood agar and MacConkey agar media. All the plates were incubated at 37°C aerobically for 24 hours. After incubation, plates were checked for presence of suspected pathogens. Organisms were identified to species level by conventional methods[16]. All isolated uropathogens were included in the study. The susceptibility to antibiotics was determined by Kirby Bauer method on Muller Hinton agar media.

**Microscopy of urine samples:**
One drop of centrifuged urine sample was transferred aseptically to a clean glass slide, covered with a clean cover slip and then examined under light microscope using 10x and 40x objectives.

**Culture:**
All urine samples were inoculated in Blood agar and MacConkey agar media by calibrated loop technique. All the plates were incubated at 37°C aerobically. After overnight incubation, plates checked for presence of suspected pathogens.

**Isolation and identification of organisms:**
All the organisms were identified by their colony morphology, staining character, pigment production, motility and other relevant biochemical tests as per standard methods[17,18]. Prior to above tests for detection of urinary pathogens from plate, colony count was done by calibrated loop method[19].

**Antimicrobial susceptibility testing:**
The susceptibility to antibiotics was determined by Kirby Bauer method on Muller Hinton agar media according to CLSI protocols[20].

For different isolated organisms Cotrimoxazole (TS), Gentamicin (GM), Amikacin (AN), Nalidixic acid (NA), Nitrofurantoin (FM), Cephradine (CRD), Levofloxacin (LEV), Ciprofloxacin (CIP), Azithromycin (AZM), Co-amoxiclav (AMC), Ceftriaxone (CRO), Cefotaxime (CTX), Ceftazidime (CAZ), Cefuroxime (CFM), Imipenem (IPM) were used. *E. coli* ATCC 25922 was used as control strains.

**Results:**
Out of 150 consecutive, non-repeat urine samples processed, 47 (31.33%) showed significant growth of uropathogens. Out of 47 isolates majority were *Esch. coli* 30 (63.82%), followed by *Acinetobacter spp*. 8 (17.02%), Coagulase-Negative *Staphylo-coccus* 4 (8.51%), *Pseudomonas spp*. 3 (6.38%) and *Klebsiella spp.* 2 (4.25%).

In this study most of the patients were in reproductive age group, 55.3% (19-40 years). Among the respondents, 68.7% (n=103) had non-significant findings that is 1-4 pus cell/ HPF and rest 31.3% (n=47) had significant findings that is ≥5 pus cell/ HPF. All the culture positive samples showed ≥5 pus cell/ HPF.

Table I: Distribution of respondents by age group.

| Age group | Respondent | Percentage |
|---|---|---|
| 1-18 | 40 | 26.7 |
| 19-40 | 83 | 55.3 |
| 41-60 | 20 | 13.3 |
| >60 | 7 | 4.7 |
| Total | 150 | 100.0 |

Table II: Distribution of respondents by microscopic findings of urine.

| Microscopic Examination of Urine | Respondent | |
|---|---|---|
| | Frequency | Percentage |
| 1-4 pus cell/ HPF | 103 | 68.7 |
| ≥5 pus cell/ HPF | 47 | 31.3 |
| Total | 150 | 100.0 |

Table III: Distribution of isolated bacteria in urine samples (n=47).

| Isolated bacteria | Urine sample (%) |
|---|---|
| E. coli | 30 (63.82%) |
| Klebsiella | 2 (4.25%) |
| Pseudomonas | 3 (6.38%) |
| Acinetobacter | 8 (17.02%) |
| Coagulase-Negative Staph. | 4 (8.51%) |
| Total | 47 (100%) |

Table IV: Association of routine microscopic examination of urine and culture.

| Microscopic Examination of Urine | Growth of micro-organism in Culture | | | | |
|---|---|---|---|---|---|
| | E. coli (n=30) | Klebsiella (n=2) | Pseudomonas (n=3) | Acinetobacter (n=8) | Coagulase-Negative Staph. (n=4) |
| 1-4 pus cell/ HPF | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| ≥5 pus cell/ HPF | 30 (100%) | 2 (100%) | 3 (100%) | 8 (100%) | 4 (100%) |
| Total | 30 (100%) | 2 (100%) | 3 (100%) | 8 (100%) | 4 (100%) |

Table V: Rate of antimicrobial drug sensitivity among the microorganism isolated from urine (n=47).

| Microorganism | | E. coli (n=30) | Klebsiella (n=2) | Pseudomonas (n=3) | Acinetobacter (n=8) | Coagulase-Negative Staph. (n=4) |
|---|---|---|---|---|---|---|
| Number (%) sensitive to Antimicrobials | LEV | 17 (56.7) | 1 (50) | 3 (100) | 7 (87.5) | 3 (75) |
| | AZM | 11 (36.7) | 0 (0) | 1 (33.3) | 4 (50) | 1 (25) |
| | AN | 28 (93.3) | 2 (100) | 3 (100) | 7 (87.5) | 4 (100) |
| | TS | 13 (43.3) | 2 (100) | 1 (33.3) | 2 (25) | 2 (50) |
| | GM | 22 (73.3) | 1 (50) | 2 (66.7) | 6 (75) | 3 (75) |
| | CRO | 17 (56.7) | 0 (0) | 2 (66.7) | 8 (100) | 3 (75) |
| | NA | 18 (60) | 0 (0) | 3 (100) | 3 (37.5) | 2 (50) |
| | CFM | 9 (30) | 0 (0) | 1 (33.3) | 2 (25) | 0 (0) |
| | CAZ | 19 (63.3) | 0 (0) | 2 (66.7) | 7 (87.5) | 0 (0) |
| | CTX | 18 (60) | 0 (0) | 2 (66.7) | 8 (100) | 1 (25) |
| | CRD | 8 (26.7) | 0 (0) | 1 (33.3) | 3 (37.5) | 1 (25) |
| | AMC | 5 (16.7) | 0 (0) | 2 (66.7) | 2 (25) | 2 (50) |
| | CIP | 16 (53.3) | 1 (50) | 3 (100) | 7 (87.5) | 2 (50) |
| | IPM | 30 (100) | 2 (100) | 3 (100) | 8 (100) | 4 (100) |
| | FM | 22 (73.3) | 2 (100) | 1 (33.3) | 6 (85.7) | 4 (100) |

Considering susceptibility pattern with different antimicrobials, it is found that almost all of the bacterial isolates were sensitive to Imipenem (100%). The third-generation Cephalosporins like Ceftriaxone, Ceftazidime and Cefotaxime were sensitive to 25-100% in different isolates. The sensitivity to Ciprofloxacin and Levofloxacin of various isolates was same between 50-100%. Sensitivity to Azithromycin was only between 25-50% and Cefixime was 25-33%. Sensitivity to Cephradine and Co-amoxiclav were 25-37.5% and 16.7-66.7% respectively. Sensitivity to Amikacin, Cotrimoxazole, Gentamicin, Nalidixic acid and Nitrofurantoin were 87.5-100%, 25-100%, 50-75%, 37.5-100% and 33.3-100% respectively.

**Discussion:**

Identification of the uropathogens and their susceptibility pattern is very important in treating the cases of Urinary Tract Infections (UTI). Total 150 respondents were selected for the study. Frequency distribution was done with age, microscopic findings, isolated bacteria. Association of microscopic findings of urine with growth of microorganism, was shown in table IV. Rate of antimicrobial drug sensitivity among the microorganism shown in the table V.

In the present study, 150 urine specimens were cultured to see the pattern of uropathogens and some 47 (31.33%) of the urine showed significant growth of bacteria. So, majority (68.67%) of the cases remaining showed either insignificant bacteriuria or no growth with urine from the clinically diagnosed cases of UTI. Prior antibiotic therapy before submitting the urine samples and clinical conditions like non-gonococcal urethritis or others that mimic UTI could be the factors responsible for insignificant bacteriuria or no growth. The isolation rate of urinary pathogens of the present study is consistent with reports of the study published recently[21].

The present study was done among 150 respondents. Among the respondents, 26.7% were in the age group of 1-18 years, nearly half (55.3%) of the respondents were of 19-40 years, 13.3% were of 41-60 years and rest 4.7% were >60 years (Table-I).

In the present study, the Enterobacteriaceae group were the most common pathogens isolated (*E. coli* 63.82%, *Klebsiella spp.* 4.25%), followed by *Acinetobacter Spp.* (17.02%), *Pseudomonas Spp.* (6.38%) and Coagulase-negative *Staphylococcus* (8.51%) (Table-III). The isolation rate of urinary pathogens of the present study is consistent with reports of the studies published elsewhere recently[22,23,24].

Among the respondents, two-third (68.7%) had non-significant microscopic findings of urine that is 1-4 pus cell/ HPF and rest one-third (31.3%) had significant findings that is ≥5 pus cell/ HPF (Table-II). Here among the cultural growth of microorganism, all (100%) shows significant microscopic findings that is ≥5 pus cell/ HPF. This is highly significant ($p<0.05$). So, there is an association between significant microscopic findings and growth of bacteria. It can be a helpful measure to diagnose the case of UTI, where urine culture facility is unavailable.

Antibiotic resistance is a common phenomenon in developing countries where drugs are available freely without prescription. Now-a-days, antibiotics have been used extensively and newer antibiotics are continuously being added for the treatment of various infections. Proper use of antibiotics is very important in reducing development of resistance to useful and life-saving antibiotics as well as to minimize unnecessary expenses and many side effects. The resistance pattern varies from one country to another.

In the present study, *E. coli* was the principal pathogen isolated showing a high susceptibility to Imipenem (100%), Amikacin (93.3%), Nitrofurantoin (73.3%), Gentamicin (73.3%) but showed variable sensitivity to other commonly used antibiotics. In case of ciprofloxacin and ceftriaxone it is 53.3% and 56.7% respectively. This is consistent with reports from different countries who have reported an increasing resistance to Ampicillin, Ciprofloxacin, and Ceftriaxone[22,24,25]. Another study from Bangladesh reported an increased resistance of the uropathogens to Ciprofloxacin[26].

*Klebsiella spp.* showed high susceptibility to Imipenem (100%), Amikacin (100%) and Nitrofurantoin (100%) but were relatively resistant to commonly used antibiotics. This findings is comparable to Manjula et al. of India, who found members of Enterobacteriaceae variably sensitive to Co-amoxiclav, Ceftriaxone, Ceftazidime and Ciprofloxacin but found all isolates sensitive to Imipenem[27].

Almost all of *Acinetobacter spp.* were 100% susceptible to Imipenem, Ceftriaxone, Ceftazidime, and Cefotaxime. 87.5% to Levofloxacin, Amikacin, Ciprofloxacin and Nitrofurantoin each. The sensitivity to Gentamicin is 75%. Similar susceptibility pattern were also reported by other investigators[28].

*Pseudomonas spp.*, a common cause of hospital-acquired UTI, was found less sensitive to the common antibiotics but sensitive to Imipenem

(100), Nalidixic acid (100) and Amikacin (100). Similar results were reported by investigators from other countries[24].

Coagulase-negative *Staphylococcus* were 100% sensitive to Imipenem, Amikacin and Nitrofurantoin but relatively resistant to other antibiotics. Similar to the present study, a recent report from Bangladesh Institute of Research in Diabetes, Endocrine and Metabolic disorders (BIRDEM), Dhaka had shown that *S. aureus* was 100% sensitive to Vancomycin, Imipenem and mostly resistant to Ampicillin[29].

Since this was a cross-sectional study, further regular monitoring is required to establish reliable information about susceptibility pattern of urinary pathogens for optimal therapy of patients with UTI.

In Bangladesh, as a developing country, public research is limited and priority based. However, with the aforementioned background, organized research in this field is expected to evolve.

**Conclusion:**

The results of the present study showed Gram-negative bacteria were the commonest organisms isolated; among which *E. coli* was the principal urinary pathogen. The sensitivity rates of the uropathogens were low for commonly used antibiotics such as Azithromycin, Cefixime, Cephradine, Co-amoxiclav and Cotrimoxazole for the treatment of UTIs. This study would help the physicians to make judicious choice of antibiotics and would be helpful for formulation of an antibiotic policy.

**References:**


1. Verheij RA, van Dijk CE, Abrahamse H, Davids R, van den Hoogen H, Braspenning J, van Althuis T. Feiten en cijfers over huisartsenzorg in Nederland [Netherlands Information Network of General Practice: Facts and figures of general practice in the Netherlands] Utrecht/ Nijmegen: NIVEL/ IQhealthcare; Landelijk Informatienetwerk Huisartsenzorg. Available at: http://www.LINH.nl [Accessed on 21 December, 2015].

2. Foxman B, Barlow R, D'Arcy H, Gillespie B, Sobel JD. Urinary tract infection: self-reported incidence and associated costs. Ann Epidemiol. 2000; 10(8): 509-15.

3. Ronald AR, Pattullo ALS. The natural history of urinary infection in adults. Med Clin North Am. 1991; 75(2): 299-312.

4. New CH. Urinary tract infection. Am J Med. 1992; 4(1): 63-70.

5. Gebre-Selassie S. Asymptomatic bacteriuria in pregnancy: epidemiological, clinical and microbiological approach. Ethiop Med J. 1998; 36(3): 185-92.

6. Pastore LM, Savitz DA, Thorp JM Jr, Koch GG, Hertz-Picciotto I, Irwin DE. Predictors of symptomatic Urinary tract infection after 20 weeks gestation. J Perinatol. 1999; 19(7): 488-93.

7. Tambyah PA, Maki DG. Catheter-associated urinary tract infection is rarely symptomatic: a prospective study of 1,497 catheterized patients. Arch Intern Med. 2000; 160(5): 678-82.

8. Van Nostrand JD, Junkins AD, Bartholdi RK. Poor predictive ability of urinalysis and microscopic examination to detect urinary tract infection. Am J Clin Pathol. 2000; 113(5): 709-13.

9. Magee JT, Pritchard EL, Fitzgerald KA, Dunstan FD, Howard AJ. Antibiotic prescribing and antibiotic resistance in community practice: retrospective study, 1996-8. BMJ. 1999; 319(7219): 1239-40.

10. Green MS, Stein ER, Amit P. Estimating the effects of nosocomial infections on the length of hospitalization. J Infect Dis. 1982; 145: 667-72.

11. Ponce de León Roca M1, Caballero Doménech JC, Aguilar Sánchez M, León Sanromá M, Fernández Ferré ML. Community-acquired urinary infection: the in vitro activity of Trimethoprim and Cotrimoxazole. Aten Primaria. 1991; 8(4): 293-4, 296, 298.

12. Kunin CM. Urinary tract infections. Detection, prevention, and management, 5th Ed. Baltimore: Williams and Wilkins; 1997. p 128-64.

13. Amdekar S, Singh V, Singh DD. Probiotic therapy: immunomodulating approach toward urinary tract infection. Curr Microbiol. 2011; 63(5): 484-90.

14. Dielubanza EJ, Schaeffer AJ. Urinary tract infections in women. Med Clin North Am. 2011; 95(1): 27-41.

15. Nicolle LE. The chronic indwelling catheter and urinary infection in long-term-care facility

residents. Infect Control Hosp Epidemiol. 2001; 22(5): 316–21.

16. Koneman EW, Allen SD, Janda WM, Shcreckenberger PC, Win WC. The Enterobacteriaceae. In: Color atlas & textbook of diagnostic microbiology, 5th ed. Philadelphia: JB Lippincott Co; 2006. p 211-302.

17. Cheesbrough M. District laboratory practice in tropical countries, Vol II. England: Cambridge University Press; 1985. p 175-180.

18. Colle JG, Miles RS, Watt B. Tests for the identification of bacteria. In: Colle JG, Simmons A, Fraser AG, Marmion BP (eds). Mackie and McCartney Practical Medical Microbiology, 14th ed. New York: Churchill Livingstone; 1996. p 131-149.

19. Hoeprich PD. Culture of the urine. J Lab Clin Med. 1960; 56: 899-907.

20. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing, sixteenth informational supplement. CLSI document M100-S15. PA, USA: Wayne. 2006.

21. Mazed MA, Hussain A, Akter N, Sultan T, Dewanje AK. Pattern of Bacteria Causing Urinary Tract Infections and Their Antibiotic Susceptibility Profile at Chittagong Medical College Hospital. Bangladesh J Med Microbiol. 2008; 2(2): 17-21.

22. Navaneeth BV, Belwadi S, Suganthi N. Urinary pathogens' resistance to common antibiotics: a retrospective analysis. Trop Doct. 2002; 32(1): 20-2.

23. Abu Shaqra Q. Occurrence and antibiotic sensitivity of Enterobacteriaceae isolated from a group of Jordanian patients with community acquired urinary tract infections. Cytobios. 2000; 101(396): 15-21.

24. Jones RN, Kugler KC, Pfaller MA, Winokur PL. Characteristics of pathogens causing urinary tract infections in hospitals in North America: results from the SENTRY Antimicrobial Surveillance Program, 1997.. Diagn Microbiol Infect Dis. 1999; 35(1): 55-63.

25. Allen UD, MacDonald N, Fuite L, Chan F, Stephens D. Risk factors for resistance to "first-line" antimicrobials among urinary tract isolates of Escherichia coli in children. CMAJ. 1999; 160(10): 1436-40.

26. Iqbal J, Rahman M, Kabir MS, Rahman M. Increasing ciprofloxacin resistance among prevalent urinary tract bacterial isolates in Bangladesh. Jpn J Med Sci Biol. 1997; 50(6): 241-50.

27. Ananthakrishanan AN, Kanungo R, Kumar K, Badrinath S. Detection of extended spectrum beta lactamase producers among surgical wound infections and burn patients in JIPMER. Indian J Med Microbiol. 2002; 18: 160-5.

28. Rahman MM, Haq JA, Morshed MAHG, Huq F. Antibiotic Susceptibility Pattern of Bacteria Isolated from an Urban Referral Hospital in Dhaka City. Bangladesh J Med Microbiol. 2008; 2(2): 7-11.

29. Huq JA. Prevalence of antibiotic resistance in medically important bacteria in Bangladesh and their molecular characterization. A multicentre study, BMRC project report. 2002; pp 47-50.