Original Article

Patterns of Antibiotic Resistance Bacteria from Community-Acquired Urinary Tract Infections in Mymensingh, Bangladesh

***Yasmin T[1], Mowla G[2], Saimon T[3], Shamima MTN[4], Islam MA[5]**

Abstract

Background*: Urinary tract infection (UTI) is a significant cause of morbidity and mortality in both developing and developed countries, representing a leading reason for antibiotic prescriptions, particularly in developing regions like Bangladesh.*

Objective*: This study aimed to identify the etiologyand antibiotic resistance patterns of community-acquired urinary tract infections (CAUTIs) in a district-level community clinic in Bangladesh.*

Methods*: We conducted a cross-sectional study at Shodesh Hospital in Mymensingh, prospectively collecting urine samples from 341 patients between January 2022 and December 2022. The collected samples were cultured and isolated bacteria were tested for antibiotic susceptibility using the disc diffusion method.*

Results*: The study revealed a culture growth rate of 26.98% (92 out of 341 samples), with a higher prevalence among female patients (68.47%). The most common pathogen identified was Escherichia coli, accounting for 54.0% of the positive cultures. Cefuroxime exhibited the highest resistance rate at 55.43%, followed by Ciprofloxacin at 13.50%.*

Conclusion*: These findings underscore the necessity for clinicians to make more informed and selective antibiotic choices in the treatment of CAUTIs, thereby potentially reducing patient morbidity and mortality.*

PAH Med Col J. Jul 2025; 2(2): 38-43

Keywords: *Serum ferritin, Pre-eclampsia, Indicator, Pregnancy*

Introduction

Urinary tract infections (UTIs) pose a significant health concern, affecting approximately 405 million people globally and resulting in around 0.23 million deaths annually. In 2019 alone, UTIs contributed to 5.2 million morbidity cases[1]. Treatment for UTIs typically begins with antibiotics, but the rise of multidrug-resistant uropathogens has become a pressing issue worldwide. The most common pathogens responsible for community-acquired urinary tract infections (CAUTIs) include Escherichia coli, Klebsiellaspp. Proteus spp. Pseudomonas spp. and Enterococci spp[2]. The incidence of UTIs caused by multidrug-resistant uropathogens is increase-ing at an alarming rate[3]. The frequency, spectrum and antibiotic resistance of these pathogens vary according to geography and over time, highlighting the need for continuous epidemiological studies on CAUTIs[4]. Notably, multidrug-resistant Escherichia coli and Klebsiella pneumonia are increasingly implicated in both CAUTIs and hospital-acquired UTIs[5]. Commonly used antibiotics for these infections, such as third-generation cephalosporins, are becoming less effective due to widespread antibiotic resistance[6]. The irrational use of antibiotics, often prescribed by non-physician practitioners, exacerbates the problem of antibiotic resistance[7]. While UTIs can affect individuals of any age and sex, women of reproductive age and older women are particularly vulnerable[8]. suspected UTI patients had significant growth of uropathogens[9]. Another recent study, indicate that

1.*Prof. Dr. Taslima Yasmin, Head of the Department Microbiology PAHMCH, President Abdul Hamid Medical College, Kishoreganj

2.Dr. Golam Mowla, Senior Consultant, Department of Paediatrics, 250 bed hospital Jamalpur.

3.Dr. Tawhid Saimon, Lecturer, Department of Microbiology PAHMCH, President Abdul Hamid Medical College, Kishoreganj

4.Dr. Mosammat Tanbir Nahar Shamima, Assistant Professor, Department of Obstetrics and Gynaecology, Enam Medical College Hospital, Dhaka.

5.Dr. Mohammad Aminul Islam, Incharge Molecular Lab, Department of Microbiology, President Abdul Hamid Medical College, Kishoreganj

Article History: Received: 02-02-2024 **Revised:** 28-04-2024 **Accepted:** 07-05-2024

Address of Correspondence: Prof. Dr. Taslima Yasmin, Head of the Dept Microbiology PAHMCH, President Abdul Hamid Medical College, Kishoreganj. E-mail:taslimasanta4@gmail.com;Cell Number:01723879448

over hospital in Bangladesh found that 43.0% of the 443(75.0%) of Escherichia coli strains causing UTIs are resistant to third-generation cephalosporins[10]. A study conducted in 2012, at a regional medical college microscopy and microbial culture, with dipstick tests Diagnostic methods for UTIs include urine screening tools[11]. However, culture remains the gold standard for definitive diagnosis[12]. Studies from Bangladesh, India and Nepal report increasing resistance of urinary pathogens to commonly used antibiotics[13,14]. Therefore, understanding the common pathogens and their antibiotic susceptibility is crucial for the empirical treatment of UTIs.

Methods

This was a cross-sectional survey conducted at a private hospital in Mymensingh, Bangladesh, from January 2022 to December 2022. The study included approximately 341 patients from the community who visited the hospital. Physicians approached patients at diagnostic centers who had ordered urine cultures and sensitivity analyses. Patients were requested to allow the study team to use their culture sensitivity results. Exclusion criteria included patients with urinary tract complications such as the presence of medical or surgical devices, renal stones, or those admitted to the hospital. Urine samples were prospectively collected from the 341 patients meeting the inclusion criteria. The samples were analyzed using standard culture methods and the isolated bacteria were tested for antibiotic susceptibility using the disc diffusion method. Urine samples were cultured using standard procedures to isolate bacterial pathogens. The isolated bacteria underwent antibiotic susceptibility testing via the disc diffusion method. This method involved placing antibiotic-impregnated discs on a culture plate inoculated with the isolated bacteria and measuring the inhibition zones to determine resistance patterns. The data collected included the frequency of positive cultures, the distribution of bacterial pathogens and their antibiotic resistance patterns. The most common pathogens and their resistance to specific antibiotics were identified and analyzed to provide insights for better Clean-catch midstream urine samples were collected after receiving patients' consent and samples were labeled with a blue color sticker for identification. The urine cultures were performed in the clinical microbiology laboratory at Shodesh Hospital in Mymensingh. Samples were inoculated on Hi-Chrome UTI agar, blood agar and MacConkey agar media using a calibrated wire loop and incubated overnight at 37°C. The plates were examined for bacterial growth and isolates were identified based on colony morphology, Gram-stain characteristics and biochemical tests. Culture results were interpreted according to standard criteria, with a growth threshold of $>10^5$ colony-forming units (CFU) per milliliter considered significant bacteriuria. Antibiotic susceptibility testing was conducted using the Kirby-Bauermethod, with interpretations following the criteria recommended by the National Committee for Clinical Laboratory Standards (NCCLS). Quality control strains used to validate the antimicrobial disk results included Escherichia coli ATCC 25922, Pseudomonas aeruginosa ATCC 27853 and Staphylococcus aureus ATCC 25923. All participants provided written informed consent before taking part in the study. In cases of minors under the age of 18, written informed consent was obtained from patients and their guardians. Participation in the study was voluntary. Participants were allowed to withdraw their consent from the study at any point which did not affect their regular treatment.

Results

During the one-year study period, a total of 341 urine samples were cultured, of which 92(26.98%) showed bacterial growth (Table I). Among the positive cultures, 63(68.47%) (Table II) were from female patients, with the most common age group being 51 to60 years, accounting for 18.47% of the cases (Figure 1). The predominant bacterium identified was Escherichia coli, present in 54.0% of the positive cultures (Table: III). Cefuroxime was the most commonly resistant antibiotic, with a resistance rate of 55.43% (Table IV).

Table I: Bacterial growth in total samples

Type	Number (n)	Percentage (%)
Growth	092	26.98
No-growth	249	73.02
Total	341	100.0

Table II: Gender distribution in culture positive samples

Type	Number (n)	Percentage (%)
Male	29	31.53
Female	63	68.47
Total	92	100.0

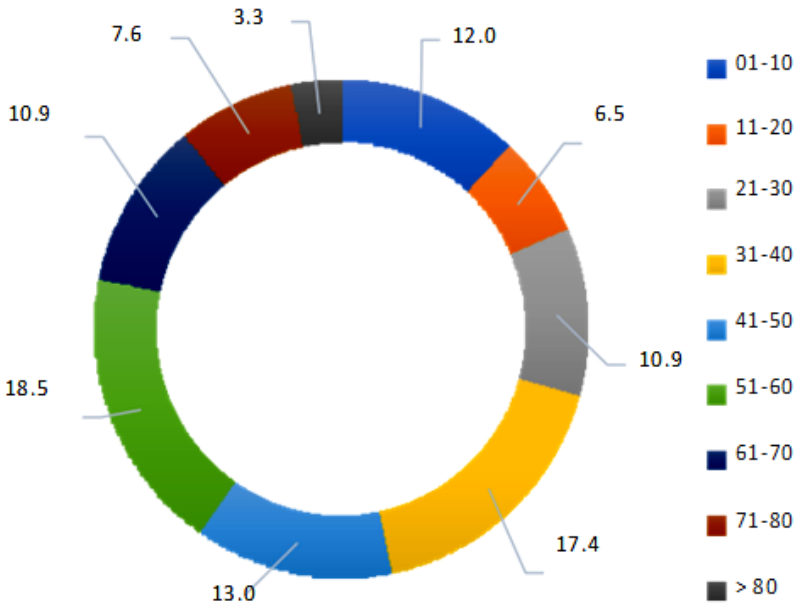

Figure 1: Pie chart showing age group-wise distribution of culture positive samples

Table III: Pattern of pathogens in CAUTIs in culture positive samples

Type	Number (n)	Percentage (%)
Escherichia coli	50	54.00
Klebsiella spp.	05	05.50
Enterococci spp.	15	16.20
Proteus spp.	04	04.30
Pseudomonas aeruginosa	10	10.86
Others	08	08.69
Total	92	100.00

Table IV: Antibiotic resistance pattern of the identified pathogens

Name of antibiotics	Number (n)	Percentage (%)
Amikacin	03	03.26
Ceftriaxone	09	09.78
Cefuroxime	51	55.43
Cefixime	05	05.43
Ceftazidime	06	06.52
Ciprofloxacin	12	13.07
Gentamicin	02	02.17
Nitrofurantion	03	03.26
Imipenem	01	01.08
Total	92	100.0

Discussion

Urinary tract infections (UTIs) represent a significant public health challenge globally, including in Bangladesh, largely due to the ongoing emergence of multidrug-resistant uropathogens. The prevalence of such resistant strains complicates the effectivetreatment of UTIs and underscores the urgent need for localized diagnostic and treatment strategies. Given the regional variations in urinary pathogens, it is crucial for physicians and microbiologists to collaborate closely in diagnosing UTIs and profiling the antibiotic susceptibility of uropathogens[15]. This cooperation is essential to effectively address the threat of multidrug-resistant bacteria and ensure that treatment protocols are tailored to the specific resistance patterns prevalent in different geographic areas. It is well-established that urinary tract infections (UTIs) are more prevalent in females compared to males, a disparity often attributed to factors such as the anatomical position of the female urethra, vaginal colonization with pathogens, sexual activity, pregnancy and potential urinary tract obstruction[15]. Our investigation corroborates this finding, as the highest frequency of infection was observed among female patients. This result aligns with the findings of Haque et al., reinforcing the understanding that female anatomical and physiological factors contribute significantly to the increased incidence of UTIs in women[16,17]. In this study, the highest significant growth was in the age group 51 to 60 years which was 17(18.47%); however, Sanjee et al. found the highest significant growth among the age groups 21-40 years (33%)[15]. Conversely, a study conducted in 2014, UTIs were more prevalent in the age group of 30 to 45 years[18]. In another study Bangladesh, more common UTI was found in 21to 30-year-old age groups, followed by 41-50 years[19]. It may be due to variations in time and place. However, variations in the occurrence of UTIs within different age groups may be due to hormonal changes affecting the mucosal adherence of bacteria, frequent sexual activity, use of spermicidal agents, menopause and prostatic enlargement[20]. In our study, the most common bacteria in CAUTI was E. coli, which was 50(54.0%) followed by Enterococci spp. Fifteen (16.20%), which was similar to Sanjee et al., who found E. coli 57.38% and Enterococci spp. 36.06%[15]. The same prevalence of uropathogens was found in our study as well as in a few studies conducted in India, Pakistan and Korea[21,22,23]. E. coli is more common in other studies in Bangladesh[24,25]. It maybe due to the fact that they are the normal fecal flora and also have some virulence factors like adhesion, pili, fimbriae and the P1-blood group phenotype receptor responsible for their attachment to uroepithelial cells[26]. We found the highest resistance to cefuroxime (55.43%), followed by ciprofloxacin (13.7%), which is similar to Sanjee at EL[15]. Another study from Bangladesh found increased resistance of the uropathogens to Ciprofloxacin[27]. According to other studies in Bangladesh, imipenem was considered the most effective drug against UTI, followed by amikacin, which correlates with our study[27]. It is very alarming that all the third-generation cephalosporins are found to be ineffective against all uropathies. From our study, it was found that the uropathogens are becoming increasingly resistant to the most common antibiotics in cases of uncomplicated UTI. Given that drug resistance can be either inherited or developed over time and is primarily driven by antibiotic overuse, we can potentially mitigatethis issue by carefully selecting prescribed antibiotics. The present study did not include nosocomial UTIs, limiting the ability to compare community-acquired research should incorporate both types to provide a more comprehensive understanding of UTI patterns and resistance.

Conclusion

The study reveals a high rate of CAUTIs caused by multidrug - resistant pathogens among the participants. The significant prevalence of antibiotic resistance, particularly to commonly used antibiotics like cefuroxime, underscores the urgent need for updated treatment guidelines and antibiotic stewardship in the region. These findings provide critical evidence for healthcare providers and policymakers to improve the management of CAUTIs, ensuring more effective and targeted use of antibiotics. Furthermore, thestudy highlights the necessity for continued research in this field, not only within Mymensingh but also across other districts in Bangladesh. Expanding this research can facilitate a broader understanding of resistance patterns and guide the development of comprehensive, region-specific treatment protocols. Collaborative efforts among researchers can contribute to a more robust epidemiological database, ultimately aiding in the fight against the growing threat of antimicrobial resistance in community settings.

References

1. Zeng Z, Zhan J, Zhang K, Chen H, Cheng S. Global, regional and national burden of urinary tract infections from 1990 to 2019: an analysis of the Global Burden of Disease Study 2019. World J Urol. 2022;40(3):755-63.
2. Bryce A, Hay AD, Lane IF, Thornton HV, Wootton M, Costelloe C. Global prevalence of antibiotic resistance in paediatric urinary tract infections caused byEscherichia coliand association with routine use of antibiotics in primary care: a systematic review and meta-analysis. BMJ. 2016;352:19-39.
3. Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. Nat Rev Microbiol. 2015; 13(5):269-84.
4. Tandogdu Z, Wagenlehner FM. Global epidemiology of urinary tract infections.Curr Opin Infect Dis. 2016;29(1):73-9.
5. Kim YH, Yang EM, Kim CJ. Urinary tract infection caused by community-acquired extended-spectrum β-lactamase-producing bacteria in infants. J Pediatr. 2017;93(3):260-6.
6. Albaramki JH, Abdelghani T, Dalaeen A, Khdair Ahmad F, Alassaf A, Odeh R et al. Urinary tract infection caused by extended-spectrum β-lactamase-producing bacteria: risk factors and antibiotic resistance. Pediatr Int. 2019;61(11):1127-32.
7. Abu Shaqra Q. Occurrence and antibiotic sensitivity of Enterobacteriaceae isolated from a group of Jordanian patients with community-acquired urinary tract infections. Cytobios. 2000;101:15-21.
8. Minardi D, d'Anzeo G, Cantoro D, Conti A, Muzzonigro G. Urinary tract infections in women: etiology and treatment options. Int J Gen Med. 2011;4:333-43.
9. Haque R, Akter ML, Salam MA. Prevalence and susceptibility of uropathogens: a recent report from a teaching hospital in Bangladesh. BMC Res Notes. 2015;8:416.
10. Acherjya GK, Tarafder K, Ghose R, Islam DU, Ali M, Akhtar N et al. Pattern of antimicrobial resistance ofEscherichia coliamong urinary tract infection patients in Bangladesh. Am J Intern Med. 2018;6(5):132-7.
11. 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;113:709-13.
12. Srinivassa H, Parija SC, Bhattacharya S, Sehgal R. Incidence of ciprofloxacin resistance in urinary isolates. East Nepal J Commun Dis. 1999;31:45-7.
13. Cruickshank R, Duguid JP, Marmion BP. Tests for identification of bacteria. In: Medical Microbiology. Vol 2. 12th ed. London: Churchill Livingstone; 1975. p.170-89.
14. National Committee for Clinical Laboratory Standards (NCCLS). Performance standards for antimicrobial susceptibility testing. Approved standard M2-A7. 8th informational supplement. Villanova (PA): NCCLS. 2000.
15. Sanjee SA, Karim ME, Akter T, Parvez MAK, Hossain M, Jannat B et al. Prevalence and antibiogram of bacterial uropathogens of urinary tract infections from a tertiary care hospital of Bangladesh. J Sci Res. 2017; 9(3):317-28.
16. Haque R, Akter ML, Salam MA. Prevalence and susceptibility of uropathogens. BMC Res Notes. 2015;8:416.
17. Stamm WE. Urinary tract infection and pyelonephritis. In: Kasper DL et al. Editors. Harrison's Principles of Internal Medicine. 16th ed. New York: McGraw-Hill. 2005. p.1715-21.
18. Masud MR, Afroz H, Fakruddin M. Antibiotic susceptibility patterns of uropathogens. Springer Plus. 2014;3:216.
19. Khan SA, Feroz F, Noor R. Study of antibiotic resistance in urinary tract infections. Tzu Chi Med J. 2013;25:39-42.
20. Mahajan R, Gupta S, Mahajan B. Antibiotic resistance trends in urinary pathogens. J Rational Pharmacother Res. 2014;2(2):44-8.
21. Gonzalez M, Schaeffer AJ. Treatment of urinary tract infections. World J Urol. 1999;17: 372-9.
22. Gul N, Mujahid TY, Ahmad S. Antibiotic resistance among uropathogens. Pak J Biol Sci. 2004;7:2051-4.
23. Mahbub MM, Azmuda N, Maumood B, Khan SI, Birkeland NK, Akhter H. Antibiotic susceptibility pattern of uropathogens. Dhaka Univ J Biol Sci. 2011;20:123-30.
24. Lina TT, Rahman SR, Gomes DJ. Antimicrobial resistance pattern of uropathogens. Bangladesh J Microbiol. 2007; 24:19-23.
25. Das R, Chandrasekhar TS, Joshi H, Gurung M, Shreshtha N, Shivabanda PG. Antibiotic

resistance in urinary isolates. Singapore Med J. 2006;47(4):281-5.

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;50:241-50.
27. Begum S, Salam MA, Alam KF, Begum N, Hassan P, Haq JA. Antibiotic resistance of uropathogens. BMC Res Notes.