Original Article

Bacteriological Profile and Antimicrobial sensitivity pattern of Escherichia coli causing Urinary tract infection in Female in a tertiary care hospital, Bangladesh

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Abstract

Background: In routine clinical practice Urinary tract infections are one of the most common bacterial infections. In many hospitals, Urinary tract infection is also the most common nosocomial infection. For formulating antibiotic policy, study of causative agents and their antimicrobial sensitivity pattern are important factors. As the antibiogram of microorganisms are frequently changing, the present study was done to analyze the recent antibiotic sensitivity pattern of most common Uropathogens *E. coli* in urinary tract infection in female. **Objectives:** This study was aimed to evaluate the uropathogens causing UTI in female and antimicrobial susceptibility patterns of *E. coli* who attended at Diabetic Association Medical College (DAMCH), Faridpur, Bangladesh. **Materials and Methods:** A cross-sectional descriptive type of study was conducted in DAMCH, Faridpur from October 2023 to October 2024. Patients who came with the symptoms of urinary tract infection were sent for urine culture and disc sensitivity test. The results were collected and analyzed further. **Results:** Among 281 urine culture reports 70 (24.91%) cases were culture positive for urinary pathogens. Post-menopausal women were more affected 41 (58.57%) than women of reproductive ages, 22 (31.43%). The Gram-negative bacteria, *Escherichia coli* was the most common isolates **54 (77.14%)** followed by *Klebsiella* 11 (15.71%), *Pseudomonas* 4(5.71%) & *Proteus* 1(1.43%)**.** *E.coli* was found more sensitive to Amikacin (98.08%), Gentamicin (96.30%), Meropenem (96.30%), Imipenem (96.00%), Tigecycline (95.83%) and Netilmicin (94.23%). On the other hands, most of the Cephalosporin group of drugs, Co-trimoxazole, Amoxiclav and Ciprofloxacin were the antibiotics had the highest resistance rates. **Conclusion:** As drug resistance among bacterial pathogens vary with time, regular surveillance and monitoring is necessary for giving updated information to physician for most effective empirical treatment of UTIs.

Keywords: Antibiotic susceptibility, Bacteriological profile, Urinary tract infection, Antibiotic resistance, Uropathogens.

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Introduction:

Urinary tract infection (UTI) is described as the health condition that has association between clinical signs and symptoms and detection of pathogenic microorganisms in the urine, bladder, urethra, kidney[1].

UTIs are the second most common bacterial infection affecting individuals of different ages worldwide[2]. *E. coli* is the most common bacteria which causes 75%-95% of UTI[3]. Increasing antibiotic resistance among urinary pathogens, especially E. coli, to commonly prescribed drugs like Co-trimoxazole has become a global reality[4]. Every year about 150 million people are diagnosed with urinary tract infection worldwide. Each and every woman has a lifetime risk of developing UTI is 60%[5]. By the age of 24, nearly one-third of women will have had at least one episode of a UTI that necessitates the use of antibiotics, and nearly 20% to 40% of women will have recurring infections[6].

Drug resistance of bacterial Uropathogens is a major issue in medical settings today[7], particularly in developing countries, where this is more common due to poverty, poor hygiene, and illiteracy[8]. However, very few studies are reported in our country, these reports reflect mainly the picture of urban community where there exist good personal hygiene & sanitation facilities resulting in less

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prevalence of UTI. That study did not represent the whole country.

The present study was conducted in patients with poor personal hygiene & sanitation facilities coming from rural catchment areas. So, the current study result more accurately reflected overall picture of rural community of Bangladesh.

Therefore, this study will help us to determine bacterial etiologic agents responsible for urinary tract infection and determining the pattern of antimicrobial susceptibility of *E. coli* which will guide physicians to choose the best antibiotics for treating affected patients.

Materials and Method:

Study design: Cross sectional descriptive type of study.

Place of study: Department of Pharmacology in collaboration with the Department of Microbiology, DAMCH.

Duration of study: One year from October 2023 to October 2024.

Sampling Technique: Convenient sampling, because it is easily accessible, convenient to meet at a particular time and places are considered to be included in the sample.

Study population: Reports of urine which are either positive or negative for culture and sensitivity test recorded in the Microbiology department of DAMCH, Faridpur.

Inclusion criteria:

I. Urine culture reports of female patient of all age groups.
II. Antibiotic Sensitivity pattern of *E. coli.*

Exclusion criteria:

I. Antibiotic Sensitivity patterns other than *E. coli*

Data collection technique: Laboratory record of Microbiology department.

Data collection instrument: A pre-designed semi-structured form

Risk related to sample: No physical or psychological risk is associated with the study.

Approval: The research protocol was approved by the Institutional Review Board of Diabetic Association Medical College, Faridpur. Permission for the study was taken from the authority concerned.

Data collection, recording, and analysis: Data was collected from the Microbiology laboratory of DAMCH, Faridpur. The informations were recorded and analyzed. All data were entered, checked, and scrutinized for the following standard procedure and analyzed by using SPSS software version 27.0. Quantitative data were summarized by mean and standard deviation. Appropriate analysis was done to fulfill the objectives of the study. Data is presented by tables and graphs based on the nature of data.

Results:

A total of 281 urine culture reports were collected from Microbiology laboratory during the study period. Out of which 70(24.91%) of the urine samples were culture positive for urinary pathogens which is shown in Table-I.

Table-I: Rate of isolation of Uropathogens from urine samples

Culture positive % (n)	Culture negative % (n)	Total % (n)
24.91 (70)	75.09 (211)	100% (281)

Table-II: Age-wise distribution of female UTIs patients attending DAMCH, Faridpur.

Before Menarche (≤12) Years[9]		Menarche to before menopause (12-45)Years[10]		Post-menopausal period (≥46) Years[10]		Total	
No.	%	No.	%	No.	%	No.	%
07	10%	22	31.43%	41	58.57%	70	100%

Escherichia coli was the most common isolates **54 (77.14%)** followed by *Klebsiella* 11 **(15.71%)**, *Pseudomonas* 4 (5.71%) and *Proteus* 1(1.43%) shown in Figure-I.

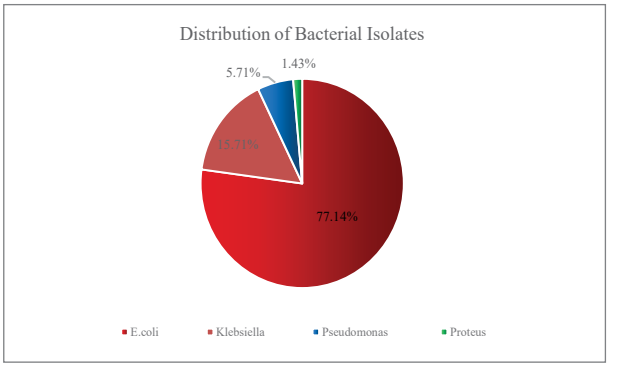

Figure-I: Distribution of Bacterial isolates collected from positive urine samples of individuals with urinary tract infections

coli was found more sensitive to Amikacin (98.08%), Gentamicin (96.30%), Meropenem (96.30%), Imipenem (96.00%), Tigecycline (95.83%) and Netilmicin (94.23%). Cefuroxime, Cefixime, Ceftriaxone, Ceftazidime, Co-trimoxazole, Cefotaxime, Amoxiclav & Ciprofloxacin were the antibiotics with the highest resistance rates in bacterial Uropathogens, at 81.82%, 70.83%, 61.76%, 60.60%, 59.26%, 55.56%, 50.00% and 47.06%, respectively against *E. coli* (Table-III).

Table-III: Antibiotic sensitivity pattern of isolated *Escherichia coli*

Antimicrobial Agents	Escherichia coli Sensitive, n (%)	Escherichia coli Resistant, n(%)	Not tested
Gentamicin	52 (96.30%)	2 (3.70%)	0
Amikacin	51(98.08%)	01 (1.92%)	02
Netilmicin	49 (94.23%)	03 (5.77%)	02
Tigecycline	23 (95.83%)	01 (4.17%)	30
Meropenem	52 (96.30%)	02 (3.70%)	00
Imipenem	24 (96.00%)	01 (4.00%)	29
Amoxiclav	27 (50.00%)	27 (50.00%)	00
Cephradine	00	03 (100%)	51
Cefuroxime	06 (18.18%)	27 (81.82%)	21
Cefixime	07 (29.17%)	17 (70.83%)	30
Cefotaxime	12 (44.44%)	15 (55.56%)	27
Ceftriaxone	13 (38.24%)	21 (61.76%)	20
Ceftazidime	13 (39.40%)	20 (60.60%)	21
Cefepime	22 (61.11%)	14 (38.89%)	18
Aztreonam	19 (63.33%)	11 (36.67%)	24
Piperacillin	21 (70.00%)	09 (30.00%)	24
Fosfomycin	02 (66.67%)	01 (33.33%)	51
Polymixin	07 (87.50%)	01(12.50%)	46
Colistin	41 (77.36%)	12 (22.64%)	01
Ciprofloxacin	18 (52.94%)	16 (47.06%)	20
Cotrimoxazole	22 (40.74%)	32 (59.26%)	00
Nitrofurantoin	45 (84.91%)	08 (15.09%)	01
Doxycycline	23 (71.88%)	09 (28.13%)	22

Discussion:

Urinary tract infection (UTI) is one of the most prevalent diseases affecting people of all age groups i.e., from neonate to geriatric age group.

Widespread use of antibiotics has led to the emergence of resistant microorganisms. As the *E. coli is* the predominant organism responsible for UTI and antibiogram of this organism is frequently changing, the present study was done to analyze the recent antibiotic sensitivity pattern of *E.coli* in urinary tract infection in female. Determining the susceptibility pattern of this microorganism will guide physicians to choose the best antibiotics for treating affected patients.

In the present study, a total 70 bacterial Uropathogens were isolated from 281urine samples. That means 24.91% had significant bacterial growth. In Haque F. T. et al the rate of UTI was 24%, which was almost like this study[11]. While it was 12.88% in a study for isolating antimicrobial sensitivity profile of uropathogens in a tertiary care hospital of Dhaka city in Rahman et al[12]**.** A higher rate of UTI in the present study may be due to patients with poor personal hygiene and sanitation facilities coming from rural catchment areas. In Pritam Pardeshi the overall rate of UTI was 33.54%, this higher rate may be due to larger sample size(584/1741)[13]. Many other studies that are done in Mumbai (33.54%), Gujarat (39.16%), Uttarakhand (49.11%) of India, Pakistan (36.1%), higher growth rate was observed[11,13-15]. In the present study, the growth rate was relatively low in comparison to above four studies which might be due to prior antibiotic therapy before submitting the urine sample, incomplete dose of antibiotic and clinical conditions like non gonococcal urethritis or other conditions that mimic UTI.

Among the female UTI patients, the highest rate (58.57%) was observed in the post-menopausal group (Age ≥46 years) than the reproductive (31.43%) and per-menarche age group (10%). This result is consistent with Pardeshi P (49.14%), Muhammad et al., (46.9%), Pandey et al., (55.05%)[13,15,16]. The highest prevalence rate has been observed in the post-menopausal age group, which might be a result of genito-urinary atrophy and vaginal prolapse after menopause that alters the vaginal p^H, decreasing the normal vaginal flora. This condition allows for Gram-negative bacteria to grow as uropathogens[17]**.**

In the current study *Escherichia coli* was the most common isolates 54 (77.14%) followed by *Klebsiella* 11 (15.71%), *Pseudomonas* 4 (5.71%) & *Proteus* 1(1.43%).

It was consistent with the reports of other studies done by by Pardeshi P, (53.77%), Joya et al, (63.90%), Muhammad et al., (72.7%), Haque F. T. et al(57.4%), Rahman et al (61.91%)[11-13,15,18]. E. coli is the most common causative organism for urinary tract infections (UTIs) because it naturally resides in the human gut, making it readily accessible to the urethral opening, especially in women due to the short distance between the anus and urethra, and certain strains of *E. coli* possess specific virulence factors that allow them to adhere to the bladder lining and establish infection within the urinary tract[19]. This study showed that *Escherichia coli,* had high susceptability rate towards Aminoglycosides [Amikacin (98.08%), Gentamicin (96.30%), Netilmicin (94.23%)], Meropenem (96.30%), Imipenem (96.00%), Tigecycline (95.83%). A study conducted by Rahman et al & Prakash D. & Saxena R S showed almost similar result[12,20]. Tigecycline was not tested in these two studies. But in a study by Muhammad et al., Amikacin, Gentamicin, Meropenem and Imipenem showed 71.20%, 69.70%, 49.50% & 39.90% sensitivity respectively[15]. Which is not consistent with the present result. Tigecycline & Netilmicin were not tested in Muhammad et al[15] .

In the current study, Escherichia *coli* shows 50% sensitivity towards Amoxicillin/clavulanic acid, which is almost similar with the result of **Pardeshi P** (51.59%) studied at Mumbai, India. **Mizanur M R et al**, studied at Gazipur city & that was 59%. However, in Dhaka city it was only 8.23% sensitive observed by **Rahman et al**[12,13,21]. Easy access and indiscriminate use of this drug might be the reason for low sensitivity of Amoxicillin/ clavulanic acid.

The present study revealed that *E.coli* were alarmingly resistyant to Cephalosporin group of drugs. Cephradine showed 100%, Cefuroxime (80.82%), Cefixime (70.83%), Cefotaxime (55.56%), Ceftriaxone (61.76%), Ceftazidime (60.60%) & Cefepime (38.89%) resistance to *Escherichia coli*. Low sensitivity to the above-mentioned drugs were also observed in various studies done in India, Afghanistan & Bangladesh[7-9,12]. The reason behind the high rate of resistance to different generations of Cephalosporin may be due to irrational prescribing of this group of antibiotics.

In recent study, cell wall synthesis inhibitors like Aztreonam, Piperacillin and Fosfomycin showed 63.33%, 70.00% & 66.67% sensitivity respectively to *E.coli*. In **Joya et al** Aztreonam showed 43.30% sensitivity and Fosfomycin 96.20% which are not similar with the present study[18]. Piperacillin was not included in this study. Where as in Muhammad et al, Aztreonam showed only 8.10% and Fosfomycin 40.40% sensitivity, which also were not consistent with the present study[15]. In Vicky P. Gandhi et al, Piperacillin showed 55.00% sensitivity which is not similar with the present study[22].

Cell membrane synthesis inhibitors like Polymixin B & Colistin showed 87.50% & 77.36% sensitivity respectively against *Escherichia coli* in the present study. In Muzammil et al., Polymixin B & Colistin showed 100% sensitivity against *Escherichia coli*[16]. In Xi J et al., Polymixin B & Colistin showed 98.6% & 98.20% sensitivity[23].

Escherichia coli showed 52.94%, 40.74% & 84.91% sensitivity against nucleic acid synthesis inhibitors like Ciprofloxacin, Co-trimoxazole & Nitrofurantoin respectively in this study.

A study conducted by Pardeshi P in Mumbai India showed 29.94%, 53.82% & 79.62% sensitivity against Ciprofloxacin, Co-trimoxazole & Nitrofurantoin respectively, which are nearly similar with the present study[13]. In Prakash D. & Saxena R S, Ciprofloxacin, Co-trimoxazole & Nitrofurantoin showed 30.30%, 15.15% & 74.24% sensitivity respectively, which were dissimilar with the current study[20].

In the current study protein synthesis inhibitor, Doxycycline showed 71.88% sensitivity against *Escherichia coli.* In Madhya Pradesh, India, a study conducted by Khare A et al., showed Mean sensitivity to Doxycycline 75% for *E.coli* which is almost similar with the present study[24].

Limitations of the study:

The major limitation of the present study is the lack of clinical information to confirm whether urinary tract infections were in hospital or community-acquired and complicated or uncomplicated. We emphasized those antibiotics that were only used for regional health purposes. Hence, our study was unable to find out about all the other types of antibiotics profiles in clinical practice. Also, we could not monitor the patient's health patterns and information about the outcomes or any further diagnostic tests they performed.

Conclusion:

The present study showed that UTIs are the leading public-health problem mainly in post-menopausal women. The main aim of this study was to focus on the uropathogenic *E. coli* and their sensitivity and resistance patterns to different groups of antibiotics commonly administered to treat UTI. But in this study, *E. coli* showed resistance to commonly used antibiotics like Amoxiclav, most of the Cephalosporin group of drugs, Ciprofloxacin, Doxycycline which have already crossed their safety limits and are unable to be treated as a first-line treatment for the suspected UTI patients. However, Meropenem, Imipenem, Gentamicin, Amikacin, Netilmicin, Polymyxin, Nitrofurantoin have good sensitivity to help physician to start as empirical treatment. As drug resistance among pathogens is an evolving process, routine surveillance and monitoring studies should be conducted at different areas to help physician to start most effective empirical treatment.

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