Bangladesh J Med Microbiol 2020; 14 (2): 3-11
Bangladesh Society of Medical Microbiologists

Original Article

Prevalence and antimicrobial sensitivity profile of uropathogens in a tertiary care hospital of Dhaka city

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Abstract
Urinary tract infection (UTI) is one of the most frequently occurring infections worldwide seeking medical attentions. The etiology of UTI and the antimicrobial sensitivity pattern of uropathogens vary in regions and change through time. This study aims to evaluate the pathogens responsible for causing UTI and analyze the antimicrobial sensitivity pattern of the isolated uropathogens. This cross sectional study was carried out in the Department of Microbiology, Bangladesh Medical College, Dhaka over a period of January 2018 to December 2019. Out of 11,274 urine samples, 1452 (12.88%) were positive for uropathogens by culture. Among these 1452 isolates, majority of them 936 (64.46%) were isolated from females. *Escherichia coli* 899 (61.91%) was the predominant organism followed by *Enterococccus* species 168 (11.57%), *Klebsiella* species 140 (9.64%), *Enterobacter* species 137 (9.44%). *Escherichia coli* showed high rate of sensitivity to nitrofurantoin 79.76%, gentamicin 75.31%, amikacin 88.65%, imipenem 97.89% and meropenem 80.87%. *Pseudomonas* species showed high rate of sensitivity to imipenem 70.45%. *Enterococcus* species showed high rate of sensitivity to vancomycin 94.05%, imipenem 70.83% and linezolid 79.76%. UTI is a very common problem and rate of antimicrobial resistance is increasing day by day. Therefore, each institution should have an antibiotic policy based on the local antibiogram which is to be renewed regularly.

Introduction
Urinary tract infection (UTI) includes a variety of clinical conditions which range from asymptomatic bacteriuria to severe renal infections resulting into sepsis[1,2]. UTIs are one of the most common bacterial infections both in the community and hospital settings[3]. It remains a major health problem considering financial cost and morbidity, with an estimated 150 million cases annually[4,5]. UTI can occur both in men and women, but clinical studies suggest that occurance of UTI is higher in women due to anatomical and physiological reasons[4,6,7]. Globally, an estimated 50% of women have experienced at least one episode of UTI in their lifetime and among them 20% to 40% will suffer from recurrent episodes[6,8].

UTIs are frequently caused by bacteria which account for more than 95% of cases[7]. The bacterial pathogens involved in UTIs are mainly gram negative bacteria which includes *Escherichia coli (E.coli), Klebsiella pneumoniae, Pseudomonas aeruginosa, Enterobacter* species, *Proteus* species and *Citrobacter* species. Among gram positive bacteria *Staphylococcus aureus, Staphylococcus saprophyticus* and *Enterococcus* species are mostly responsible for causing UTI[2,7]. Among bacteria *E.coli* accounts for majority of the causes of UTI[9].

Over the last few years, UTI is mostly treated empirically before the laboratory results of urine culture are available leading to frequent misuse of antibiotics. Such uncontrolled and widespread use of antibiotics has contributed to the emergence of resistant uropathogens[9,10]. The antimicrobial sensitivity data of UTI causing microorganisms varies widely in different geographical regions and change through time. Since most of the cases of UTI are treated empirically, so in that situation criteria for the selection of antimicrobial agents should be determined on the basis of most likely uropathogens and its expected sensitivity pattern in that geographical area[10]. Thus

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periodic monitoring of the etiologic agents of UTI and their sensitivity pattern in a particular area is crucial for effective treatment and also to prevent the emergence of resistant strains[11].

Considering the above facts the present study was undertaken to determine the bacterial agents responsible for causing UTI and to evaluate their antimicrobial sensitivity pattern among individuals with suspected UTIs.

Materials and Methods

This cross sectional study was conducted in the Department of Microbiology, Bangladesh Medical College, Dhaka over a period of two years, from January 2018 to December 2019. Total 11, 274 urine samples were collected from clinically suspected UTI patients of different clinical wards and outpatient departments of Bangladesh Medical College and Hospital.

Suspected UTI patients of both sexes were included in this study. Clean catch mid stream urine (MSU) and urine from catheter site was collected following standard procedures[12]. Urine samples were brought to the Microbiology laboratory as early as possible and processed immediately[13]. All the urine samples were inoculated semi quantitatively using a sterile calibrated wire loop (0.001ml of urine) on Cystine Lactose Electrolyte Deficient (CLED) agar media and incubated aerobically at 37°C for 24 hours and extended up to 48 hours in culture negative cases. Pure growth of a single microorganism with a colony count of >10^5 colony forming units (cfu)/ml of urine was considered as significant bacteriuria[14]. CLED agar media was procured from Hi Media Laboratories Pvt. Ltd., India. The bacterial isolates were identified by observing colony morphology, Gram staining characteristics and relevant biochemical tests[15,16].

Antimicrobial sensitivity test of the isolates was carried out by Kirby Bauer disc diffusion technique using Mueller Hinton agar media[17]. Interpretations were made by following Clinical and Laboratory Standards Institute (CLSI) guidelines[18] Mueller Hinton agar media and antimicrobial discs were procured from Oxoid Ltd., UK. The following antimicrobial discs were used: amoxicillin (10µg), amoxicillin/clavulanic acid (20/10µg), cefradine (30µg), cefuroxime (30µg), ceftriaxone (30µg), ceftazidime (30µg), mecillinam (25µg), nitrofurantoin (300µg), nalidixic acid (30µg), ciprofloxacin (5µg), co-trimoxazole (25µg), gentamicin (10µg), amikacin (30µg), netilmicin (30µg), aztreonam (30µg), imipenem (10µg), meropenem (10µg), piperacillin/tazobactam (100/10µg), colistin (10µg), cloxacillin (5µg), methicillin (5µg), erythromycin (15µg), azithromycin (15µg), vancomycin (30µg), linezolid (30µg).

Results

A total of 11,274 urine samples were collected in the study period of two years of which, 1452 (12.88%) were positive for uropathogen by culture which is shown in Figure-I.

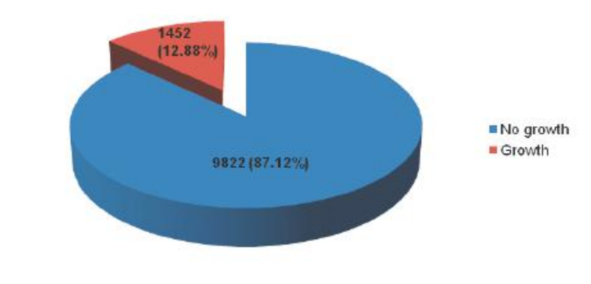

Figure - I: Rate of isolation of organisms from urine samples (n= 11,274)

Among these 1452 isolates, majority of the pathogens 936 (64.46%) were isolated from females and the rest 516 (35.54%) were isolated from males which is depicted in Table-I.

Table - I: Gender wise distribution of culture positive UTI cases (n=1,452)

Gender	Gender	Gender
Male	516	35.54
Female	936	64.46
Total	**1452**	**100**

Table-II showed frequency of isolated bacteria and the most predominant one was *Escherichia coli* 899 (61.91%), followed by *Enterococcus* species 168 (11.57%), *Klebsiella* species 140 (9.64%), *Enterobacter* species 137 (9.44%), *Pseudomonas* species 44 (3.03%), *Staphylococcus aureus* 39 (2.69%), *Staphylococcus* species 15 (1.03%), *Proteus* species 7 (0.48%) and *Acinetobacter* species 3 (0.21%).

Table - II: Distribution of bacteria in culture positive UTI cases (n=1,452)

Isolated bacteria	Number of bacteria (%)
Escherichia coli	899 (61.91%)
Enterococcus spp.	168 (11.57%)
Klebsiella spp.	140 (9.64%)
Enterobacter spp.	137 (9.44%)
Pseudomonas spp.	44 (3.03%)
Staphylococcus aureus	39 (2.69%)
Staphylococcus spp.	15 (1.03%)
Proteus spp.	7 (0.48%)
Acinetobacter spp.	3 (0.21%)
Total	**1452 (100%)**

Antimicrobial sensitivity pattern of gram negative rods were shown in Table-III. 8.23%, 6.67%, 28.48%, 34.82%, 37.37%, 44.16%, 79.76%, 5.67%, 39.71%, 43.05%, 75.31%, 88.65%, 69.74%, 31.03%, 97.89% and 80.87% strains of *Escherichia coli* were sensitive to amoxicillin /clavulanic acid, cefradine, cefuroxime, ceftriaxone, ceftazidime, mecillinam, nitrofurantoin, nalidixic acid, ciprofloxacin, co-trimoxazole, gentamicin, amikacin, netilmicin, aztreonam, imipenem and meropenem respectively. 30.71%, 23.57%, 45.71%, 59.29%, 55%, 30%, 34.29%, 17.86%, 51.43%, 49.29%, 72.14%, 85%, 75%, 42.14%, 88.57% and 87.86% strains of *Klebsiella* species were sensitive to amoxicillin/clavulanic acid, cefradine, cefuroxime, ceftriaxone, ceftazidime, mecillinam, nitrofurantoin, nalidixic acid, ciprofloxacin, co-trimoxazole, gentamicin, amikacin, netilmicin, aztreonam, imipenem and meropenem respectively. 20.44%, 13.87%, 33.58%, 48.18%, 47.45%, 37.96%, 47.45%, 10.95%, 52.55%, 54.01%, 70.80%, 73.72%, 75.18%, 40.15%, 85.40% and 80.29% strains of *Enterobacter* species were sensitive to amoxicillin/clavulanic acid, cefradine, cefuroxime, ceftriaxone, ceftazidime, mecillinam, nitrofurantoin, nalidixic acid, ciprofloxacin, co-trimoxazole, gentamicin, amikacin, netilmicin, aztreonam, imipenem and meropenem respectively. 28.57%, 85.71%, 71.43%, 85.71%, 85.71%, 42.86%, 28.57%, 28.57%, 57.14%, 42.86% and 57.14% strains of *Proteus* species were sensitive to amoxicillin/-clavulanic acid, cefradine, cefuroxime, ceftriaxone, ceftazidime, mecillinam, nitrofurantoin, nalidixic acid, ciprofloxacin, co-trimoxazole and gentamicin respectively. All the strains of *Proteus* species were sensitive to amikacin, netilmicin, aztreonam, imipenem and meropenem.

Table - III: Antimicrobial sensitivity pattern of gram negative isolates (n=1,183)

Antimicrobial agents	*Escherichia coli* (n=899)	*Klebsiella* spp. (n=140)	*Enterobacter* spp. (n=137)	*Proteus* spp. (n=7)
Amoxicillin/clavulanic acid	74 (8.23%)	43 (30.71%)	28 (20.44%)	2 (28.57%)
Cefradine	60 (6.67%)	33 (23.57%)	19 (13.87%)	6 (85.71%)
Cefuroxime	256 (28.48%)	64 (45.71%)	46 (33.58%)	5 (71.43%)
Ceftriaxone	313 (34.82%)	83 (59.29%)	66 (48.18%)	6 (85.71%)
Ceftazidime	336 (37.37%)	77 (55.00%)	65 (47.45%)	6 (85.71%)
Mecillinam	397 (44.16%)	42 (30.00%)	52 (37.96%)	3 (42.86%)
Nitrofurantoin	717 (79.76%)	48 (34.29%)	65 (47.45%)	2 (28.57%)
Nalidixic acid	51 (5.67%)	25 (17.86%)	15 (10.95%)	2 (28.57%)
Ciprofloxacin	357 (39.71%)	72 (51.43%)	72 (52.55%)	4 (57.14%)
Co-trimoxazole	387 (43.05%)	69 (49.29%)	74 (54.01%)	3 (42.86%)
Gentamicin	677 (75.31%)	101 (72.14%)	97 (70.80%)	4 (57.14%)
Amikacin	797 (88.65%)	119 (85.00%)	101 (73.72%)	7 (100.00%)
Netilmicin	627 (69.74%)	105 (75.00%)	103 (75.18%)	7 (100.00%)
Aztreonam	279 (31.03%)	59 (42.14%)	55 (40.15%)	7 (100.00%)
Imipenem	880 (97.89%)	124 (88.57%)	117 (85.40%)	7 (100.00%)
Meropenem	727 (80.87%)	123 (87.86%)	110 (80.29%)	7 (100.00%)

Antimicrobial sensitivity pattern of *Pseudomonas* species and *Acinetobacter* species were shown in Table-IV. *Pseudomonas* was 70.45% sensitive to imipenem, 52.27% to aztreonam, 50% sensitive to piperacillin/tazobactum, ceftazidime and ciprofloxacin, 45.45% to amikacin, 43.18% to meropenem. Low rate of sensitivity was observed in netilmicin 25%, gentamicin 22.73%, colistin 13.64% and ceftriaxone 11.36%. All the strains of *Pseudomonas* and *Acinetobacter* were resistant to cefuroxime. In case of *Acinetobacter* species 33.33% sensitivity observed in case of piperacillin/tazobactam, ceftriaxone, ceftazidime, ciprofloxacin, amikacin, netilmicin and aztreonam. All the strains of *Acinetobacter* were resistant to gentamicin, imipenem, meropenem and colistin.

Table - IV: Antimicrobial sensitivity pattern of *Pseudomonas* spp. and *Acinetobacter* spp. (n=47)

Antimicrobial agents	*Pseudomonas* spp. (n=44)	*Acinetobacter* spp. (n=3)
Piperacillin/tazobactam	22 (50.00%)	1 (33.33%)
Cefuroxime	0 (0.00%)	0 (0.00%)
Ceftriaxone	5 (11.36%)	1 (33.33%)
Ceftazidime	22 (50.00%)	1 (33.33%)
Ciprofloxacin	22 (50.00%)	1 (33.33%)
Gentamicin	10 (22.73%)	0 (0.00%)
Amikacin	20 (45.45%)	1 (33.33%)
Netilmicin	11 (25.00%)	1 (33.33%)
Aztreonam	23 (52.27%)	1 (33.33%)
Imipenem	31 (70.45%)	0 (0.00%)
Meropenem	19 (43.18%)	0 (0.00%)
Colistin	6 (13.64%)	0 (0.00%)

Enterococcus species showed higher rate of sensitivity to vancomycin 94.05%, linezolid 79.76% and imipenem 70.83%. 36.90%, 31.55%, 22.02%, 20.83%, 17.86%, 14.89%, 8.33%, 7.74%, 1.79% and 1.19% sensitivity was observed in case of meropenem, gentamicin, co-trimoxazole, erythromycin, cefradine, ciprofloxacin, methicillin, azithromycin, cloxacillin and amoxicillin respectively. *Staphylococcus aureus* showed higher rate of sensitivity to imipenem 97.44%, vancomycin 94.87%, linezolid 84.62% and co-trimoxazole 71.80%. In case of *Staphylococcus* species, 66.67% sensitivity was found in case of vancomycin, imipenem, meropenem and linezolid. All the strains of *Enterococcus* species, *Staphylococcus aureus* and *Staphylococcus* species were resistant to amoxicillin /clavulanic acid (Table-V).

Table - V: Antimicrobial sensitivity pattern of Gram positive isolates (n=222)

Antimicrobial agents	*Enterococcus* spp. (n=168)	*Staphylococcus aureus* (n=39)	*Staphylococcus* spp. (n=15)
Amoxicillin	2 (1.19%)	2 (5.13%)	0 (0.00%)
Amoxicillin/clavulanic acid	0 (0.00%)	0 (0.00%)	0 (0.00%)
Cefradine	30 (17.86%)	19 (48.72%)	4 (26.67%)
Cloxacillin	3 (1.79%)	2 (5.13%)	0 (0.00%)
Methicillin	14 (8.33%)	1 (2.56%)	0 (0.00%)
Ciprofloxacin	25 (14.89%)	18 (46.15%)	3 (20.00%)
Co-trimoxazole	37 (22.02%)	28 (71.80%)	5 (33.33%)
Erythromycin	35 (20.83%)	10 (25.64%)	3 (20.00%)
Azithromycin	13 (7.74%)	5 (12.82%)	2 (13.33%)
Gentamicin	53 (31.55%)	26 (66.67%)	9 (60.00%)
Vancomycin	158 (94.05%)	37 (94.87%)	10 (66.67%)
Imipenem	119 (70.83%)	38 (97.44%)	10 (66.67%)
Meropenem	62 (36.90%)	25 (64.10%)	10 (66.67%)
Linezolid	134 (79.76%)	33 (84.62%)	10 (66.67%)

Discussion

Urinary tract infection (UTI) is one of the most common causes for seeking medical attention[19]. Due to inappropriate and excessive use of antibiotics in recent years it is mandatory to know the prevalence of bacteria and their sensitivity to commonly used antimicrobials[20].

In the present study, a total of 1452 (12.88%) bacterial uropathogens were isolated from 11,274 urine samples (Figure-I). Similar rate of isolation of uropathogen was reported in a study done in Bangladesh by Akter and Kabir (12.75%) and also observed in another study done in India by Kumar et al., (12.18%)[21,22]. Various studies done in India and Iran also showed almost similar rate of growth[23-26]. In contrary to our finding, higher growth rate was observed in other studies done in Bangladesh by Haque et al., (42.66%) and in India by Mishra et al., (43.61%)[27,28]. In our study, the rate of growth was relatively low in comparison to above two studies and the reason 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[29].

The current study reported a high prevalence of UTI in females (64.46%) in comparison to males (35.54%) (Table-I) which correlate with the findings from other studies[10,22,24,30]. The reason behind this high prevalence of UTI in females is due to close proximity of the urethral meatus to the anus, shorter length of the urethra, sexual intercourse, incontinence and bad toilet[10,31].

Escherichia coli (61.91%) was the most prevalent bacteria isolated from culture positive urine samples (Table-II). This finding is in agreement with reports from other studies where the percentages were 59.30%, 61%, 63.44%, 63.6% and 63.93%[27,32-35]. Following *E. coli*, *Enterococcus* species was found second most common bacterial isolates and this observation correlates with a study done in Bangladesh by Sanjee et al[36]. The prevalence of *Enterococcus* species was 11.57% and this finding was similar to a study done in Bangladesh By Haque et al., (11.56%)[27]. In current study, the frequency of *Klebsiella* species, *Pseudomonas* species and *Staphylococcus* species were 9.64%, 3.03% and 1.03% respectively and similar rate of isolation was observed in a study done by Kashef et al[9]. Present study revealed the frequency of *Staphylococcus aureus* was 2.69% and this finding coincide with a study done in India where the percentage was 2.4%[37]. The prevalence of *Proteus* species and *Acinetobacter* species of our study resemble with a study done by Santosh and Siddiqui[38] .

A study done in Bangladesh reported the prevalence of *Klebsiella* species, *Pseudomonas* species and *Proteus* species were 1.9%, 7.9% and 7.2% respectively and these finding did not correlate with our study[29]. In contrary to our observation, various studies done in different countries reported *Klebsiella* species as second most common isolate[8,11,25,30]. Yadav et al., in their study reported the frequency of *Staphylococcus aureus, Staphylococcus* species and *Enterococcus* species were 12%, 7% and 6% respectively and these observation did not match with our findings[32]. Unlike current study, the prevalence of *Enterobacter* species was low in other studies[4,10].

Higher prevalence of gram negative organisms in our study was consistent with various studies done worldwide[8,9,11,30,34]. Higher incidence of gram negative rods, related to *Enterobacteriaceae*, in causing UTI has several factors responsible for their attachment to the uroepithelium. These gram negative organisms also by the help of adhesins, pili, fimbriae and P-1 blood group phenotype receptor colonize in the urogenital mucosa[10,31].

The current study depicted that *Escherichia coli, Klebsiella* species, *Enterobacter* species and *Proteus* species showed low sensitivity to amoxicillin/clavulanic acid (Table-III). This observation correlated with various studies done in India[10,30,39,40]. In contrary to our findings, higher rate of sensitivity was observed in a study done by Mihankhah et al.[26] Easy access and indiscriminate use of this drug might be the reason of low sensitivity of amoxicillin/clavulanic acid in our study.

In present study in case of cephalosporin group of drugs, cefradine showed 6.67%, 23.57%, 13.87% and 85.71% sensitivity, cefuroxime showed 28.48%, 45.71%, 33.58% and 71.43% sensitivity, ceftriaxone showed 34.82%, 59.29%, 48.18% and 85.71% sensitivity, ceftazidime showed 37.37%, 55.00%, 47.45% and 85.71% sensitivity to *Escherichia coli, Klebsiella* species, *Enterobacter* species and *Proteus* species respectively. Low sensitivity to the above mentioned drugs observed in various studies done in India, Pakistan and Bangladesh[10,11,27,29]. The reason behind the low rate of sensitivity to different generations of cephalosporin may be caused by ESBL producing organisms.

In case of mecillinam, no study was found except one which was done in Bangladesh where the overall percentage of sensitivity was 88% and this finding did not correlate with our study[41].

In current study, Nitrofurantoin showed 79.76%, 34.29%, 47.45% and 28.57% sensitivity to *Escherichia coli, Klebsiella, Enterobacter* and *Proteus* species respectively. Similar percentage of sensitivity was observed in a study done by Haque et al., in Bangladesh where the percentage was 83.90%, 36.36%, 50% and 33.33%[27]. Higher rate of sensitivity to nitrofurantoin was observed in a study done in Bangladesh by Akter and Kabir[21]. Sensitivity of nitrofurantoin to *Escherichia coli* was more in comparison to other organisms[27,30,32]. The consistent and high level sensitivity of *E.coli* to nitrofurantoin may be influenced by its narrow spectrum of activity, limited indication, narrow tissue distribution and limited contact with bacteria outside the urinary tract and thus nitrofurantoin has become an important oral agent in the treatment of uncomplicated urinary tract infection[28].

Sensitivity to nalidixic acid was very low in current study and like our study low rate of sensitivity to nalidixic acid was observed in a study done by Muhammad et al[11]. A study done in Bangladesh found all the strains of *Klebsiella, Enterobacter, Proteus* species and 8.47% strains of *Escherichia coli* were resistant to nalidixic acid[27]. In case of ciprofloxacin 39.71%, 51.43%, 52.55% and 57.14% strains of *Escherichia coli, Klebsiella, Enterobacter* and *Proteus* species were sensitive and these observation was similar to a study done in India[30]. In comparison to our study lower rate of sensitivity was observed in a study done in Pakistan[11]. 43.05%, 49.29%, 54.01% and 42.86% strains of *Escherichia coli, Klebsiella, Enterobacter* and *Proteus* species were sensitive to co-trimoxazole. A study done in India showed similar rate of sensitivity like our study[30]. On the contrary to our study another study done in India observed very low rate of sensitivity to co-trimoxazole[37]. All the strains of *Proteus* and 31.03%, 42.14% and 40.15% strains of *Escherichia coli, Klebsiella* and *Enterobacter* species were sensitive to aztreonam. Similar to our study low rate of sensitivity to aztreonam was observed in a study done in Pakistan[11]. Extensive clinical practice of the above mentioned drugs might be one of the causes of lower rate of sensitivity to the drugs[29].

In current study, 75.31%, 72.14%, 70.80% and 57.14% strains of *Escherichia coli, Klebsiella, Enterobacter* and *Proteus* species were sensitive to gentamicin. A study done by Kibret and Abera and another study done by Pardeshi found similar rate of sensitivity like our study[10,34]. Higher rate of sensitivity to amikacin was observed in our study and the percentage was 88.65%, 85%, 73.72% and 100% to *Escherichia coli, Klebsiella, Enterobacter* and *Proteus* species respectively. Thattil and Santosh and Kavita et al., in their studies also found higher rate of sensitivity to amikacin[20,40]. In this study, in case of netilmicin the sensitivity pattern was high and almost similar rate of sensitivity like present study was observed in a study done by Prakash and Saxena[31].

In this study, 97.89%, 88.57%, 85.40% and 100% strains of *Escherichia coli, Klebsiella, Enterobacter* and *Proteus* species were sensitive to imipenem. Various studies done in India and Iran also found higher rate of sensitivity like our study[20,25,28,37,38]. A study done in Bangladesh by Afroz et al., also observed higher rate of sensitivity[29]. Higher rate of sensitivity also observed in case of meropenem and like our study increased level of sensitivity observed in two studies[30,31]. Urinary tract infection caused by gram negative rods may be treated by nitrofurantoin, gentamicin, amikacin, netilmicin, imipenem and meropenem according to the findings of the present study.

In present study, imipenem showed 70.45% sensitivity to *Pseudomonas* species followed by aztreonam where the percentage of sensitivity was 52.27%, piperacillin/ tazobactam, ceftazidime and ciprofloxacin showed 50% sensitivity (Table-IV). In Pakistan a study done by Muhammad et al., observed sensitivity to ciprofloxacin and aztreonam 50%, imipenem 66.7% and these finding correlates with our study[11]. Sensitivity of piperacillin/ tazobactam of our study correlated with a study done in India[30]. In this study, *Pseudomonas* in UTI patients showed low rate of sensitivity in case of ceftriaxone, gentamicin, netilmicin and colistin. All the strains of both *Pseudomonas* and *Acinetobacter* were resistant to cefuroxime and in case of *Acinetobacter* all the strains were resistant to gentamicin, imipenem, meropenem and colistin. Studies done in Iran also showed low rate of sensitivity to ceftriaxone and gentamicin and their observations correlated with our study[9,26]. A study done in India observed all the strains of *Pseudomonas* and *Acinetobacter* were resistant to colistin and these finding was almost similar with our study[23].

In current study, almost all the strains of *Enterococcus, Staphylococcus aureus* and *Staphylococcus* species were resistant to amoxicillin (Table-V) and similar findings were observed in a study done in Pakistan[11]. In present study, all the strains were resistant to amoxicillin/clavulanic acid and these observation did not correlate with a study where 31.2%, 54.55% and 53.85% sensitivity observed in case of *Enterococcus, Staphylococcus aureus* and *Staphylococcus* species respectively[28]. Low rate of sensitivity was observed in case of cefradine, ciprofloxacin, erythromycin and azithromycin. Various studies also showed low rate of sensitivity to the above mentioned drugs and their findings correlated with our studies[11,28,34]. Antibiotic resistance to the above mentioned drugs might be due to frequent misuse of the drugs[9].

The most effective antimicrobial agent for gram positive cocci in present study were vancomycin, imipenem and linezolid. *Enterococcus, Staphylococcus aureus* and *Staphylococcus* species showed 94.05%, 94.87% and 66.67% sensitivity to vancomycin. All the strains of *Enterococcus* and *Staphylococcus aures* and 75.21% strains of *Staphylococcus* species were sensitive to vancomycin and these finding was almost similar with current study[28]. Another two studies done in India showed all the strains of *Enterococcus, Staphylococcus aureus* and *Staphylococcus* species were sensitive to vancomycin[32,37]. In present study, 70.83%, 97.44% and 66.67% strains of *Enterococcus, Staphylococcus aures* and *Staphylococcus* species were sensitive to imipenem. A study done in Bangladesh found all the strains of *Enterococcus, Staphylococcus aureus* and *Staphylococcus* species were sensitive to imipenem[21]. A study done in Pakistan found all the strains of *Enterococcus*, 85.7% strains of *Staphylococcus aureus* and 66.7% strains of *Staphylococcus* species were sensitive to imipenem and these finding was almost similar with our study[11]. In current study, 79.76%, 84.62% and 66.67% strains of *Enterococcus, Staphylococcus aureus* and *Staphylococcus* species were sensitive to linezolid. Raina and Najotra in their study found all the strains of *Enterococcus, Staphylococcus aureus* and *Staphylococcus* species were sensitive to linezolid[37]. A study done by Mishra et al., in their study found 78.4% strains of *Enterococcus* and 89.61% strains of *Staphylococcus aureus* were sensitive to linezolid and these finding correlated with present study[28]. Urinary tract infection caused by gram positive cocci may be treated by vancomycin, imipenem and linezolid according to the findings of the present study.

Conclusion

As drug sensitivity among bacterial pathogens is changing with time and place, regular surveillance and continuous monitoring is very essential to provide physicians updated information on most effective empirical treatment of UTIs. Empirical choice of antibiotic in treatment should be based on the knowledge of local prevalence of causative microorganisms and their antibiogram and not on universal guidelines.

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