ORIGINAL ARTICLE

Microbiological Profile and Antibiogram of Uropathogens Isolated at a Tertiary Care Hospital

Shah Dharati[1], Shah Atit[1], Patel Lata[1], Pethani Jayshri[1], Limbachia Urvashi[1], Shah Hiral[1]*

[1]Department of Microbiology, Smt. N.H.L Municipal Medical College, Ahmedabad-380006 (Gujarat) India

Abstract:

Background: Urinary Tract Infections (UTIs) are amongst the most common bacterial infections encountered. As there is an emergence of resistance in the uropathogens to multiple drugs, a local study regarding the sensitivity pattern of common uropathogens is necessary. *Aim and Objectives:* This study was aimed at analyzing the antimicrobial susceptibility pattern of prevalent uropathogens, isolated from patients at a tertiary care hospital in Ahmedabad. *Material and Methods:* The study was performed in the Department of Microbiology, Sardar Vallabhbhai Patel Hospital, N.H.L Municipal Medical College, Ahmedabad. Urine samples sent to the microbiology laboratory for culture and sensitivity over a period of one year were included in this study. Antimicrobial susceptibility testing was done on cultured isolates by VITEK 2-compact system (Biomerieux, France) following the manufacturer's instructions method as recommended in CLSI, 2020. *Results:* Out of a total of 6208 urine samples received, 1494 isolates obtained from 1484 culture-positive samples. The most commonly isolated organism was *Escherichia coli* (38.48%), followed by *Klebsiella spp* (14.85%) and *Pseudomonas aeruginosa* (10.30%). *E. coli* was most susceptible to fosfomycin (99.46%), colistin (98.43%), and tigecycline (97.39%). *Klebsiella spp* were most susceptible to colistin (84.78%). Nearly, 75% strains of *Klebsiella spp* were showing resistance to Carbapenems due to Carbapenemase production. *Conclusion:* Overenthusiastic use of the antibiotic has resulted in the emergence of drug-resistant bacterial strains in patients. The study of antimicrobial susceptibility patterns of uropathogens in a particular area can guide the clinicians in the rational choice of empirical treatment to prevent the misuse of antibiotics.

Keywords: Antibiogram, Uropathogens, Urinary Tract Infection, Carbapenemase

Introduction:

Urinary Tract Infections (UTIs) are one of the most common bacterial infections encountered in clinical practice in developing countries with a high rate of morbidity and financial cost [1]. Poor personal hygiene and urinary tract abnormalities are some of the highlighting factors causing urinary tract infections [2-4]. It may lead to long-term complications like hypertension and chronic renal disease. Approximately 150 million people suffer from UTI annually all over the world counted for almost 40-50% of nosocomial infections [5]. The causative microorganism for urinary tract infection varies from place to place over a period of time with changes in their susceptibility and resistance patterns [4, 6]. The most common pathogenic organisms of UTI are *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Proteus sp*, *Candida*, and *Enterococci* [7-9]. Uropathogenic *E. coli* is a leading cause of the vast majority of UTIs, and has a wide variety of specific virulence

factors such as adhesins and toxins in addition to the common ones [10]. Since many UTIs are treated empirically, without any antibiotic susceptibility testing leads to increased drug resistance in bacteria against commonly used antibiotics [11]. The selection criteria of antimicrobial agents should be depending upon the most likely pathogen and its expected resistance pattern in a geographic area [1, 12]. This observational study was undertaken to determine the bacteriology and antimicrobial susceptibility pattern of uropathogens in a tertiary care hospital. Urine samples from patients suspected of having UTI were collected and processed according to standard microbiological techniques [13]. The study was aimed to identify the microorganisms and analyze their antimicrobial susceptibility pattern of prevalent uropathogens isolated from a tertiary care hospital, Ahmedabad and to help clinicians choosing empirical antibiotic therapy based on antibiogram.

Material and Methods:

This study was conducted in a tertiary care hospital for one year, from 1st March 2019 to 28th February 2020.

Study population:

The present study included 6208 urine samples collected from the suspected cases of UTI.

Inclusion criteria- All patients attending the outpatient and inpatient department of Sardar Vallabhbhai Patel Hospital presented with signs and symptoms of UTI irrespective of their age groups or genders.

Collection of urine samples:

Clean catch midstream urine or catheterized urine samples were collected in a sterile wide-mouthed screw-capped container. Urine samples were sent to the bacteriology lab and processed immediately within 2 hours of collection. Samples were stored at 4°C in the case of any undue delay.

Sample processing and incubation of culture media:

Samples were inoculated with a calibrated loop of 2.2mm diameter dispensing volume of 0.005 ml on Blood agar and MacConkey agar and incubated aerobically overnight at 37ºC. After incubation, the plates were examined for bacterial growth.

Culture:

The colony count was done using a semi-quantitative method. The colonies grown on culture media were counted and multiplied by 200 to give an estimate of the number of bacteria present per ml of urine. A pure growth of microorganisms with a colony count of greater than 1,00,000 colony forming units (cfu)/mL of urine was considered significant bactereuria. Repeat sample collection was requested in cases of any mixed/contaminated growth.

Identification of uropathogens:

VITEK 2 is an automated system used for identification and Antimicrobial Susceptibility Testing (AST) of bacteria and yeast. Separate cards are available for the identification of Gram-negative bacteria, Gram-positive bacteria, fastidious bacteria, and yeasts. Cards for AST testing are available as N-235,280 and 281 for Gram negative bacteria, P-628 for Gram positive bacteria, and YST-08 for yeast. The 64 well plastic GN card contains 41 tests which include 18 tests for sugar assimilation, 18 tests for sugar fermentation, 2 decarboxylase tests, and 3 miscellaneous tests

(for urease, utilization of malonate, and tryptophan deaminase). Identification and AST cards are inoculated with microorganism suspensions of 0.5 McFarland standards from a plate of pure culture using an integrated vacuum apparatus. The results of identification were usually available within 4-6 hours and AST within 16-18 hours. The VITEK-2 system automatically processes the antimicrobial susceptibility cards until Microbial Inhibition Concentration (MIC)'s are obtained. The VITEK-2 compact system subsequently corrects, where necessary for MIC or clinical category by the internal database of possible phenotypes for microorganism antimicrobial agent combinations [14].

Results:

During the study period of one year, a total of 21,053 samples were submitted to the microbiology laboratory for culture and sensitivity. Out of this, 6208(29.49%) were urine samples. The majority of them were indoor samples compared to Outpatient Department (OPD) samples. Out of a total of 6208 samples processed, 1484 samples were positive in a culture growing 1494 different isolates. 10 samples showed mixed growth with two organisms (Tables 1 and 2).

Bacteriological profile:

Out of the 1494 isolates, *Escherichia coli* 575 (38.48%) was the predominant isolate followed by *Klebsiella pneumoniae* 222(14.85%), *Pseudomonas aeruginosa* 154(10.30%), *Candida tropicalis* 124(8.29%), and *Providencia rettgeri* 56(3.74%).*Proteus mirabilis* 29(1.94%), *Morganella morganii* 28(1.87%), *Myroides spp* 27(1.8%) and *Acinetobacter spp* 27(1.8%) were other isolates of Gram-negative bacteria. Amongst Gram-positive isolates, *Enterococcus spp* 44(2.94%) were commonest followed by *Staphylococcus aureus* 5(0.33%) and Coagulase-negative *Staphylococcus* 2(0.13%). Out of a total of 199 *Candida spp* isolated, *C. tropicalis* was highest in number 124(8.29%) followed by *C.albicans* 35(2.34%) (Tables-3 A, B, C).

Table 1: Site Wise Distribution of Urine Samples

Urine Samples	OPD	IPD	Total
Total number (%)	168(2.70%)	6040(97.29%)	6208

**OPD: Outpatient department, IPD: Inpatient department*

Table 2: Distributions of Culture Positive Urine Samples

Type of sample	Total number received		Culture positive		Total isolates
	Number	Percentage	Number	Percentage	Number
Urine	6208	29.49	1484	23.9	1494
Total samples	21053	100	6354	100	6932

Table 3A: Distributions of Gram-Negative Organisms

Species distribution of Gram-negative organisms	Total isolates	Percentage
Escherichia coli	575	38.4873
K. pneumoniae subsp. pneumoniae	222	14.8594
Pseudomonas aeruginosa	154	10.3079
Providencia rettgeri	56	3.7483
Proteus mirabilis	29	1.9411
Morganella morganii	28	1.8742
Acinetobacter baumannii complex	27	1.8072
Myroides species	27	1.8072
Enterobacter cloacae complex	16	1.0710
Citrobacter freundii	9	0.6024
Pseudomonas putida	9	0.6024
Citrobacter koseri	4	0.2677
Enterobacter aerogenes	4	0.2677
Serratia marcescens	4	0.2677
Total	1164	77.9116

Table 3B: Distributions of Gram-Positive Organisms

Species distribution of Gram-positive organisms	Total isolates	Percentage
Enterococcus faecalis	22	1.4726
Enterococcus faecium	22	1.4726
Staphylococcus aureus	5	0.3347
Total	49	3.2798

Table 3C: Distributions of *Candida Spp*

Candida spp.	Total isolates	Percentage
C. tropicalis	124	8.2999
C. albicans	35	2.3427
C. auris	5	0.3347
C. catenulata	4	0.2677
C. famata	7	0.4685
C. glabrata	4	0.2677
C. guilliermondii	1	0.0669
C. kefyr	1	0.0669
C. krusei	1	0.0669
C. lusitaniae	4	0.2677
C. parapsilosis	6	0.4016
C. rugosa	7	0.4685
Total	199	13.3199

Other Organisms	Total isolates	Percentage (%)
Total	**82**	**5.488621**

E. coli was most susceptible to fosfomycin (99.46%), colistin (98.43%), and tigecycline (97.39%). Susceptibility to amikacin was 81.64%. Imipenem and meropenem showed susceptibility of 68.14% and 67.36% respectively.

Nitrofurantoin, the drug used exclusively to treat UTI showed a sensitivity of 64.74% comparable to carbapenems. Susceptibility to cotrimoxazole, amoxiclav, norfloxacin was 38.35%, 33.28%, and 33.19% respectively. Fluoroquinolones like ofloxacin, ciprofloxacin, levofloxacin vary in susceptibility from 9-15%. Cephalosporins - ceftriaxone, cefixime, and cefuroxime showed only 16.16%, 14.89% and 11.95% sensitivity respectively. Least susceptibility was observed to nalidixic acid (6.57%) and ampicillin (6.21%) (Table 4).

Klebsiella species were most susceptible to colistin (84.78%). Sensitivity to amikacin was 31.82% and gentamicin sensitivity was 25.45%. Imipenem and meropenem showed sensitivity of 23.91% and 21.73% respectively, reflecting increasing resistance pattern towards carbapenems in *Klebsiella spp.* Other widely used antibiotics like

tigecycline and nitrofurantoin were found sensitive in only 28.99% and 5.74% isolates respectively. Fluoroquinolone (ciprofloxacin, ofloxacin, levofloxacin) sensitivity ranges between 2-10% except for norfloxacin which showed sensitivity in 23.46% isolates. Third generation cephalosporins sensitivity was found between 4-10% only due to ESBL production (Table 4).

Pseudomonas spp were most susceptible to colistin (80.66%) followed by Amikacin (38.96) and gentamicin (37.90%). Sensitivity to carbapenem was 36.66% and 32.45% for imipenem and meropenem as many strains of *P. aeruginosa* were producing Metallo β-Lactamase (MBL) or carbapenemase. Piperacillin/tazobactam was sensitive in 33.11% isolates. Norfloxacin and ofloxacin were sensitive in 22.22% isolates each whereas other fluoroquinolones ciprofloxacin and levofloxacin vary in susceptibility from 25-35%. *Pseudomonas spp* were least susceptible to ticarcillin/clavulanic acid (13.19%) (Table 4). *Providencia rettgeri* was most sensitive to aztreonam-15.56%. Most of *P. rettgeri* isolates (80-90%) were multi drug resistance. Amongst fluoroquinolone group, only ciprofloxacin showed sensitivity in 1.79% isolates (Table 4).

Table 4: Gram Negative Organisms and Antibiotic Susceptibility

Organism (Total)	**E. coli (575)**		**K. pneumo-niae (222)**		**P. aeruginosa (154)**		**P. rettgeri (56)**		**P. mirabilis (29)**		**M. morganii (28)**		**A. baumannii (27)**		**Other enterobacteriacea (37)**		**Other non fermentor (36)**	
Antibiotic drug	N/Out of*	%	N/Out of	%	N/Out of	%	N/Out of	%	N/Out of	%	N/Out of	%	N/Out of	%	N/Out of	%	N/Out of	%
Ampicillin	33/531	6	0/214	0			1/11	10	1/13	8	0/6	0						
Amoxicillin/ Clavulanic Acid	177/532	33	21/214	10					3/13	24	0/7	0			2/25	8		
Amikacin	467/572	82	70/220	32	60/154	39	3/56	5	8/29	28	18/28	64	12/19	63	15/36	42	4/35	11
Aztreonam	10/40	25	0/6	0			7/45	16	4/16	25	7/21	33	1/4	25	4/11	36	0/26	0
Ceftazidime	65/228	29	7/88	8	49/147	33	1/46	2	2/16	13	7/23	30	8/21	39	9/24	38	1/35	3
Cefalotin	15/188	8	4/82	5			0/1	0			0/2	0			1/13	8		
Cefixime	28/188	15	4/82	5			0/1	0			0/2	0			2/13	15		
Ciprofloxacin	65/572	11	17/220	8	52/154	34	1/56	2	2/29	7	9/28	32	10/26	38	10/36	28	1/35	3
Ceftriaxone	86/532	16	22/214	10			1/11	10	3/13	24	1/7	14	1/5	20	7/25	28		
Colistin	377/383	98	117/138	85	121/150	81	1/55	2	0/29	0	2/25	8	24/26	92	19/23	83	0/26	0
Cefuroxime	41/343	12	11/132	8			1/10	10	3/13	24	0/5	0			1/12	8		
Cefuroxime Axetil	41/343	12	11/132	8			1/10	10	3/13	24	0/5	0			1/12	8		
Doripenem	31/40	78	0/6	0	52/144	36							9/21	43	6/11	55		
Ertapenem	354/532	67	39/214	18			1/11	10	5/13	38	3/7	43			9/25	36		
Cefepime	178/384	46	24/138	17	56/151	38	2/55	4	6/29	21	12/26	46	10/26	38	8/23	35	1/35	3

Continued...

Organism (Total)	E. coli (575)		K. pneumo-niae (222)		P. aerugino sa (154)		P. rettgeri (56)		P. mirabilis (29)		M. morganii (28)		A. bauman nii (27)		Other enteroba cteriacea (37)		Other non fermentor (36)	
Fosfomycin	187/188	99	35/82	43			0/1	0			0/2	0			12/13	92		
Cefoxitin	72/188	38	9/82	11			0/1	0			1/2	50			1/13	8		
Nitrofurantoin	336/519	65	12/209	6			1/10	10	0/13	0	0/7	0			8/24	33		
Gentamicin	355/571	62	56/220	25	58/153	38	2/56	4	4/29	14	9/28	32	9/26	35	12/36	33	4/35	11
Imipenem	261/383	68	33/138	24	55/150	37	1/55	2	0/29	0	3/25	12	11/26	42	6/19	32	1/35	3
Levofloxacin	36/362	10	13/131	10	43/149	29	0/54	0	1/26	4	8/23	35	10/23	43	6/23	27	1/35	3
Meropenem	258/383	67	30/138	22	49/151	32	2/55	4	10/29	34	14/25	56	11/26	42	9/23	39	1/35	3
Minocycline	31/40	78	3/6	50			1/45	2	2/16	13	7/21	33	16/21	76	6/11	55	32/35	91
Nalidixic Acid	35/532	7	23/214	11			0/11	0	1/13	8	1/7	14			4/25	16		
Norfloxacin	78/235	33	23/98	23	2/9	22	0/1	0	1/1	100	1/2	50			5/14	36		
Ofloxacin	78/524	15	23/210	11	2/9	22	0/10	0	1/11	10	1/4	25			4/25	16		
Cefoperazone/ Sulbactam	214/384	56	25/138	18	49/151	32	2/55	4	7/29	24	8/26	31	11/26	42	6/23	27	1/35	3
Trimethoprim/ Sulfamethoxa-zole	219/571	38	60/220	27			1/56	2	2/29	7	11/27	41	9/26	35	15/36	42	1/35	3
Ticarcillin/ Clavulanic Acid	22/40	55	0/6	0	19/144	13	1/45	2	4/16	25	9/21	43	9/21	43	4/11	36	0/35	0
Tigecycline	374/384	97	40/138	29			1/55	2	1/29	3	4/26	15	20/26	77	10/23	43	1/35	3
Ticarcillin	14/188	7	0/82	0	0/3	0	0/1	0			1/2	50			4/13	31		
Piperacillin/ Tazobactam	270/569	47	28/220	13	51/154	33	2/56	4	21/29	72	15/28	54	8/24	33	10/32	31	1/36	3

**- Number / out of*

Proteus mirabilis was found susceptible to piperacillin/tazobactam and meropenem in 72.41% and 34.48% isolates respectively. Ceftriaxone and cefuroxime sensitivity were 23.77% each (Table 4). Amongst Gram-positive bacteria, *Enterococcus faecalis* was most susceptible to tigecycline (100%) and daptomycin (100%). Teicoplanin and vancomycin sensitivity was 90.90% and 90.48% respectively. Linezolid was sensitive in 81.82% isolates. *E. faecium* isolates were found 100% susceptible to tigecycline. Susceptibility to vancomycin and ticoplanin was 76.19% and 72.73%. Resistance to vancomycin and teicoplanin was more in *E. faecium* isolates than *E. feacalis* (Table 5).

Table 5: Gram Positive Organisms and Antibiotic Susceptibility

Antibiotic drug	*E. faecalis*		*E. faecium*		*S. aureus*	
Total count	**Number/Out of**	**%**	**Number/Out of**	**%**	**Number/Out of**	**%**
Ciprofloxacin	1/22	4.55	0/22	0.00	2/5	40
Clindamycin					3/5	60
Daptomycin	19/19	100			4/4	100
Erythromycin	0/22	0	0/22	0.00	3/5	60
Nitrofurantoin	16/22	72.73	0/21	0.00	4/5	80
Gentamicin					3/5	60
Gentamicin High Level (synergy)	4/22	18.18	6/22	27.27		
Inducible Clindamycin Resistance					5/5	100
Levofloxacin	1/22	4.55	0/22	0.00	2/5	40
Linezolid	18/22	81.82	18/22	81.82	4/5	80
Oxacillin					2/5	40
Cefoxitin Screen					3/5	60
Benzylpenicillin	9/22	40.91	0/22	0.00	0/5	0
Rifampicin					4/5	80
Trimethoprim/Sulfamethoxazole					3/5	60
Tetracycline	2/22	9.09	7/22	31.82	2/5	40
Teicoplanin	20/22	90.91	16/22	72.73	4/5	80
Tigecycline	19/19	100.00	21/21	100.00	3/3	100
Vancomycin	19/21	90.48	16/21	76.19	4/5	80

Table 6: Comparison of Susceptibility Rates of *E. coli* to Various Antibiotics Found in Various Studies across India and Abroad

Studies	Country	Nitrofurantoin (%)	Ciprofloxacin (%)	Gentamicin (%)	Amikacin (%)	Imipenem (%)	Cotrimoxazole (%)
Saxena *et al*. [1]	India	74.24	30.3	30.3	90.91	98.48	15.5
Somashekara *et al*. [18]	India	-	28	-	84	92	31.2
Singhal *et al*. [19]	India	88.66	16.22	-	65	-	-
Kulkarni *et al*. [28]	India	92.41	34.18	59.24	90.89	96.71	-
Sabir *et al*. [29]	Pakistan	-	29.2	26.4	71.7	39.5	-
Kashef *et al*. [31]	Iran	71.3	68.1	49.3	-	-	38.2
Stefaniuk *et al*. [25]	Poland	64	65.8	92.7	98.9	100	65.1
Mamuye' [32]	Ethiopia	20.8	54.8	22.6	-	-	22.6
George *et al.* [20]	India	84.15	34.1	63.6	90.9	97.7	52.3
Harshkumar *et al.* [21]	India	72.73	18.97	53.16	61.46	91.69	32.02
Current study	India	64.73	11.36	62.17	81.64	68.14	38.35

Discussion:

The spectrum of micro-organisms causing UTIs is wide. This study gives an insight into UTI, one of the most common infections leading to antibiotic prescriptions from a tertiary care hospital. The culture positivity rate (isolation rate) was 23.9%. This rate was similar to various studies from the developing world like a study done by Majumder *et al*. (isolation rate-24%) in 2011 and a study done by Thattil *et al*. (isolation rate-20.73%) in 2018 [15-16]. Previous studies have suggested *E. coli* to be the most common cause of UTIs in the Indian population, followed by other uropathogens like *Klebsiella spp*, *Pseudomonas spp*, *Proteus spp*, *Enterococcus spp*, and *S. aureus* [17].

E. coli was the most common isolated organism in our study, in trend with other studies across India [1, 18-22]. High *E. coli* isolation rate of 69.8% and 65.8% was observed in studies conducted by George *et al*. and Mangalgi *et al.* respectively in Karnataka, whereas 37.41% was seen in a study done by Manojkumar *et al*. which is closely comparable to 38.48% seen in our study [20, 23]. Fosfomycin sensitivity rate of 99.46% in our study is comparable to a study done by Maraki *et al*. in Greece, while a study done by Stefaniuk *et al*. showed a sensitivity of 77.6 % and 62.2 % for

uncomplicated and complicated UTI respectively [24-25]. Colistin being 2nd most susceptible drug in our study with 98.43% sensitivity is comparable to study done by Birhman *et al.* in Greater Noida (sensitivity rate 100%) [26]. Susceptibility rate 97.39% for tigecycline was closely related to a study done by Velez *et al.* (sensitivity rate-100%) [27]. Susceptibility to amikacin (81.64%) was closely comparable to the study done by Somashekara *et al.* (sensitivity-84%) and higher than a recent study done by Harshkumar *et al*. in our area. This finding suggests amikacin still holds good to treat complicated UTI [18, 21].High susceptibility of *E. coli* to meropenem (91.89%) and imipenem (91.69%) was noted in other studies across India [1, 18-20, 28]whereas a study done in Lahore, Pakistan by Sabir *et al*. reported a low *E. coli* susceptibility rate of 39.5% to imipenem [29]. In our study, we have noted 68.14% susceptibility to imipenem and 67.36% to meropenem. Susceptibility of *E. coli* to nitrofurantoin was found low at 64.73%, in trend with other studies across India and is comparable to a study done in Bangladesh in 2016 with 62.86% sensitivity [1, 19-20, 28, 30]. Susceptibility of *E. coli* to cotrimoxazole was 38.35% in this study, while in other studies across India it is varied from 15.15% to 52.3% [1, 20]. Susceptibility of *E. coli* to ciprofloxacin was 11.36% which is lower as compared to susceptibility rates seen in other studies across India and Pakistan [1, 18, 20, 29]. High susceptibility rates of *E. coli* to ciprofloxacin were reported in studies done in Iran (68.1%), Poland (65.8%) and Ethiopia (54.8%) showing geographical variations in antibiotic susceptibility trends [25, 31-32] (Table 6).

Klebsiella spp were the second most commonly isolated uropathogens (isolation rate 14.85%), findings are similar to various studies done across India. A study from Meerut, North India showed a slightly lower isolation rate than our study [1, 18, 20]. *Klebsiella spp* were most susceptible to colistin (84.78%) which is similar to study done by Saha *et al*. (sensitivity-89.42%)whereas in a study done by Varghese *et al*., the sensitivity of colistin was 77% only [33-34]. Susceptibility to nitrofurantoin was found to be 5.74% which is very low as compared to various studies across India which showed susceptibility range varied from 38% to 67% [1, 19]. *Klebsiella spp* showed a high rate of resistance to carbapenems due to the increasing production of carbapenemase.

From this study, it is clear that the uropathogens are becoming resistant to the most commonly prescribed antibiotics for treatment of uncomplicated UTIs. Major factors known to influence the evolution and transfer of multidrug resistance among microorganisms are incomplete doses, ease of access, over-prescription, prescription of higher generation antimicrobials, prescribing antibiotics without laboratory results, and indiscriminate use of antimicrobials in agriculture and livestock sectors. As drug resistance is mainly an acquired property which can also be lost at any time. For this reason, in many instances, the resistance profile of some drugs shows rises and downfalls with course of time towards a particular pathogen [30].

Conclusion:

E. coli is still most common bacterial pathogen causing UTI. For uncomplicated UTI caused by *E. coli*, antibiotic of choice is nitrofurantoin over cotrimoxazole and fluoroquinolones. For complicated UTI caused by *E. coli*, the preferred choice of antibiotic is amikacin over carbapenems.

For UTI caused by *Klebsiella spp*, the preferred antibiotic is colistin. For uncomplicated UTI by *Enterococcus spp* antibiotic of choice is linezolid while for complicated UTI, antibiotics like tigecycline, teicoplanin, and vancomycin are preferred. Overenthusiastic use of the antibiotic has resulted in the emergence of drug-resistant bacterial strains in patients. The study of anti-microbial susceptibility patterns of uropathogens in a particular area can guide the clinicians in the rational choice of antibiotic treatment so that misuse of antibiotics can be prevented.

References

1. Prakash D, Saxena RS. Distribution and Antimicrobial Susceptibility Pattern of Bacterial Pathogens Causing Urinary Tract Infection in Urban Community of Meerut City, India. *ISRN Microbiol* 2013;2013: 749629.
2. Johnson JR, Stamm WE. Urinary tract infections in women : diagnosis and treatment. *Ann Intern Med* 1989;111(11):906-917.
3. Memon BA. Predominant and common cause of urinary tract infection(s) in Sukkur city. *Rawal Med J* 2007;32(2): 99-101.
4. Ehinmidu JO. Antibiotics susceptibility patterns of urine bacterial isolates in Zaria, Nigeria. *Trop J Pharm Res* 2003; 2(2):223-228.
5. Rajan S, Prabavathy J. Antibiotic sensitivity and phenotypic detection of ESBL producing E.coli strains causing urinary tract infection in a community hospital, Chennai, Tamil Nadu, India. *Webmedcentral Pharm Sci* 2012; 3(11):1-17.
6. Abejew AA, Denboba AA, Mekonnen AG. Prevalence and antibiotic resistance pattern of urinary tract bacterial infections in Dessie area , North-East Ethopia. *BMC Res Notes* 2014;7(1):1-7.
7. Salek SB. Infective Syndrome in Medical Microbiology, 4th edition, 1992.
8. Kolawole AS, Kolawole OM, Kandaki-Olukemi YT, Babatunde SK, Durowade KA, Kolawole CF, *et al*. Prevalence of urinary tract infections (UTI) among patients attending Dalhatu Araf Specialist Hospital, Lafia, Nasarawa State, Nigeria. *Int J Med Sci* 2009; 1(5):163-167.
9. Khorvash F, Mostafavizadeh K, Mobasherizadeh S, Behjati M. A Comparison of antibiotic susceptibility patterns of Klebsiella associated urinary tract infection in spinal cord injured patients with nosocomial infection. *Acta Med Iran* 47(6):447-450.
10. Sedighi I, Mozaffari Nejad AS, Amanati A, Nakhaei S, Alikhani MY. Virulence factors and antibiotic resistance in uropathogenic and commensal Escherichia coli isolates. *J Krishna Inst Med Sci Univ* 2016;5(4):50–57.
11. Chiu C. Definitions, Classifications, and Antibiotics. In: Rané A., Dasgupta R. (eds) Urinary Tract Infection. Springer, London. 2013: 1-10.
12. Uwaezuke JC, Ogbulie JN. Antibiotic sensitivity pattern of urinary tract pathogens in Port–Harcourt , *Nigeria. J Appl Sci Environ Mgt* 2006;10(3):103-107.
13. Raina S, Najotra. DK. Bacteriological profile and antibiogram of uropathogens from a tertiary care hospital: a two year retrospective analysis. *Int J Curr Microbiol Appl Sci.* 2019;8(1):1206-1212.
14. Simgamsetty S, Yarlagadda P, Myneni RB, Penmetcha U. Identification and antimicrobial susceptibility patterns of non-fermentative gram negative bacilli in a tertiary care hospital: our experience. *Int J Health Sci Res* 2016; 6(8):105-111.
15. Majumder M, Ahmed T, Sakib N, Khan AR, Saha CK. A follow up study of bacteriology and antibiotic sensitivity pattern of urinary tract infection in a tertiary care hospital in Bangladesh. *J Bacteriol Parasitol* 2018;9(1):334.
16. Thattil SJ, Santhosh S. Prevalence of UTI in different age groups in a tertiary care hospital and their antibiogram. *Int J Contemp Med Res* 2018; 5(1):3-6.
17. Kamat US, Fereirra A, Amonkar D, Motghare DD, Kulkarni MS. Epidemiology of hospital acquired urinary tract infections in a medical college hospital in Goa. *Indian J Urol* 2009;25(1):76-80.
18. Somashekara SC, Deepalaxmi S, Jagannath N, Ramesh B, Laveesh MR, Govindadas D. Retrospective analysis of antibiotic resistance pattern to urinary pathogens in a Tertiary Care Hospital in South India. *J Basic Clin Pharma* 2014;5(4):105-108.

19. Singhal A, Sharma R, Jain M, Vyas L. Hospital and community isolates of uropathogens and their antibiotic sensitivity pattern from a tertiary care hospital in North West India. *Ann Med Heal Sci Res.* 2014;4(1):51-56.
20. George CE, Norman G, Ramana GV, Mukherjee D, Rao T. Treatment of uncomplicated symptomatic urinary tract infections : Resistance patterns and misuse of antibiotics. *J Fam Med Prim Care* 2015; 4(3):416-421.
21. Patel HB, Soni ST, Bhagyalaxmi A, Patel NM. Causative agents of urinary tract infections and their antimicrobial susceptibility patterns at a referral center in Western India: An audit to help clinicians prevent antibiotic misuse. *J Family Med Prim Care* 2019;8(1): 154-159.
22. Mangalgi S, Sajjan A. Asymptomatic bacteriuria in pregnancy. *J Krishna Inst Med Sci Univ* 2018; 7(3):35–42.
23. Manoj Kumar, Manish Kumar Sinha, Ashok Kumar Sharma, Amber Prasad, Ashwini Verma. Antibiogram of the prevalent uropathogens isolated at a tertiary care hospital. *Int J Med Res Prof* 2018; 4(2):314-317.
24. Maraki S, Samonis G, Rafailidis PI, Vouloumanou EK, Mavromanolakis E, Falagas ME. Susceptibility of urinary tract bacteria to fosfomycin.*Antimicrob Agents Chemother* 2009;53(10):4508–4510.
25. Stefaniuk E, Suchocka U, Bosacka K, Hryniewicz W. Etiology and antibiotic susceptibility of bacterial pathogens responsible for community-acquired urinary tract infections in Poland. *Eur J Clin Microbiol Infect Dis* 2016;35(8):1363-1369.
26. Birhman N, Mohan S, Sarwat T, Yousuf M, Kakru DK. Bacteriological profile of catheter associated urinary tract infection. *Acta Scien Microbiol* 2020; 3(5):77-80.
27. Velez RP, Richmond E, Dudley-Brown S. Antibiogram, clinical practice guideline andtreatment of urinary tract infection. *J Nurse Practit* 2017; 13(7): 617-622.
28. Kulkarni SR, Peerapur B V, Sailesh KS. Isolation and antibiotic susceptibility pattern of Escherichia coli from urinary tract infections in a tertiary care hospital of North Eastern Karnataka. *J Nat Sci Biol Med* 2017;8(2):176-180.
29. Sabir S, Anjum AA, Ijaz T, Ali MA, Muti ur Rehman Khan MN. Isolation and antibiotic susceptibility of E . coli from urinary tract infections in a tertiary care hospital. *Pak J Med Sci* 2014;30(2):389-292.
30. 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):317-328.
31. Kashef N, Djavid GE, Shahbazi S. Antimicrobial susceptibility patterns of community-acquired uropathogens in Tehran, Iran. *J Infect Dev Ctries* 2010;4(4):202-206.
32. Mamuye Y. Antibiotic Resistance Patterns of Common Gram-negative Uropathogens in St . Paul 's Hospital Millennium Medical College. *Ethiop J Heal Sci* 2016;26(3):93-100.
33. Saha AK. Pattern of antimicrobial susceptibility of klebsiella pneumoniae isolated from urinary samples in urinary tract infection in a tertiary care hospital, Kishanganj, Bihar, 5 years' experience. *Int J Contemp Med Res* 2019;6(12):L25-L28.
34. Varghese A, George S, Gopalakrishnan R, Mathew A. Antibiotic susceptibility pattern of Klebsiella pneumoniae isolated from cases of urinary tract infection in a tertiary care setup. *J Evol Med Dent Sci* 2016;5(29): 1470-1474.

Author for Correspondence:
Dr. Shah Atit, Department of Microbiology, Smt. N.H.L Municipal Medical College, Ahmedabad-380006, Gujarat Email:atit28@gmail.com Cell:9824049449, 8320182621

How to cite this article:
Shah DT, Shah AD, Patel LD, Pethani JD, Limbachia UN, Shah HJ. Microbiological Profile and Antibiogram of Uropathogens Isolated at a Tertiary Care Hospital. *J Krishna Inst Med Sci Univ* 2021; 10(1):15-26

Submitted: *03-Nov-2020* ***Accepted:*** *12-Dec-2020* ***Published:*** *01-Jan-2021*