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Prevalence of Gram-negative pathogens in Urinary Tract Infections andTheir Antibiogram: Gurugram, India

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ABSTRACT: Introduction: Urinary tract infection (UTI) is a matter of the world's current concern because it is spreading exponentially and is ranked next to the most infecting respiratory tract infection.It has left no boundary of age group, from neonates to geriatrics all are susceptible to getting UTI. This is more frequently diagnosed in women characterized by painful micturition, pyuria,cases even lead to complicated UTIs. With the proceeding time, patients are acquiring multidrug resistance (MDR) thus making treatment even more complicated. **Aim:**Therefore, this study is undertaken to find out the diversity of uropathogens causing urinary tract infection and elucidate the new variation of susceptibilities by referring to the antibiogram in Gurugram. **Method & Material:**The urine sample size is 1962 noted for 6 months, cultured over CLED agar, gram-negative bacteria were identified and antimicrobial susceptibility testing was carried out by BD Phoenix™M50.**Results**:484gram-negative uropathogens were observed. Dominantly seen microorganisms were E.coli, K.pneumoniae, P.aeruginosa,Morganella morganii, Proteus mirabilis, Citrobacter koseri, and Klebsiella oxytoca, Aeromonas caviae, Serratia marcescens, Enterobacter cloacaewere found less often. However, Stenotrophomonas maltophilia, Acinetobacter baumannii, Pantoea agglomerans, Providencia rettgeri, Aeromonas veronii, and Burkholderia cepacia complex are rarely observed. The antibiogram shows that oral drugs like Nitrofurantoin and Fosfomycin or intravenous antibiotics such as Amikacin, Gentamicin, Piperacillin/tazobactam have shown high sensitivity towards E.coli hence can be used for the treatment of UTI.**Conclusion:**The unique antibiogram of this area suggests there is a need for special attention for UTI by policymakers, physicians and other people.

KEYWORDS: UTI, Gram-negativeuropathogen, ESBL, Antibiogram.

I. INTRODUCTION

According to various reports,UTIis the very next emerging disease following respiratory tract infection in the world,[1]accounting for a quarter of all infections currently occurring. There are around and over 150 million cases of UTI being reported across the globe per annum which costs a 5.4 billion Euros economic burden.[2,3]This situation gave rise to morbidity and increased concerns of every person.

Clinically, if the infection is in the lower urinary tract (bladder), it is termed cystitis and if infected in the upper urinary tract (kidney), it is pyelonephritis which comes under an uncomplicated type of UTI. Cystitis is characterized by symptoms such as pain and frequent urination. Pyelonephritis includes fever with abdominal ache. At times pyuria is also witnessed. These symptoms may vary from individual to individual of different age groups.[4] The critical stage of infection which is a reason for mortality is complicated UTI acquired by catheters, neurological disorders, immune-suppression, urinary obstruction, renal failure. Conditions like malnutrition, living in an unhygienic environment are the factors behind the spread of UTIs in people mostly in rural areas.[5] About 50%- 60% of all women are predicted to get UTIs once in their lifetime. It is evidenced that women are more prone to UTIs than men because the urethra in females is shorter than in males hence pathogenic microorganisms need to travel less distance to infect females.[6] Sexually active, birth control using and pregnant women catch UTIs very frequently.[7]

UTI is generally caused by bacterial agents (bacteriuria), but other fungal agents like Candida sp. are also relevant pathogens. Both gram-positive and gram-negative bacteria are found in people with UTIs. Facultative anaerobic gram-positive uropathogens of order Bacillales and Lactobacillales like Staphylococcus aureus and Staphylococcus saprophyticus (Group B) Enterococcus faecalis and Enterococcus faecium (Group D).[1,8]S.aureusisolation indicatesinfection of endocarditis and bacteriuria. E.faecalis and E.faecium infection is a sign of fecal contamination in mostly urban areas.[9] While Escherichia coli, Klebsiella pneumoniae members of order

Enterobacterales, Pseudomonas aeruginosa of order Pseudomonadales are the commonest gram-negative bacteria isolated from patients with bacteriuria, cystitis, and pyelonephritis.[10] A few strains of E.coli and K.pneumoniae are the extended-spectrum Beta-lactamase producers(ESBL) are giving challenges to the complications with UTI.[11] Some microbes like Serratia sp., Morganella morganii, Proteus mirabilis, Citrobacter, and Enterobacter are seen less often. Stenotrophomonas maltophilia, Acinetobacter, and Burkholderia cepacian complex are rarely observed.[12]

UTI can be symptomatic and asymptomatic based on the colonialization of microbes. If the count is $\geq 10^3$ CFU/ml symptomatic UTI is diagnosed.[13] The symptomatic infection is due to the bacterial virulence that fights against the host defense mechanism. The reason behind the prevalence of gram-negative bacteria is due to the adherence to the uroepithelial glycolipid receptors like pili, fimbriae- type I, and type P which ultimately expresses the Galα1-4Galβ sugar which is a P blood group antigen (a receptor for toxic released by gram-negative bacteria).[14] The type I fimbriae enables colonization of uropathogens in the urogenital mucosa and activates the inflammatory response.[15]

The empirical treatment of Urinary tract infection is currently the use of antibiotics as antimicrobial agents. Improper use of antibiotics like incompletion of dose, overuse, or incorrect prescriptions (without referring to the observed result of microbial laboratories, generic drugs are prescribed) by medical practitioners is giving rise to multidrug resistance (MDR). The emergence of the ESBL group of E. coliand K.pnuemoniae is posing a serious threat to the treatment of UTI because ESBLs can hydrolyze the oxyimino and monobactams hence widely used cephalosporins and monobactams don't stand as the choice of antibiotics in this case.[16] Along with this, ESBL are biofilm producers that successfully trap the antimicrobial agents, making them dysfunctional for treatment.[17] However, cephamycin and carbapenems are not affected by ESBLs. Antibiotics generally taken for treatment of urogenital tract infection are aminoglycosides-amikacin, gentamicin, tobramycin; β-lactamase inhibitor-amoxicillin/clavulanic acid, ampicillin, piperacillin/tazobactam; cephalosporin-cefoxitin, ceftazidime, cefepime, cefazolin, cephalexin, ceftriaxone; carbapenems-ertapenem, meropenem, imipenem; fluoroquinolones- ciprofloxacin; monobactam-aztreonam; glycylcycline-tigecycline; phosphonic acid-fosfomycin and sulfonamides-trimethoprim, trimethoprim/ sulfamethoxazole.[18]

II. MATERIAL AND METHODOLOGY

Study design-This study was counseled from the midstream clean-catch urine samples of UTI suspected patients recommended by physicians visiting a tertiary care reference lab, Gurugram-India, and was processed in the Department of Microbiology. The study focused on the samples collected from September 2021 to February 2022.

Sample processing-The samples were processed within 1-2 hours of the collection or if delayed for some reason, they were kept at 4℃. The urine samples were cultured as per the standard protocol maintained by the laboratory. 0.1 ml of urine was inoculated with a calibrated inoculating loop on Cystine lactose electrolyte deficient agar also called CLED agar with Andrade indicator (Hi-media Pvt. Ltd). The processed samples were then incubated for about 24hours at 37℃ under aseptic aerobic conditions. A pure growth of isolate with a colony count >10^^{3}colony forming units (CFU)/ml was considered for further identification purposes. Further identification was carried out by Gram staining, biochemical properties, and morphological characteristics. Confirmatory identification was carried out by BD Phoenix™ M50 automated system (Becton, Dickinson and Company, USA). On the other hand, plates with no or insignificant growth were incubated for another 24 hours before discarding and stating it as negative culture.

Inclusions and Exclusions-All the gram-negative uropathogens having pure growth were included in this study. Gram-positive bacteria, fungal species, and mixed growth were not included.

Quality Control -The bacterial suspension was made and adjusted to 0.5 McFarland standard solution (Hi-media Pvt. Ltd). American Type Culture Collection (ATCC) reference strains of E.coliATCC-25922, Klebsiella pneumoniaeATCC-700603, Pseudomonas aeruginosa ATCC-27853were used as quality control strains and were purchased from Kwik-Stick by Microbiologics, U.S.

Confirmation for ESBL production-ESBL production in E.coli, Klebsiella pneumoniae, Klebsiella oxytoca, Proteus mirabiliswas performed by CLSI phenotypic confirmation method. A comparison between the zone of inhibitions of Ceftazidime (30µg) and Cefotaxime (30µg)disc, alone and in combination with Clavulanate (10 µg) was performed. Interpretation of confirmatory results was made if there is a >5mm zone diameter increase in any of these antibiotics.

This zone was produced by Clavulanate by inhibiting the β lactamase. For this screening test, E.coli ATCC-25922 wasused as a negative control, and Klebsiella pneumoniaeATCC-700603 wasused as a positive control.

Antibiotic Susceptibility testing-Antibiotic susceptibility test was carried out automatically by BD Phoenix™ M50 automated system. The procedures were followed as per manufacturer instructions. Panels of NMIC-404 and NIDwere loaded into the machine within 30 min of inoculation. The sensitivity and resistance of gram-negative bacteria (GNB) were tested against 22 different antibiotics (as referred by CLSI guidelines 2021 and 2022)by both automated by Kirby Bauer's method as shown in the table 1.

Table 1: Antibiotics used and their abbreviations

Antibiotics	**Abbreviations**
Amikacin	AK
Amoxicillin-clavulanate	AMC
Ampicillin	AMP
Aztreonam	AT
Cefazolin	CZ
Cefepime	CPM
Cefoxitin	CX
Ceftazidime	CAZ
Ceftriaxone	CTR
Cephalexin	CN
Ciprofloxacin	CIT
Ertapenem	ERT
Meropenem	MRP
Imipenem	IPM
Fosfomycin	FO
Gentamicin	GEN
Nitrofurantoin	NIT
Piperacillin-tazobactam	PT
Tigecycline	TGC
Tobramycin	TOB
Trimethoprim	TR

Trimethoprim-sulfamethoxazole	COT

The BD Phoenix™ M50 uses the chromogenic and fluorogenic methods of detection and is highly accurate with the value of minimum inhibitory concentration (MIC) by following breakpoint method.

Limitation of Study-Our study is made on only thosesamples that were recommended by the physicianand received in the laboratory for the diagnosis. Therefore, there might be a possibility that there is a little variation in the actual prevalence of UTI among the patients in Gurugram.

Statistical Analysis-The statistical analysis (Chi-square test) was calculated with the help of SPSS software. A p-Value <0.05 was considered statistically significant at a 95% level of confidence.

III. RESULT AND DISCUSSION

In this prospective study, a total of 1962 samples of patients suspected of having UTIs were observed out of which 496 uropathogenic isolates were found. In 496 isolates, males were 30.84% (153/496) and females were 69.15% (343/496). It was analyzed that there is a significant difference (p=0.000) between UTI and gender (Table 2).

Table 2: Distribution of negative and positive samples concerning gender and its significant difference

Gender	No. of Negative Sample(n=1466)	No. of Positive samples (n=496)	χ2 (Chi-Square)	p-value
Male	589	153	13.7204	0.000
Female	877	343		

In 153 male patients, 98.03% (150/153) were gram-negative uropathogens and 1.9% (3/153) gram-positive uropathogens. Likewise, out of 343 female patients, 97.37% (334/343) were gram-negative pathogens and 2.62% (9/343) gram-positive pathogens that caused UTI (Table 3).

Table 3: Gram-negative and Gram-positive uropathogens in male and female

Microbe	No. of male (%)	No. of female (%)	Total
Gram-Negative	150 (98.03)	334(97.37)	484
Gram-Positive	3(1.9)	9(2.62)	12

As per the aim of the study, gram-positive uropathogens were excluded and thus a total of 484 isolates of gram-negative bacteria were further studied. To analyze the role of the age group in the case of UTI, the patients were categorized into standard age distribution (Table 4). Incidence of gram-negative uropathogen was mostly found in middle-aged adult males and females, 44.66 % (67/150) and 58.98% (197/334) respectively followed by the geriatric age group where 44.66% (67/150) were males and 24.55% (82/334) were females. Male patients that come under the pediatric age group were 6.67% (10/150) and females were least infected of this group,5.98% (20/334). A few young adult males were affected with a value of 4% (6/150) and 10.47% (35/334) of females of this age group found to have UTI.

Table 4: Analysis of gram-negative uropathogens as per age group and their gender

Age	Age Group	Male		Female		Total	
		Number	Percent (%)	Number	Percent (%)	Number	Percent (%)
<14	Pediatric	10	6.67	20	5.98	30	6.19
15-24	Young Adult	6	4.0	35	10.47	41	8.47
25-65	Middle Aged Adult	67	44.66	197	58.98	264	54.54
>65	Geriatric	67	44.66	82	24.55	149	30.78

In the sequence of our study, a plethora of uropathogenic diversity was observed. Six microbes were observed with high frequencies namely E. coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Citrobacter koseri, Morganella morganii, and Proteus mirabilis. Viewing in detail with the parameters, E.coli75% (363/484) consists of ESBLs 28% (103/363) as well. E.coliis frequently observed in all age group distribution. Middle-aged male and female adults were widely found to have UTIs caused by E. coliwith a percentage of 10.53 and 30.99 respectively. The least affected was pediatric age with 0.8% males and 3.5% females. In this study, we used both conventional and automated method for the detection of ESBL sp. in order to check the efficacy of the machine.

The second most seen uropathogen was Klebsiella pneumoniae 13% (63/484). Adult males and females of middle-aged were to have Klebsiella pneumoniae infection 1.8% and 6.1% respectively. Females of the pediatric age group were least infected (0.4 %).

Following Klebsiella pneumoniae, Pseudomonas aeruginosa was found to cause UTI 2.2% (11/484). Here middle-aged males 0.8% and females of age group both middle-aged and geriatric classes are equally infected with 0.4% each.

1.6 % (8/484) of Citrobacter koseri caused UTI in our study. Middle-aged females 0.6% and geriatric males 0.4% were mostly seen with this infection. The males' low-infected age group was both pediatric and young adult, 0.2% each.

Overall, UTI caused by Morganella morganii was just 1.4% in which highly affected group of male and female was geriatric with 0.6% and 0.4% respectively. Young adult females and middle-aged males were found least.

The last mostly found uropathogen was Proteus mirabilis with an overall count of 6 out of 484 (1.2%) reported. Most middle-aged females had this infection (0.8%).

Moderately diagnosed uropathogens were Serratia marcescens 0.8% (4/484) mostly in geriatric males (0.4%), Aeromonas caviae0.6% (3/484) found in middle-aged adult males and males and females of geriatric age group, Enterobacter cloacae 0.6% found in young adult male 0.2% and middle-aged and geriatric age females 0.2% each, and Klebsiella oxytoca 0.6% (3/484) in pediatric males 0.2% and geriatric males 0.4%.

However, rarely found UTI-causing pathogens were Acinetobacter baumannii 0.4% (2/484) in middle-aged females, Klebsiella aerogenes 0.4% (2/484) in geriatric males, 0.4% (2/484) of Proteus vulgaris found to infect pediatric male and middle-aged females. Likewise, Providencia rettgeri was 0.4% (2/484) in middle-aged males and females 0.2% and 0.2% respectively. Aeromonas veronii, Burkholderiacapacia, Pantoeaagglomerans, Pseudomonas putida, Stenotrophomonas maltophilia were equally found with 0.2% each were also uropathogens that were found very less often (Table 5).

Table 5: Diversity of gram-negative uropathogens in males and females of different age groups

Uropathogens	**Percent (%)**	**Male% (Female %)**			
		Pediatric	Young Adult	Middle-Aged Adult	Geriatric
Acinetobacter baumannii	0.4	-	-	0(0.4)	-
Aeromonascaviae	0.6	-	-	0.2(0)	0.2(0.2)
Aeromonas veroni	0.2	-	-	0(0.2)	-
Burkholderiacapacia	0.2	-	-	-	0.2(0)
Citrobacter koseri	1.6	0.2(0)	0(0.2)	0(0.6)	0.4(0.2)
Escherichia coli	75	0.8(3.5)	0.8(5.9)	10.53(30.99)	9.2(13.01)
Enterobacter cloacae	0.6	-	0.2(0)	0(0.2)	0(0.2)
Klebsiella aerogenes	0.4	-	-	-	0.4(0)
Klebsiella pneumoniae	13.0	0.4(0.4)	0(0.8)	1.8(6.1)	1.03(2.27)
Klebsiella oxytoca	0.6	0.2(0)	-	-	0.4(0)
Morgenella morganii	1.4	-	0(0.2)	0.2(0)	0.6(0.4)
Pseudomonas aeruginosa	2.2	-	-	0.8(0.4)	0.6(0.4)
Pantaoeaagglomerans	0.2	-	-	0(0.2)	-
Proteus mirabilis	1.2	0.2(0.2)	-	0(0.8)	-

Proteus vulgaris	0.4	0.2(0)	-	0(0.2)	-
Providencia rettgeri	0.4	-	-	0.2(0.2)	-
Pseudomonas putida	0.2	-	-	-	0(0.2)
Serratia marcescens	0.8	-	0.2(0)	0(0.2)	0.4(0)
Stenotrophomonas maltophilia	0.2	-	-	-	0.2(0)

Our Antibiotic susceptibility study focused mainly on the six frequently found uropathogenic E. coli, Citrobacter koseri, Klebsiella pneumoniae, Morganella morganii, Pseudomonas aeruginosa, and Proteus mirabilis against 22 different antibiotics.ESBL producing microbes like E. coli(28.17%), Klebsiella pneumonia (32.25%), Klebsiella oxytoca(33.33%) were also obtained. The conventional and automated method followed was similar to each other.

Table 6: ESBL producing uropathogens observed in the study

ESBL producing uropathogens	Positive	Negative
E.coli	102/362 (28.33%)	260/362 (71.82%)
Klebsiella pneumoniae	20/62 (32.25%)	42/62 (67.74%)
Klebsiella oxytoca	1/3 (33.33%)	2/3 (66.66%)
Proteus mirabilis	0/6	6/6 (100%)

Each of the pathogen causing UTI showed a varied level of sensitivity and resistance pattern. E.colishowed high resistance toward Ampicillin 79.61% followed by Cefazolin 71.07%, Ceftriaxone 70.52%, Cephalexin 65.55%, and Ciprofloxacin 61.98%, and high sensitivity toward Fosfomycin 96.69%, Amikacin 92.56%, Nitrofurantoin 87.60%, Piperacillin/tazobactam 84.02%, Meropenem 82.36%, Imipenem 79.33%, Ertapenem 76.85% and Gentamicin 75.48%.

The isolate of Citrobacter koseri show-cased the greatest resistance towards Nitrofurantoin 37.5%. It shows a 100% sensitivity rate towards antibiotics like Amikacin, Amoxicillin-clavulanate, Aztreonam, Cefazolin, Cefepime, Cefoxitin, Ceftazidime, Ceftriaxone, Ciprofloxacin, Ertapenem, Gentamicin, Imipenem, Meropenem, Piperacillin/ tazobactam, Tobramycin, Trimethoprim, Trimethoprim/sulfamethoxazole.

Antibiotics like Cefazolin 52.38%, Cephalexin, and Ceftriaxone 55.56% showed resistance to Klebsiella pneumoniae. However, Amikacin, Gentamicin, Imipenem, Tobramycin, Tigecycline, Piperacillin/tazobactam, Trimethoprim/sulfamethoxazole, Meropenem, Ertapenem, Ciprofloxacin, Cefoxitin, and Amoxicillin clavulanate showed sensitivity rates of 88.88%, 85.71%, 73.01%, 73.01%, 71.42%, 66.66%, 63.49%, 63.49%, 61.90%, 61.90%, 61.90%, 55.55% respectively.

Cephalexin and Imipenem showed 85.71% resistance against Morganella morganii. Coming to sensitivity patterns, Amikacin, Piperacillin/tazobactam, Tobramycin all were 100% effective along with this antibiotic like Aztreonam, Cefepime, Ceftazidime, Ceftriaxone, Gentamicin, Meropenem, showed a common sensitivity rate of 85.71%.

Pseudomonas aeruginosa was found to have resistance rate as follows Cefazolin 90.90%, Ertapenem 72.72% and Ciprofloxacin 63.63%. Likewise, Amikacin, Gentamicin, Piperacillin/tazobactam, and Cefepime showed high sensitivity rates of 72.72%, 63.63%, 54.54%, and 54.54% respectively.

Lastly, Proteus mirabilis was found resistant toTrimethoprim/sulfamethoxazole 83.33%, also Ampicillin, Ciprofloxacin, Meropenem, and Trimethoprim showed a common rate i.e., 66.67%. Cefoxitin, Piperacillin/tazobactam had a 100% effectivity rate along with these, Amoxicillin-clavulanate and Ertapenem both had 83.33%, followed by Aztreonam, Cefepime, Ceftazidime all were 66.67%. Some antibiotics like Amikacin, Ceftriaxone, Cephalexin, and gentamicin showed 50-50% sensitivity and resistance rates.

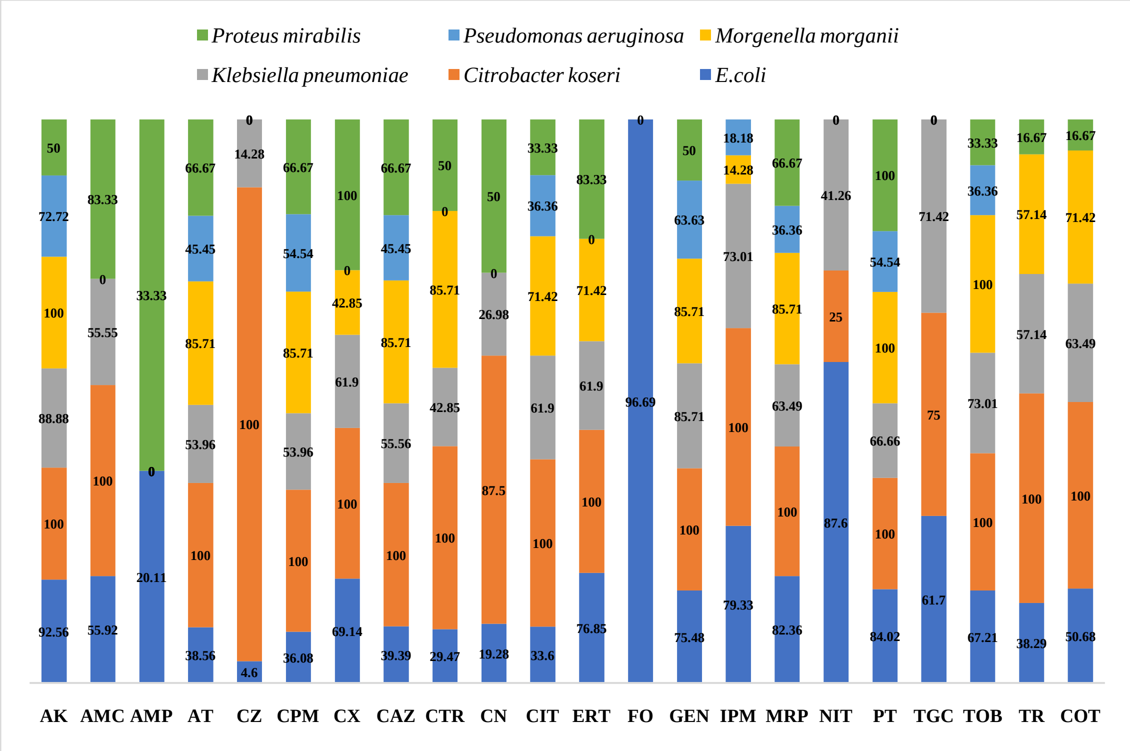

Fig.1 Antibiogram representing sensitivity pattern of each gram-negative uropathogenic microorganism.

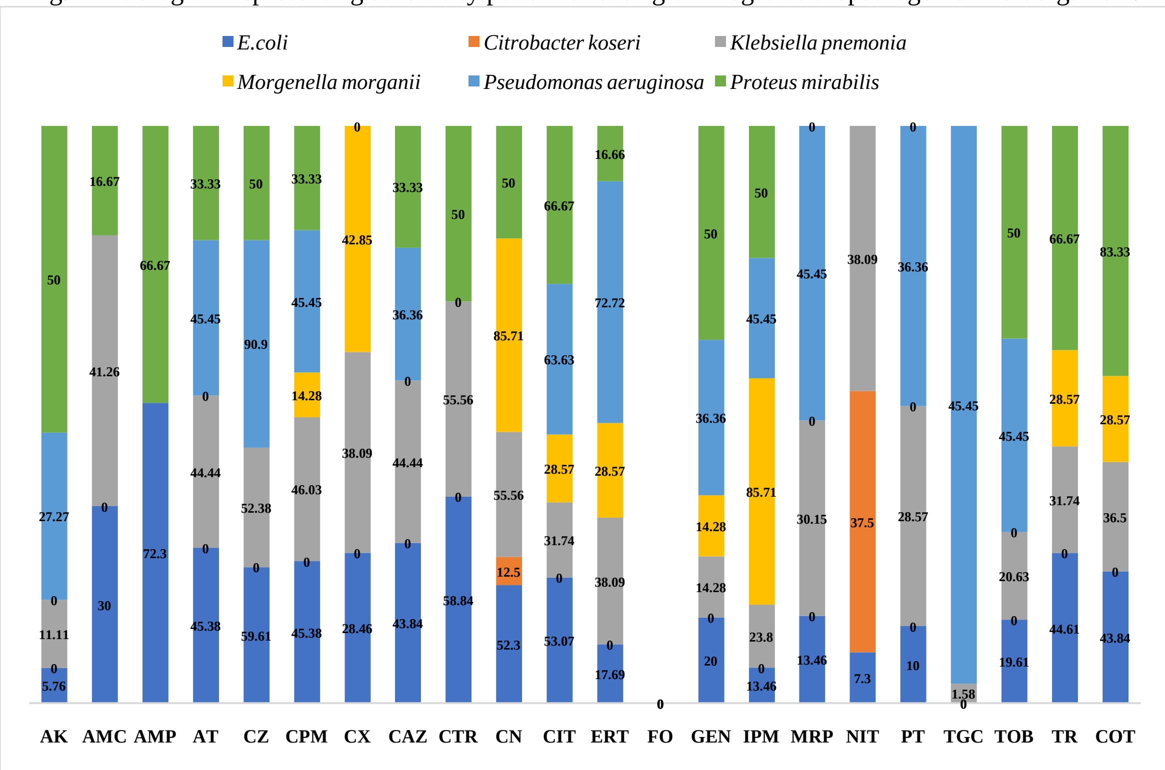

Fig.2 Antibiogram representing resistance pattern of each gram-negative uropathogenic microorganism

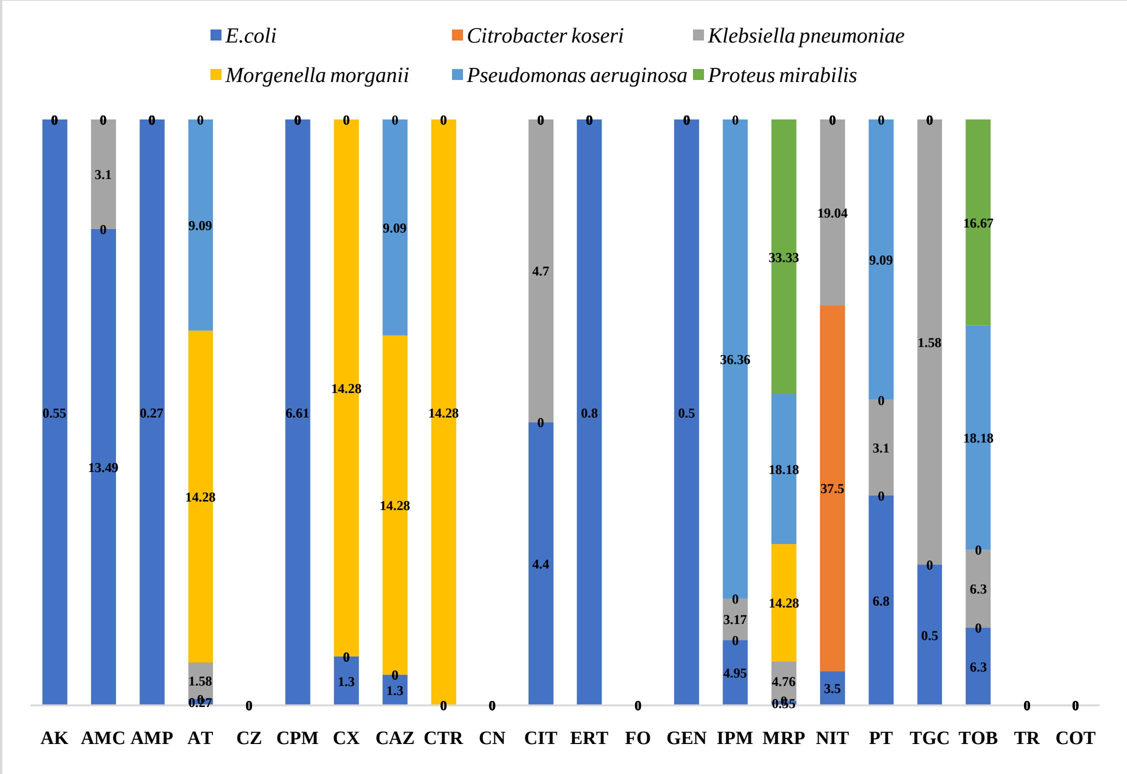

Fig.3Antibiogram representing the intermediate pattern of each gram-negative uropathogenic microorganism.

In this present investigation, out of 484 samples, females with UTI were more in number than males in Gurugram as in the study of Rajput and Sarsaiya.,[15] Also, we found that Gram-negative uropathogen were relevantly found to cause UTI which contradicted the study of Gajdács et al.,[1]that stated gram-positive bacteria were mostly causing UTI in their study. In our study, mostly middle-aged adults in age range about 25-65 years were diagnosed with UTI which showed similarity to the work of Dash et al.,[19] The reason behind the widespread UTIs may be due to improper hygiene, higher sexual activities, pregnancy in cases of females, and postmenstrual effects.[20] There were only a few cases of UTI in neonates as compared to other age groups which is contradicted by the study of Mohamed et al., Antoonet al., [21,22]

According to the present study, the Enterobacteriaceae family was mostly found including E.coli, Klebsiella pneumoniae, Citrobacter koseri followed by Pseudomonadaceae family which includes Pseudomonas aeruginosa and Morganella morganii Morganellaceae family. E.coliis the most important uropathogen contributing to UTI, many studies showed a similar outcome Verma et al., Rajput et al., [23,1]

Klebsiella pneumoniae, Morganella morganii, Citrobacter koseri Pseudomonas aeruginosa, and Proteus mirabilis were among the uropathogenic agents that greatly caused UTIs. But some studies like Mamoria et al.,[24] found that Morganella morganii and Citrobacter koseri were found minimal in numbers. The presence of rare species like Burkholderia cepacian may be due to diabetes, the use of anesthetic gels or may be nosocomial UTI by Du et al, Abdullah et al., [25,26]

Infection caused by Citrobacter koseri, Klebsiella pneumoniae, Morganella morganii can be cured easily by the use of antibiotics like Amikacin, Ceftazidime, Ciprofloxacin, Ertapenem, Gentamicin Meropenem Piperacillin/tazobactam, Tobramycin, and Trimethoprim/sulfamethoxazole. While in many cases it is seen that patients are evident to get towards multidrug resistance. This might be caused due to overuse or taking of antibiotics before getting culture results from laboratories for correct treatment. Uropathogens that are hard to treat are E. coli, Klebsiella pneumoniae, and Proteus mirabilis as they show multidrug resistance. Prevalence of ESBL strain in E.coliand Klebsiella pneumoniae has given rise to this condition. The study by Rajput and Sarsaiya.,[16] demonstrated that biofilm produced by ESBL strains makes it untreatable by most antibiotics. The antibiotics that can break the β lactam rings like β lactam inhibitor Amoxicillin-clavulanate, ampicillin, and piperacillin

/tazobactam play a key role in treatment. According to our study, Amikacin, Cephalexin, Ertapenem, Piperacillin/tazobactam are found to cure UTI to a lot extent. According to the study of Zhao et al.,[27] conducted in China, E.colishowed resistance towards Amikacin, Ampicillin, Imipenem, Gentamicin to a lot extent while our study showed sensitivity towards Amikacin, Piperacillin/tazobactam, Fosfomycin, Gentamicin and study of Mehrishiet al.,[28] conducted at Himachal Pradesh reported a similarity as in our work. Similarly, for Klebsiella pneumoniae, Imipenem showed 73.01%, Piperacillin/tazobactam 66.66% while Zubair et al., 2019[29] said that this microorganism was 100% sensitive to both the antibiotics. Gajameret al., 2020,[30] a study from North India support as well as contradicts the antibiogram of our area and the contradicting data is the resistance of Trimethoprim/sulfamethoxazole which came sensitive as per our investigation. Citrobacter koseri was one of the predominant microbes in our study and was found 100% sensitive towards Imipenem, Gentamicin, and Cefepime while data given by Amin et al.,[31] of Navi Mumbai stated that this uropathogen was 100% sensitive towards Imipenem and 100% resistant against both Gentamicin and Cefepime. They also reported that Pseudomonas aeruginosa was 97% sensitive towards Imipenem and 100% resistant towards Aztreonam but our study depicts different data that this microbe was resistant to Imipenem and 45.45% sensitive towards Aztreonam. The study of antibiotic susceptibility patterns for Proteus mirabilis shows a similarity with that of Singh et al.,[32] conducted in Delhi. They also conveyed that Morganella sp. was resistant towards Nitrofurantoin and decreased sensitivity against imipenem but our study showed resistivity for imipenem.

IV. CONCLUSION

From this study, we can conclude that antibiotic susceptibility patternsis varying vividly and leading to MDR.This condition is due to the reprehensible practice of antibiotics in the country to combat UTI, surveillance committees can be brought in action to study antibiogram of OPD cases of the particular area and policymakers can make sure drug prescriptions are at par regulation. Campaigns targeting UTI can be savoir-faire for people. Organizing conferences focusing on recent trends of antibiotic therapy can help physicians of that area for pre-treatment against UTI.

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