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STUDY OF ANTIBIOTIC PRESCRIPTION AND RESISTANCE PATTERN IN URINARY TRACT INFECTION: A RETROSPECTIVE STUDY

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ABSTRACT
Urinary tract infections are a severe public problem and are caused by a range of pathogens. The aim of the study was to evaluate prevalence of uropathogen and antibiotic prescribing and resistant pattern in urinary tract infection in a tertiary care hospital. A total of 185 patients satisfying the inclusion criteria were analyzed. Demographic data, clinical presentations, urine culture results, management were analyzed. The result shows that majority (61.08%) were females. The majority of the patients with UTI were in the age group between 71-80 years. The majority of the patients with UTI were predisposed to DM (58.37%). The majority of UTI was caused by gram negative bacteria (174 patients) whereas only (14 patients) was caused by gram positive. The most common antibiotics prescribed was Faropenam (38.91%). E.Coli showed higher resistance to Linezolid (99.01%).

KEY WORDS: Uropathogens, urinary tract infection (UTI), antibiotic prescribing, resistance, sensitivity, antibiotic susceptibility.

INTRODUCTION
A urinary tract infection (UTI) is defined as the presence of microorganisms in the urine that cannot be accounted for by contamination. Urinary tract infections are caused by a range of pathogens, most commonly Escherichia coli, klebsiella pneumonia, Proteus mirabilis, Enterococcus faecalis and Staphylococcus saprophyticus. The incidence of UTIs in adult males aged under 50 years is low, with adult women being 30 times more likely than men to develop a UTI. UTIs are classified into Uncomplicated, Complicated and Recurrent. Uncomplicated UTIs typically occur in healthy adult non pregnant women, whereas complicated UTIs are found in either sex and at any age, frequently associated with structural or functional urinary tract abnormalities. UTIs are classified as lower urinary tract infections and upper urinary tract infections. Patients with lower UTI like cystitis may present with symptoms such as dysuria, frequent urination, supra-pubic pain, hematuria, nocturia, and back pain. The common symptoms of upper tract infection like Pyelonephritis include loin pain, costovertebral angle (CVA) tenderness, fever, chills, nausea and vomiting, elevated WBC count. The presence or extent of infection cannot be easily determined by the clinical signs and symptoms. The management of a patient with a UTI includes initial evaluation, selection of an antibacterial agent and duration of therapy, and follow-up evaluation. The initial selection of an antimicrobial agent for the treatment of UTI is primarily based on the severity of the presenting signs and symptoms, the site of infection, and whether the infection is determined to be complicated or uncomplicated.

MATERIALS AND METHODS
Patients who had significant growth in their urine culture was identified from the microbiology lab of the hospital. Patients of all age groups and gender, cases with clinical symptoms of UTI and growth in the urine culture and all types of UTIs were included and patients with long term catheterization were excluded from the study. Demographic and medical details were documented in the self-designed patient profile form; it includes age, sex, number of hospital days, reason for admission, urine routine examination, past medical and medication history, predisposing factors like diabetes mellitus, structural abnormalities, menopause, renal stone, renal failure, history of UTI, and antibiotic resistance pattern and antibiotic management were collected from patient medication chart. Patient data from 2017 to January 2022 was collected.

Informed consent is not obtained in the study since it is a retrospective study and no individual patient data was revealed in the study. Approval from the hospital's IRB was obtained prior to the study. Chi square test was used to find association of uropathogens with age and gender. For all statistical interpretations, $p < 0.05$ was considered the threshold for statistical significance.

RESULT AND DISCUSSION

Classification according to patient's gender

Table 1 shows gender distribution of the study population.

GENDER	No. of Patients (N=185)	Relative Frequency
MALE	72	61.08%
FEMALE	113	38.91%

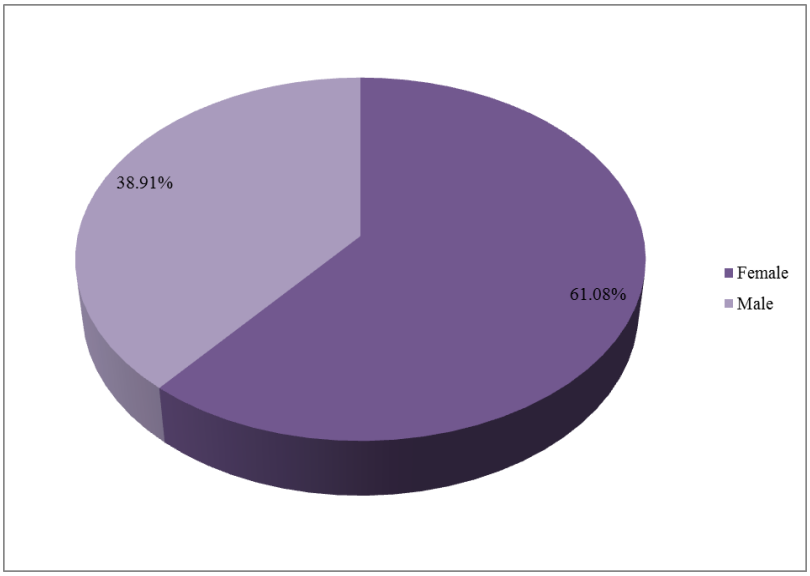

Figure 1: Pie diagram showing gender distribution of the study population.

From the above table1, it interprets that high prevalence of UTI was found in females (61.8%) and (38.91%) in males. This study correlates with the study conducted by Akram M, Shahid M et al in 2007. In their study, 66.66% were females and 33.34% were males. The reason behind this high prevalence of UTI in females is due to close proximity of the urethral meatus to the anus, shorten urethra, incontinence, and change in normal vaginal floral.

Classification according to age range

Table 2 shows age wise distribution of the study population.

Category	0-10 years	11-20 years	21-30 years	31-40 years	41-50 years	51-60 years	61-70 years	71-80 years	>80 years
Relative Frequency	7.02%	1.08%	3.24%	5.40%	5.40%	10.81%	22.16%	25.40%	19.45%

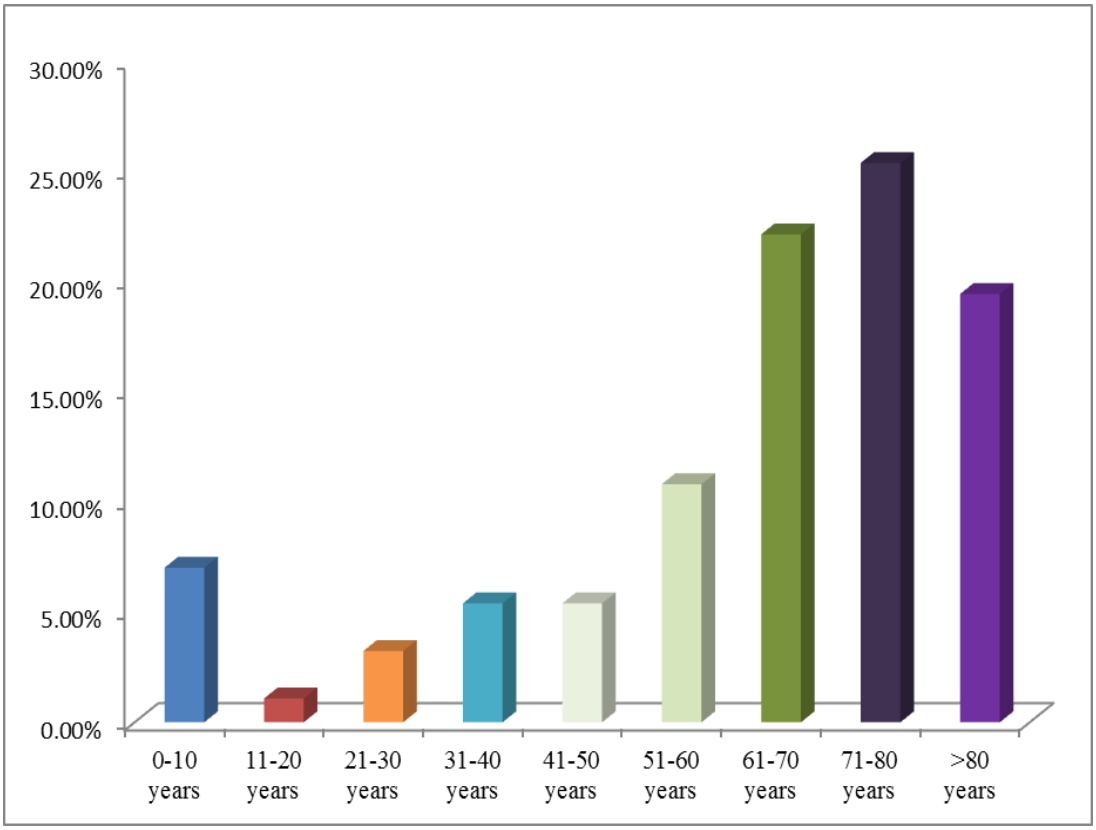

Figure 2: Bar diagram showing age wise distribution of the study population.

From the above table 2, the overall occurrence of UTI recorded was highest among elderly between 71–80 years (25.40%) followed by the age group 61- 70 (22.16%) years and >80 years (19.45%) when compared to other age groups. Similar observations was reported in study conducted by Magliano E, Graziole V et al in 2012. According to their study, the prevalence of UTI was higher among subjects aged 60 years or more (58.67%), followed by 30 – 59 years (30.15%), 15-29 years (6.08%) and ≤ 14 years (5.08%).

Classification according to the association of predisposing factors with UTI

Table 3 shows Predisposing Factors with UTI.

Parameter	**No. of Patients** (N=144)	**Relative Frequency**
DM	17	11.81
DM+RENAL FAILURE+MENOPAUSE	7	4.86
DM+MENOPAUSE	39	27.08
MENOPAUSE	17	11.81
DM+RENAL FAILURE	11	7.64
STRUCTURAL ABNORMALITY	3	2.08
DM+MENOPAUSE+STRUCTRURAL ABNORMALITY	4	2.78
RENAL STONE	3	2.08
H/O UTI	6	4.17
DM+H/O UTI	10	6.94
RENAL FAILURE	2	1.39
OTHERS	25	17.36

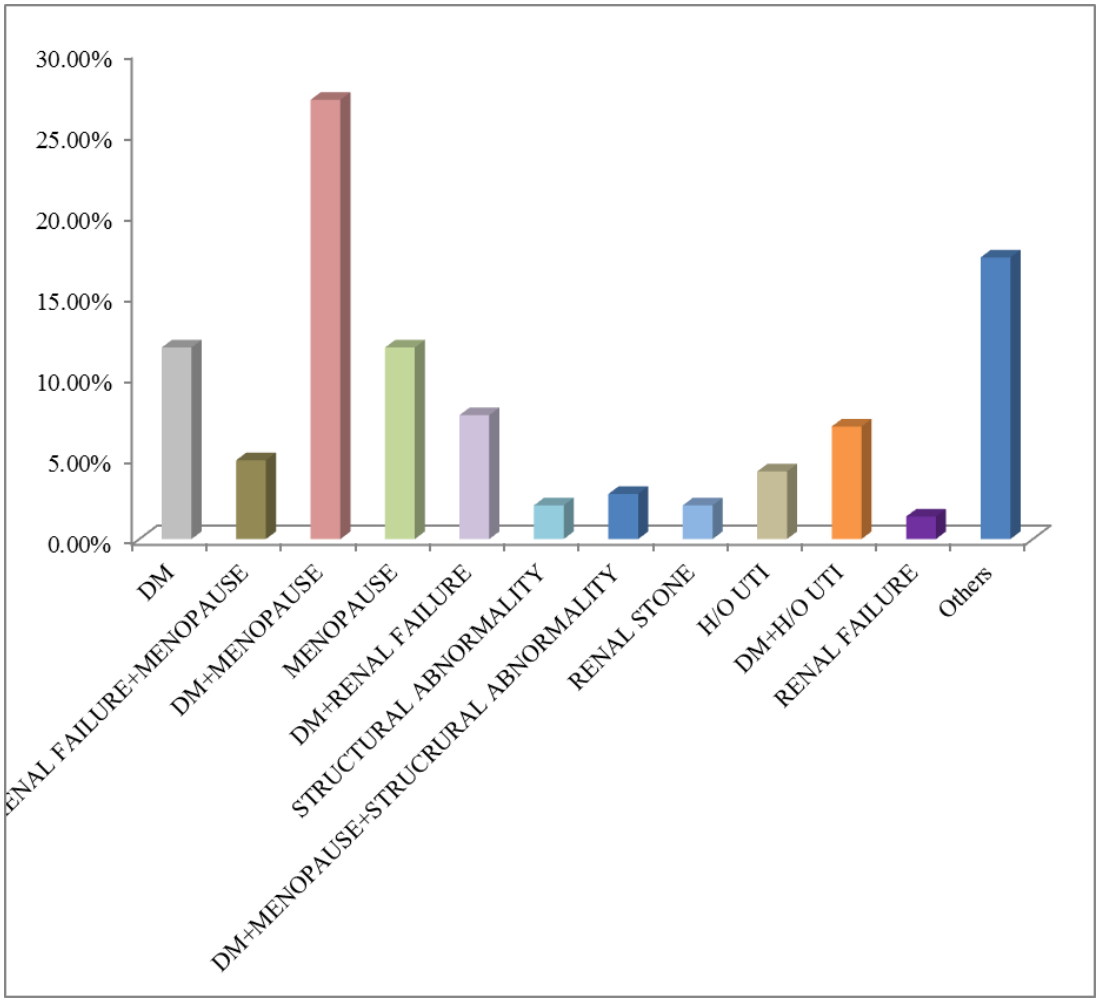

Figure 3: Bar diagram showing percentage of patients diagnosed with Predisposing Factors with UTI.

In this study, Diabetes + Menopause (27.08%) was found to be the major predisposing factor. Diabetes Mellitus appears to increase the risk of developing complications of UTI. DM leads to UTI because hyperglycemia facilitates colonization and growth of variety of organisms in urinary tract. Vulvovaginal atrophy is also a risk factor in this group due to the relationship between estrogen, glycogen production, and colonization by Lactobacilli, all of which are reduced following the menopause.

Classification according to the distribution of organism among culture-positive samples

Table 4: Table showing distribution of organism among culture-positive samples.

Organisms	E COLI	CITROBACTER	PSEUDOMONAS	KLEBSIELLA	ACINETOBACTER	STAPHYLOCOCUS	PROTEUS	STREPTOCOCCI
No. of Organisms present	102	23	26	17	8	6	3	8
Relative Frequency	55.13%	12.43%	14.05%	9.18%	4.32%	3.24%	1.62%	4.32%

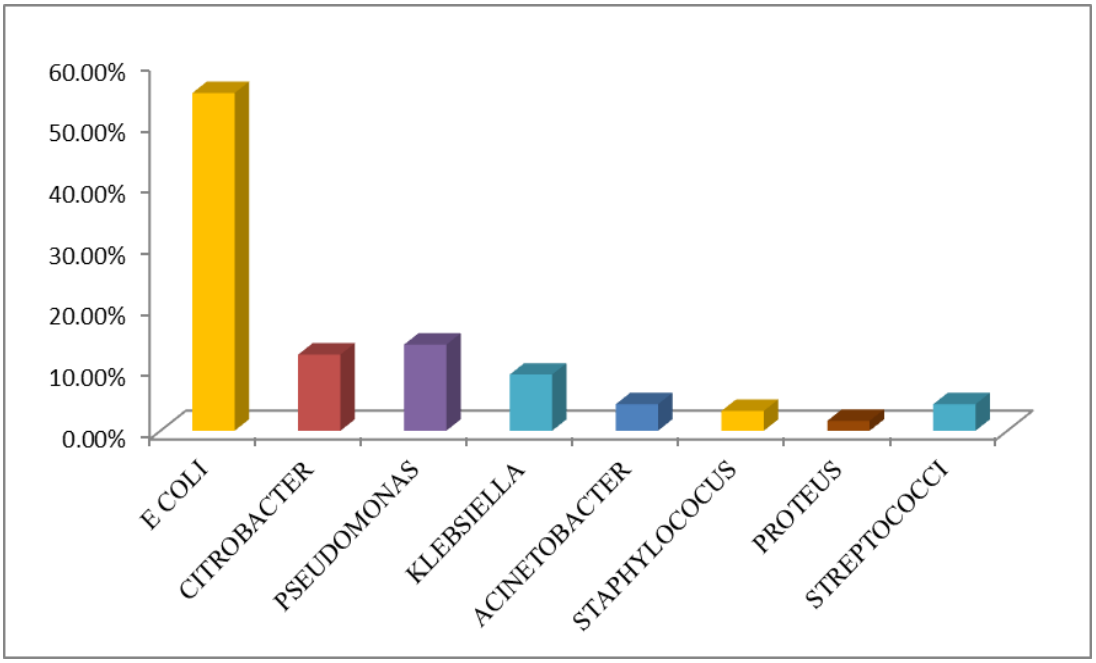

Figure 4: Bar diagram showing distribution of organism among culture-positive samples.

The above table shows Escherichia coli (55.13%) is the predominant organism causing UTI followed by Pseudomonas (14.05%), Citrobacter (12.43%), Klebsiella (9.18 %), Acinetobacter (4.32 %), Streptococci (4.32 %), Staphylococcus (3.24%) and Proteus (1.62%). In our study, E. coli was found to be the most common bacteria causing UTI. This result correlates with the study conducted by George CE, Norman G et al in 2015. In their study, E. coli 69.8%was the common isolate causing UTI followed by Klebsiella pneumoniae (7.9%), CoNS (4.8%) and Pseudomonas species (4.8%).

Classification according to antibiotic resistance percentage

Table 5 (a) shows the Antibiotic Resistance Percentage of the most prevalent Uropathogen isolated from culture positive samples.

Antibiotic	Relative Frequency
Cefuroxime	71.56%
Ampicillin/sulbactam	16.66%
Cefperazone/sulbactam	51.96%
Levofloxacin	46.07%
Cefixime	62.74%
Ceftriaxone	55.88%
Sparfloxacin	45.09%
Nalidixic acid	77.45%
Ciprofloxacin	46.07%
Furantoin	6.86%
Cefotaxim	51.96%
Meropenem	0.98%
Cefepime	23.52%
Gentamicin	20.58%

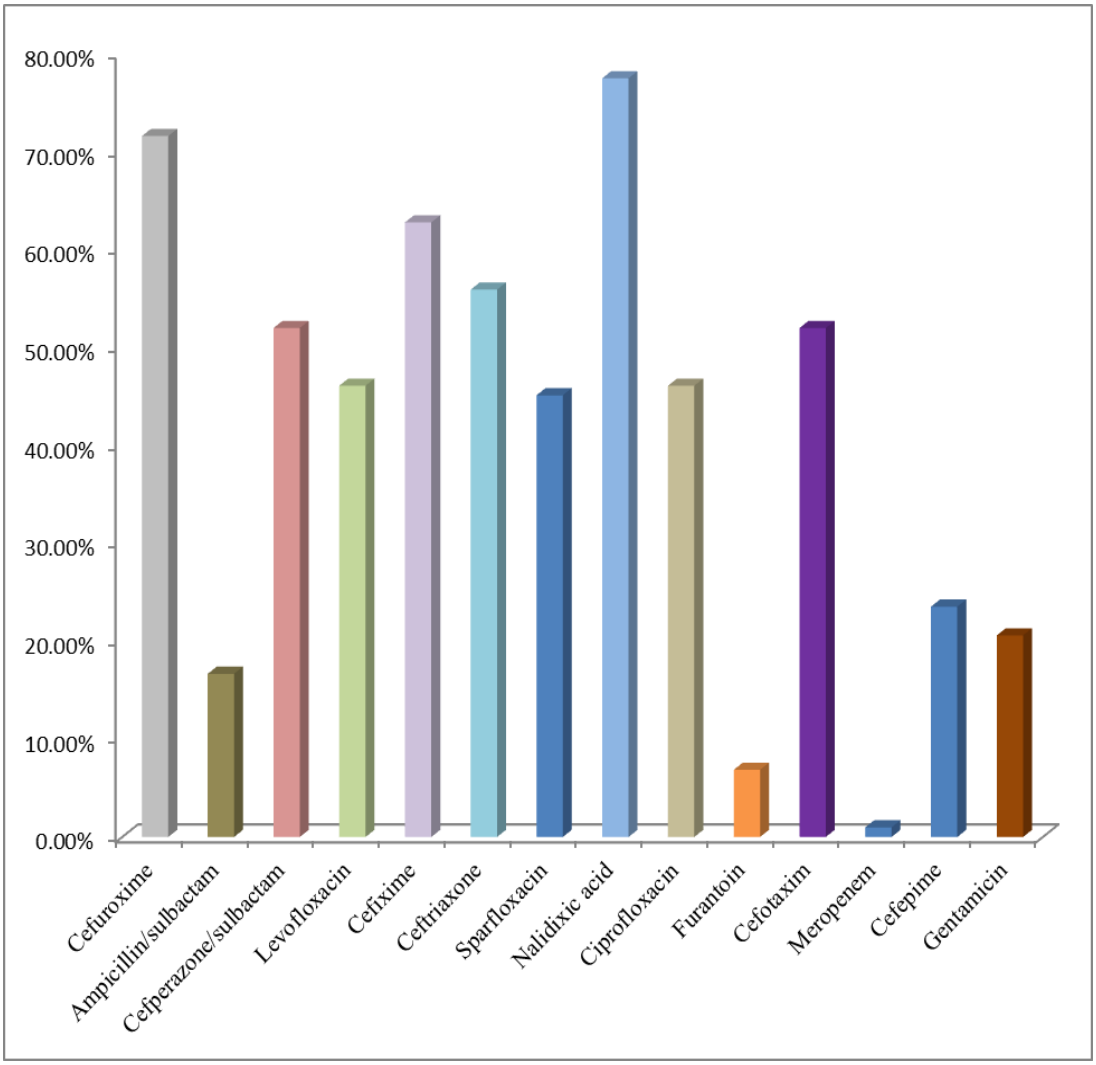

Figure 5 (a): Bar diagram showing Antibiotic Resistance Percentage of the most prevalent Uropathogen isolated from culture positive samples.

Table 5 (b) shows the Antibiotic Resistance Percentage of the most prevalent Uropathogen isolated from culture positive samples (continued…)

Antibiotic	Relative Frequency
Amikacin	16.66%
Cephalexin	62.74%
Linezolid	99.01%
Ofloxacin	47.05%
Tetracycline	39.21%
Cotrimoxazole	57.84%
Norfloxacin	45.09%
Tigecycillin	12.79%
Ceftizoxime	52.94%
Chloramphenicol	5.88%
Piperacillin	1.96%
Piperacillin/ tazobactam	61.76%

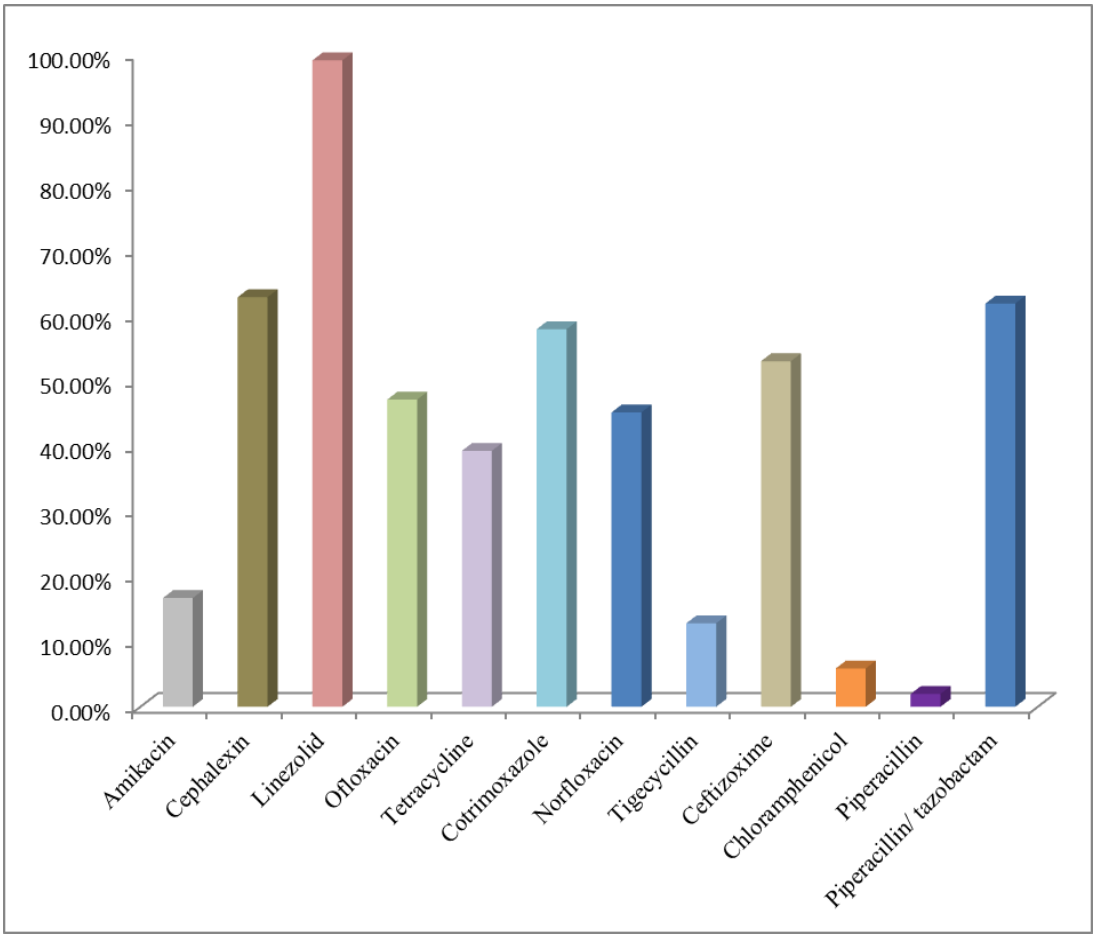

Figure 5 (b): Bar diagram showing Antibiotic Resistance Percentage of the most prevalent Uropathogen isolated from culture positive samples (continued…).

In this study, drug resistance was found in 100% of samples. Antibiotic resistance was observed commonly in Linezolid (99.01%), Nalidixic acid (77.45%), Cefuroxime (71.56%), Cefixime (62.74%), Cephalexin (62.74%), Piperacillin/Tazobactam (61.76%), Cotrimoxazole (57.84%), Ceftriaxone (55.88%), Ceftizoxime (52.94%), Cefperazone/ sulbactam (51.96%) and Cefotaxime (51.96%). This result does not correlate with the study conducted by Babu SL, Jobin SR in 2020.

Classification according to antibiotic prescribing pattern

Table 6 (a) shows the Antibiotic Prescribing Pattern.

Antibiotic	**Number of times prescribed** (N=421)	**Relative Frequency**
Faropenem	72	38.91%
Piperacillin	71	38.37%
Nitrofurantoin	42	22.70%
Imipenem	28	15.13%
Cefixime	24	12.97%
Meropenem	23	12.43%
Ciprofloxacin	22	11.89%
Cefoperazone	19	10.27%
Ceftriaxone	15	8.10%
Cefuroxime	12	6.48%
Cefotaxim	11	5.94%
Cefepime	10	5.40%
Amikacin	7	3.78%
Ofloxacin	7	3.78%

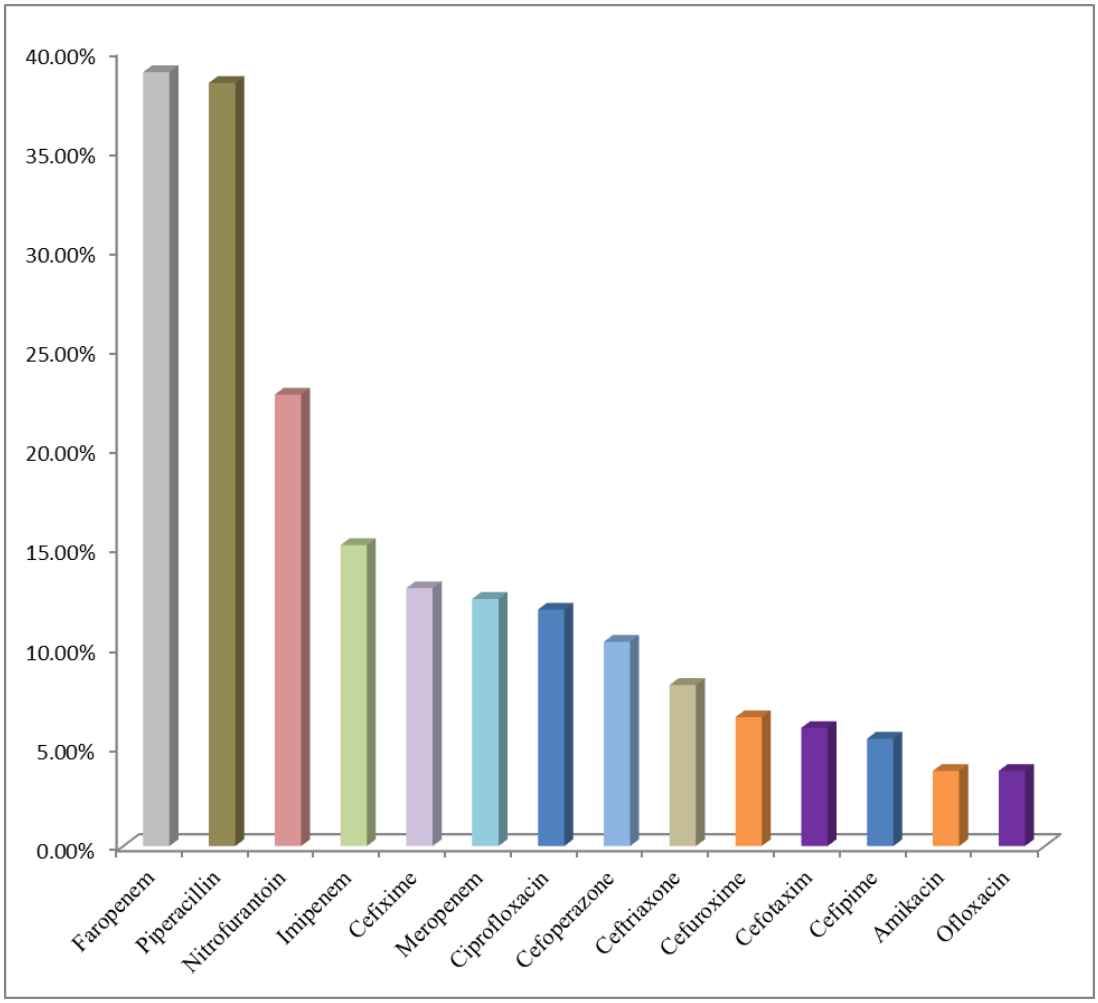

Figure 6 (a) Bar diagram showing Antibiotic Prescribing Pattern.

Table 6 (b) shows the Antibiotic Prescribing Pattern (continued…).

Antibiotic	Number of times prescribed	Relative Frequency
Sultamicillin	7	3.78%
Amoxicillin	7	3.78%
Levofloxacin	6	3.24%
Cephalexin	6	3.24%
Azithromycin	4	2.16%
Cefpodoxim	4	2.16%
Tinidazole	4	2.16%
Linezolid	4	2.16%
Metronidazole	4	2.16%
Cotrimoxazole	3	1.62%
Gentamicin	3	1.62%
Clarithromycin	2	1.08%
Norfloxacin	1	0.54%
Moxifloxacin	1	0.54%
Ampicillin	1	0.54%
Ceftazidime	1	0.54%

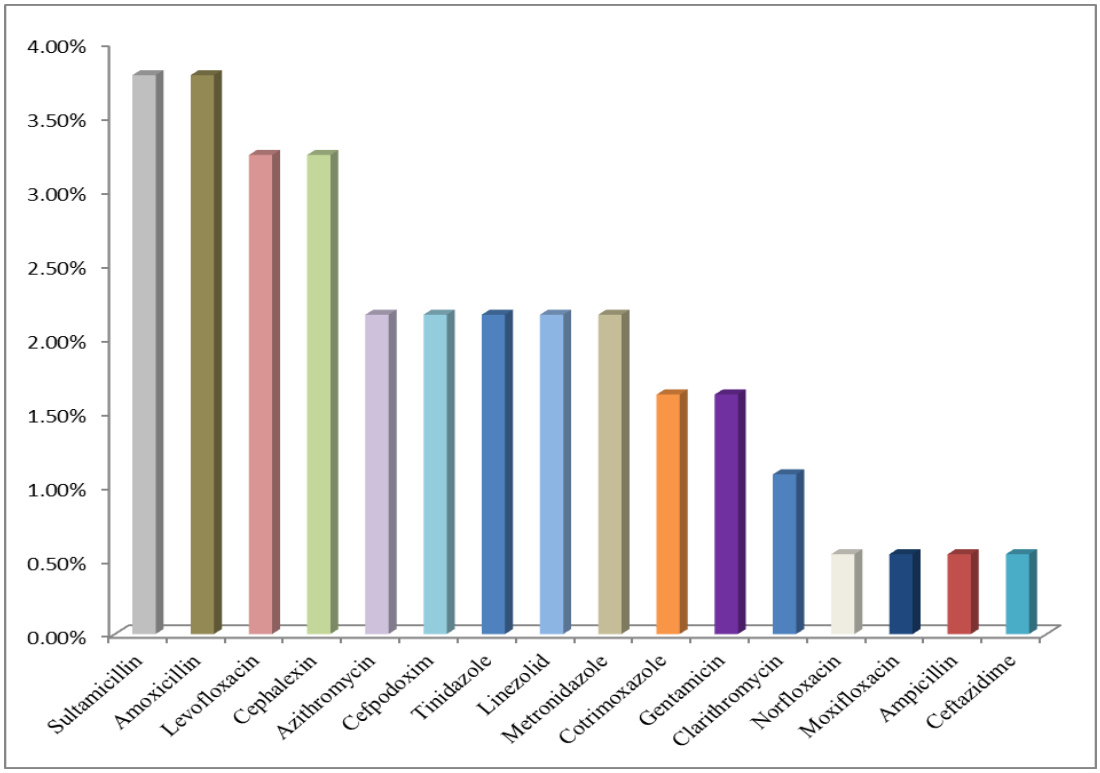

Figure 6 (b): Bar diagram showing Antibiotic Prescribing Pattern (continued…)

The above table shows Faropenem (38.91%) is the most prescribed antibiotic followed by Piperacillin(38.37%), nitrofurantoin (22.70%), imipenem (15.13%) and cefixime (12.97%) . This result does not correlate with the study conducted by Chandrashekhar D et al in 2018.

Classification according to types of therapy

Table 7 shows the Types of Therapy.

Organism	Monotherapy	Combination Therapy
E Coli	9	55
Pseudomonas	2	20
Citrobacter	2	15
TOTAL	13	90

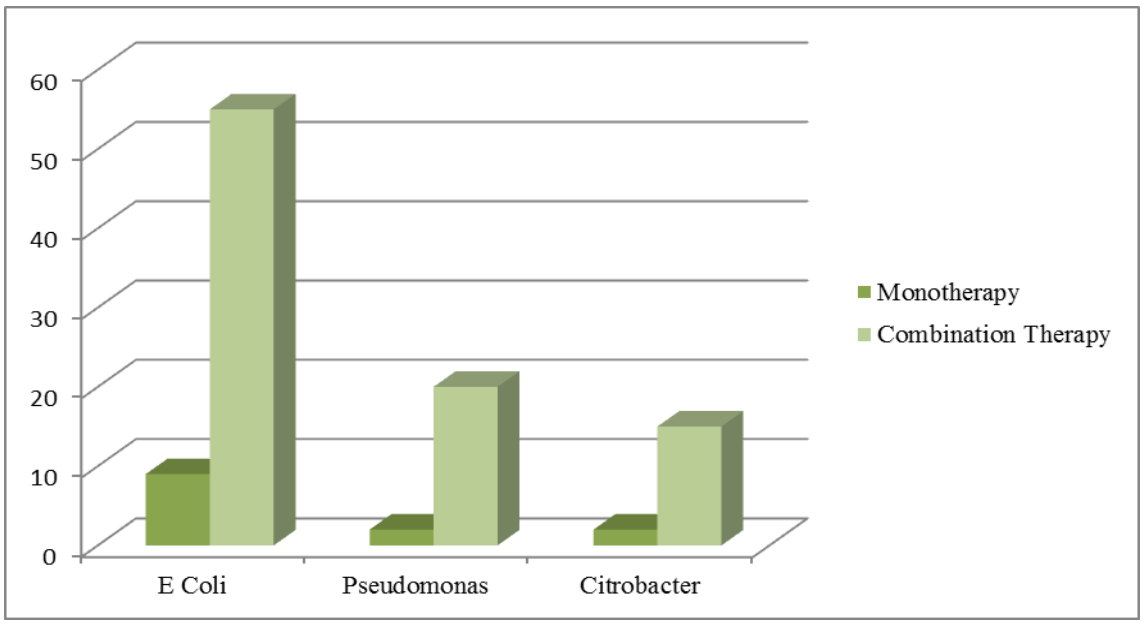

Figure 7 showing the types of Therapy.

For each Uropathogen, Combination therapy is the most prescribed type of treatment.

Classification according to antibiotic susceptibility pattern

Table 8(a) showing the Antibiotic Susceptibility Pattern.

ANTIBIOTICS	RESISTANCE (N=1117)	SENSITIVE (N=1443)
CEFUROXIME	72	16
AMPICILLIN/SULBACTAM	17	74
CEFOPERAZONE/SULBACTAM	53	17
LEVOFLOXACIN	47	39
CEFIXIME	64	23
CEFTRIAXONE	57	28
SPARFLOXACIN	46	38
CLINDAMYCIN	0	0
ROXITHROMYCIN	0	0
NALIDIXIC ACID	79	8
CIPROFLOXACIN	47	41
FURANTOIN	7	91
CEFOTAXIME	53	21
MEROPENEM	1	101
CEFEPIME	24	57
ERYTHROMYCIN	0	1
TOBRAMYCIN	6	80
COLISTIN	4	98

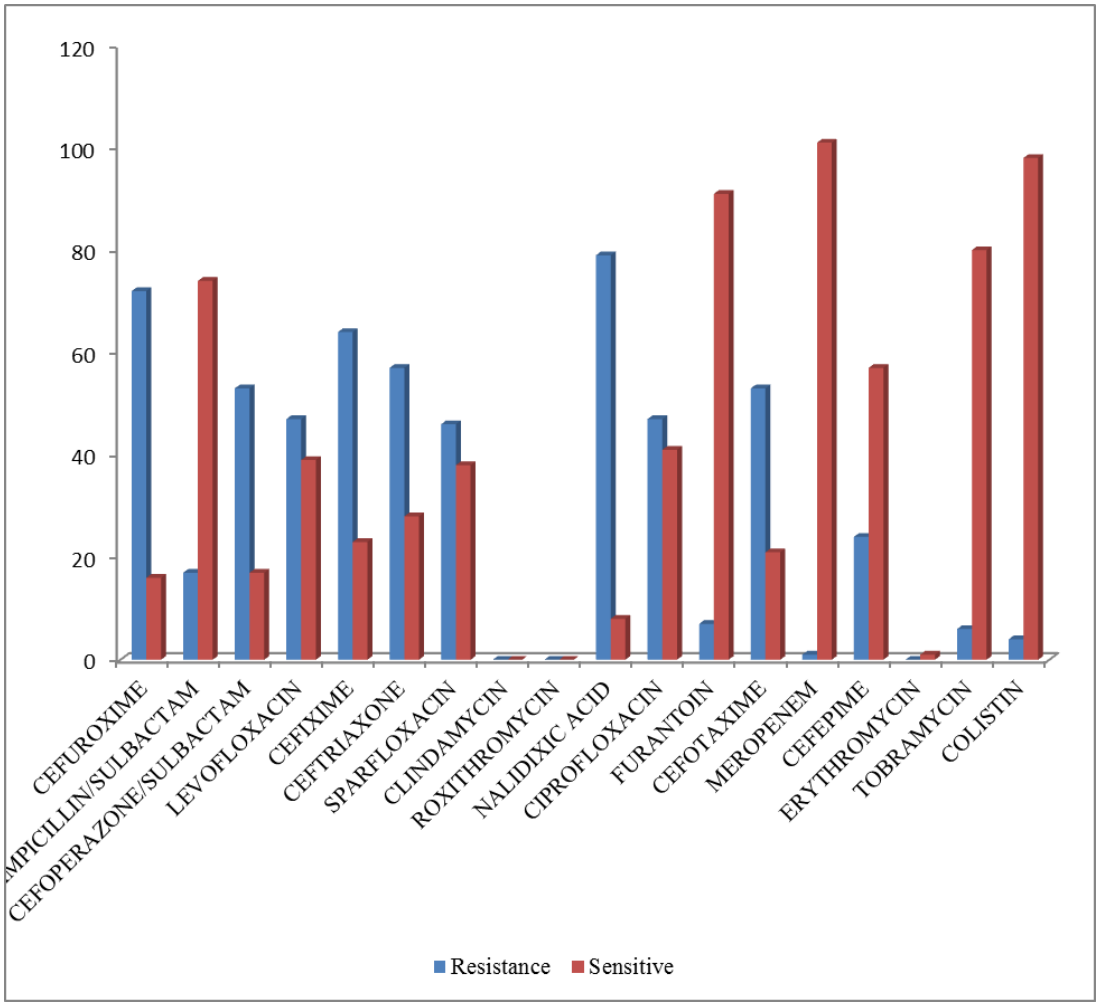

Figure 8 (a) Bar diagram showing Antibiotic Resistance Percentage of the most prevalent Uropathogen isolated from culture positive samples.

Table 8 (b) showing Antibiotic Susceptibility Pattern (continued…).

ANTIBIOTICS	RESISTANCE	SENSITIVE
GENTAMICIN	21	48
AMIKACIN	17	52
IMIPENEM	0	100
OFLOXACIN	48	36
TETRACYCLINE	40	58
COTRIMOXAZOLE	59	43
NORFLOXACIN	46	37
CLOXACILLIN	0	0
TIGECYCLINE	13	68
CEFTIZOXIME	54	42
CHLORAMPHENICOL	6	93
PIPERACILLIN	2	0
PIPERACILLIN/TAZOBACTAM	63	10
VANCOMYCIN	0	1
NETILLIN	6	92
METHICILLIN	0	0
CEPHALEXIN	64	29
LINEZOLID	101	1
LINCOMYCIN	7	0

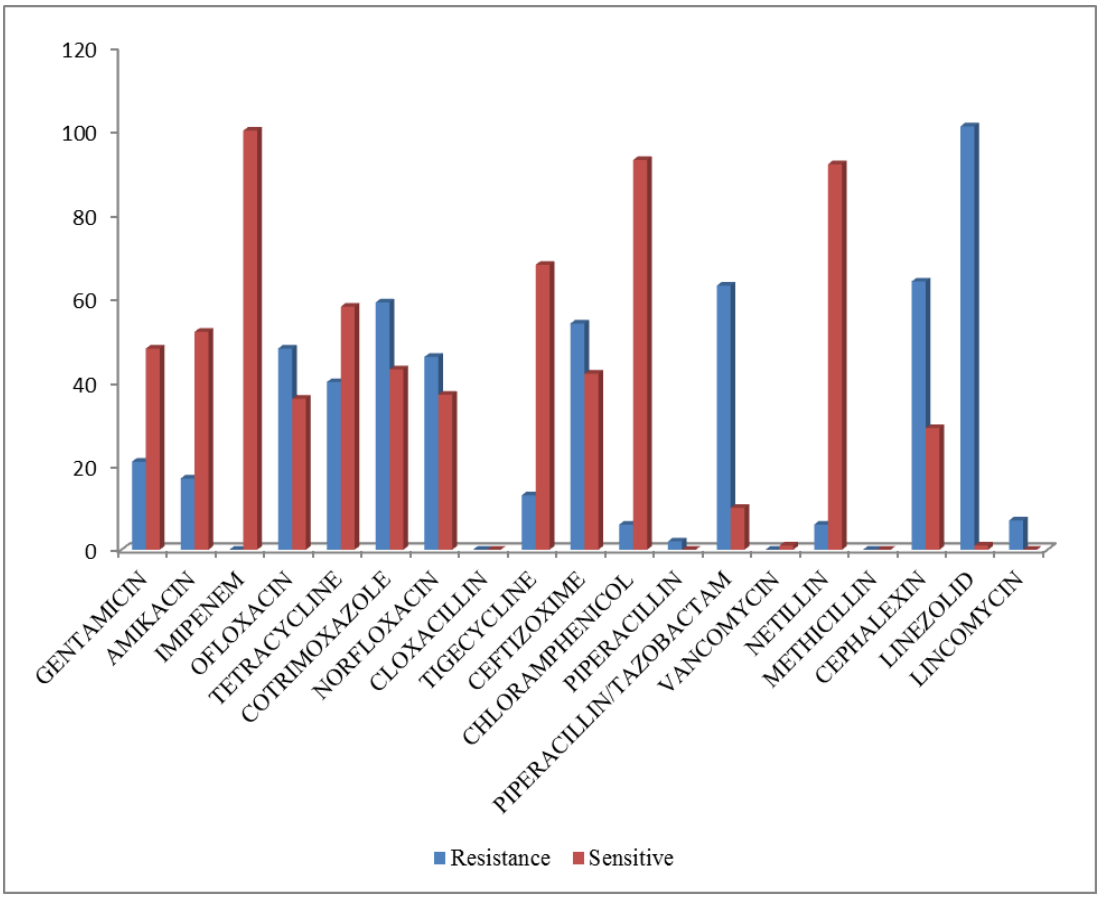

Figure 8 (b): Bar diagram showing Antibiotic Susceptibility Pattern (continued…)

The above table 8 shows that meropenem (99.01%) has the highest Antibiotic Sensitivity Percentage followed by imipenem (98.0%) and colistin (96.07%).

Classification according to the association of uropathogens and gender

Table 9 showing the association of Uropathogens and Gender.

	GRAM NEGATIVE	GRAM POSITIVE	χ^2	df	P VALUE
MALE	66	4	0.4857	1	0.4858
FEMALE	108	10			
Total	**174**	**14**			

Here p value >0.05. So the gender of the patients and types of organisms have association.

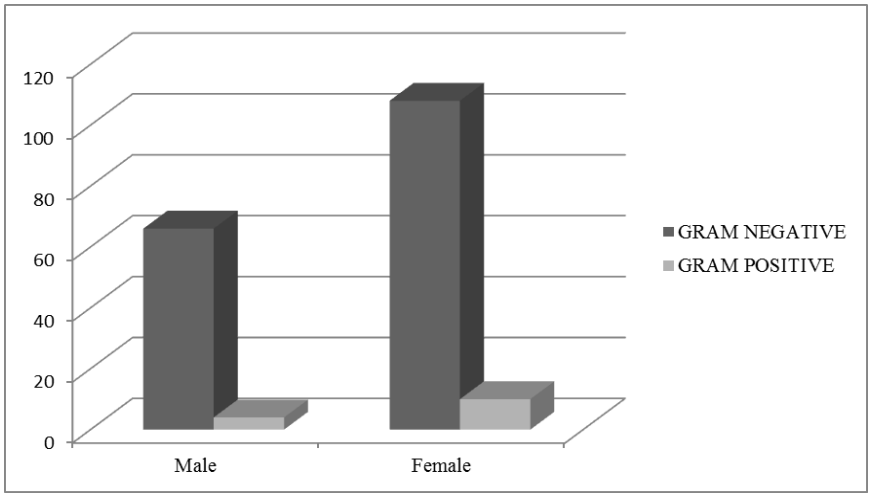

Figure 9: Multiple Bar diagram showing the association of Uropathogens and Gender.

In the study population, female patients are tending to be affected by the uropathogens more. Out of that Gram Negative uropathogens are found in larger number.

Classification according to the association of gender and age

Table 10 showing the association of Gender and Age.

	Male	Female	χ^2	df	P VALUE
0-12	6	8	4.47	3	0.21
13-18	0	1			
19-59	11	31			
>60	55	73			
Total	72	113			

Here, T value >χ^2 value.so the gender and age of the patients are associated.

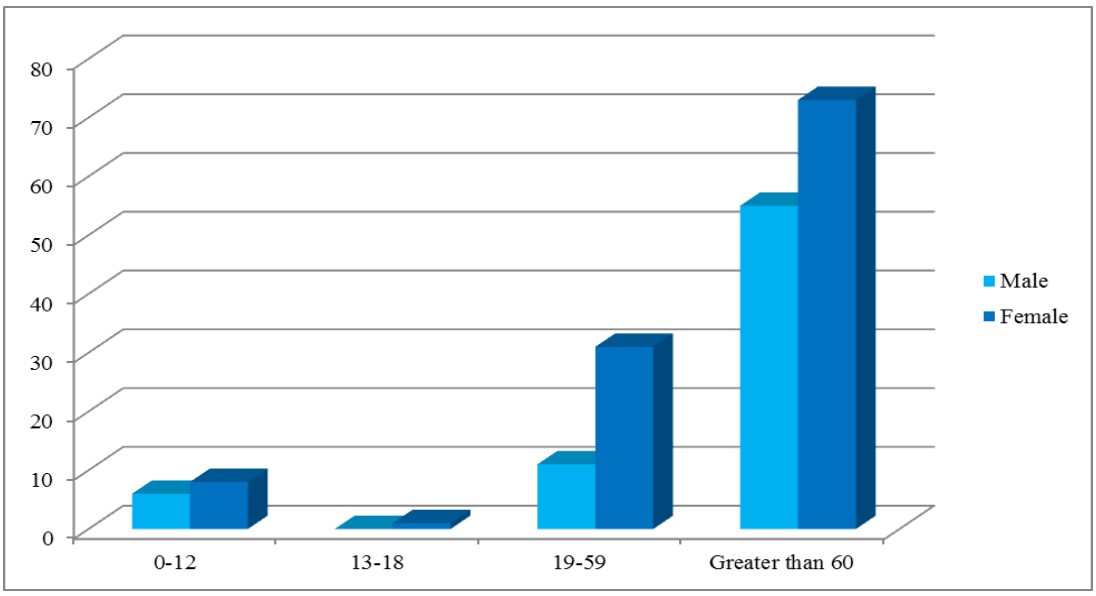

Figure 10: Multiple Bar diagram on gender and age

Most of the patients diagnosed with UTI are of an age greater than 60. Out of the women are more prone to UTI. The least number of patients are found between the ages 13 and 18.

CONCLUSION

The study portrayed that prevalence of UTI was high among female patients between the age group of 71-80years. The majority of the patients with UTI were predisposed to DM (58.37%). The most common antibiotic prescribed was Faropenam (38.91%). E coli showed higher resistance to Linezolid (99.01%). As drug resistance among bacterial pathogens is changing with time and place, regular surveillance and monitoring is very essential to provide physicians updated information on most effective empirical treatment of UTIs. Empirical antibiotic choice in treatment of UTI should be based on the knowledge of antibiotic susceptibility pattern.

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Miss Abiya Elsa Mathew
Miss Anju Benson
Miss Suryakanthi Abhiram

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