Original Article

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Study on Prevalence and Antimicrobial Sensitivity Pattern of Bacteria Causing Urinary Tract Infection in a Tertiary Care Hospital in Sylhet.

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Abstract

Background: UTI is one of the common bacterial infections occurring hospitals and the community of Bangladesh.

Aims and objectives: The aim of this study is to determine the prevalence of UTIs in male and female patients as well as the effect of gender and age on its prevalence. And evaluate sensitivity to common antibiotics.

Materials & methods: A cross-sectional observational study was conducted in the Department of Microbiology, Sylhet Women's Medical College Hospital for a period from May 2021 to October 2021. Urine samples were collected from all suspected UTI patients attending to OPD/ IPD of various departments of Sylhet women's Medical College Hospital. Isolation and antimicrobial susceptibility were performed using standard microbiological methods.

Results: During the study period, a total number of samples sent to the microbiology laboratory from out and in patients of the various departments were 3139 of which 697 (18.0%) of the sample were tested positive and 2442 (82.0%) of the samples were negative. The overall prevalence of UTI for both male and female patients was found to be 18%. In this study, a high prevalence of UTIs showed in females (75%) than in males (25%).The highest susceptible age group of patients to UTI was the age group more than 60 years for both sex (30.3%). *Escherichia coli* was found the dominant bacteria among the isolated causative pathogens with a rate of (46.1%), the second highest is *Klebsiella spp.* (31.7%) followed by *Staphylococcus saprophyticus* 6.3%, *Enterococcus faecalis* 5.75%, *Pseudomonas* species 5.5% and *Staphylococcus aureus* 4.7%. Among them, a good number of isolated pathogens were multidrug resistance.

Conclusion: This study reveals a significant prevalence of bacterial isolates in urine with multi drug resistance. Routine bacterial surveillance of causative agents and antibiotic susceptibility to prevent further emergence and spread of resistant bacterial pathogens.

Keywords: UTI, Culture, Antibiotic susceptibility pattern, Multidrug resistance.

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Introduction

Bacterial urinary tract infection is the commonest infection affecting the urinary tract.

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The biology of the urinary tract infection affects the parts of the urinary tract includes the upper and lower urinary tract.[2] Lower urinary tract infections involve the urinary bladder (cystitis), urethra (urethritis) and in case of male prostate (prostatitis) and upper urinary tract infections involve the kidney (pyelonephritis) and ureter.

Generally, UTIs are classified based on the factors that trigger the infection and the nature of the occurrence. Such as uncomplicated or complicated (based on factor that triggers the infection).Another one is, primary or recurrent (depending on the nature of infection).[2]

About 150 million people develop a urinary tract infection each year worldwide.[3]They are more common in women than men. In women, UTI is the most common form of bacterial infection.[5]Upto 10% of women have a urinary

tract infection yearly and half of the women have at least one infection at some point in their lives.[5]They occur most frequently between the ages of 16 and 35 years. Recurrences are common.[5] UTIs are one of the most important causes of morbidity in the general population and are the second most important cause of hospital visits. It also contributes to the most common nosocomial infection in many hospitals and accounts for approximately 35% of all hospital- acquired infections.[6]This burden causes a serious impact on the socioeconomic life of individuals and also leads to a large proportion of antibacterial drug consumption.[7]

UTIs are more common in females than in males as the female urethra is structurally found less effective for preventing bacterial entry. It may be due to the proximity of the genital tract and urethra and adherence of the urothelial mucosa to the mucosa of the mucopolysaccharide lining.The factors which also make females more susceptible to UTIs are sexual activity and pregnancy.[8]

The physiological changes associated with pregnancy make the healthy pregnant women prone to serious complications of the urinary tract. Factors like hormonal, mechanical and physiological changes during pregnancy add up to the vital changes in the urinary tract.[9] This in turn has an intense impact on the acquirement of the infection. Sexual activity in females also increases the risk of urethral contamination, as the bacteria could be pushed into the urethra during sexual intercourse as well as bacteria being massaged up the urethra into the bladder during childbirth.[10] Apart from these, diabetic patients are highly vulnerable to encountering the infection when compared to non-diabetic individuals. Genetic factors of an individual also make liable to encounter the infection and the condition is generally found in elderly patients subjected to long term hospitalized conditions.[11] Besides these, populations with spinal cord injuries, indwelling catheters, multiple sclerosis, immunodeficiency and underlying urological abnormalities are at risk of UTIs.[11]

UTI treatment incurs a considerable cost, both directly and indirectly on the health care system. In the United States of America , approximately 5% of all patients acquired infections after admission to the hospital with an estimated cost of $1.6 million annually.[11] The spectrum of UTI symptoms ranges from a mild self-limiting illness (burning sensation during micturition), bacteremia to severe sepsis with a mortality rate of 20%- 40%.[12]

Across the globe, the microorganisms responsible for UTIs remain constant. Among the all bacterial pathogens *Escherichia coli* has become the most prevailing organism (80- 85%) in charge of UTI. Other bacterial etiologies imply *Staphylococcus saprophyticus, Proteus*, *Pseudomonas, Klebsiella, Enterococcus spp*.[13]The emerging antimicrobial resistance has been a burden for the treatment of various infectious diseases. It has been considered as a global emerging threat to public.[13]Particularly in developing countries including Bangladesh.[14] Antibiotic overuse, irrational use and irregular consumption due to wrong prescription or poor compliance all these factors contribute to widespread drug resistance.[15]

Aims and Objectives:

The patterns of organisms causing infections and their antibiotic resistance pattern widely differ from one country to another. The aim of this study is to determine the prevalence of UTI in male and female patients as well as the effect of gender and age on its prevalence. And evaluate sensitivity pattern to common antibiotics.

Materials and methods

This study was undertaken for a period from May 2021 to October 2021 at the Department of Microbiology, Sylhet Women's Medical College Hospital. Clean catch mid stream urine samples were collected from the all suspected UTI patients attending to OPD/ IPD of various department of Sylhet women's Medical College Hospital, using sterile screw capped containers.Verbal informed consent was obtained from all patients prior to sample collection.

Sample size: Total 3139

Sampling method: Consecutive random sampling method

Statistical analysis: Cross sectional Observational study

Inclusion criteria: 1) Patients having clinical evidence of UTI 2) Age 15 to >48 years 3) Male and female patients who attend in OPD and IPD 4) Marital status 5) Obstetric history

Exclusion criteria: 1) Patients on antibiotic therapy 2) Patients with history of hospital admission a week before their presentation in OPD and IPD to rule out hospital acquired infection.3) Critically ill patients 4) Having congenital urinary tract abnormalities 5) Female on menstruation phase of menstrual cycle 6) Patients not willing to participate in the study

Identification of isolated organisms: The samples were cultured in Blood agar, Chocolate agar, MacConkeys agar media and chromo agar media. Media plates were incubated for 24 hours at 37ºC and finally for 48 hours. The colonies were identified on the basis of colony morphology and Gram staining and various biochemical tests. A growth of >10 colony forming units/ml was considered as significant bacteriuria. Cultures with more than two colonies were considered as contaminants and such samples were discarded.

Antimicrobial sensitivity test: Antibiotics susceptibility test of the isolates were performed on Muller Hinton agar media by standard Kirby Bauers disk diffusion method. After 24 hours the inhibition zones were measured and interpreted by the the recommendations of clinical and laboratory standards. The following standard antibiotic disc were used for the isolates.
The following standard antibiotic disce were used: Amoxicillin and Clavulanic acid, Amikacin, Azithromycin, Cefaclor, Cefixime, Ceftriaxone, Cefuroxime, Ceftazidime, Ciprofloxacilin, Colistin, Doxycycline, Gentamycin, Imipenem, Levofloxacin, Linezolid, Meropenem, Nalidixic acid and Nitrofurantoin.

Multiple Antibiotic Resistance Indexing (MAR): The following formula was used for the calculation of MAR index of antibiotics.

MAR index for an antibiotics: Number of antibiotics resistant to the isolates
Antibiotic resistance increase with the increasing MAR values.

Statistical analysis: Data entry, data checking, compiling and editing was done manually and data analysis was done as per the objectives of the study. Data analysis was done with Microsoft excel using SPSS version 24. The statistical analysis methods are bar diagrams, charts, pie diagrams and averages. P value of >0.05 was considered to be statistically significant.

Ethical Consideration: An ethical approval letter was obtained from the Sylhet Women's Medical College Hospital prior to the commencement of data collection. The data were retrospective and therefore there was no need for consent.

Result
During the study period, Total number of samples sent to microbiology laboratory from out and in patients of the various departments were 3139 of which 697 (18.0%) of the sample patients were tested positive and 2442(82.0%) of the samples were negative. The overall prevalence of UTI for both male and female patients was found to be 18%.

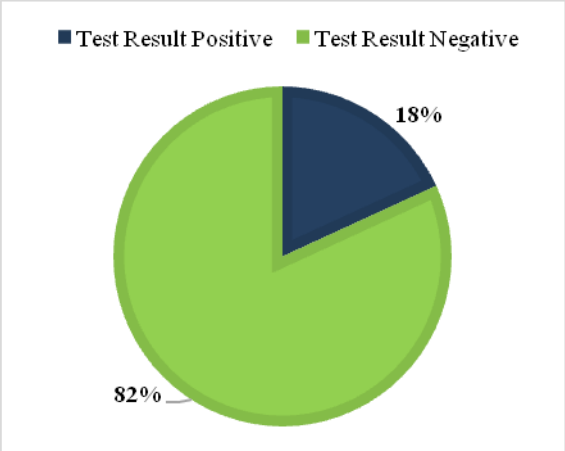

Figure.1: Urine test status of the targeted sample.

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In this study a high prevalence of UTI showed in females (75%) than in males (25%)

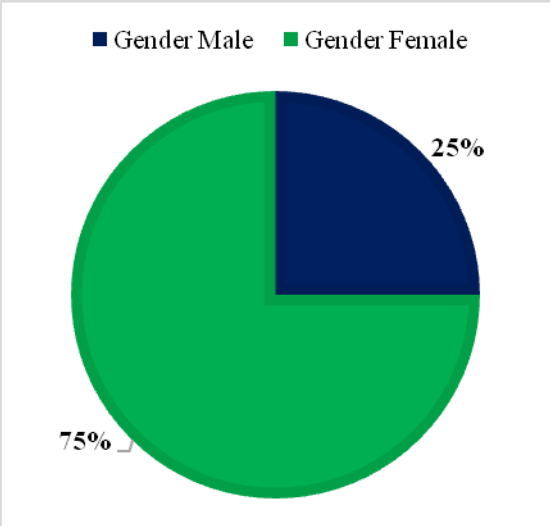

Figure.2: Gender status of the sampled patients.

The highest susceptible age group of patients to UTI was age group more than 60 years for both sex (30.3%). Then for 21 to 30 years age group, there were (19.2%) of the positive, for 51 to 60 years age group, there were (15.9%), for 31 to 40 and 11 to 20 years of age group both were (9.8%), for 41 to 50 years age group, there were (9.3%) and for below 10 years of age group, there were only (5.7%) of the patient's urine tested positive. This status claims that the child's are also in the risk zone.

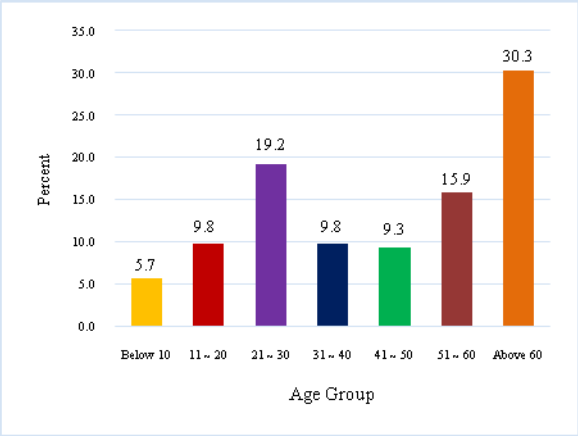

Figure. 3: Age group of the positive tested patients

E. coli was formed the dominant bacteria among all isolated uropathogens with the prevalence rate of 46.1%. The second most prevalent isolates was klebsiella staphylococcus saprophyticus 6.3%, Enterococcus faecalis 5.75%, Pseudomonas species 5.5% and staphylococcus aureus 4.7%.

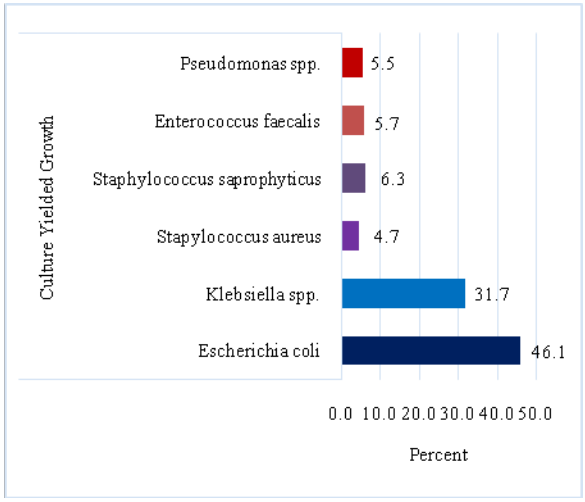

Figure.4: Culture yielded growth of the urine.

Antibiotic susceptibility pattern

For *E. coli* isolates as showed in Table-1, 95% sensitive to Meropenem, 94.7% to Colistin, 94.4% to Imipenem, 93.5% to Amikacin, 91.6% to Amoxicillin and clavulanic acid, 88.2% to piperacillin & Tazobactum, 87.9% to Gentamycin, 81.3% to Nitrofurantoin and 53.6% to ciprofloxacin. The highest percentage of resistance to certain antibiotics like 96.0% to Linezolid,83.3% to cefixime, 77.7% to Nalidixic acid, 71.55 to cefaclor and 70.15 to Ceftazidime. For *klebsiella spp.* the highest percentage of sensitivity was found to be with colistin 94.6%, followed by 91.9% for Meropenem, 91% for Imipenem, 88.75 for Amoxicillin &clavulanic acid, 87.8% for Amikacin, 82.45 for Gentamycin. The highest percentage of resistance with linezolid 96.85, Cefixime 81.8%, 74% for cefactor,70.1% to Ceftazidime.

		Culture Yielded Growth						
		E. Coli **n (%)**	***Klebsiella spp.*** **n (%)**	***S.Aureus*** **n (%)**	***S. Saprophyticus*** **n (%)**	***E. Faecalis*** **n (%)**	***Pseudomonas spp.*** **n (%)**	**P-value**
Amoxicillin & Clavulanic Acid	S	294(91.6)	196(88.7)	33(100.0)	44 (100.0)	37 (92.5)	22 (57.9)	<0.001
	R	24(7.50	21(9.5)	0(0.0)	0 (0.0)	3 (7.5)	14 (36.8)	
	I	3(0.9)	4 (1.8)	0(0.0)	0 (0.0)	0 (0.0)	2 (5.3)	
Amikacin	S	300 (93.5)	194(87.8)	33 (100.0)	40 (90.9)	16(40.0)	26(68.4)	<0.001
	R	21 (6.5)	26 (11.8)	0(0.0)	4(9.1)	23(57.5)	8(21.1)	
	I	0 (0.0)	1 (0.5)	0(0.0)	0(0.0)	1 (2.5)	4 (10.5)	
Azithromycin	S	82(25.5)	54(24.4)	4(12.1)	8(18.2)	4(10.0)	9(23.7)	<0.001
	R	202(62.9)	142(64.3)	29(87.9)	36(81.8)	36(90.0)	24(63.2)	
	I	37(11.5)	25(11.3)	0(0.0)	0(0.0)	0(0.0)	5(13.2)	
Cefaclor	S	73(27.0)	45(24.9)	18(62.1)	17(44.7)	13(37.1)	0(0.0)	<0.001
	R	193(71.5)	134(74.0)	10(34.5)	19(50.0)	18(51.4)	35(100.0)	
	I	4(1.5)	2(1.1)	1(3.4)	2(5.3)	4(11.4)	0(0.0)	
Cefixime	S	43(13.4)	35(15.8)	3(9.1)	294.5)	3(7.5)	0(0.0)	<0.05
	R	269(83.8)	180(81.4)	30(90.9)	42(95.5)	37(92.5)	38(100.0)	
	I	9(2.8)	6(2.7)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	
Ceftriaxone	S	138(43.0)	95(43.0)	12(36.4)	10(22.7)	16(40.0)	3(7.9)	<0.001
	R	179(55.8)	118(53.4)	21(63.6)	29(65.9)	23(57.5)	33(86.8)	
	I	4(1.2)	8(3.6)	0(0.0)	5(11.4)	1(2.5)	2(5.3)	
Cefuroxime	S	95(29.6)	76(34.4)	24(72.7)	21(47.7)	12(30.0)	0(0.0)	<0.001
	R	221(68.8)	142(64.3)	7(21.2)	20(45.5)	27(67.5)	37(97.4)	
	I	5(1.6)	3(1.4)	2(6.1)	3(6.8)	1(2.5)	1(2.6)	
Ceftazidime	S	81 (25.2)	59(26.7)	1(3.0)	2(4.5)	4910.0)	4(10.5)	<0.001
	R	225(70.1)	155(70.1)	31(93.9)	41(93.2)	36(90.0)	32(84.2)	
	I	15(4.7)	7(3.2)	1(3.0)	1(2.3)	0(0.0)	2(5.3)	
Ciprofloxacin	S	172 (53.6)	141(63.8)	18(54.5)	23(52.3)	24(60.0)	23(60.5)	<0.001
	R	140 (43.6)	79(35.7)	14(42.4)	15(34.1)	16(40.0)	13(34.2)	
	I	9(2.8)	1(0.5)	1(3.0)	6(13.6)	0(0.0)	2(5.3)	
Colistin	S	304(94.7)	209(94.6)	17(51.5)	25(56.8)	10(25.0)	32(84.2)	<0.001
	R	17(5.3)	12(5.4)	16(48.5)	19(43.2)	30(75.0)	5(13.2)	
	I	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(2.6)	
Doxycycline	S	195(60.7)	133(60.2)	28(84.8)	38(86.4)	17(42.5)	14(36.8)	<0.001
	R	118(36.8)	77(34.8)	2(6.1)	4(9.1)	21(52.5)	23(60.5)	
	I	8(2.5)	11(5.0)	3(9.1)	2(4.5)	2(5.0)	1(2.6)	
Gentamicin	S	282(87.9)	182(82.4)	25(75.8)	31(70.5)	18(45.0)	25(65.8)	<0.001
	R	34(10.6)	34(15.4)	7(21.2)	8(18.2)	20(50.0)	10(26.3)	
	I	5(1.6)	5(2.3)	1(3.0)	5(11.4)	2(5.0)	3(7.9)	
Imipenem	S	303(94.4)	201(91.0)	28(84.8)	40(90.9)	38(95.0)	26(68.4)	<0.001
	R	14(4.4)	15(6.8)	5(15.2)	3(6.8)	1(2.5)	10(26.3)	
	I	4(1.2)	5(2.3)	0(0.0)	1(2.3)	1(2.5)	2(5.3)	
Levofloxacin	S	175 (54.5)	150(67.9)	18(54.5)	29(65.9)	25(62.5)	25(65.8)	<0.001
	R	135(42.1)	65(29.4)	11(33.3)	9(20.5)	15(37.5)	11(28.9)	
	I	11(3.4)	6(2.7)	4(12.1)	6(13.6)	0(0.0)	2(5.3)	
Linezolid	S	12(3.7)	7(3.2)	30(90.9)	35(79.5)	34(85.0)	0(0.0)	<0.001
	R	308(96.0)	214(96.8)	3(9.1)	9(20.5)	5(12.5)	38(100.0)	
	I	1(0.3)	0(0.0)	0(0.0)	0(0.0)	1(2.5)	0(0.0)	
Meropenem	S	305(95.0)	203(91.9)	28(84.8)	40 (90.9)	35(87.5)	28(73.7)	<0.001
	R	14(4.4)	16(7.2)	5(15.2)	3(6.8)	3(7.5)	9(23.7)	
	I	2(0.6)	2(0.9)	0(0.0)	1(2.3)	2(5.0)	1 (2.6)	
Nalidixic Acid	S	69(21.5)	90(40.7)	1(3.0)	4(9.1)	8(20.0)	5(13.2)	<0.001
	R	248(77.3)	125(56.6)	31(93.9)	39(88.6)	31(77.5)	31(81.6)	
	I	4(1.2)	6(2.7)	1(3.0)	1 (2.3)	1(2.5)	2(5.3)	
Nitrofurantoin	S	260(81.3)	107(48.4)	30(90.9)	37(84.1)	35 (87.5)	3(7.9)	<0.001
	R	49(15.3)	97(43.9)	1(3.0)	7(15.9)	4(10.0)	35(92.1)	
	I	11(3.4)	17(7.7)	2(6.1)	0(0.0)	1(2.5)	0(0.0)	

Table.1: Prevalence of the Antibiotics for the growth culture.

*S = Sensitive; *R = Resistant; *I = Intermediate P-value consider based on the Chi-square test

Multidrug resistance pattern of bacterial isolates

Multidrug resistance strains were common for both Gram negative and Gram positive isolates. Out of 697 isolates 429 were (61.54%) found to be resistant to more than 7 drugs. Among the isolates 7 (1.00%) were found to be resistant to more than 1 drugs and 155 (22.23%) were found not to be resistant to any antibiotics used for the susceptibility test.

Isolates	Frequency	R_1 (%)	R_2 (%)	R_3 (%)	R_4 (%)	R_5 (%)	R_6 (%)	$R_{7\&\ more}$ (%)
Escherichia coli	321	2(0.6)	21(6.5)	29(9.0)	20(6.2)	24(7.5)	24(7.5)	201(62.6)
Klebsiella spp.	221	5(2.3)	15(6.8)	18(8.1)	14(6.3)	19(8.6)	24(10.9)	126(57.0)
Staphylococcus saprophyticus	44	0(0.0)	1(2.3)	2(4.5)	0(0.0)	12(27.3)	8(18.2)	21(47.7)
Enterococcus faecalis	40	0(0.0)	1(2.5)	1(2.5)	2(5.0)	2(5.0)	4(10.0)	30(75.0)
Pseudomonas spp.	38	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(2.6)	0(0.0)	37(97.4)
Staphylococcus aureus	33	0(0.0)	0(0.0)	2(6.1)	6(18.2)	6(18.2)	5(15.2)	14(42.4)

Table 2: Multi Drugs Resistance pattern of bacterial isolates from urine culture.*R_n- Resistant for n Antibiotics.

Discussion

This study provides valuable data to compare and monitor the status of antimicrobial resistance among uropathogens to improve efficient empirical treatment. Increasing antimicrobial resistance has been documented globally.

The Prevalence of UTI was found to be 18% in this study. Prevalence (41.20%) conducted by Sadia Saber et al. in a tertiary care teaching hospital, Dhaka,[16]42% conducted by Sonia et.al in a Diagnostic centre in Dhaka,[17]32.5% conducted by Soroj Kumar Sah in Nepal,[18] 53.82% in India by Devanand Prakash[19]. The difference in the positivity may be due to study design or epidemiological difference in the etiological difference in etiological agents.

Our study showed a high prevalence of UTI in females (75%) than in Males (25%) which correlates with other findings which revealed that the frequency of UTI is greater in females as compared to males. Because the urethra is shorter in women when compared to men, they are more prone to infections associated with the urinary tract. The shorter length of the urethra in women enhances the scope for the pathogen to invade the bladder infection. A study revealed that males are more prone to UTI than female[17].

Our Findings shows that higher percentage of suspected UTI Patients were belonging to the aged group>60 years, for both sex (30.3%). Then for 21 to 30 years age group the rate was (19.2%), For 51 to 60 years age group the rate was (15.9%), for 31 to 40 and 11 to 20 years age group both were (9.8%), for 41 to 50 years age group there were (9.3%) and for below 10 years of age group, there were only (5.7%) of the tested sample. This study differs from the other studies done in Dhaka by Sonia et al.[17] where the highest prevalence was observed in female age 16-35 years (70.73%), age group 30-44 years (57.28%) by Sadia et al.[16]

The occurrence of UTI among elderly >48 years (63-51%) showed in a study done by devanand et al. in meerut city,India[19]. However, Our results agree with the study done in Japan with a 20 year period in Which a trend of increasing complicated UTI was reported in elderly patients

(71.15%). The main cause behind this increasing incidence of UTI with advancing age in males is due to prostate enlargement and neurogenic bladder.

The most prevalent organisms in all the age group in the current study were *Escherichia coli* (46.1%), followed by *klebsiella spp* (31.7%), *Staphylococcus saprophyticus* (6.3%), *Enterecoccus fecalis* (5.7%), *Pseudomonas spp*.(5.5%), *Staphylococcus aureus* (94.7%). Similar observation were found in a study done by Majumder et al. Sakib et al. in a tertiary care hospital in Bangladesh[20] and also done by Devanand et al. in Merurut city,India[19]. But with a different rate obtained in a study in U.S.A (87.0% to 75.5%), Where the rate was 83.0% to 69% as seen by Rayan et al. in India[21]. On the contrary,In the report of Nabeela et.al klebsiella spp. and proteus spp. were for 16% and 11% of urinary tract infections[22].

This variations may be due to different life style, lack of education, improper sanitation, lack of hygiene, poor health care system, inadequate availability of water and also may be due to geographical variations.

*Escherichia coli*was the most common isolated organisms in our study. Escherichia coli shows high level of sensitivity towards Amoxicillin and Clavulonic acid, Amikacin, Piperacillin, Tazobactum, Colistin, Imipenem, Meropenem, and Gentamycin which is similar to the study conducted by Devanand et al.[19] and Suman Kumar in India.[23]

In a study done in Bangladesh by Majumdar et al. showed the predominant isolated organism was E. Coli with most powerful antibiotic was Meropenem, Imipenem, Tazobactum and Amikacin[20].

E. Coli. shows a high level of resistance towards Linezolid, Cefixime, and Nalidixic acid. This increasing resistance may be due to improper dosing and duration of antibiotics in this particular region. In a study in India by Ramchandra et al[19] shows similar resistance to Nalidixic acid, Ceftazidime and Cefaclor.

For *Klebsiella spp.* the highest percentage of sensitivity was found to be with Colistin, and Gentamycin followed by Meropenem and Imipenem. The highest percentage of resistance was with Linezolid, Cefixime and Cefaclor. This study is similar with a study done by Raihan rabbani in Bangladesh that shows more than 98% of the isolates are sensitive to Imipenem.

Antibiotic resistance is a global trouble and in the megacities. Antimicrobial resistance comes primarily as a result of selective pressure on susceptible microbes by the use of therapeutic agents, there are also further multiple factors for the spread of resistance. Using broad spectrum agents, easy availability of antimicrobials, poor drug quality, treatment termination, and the indiscriminate use of antibiotics in agriculture and farming in different parts of the country.

The emergence and spread of resistance can be reduced through appropriate or careful use of antimicrobial drugs and increasing awareness among the population to the hazards of inappropriate antimicrobial use through public health education campaign. Sensitivity tests should be routinely performed in all UTI cases. Appropriate antibiotics need to be prescribed based on the antibiotic susceptibility test which will be narrow spectrum, effective and less expensive with least side effects.

Conclusion: Prevalence of UTI in our study was 18.0%. Among all age groups Escherichia coli and Klebsiella spp. were found the dominant bacteria of the isolated uropathogens. The frightening issue is that about 429 of the isolates were resistance to more than seven drugs. Almost all the isolates were found to be sensitive with Meropenem, Colistin, Imipenem, Amikacin, Amoxycillin and Clavulonic acid. Routine monitoring of microbial resistance helps in proper selection of antimicrobials. In addition, the result may guide the prophylactic and empirical use of antimicrobials in urinary tract infections.

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