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Study on the Antibiotic Sensitivity and Resistance Pattern of Urinary Tract Infection in a Tertiary Health Care Facility

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ABSTRACT

Urinary tract infections (UTIs) are inflammatory disorders caused by bacteria, and continue to be the most prevalent illnesses in both outpatients and hospitalized patients. Current knowledge of antimicrobial sensitivity patterns is required for effective therapy. Management depends on the type of UTI, with antibiotics responding well to simple cystitis. Antibiotic resistance is a global issue. The purpose is to identify the most common causal agents and assess the antibiotic sensitivity patterns of those discovered in the population. **Method:** Patients hospitalized at Basavewshwara Medical College and Hospital, Chitradurga between June and December 2023 and diagnosed with UTI with or without concomitant diseases were included in the prospective observational study at the Department of Urology. The study covered patients aged 18 and above, with special populations such as children and pregnant women omitted. By getting written consent, patients were enrolled & acquired data were electronically captured and analyzed using descriptive statistics in Microsoft Excel 2019. The sample size was computed based on the frequency of the reported cases. **Results:** Out of 200 samples collected, 158 samples show significant growth of bacteria. The Most prevalent one was Escherichia coli (62.02%) followed by Klebsiella pneumoniae (12.02%), Acinetobacter baumannii (9.49%), Klebsiella oxytoca and Enterococcus faecalis 5.69% and Pseudomonas aeruginosa 5.06%. More than 70% of the isolates were sensitive to Cefoperazone and amoxicillin, while 69% showed meropenem, followed by Linezolid (65%). A very high rate of sensitivity was seen against Doxycycline (47.6%), Cefotaxime(44.1%), and Chloramphenicol(43.7%). E.coli showed high sensitivity to Meropenam, and Nalidixic acid(82.65%) followed by Linezolid(76.53%). **Conclusion:** The study reveals Escherichia coli as the most prevalent uropathogenic isolate, sensitive to Meropenam, Nalidixic acid, and Linezolid, and less sensitive to Cephalosporin group and Piperacillin Tzobactam. This information highlights the need for targeted treatment strategies and the importance of continuously monitoring antibiotic resistance patterns.

INTRODUCTION:

Urinary tract infections (UTIs) are inflammatory disorders caused by abnormally proliferating microorganisms in the urinary system. They can be community-acquired or hospital-acquired, affecting public health care and quality of life. Women are more likely to experience UTIs due to the urethra's proximity to the gut opening.[1]UTIs are the second most common bacterial infection affecting 150 million people annually around the globe, UTIs affect Children, Over 12% of men sufferfromUTIs,[2]and females of all ages experience higher incidence rates, with 40% to 50% experiencing at least one clinical episode.[3]

UTIs can be classified as uncomplicated (cystitis) or complicated (pyelonephritis). Risk factors for cystitis include gender, prior UTIs, sexual activity, vaginal infection, diabetes, obesity, and genetic susceptibility. Complicated UTIs involve factors that compromise the urinary tract or host defence, such as obstruction, neurological disease, immunosuppression, renal failure, renal transplantation, pregnancy, and foreign bodies. UTIs are caused by both Gram-negative and Gram-positive bacteria and certain fungi. Uropathogenic Escherichia coli (UPEC) is the most common causative agent for both uncomplicated and complicated UTIs.[3]

UTI is a condition where pathogenic organisms are found in the urine, urethra, bladder, kidney, or prostate. Over 105 organisms per millilitre indicates infection, while higher counts may be due to specimen contamination. The process begins with gut contamination, urethra colonization, and bladder migration.[3,4]The misuse of antimicrobial agents has led to antibiotic resistance, a global issue. Understanding the organisms causing UTIs and their antibiotic susceptibility is crucial for effective treatment.[4]The management depends on the type of UTIs, with simple, uncomplicated cystitis responding well to oral antibiotics, resulting in better clinical outcomes.[5]

Antibiotic resistance in uropathogenic may increase because of antibiotic therapy that frequently begins before test results (empirical therapy). Growing antibiotic resistance in UTI patients, which varies depending on geography and regional location, is a global problem.[6] The primary cause of the developing resistance pattern is the abuse of antibiotics. Because there are few effective treatments for infections brought on by resistant microorganisms, the sickness is more likely to last longer and result in death. One of the most frequent bacterial illnesses in all types of populations is urinary tract infections (UTIs), which can have serious negative effects.[7]

Antimicrobial therapy is the cornerstone of treating any bacterial illness, including a UTI. Since urinary tract infections (UTIs) are more prevalent, particularly in women, it is critical to start treating them with carefully monitored antibiotic usage. The clinician is responsible for providing his patients with appropriate care while following practice standards for appropriate antibiotic stewardship. The place, intensity, and host/bacterial characteristics all influence the kind and length of antimicrobial treatment.[8]

Materials and methodology

Study Area and population: The prospective observational study in the Department of Urology was conducted on patients admitted to Basaveshwara Medical College and Hospital Chitradurga between January and August 2023 to identify the most common causative agents and evaluate the antibiotic sensitivity patterns of the identified ones in the population. The sample size was calculated based on the incidence of the cases reported. The sample size was calculated based on the formula, $\mathbf{n= Z^2\alpha\rho\ (1-\rho)/e^2}$

At a confidence interval of 95%, the sample size for the study was calculated as **n=158.**

Patients were followed up Regularly by visiting the ward for regular follow-ups to collect the data needed for the study. A data collection form was designed to gather information about the causative organism and its susceptibility pattern toward antibiotics.

Exclusion Criteria: The study excluded patients who were pregnant females with asymptomatic bacteriuria, patients under the age of five, patients with polymicrobial infections involving more than two bacterial species, and patients who had previously been on antibiotic therapy.

Sample Collection & Processing: A sterile screw-capped universal container was used to collect the clean catch midstream urine from each participant. To avoid contamination, aseptic sample collection techniques were taught to every patient. When a patient visits the outpatient department (OPD), they willingly provide a urine sample, which is collected without the need for intrusive procedures. Nevertheless, before the collection of specimens, patients' written or verbal agreement was also obtained, and the study was approved by the institutional committee. To identify bacterial uropatogens, a sterile, calibrated loop full of urine samples was placed on sheep blood agar and Mac Conkey agar and incubated for 24 hours at 37℃**.**

Statistical Analysis: The collected data were electronically documented and were analyzed using descriptive statistics for UTI prevalence, and uropathogenic frequency, All statistical tests were performed using Microsoft Excel 2019.

RESULTS:

Out of 200 urine samples processed 158 (79%) gave significant growth of pathogens, Table 1 summarises the demographic profile of UTI. The patients were between 18-90 years of age. UTI prevalence is higher among females (58.22%) than males (41.77%). Femalesof reproductive age group (18-49 years) constituted 51.89% of the total patients with UTI. However, elderly(50-90years) males had some quite similar incidence of UTI (6.96%) compared to elderly females (6.32%).

Table 1: Age and Sex Distribution of patients with Urinary tract infections

Age group (In Years)	**Females**	**Males**
18-29	32	31
30-49	50	25
50-90	10	11

The commonest isolates were Escherichia coli, Klebsiella pneuoniae, Acinetobacter baumannii, Klebsiella oxytoca, Enterococcus Faecalis, Pseudomonas aeruginosa. (These represented **62.025%, 12.025%, 9.49%,6.32%, 5.69%, 4.43%** of isolate respectively). Table 2 depicts the frequency of isolation of ESBL-producing organisms over the study period. Extended-spectrumbeta-lactamase production was observed in **46.87% of E. coli** strains and 25% of Klebsiella strains. The Pie Chart Shows the distribution of organisms.

Most common isolates were Escherichia coli, Klebsiella pneuoniae, Acinetobacter baumannii, Klebsiella oxytoca, Enterococcus Faecalis, Pseudomonas aeruginosa. (These represented **62.025%, 12.025%, 9.49%, 6.32%, 5.69%, 4.43%** of isolate respectively).

Fig 1: Pie Chart shows the distribution of organisms

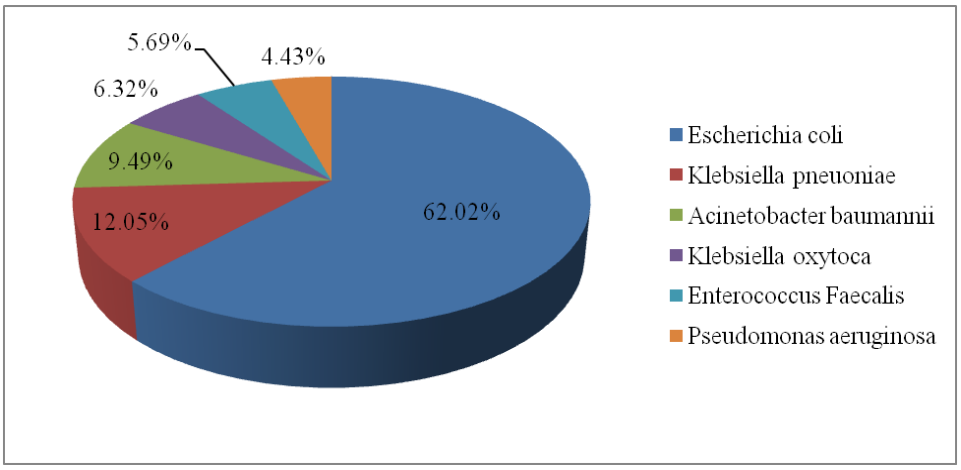

Figure 1: The Pie Chart showing the distribution of organisms.

The anti-microbial agents of different classes against the six most frequent UTI pathogens are summarized in Table 2.

Table 2: Antibiotic sensitivity and Resistance pattern of isolated organisms in UTI

Antimicrobial Agents	**E, Coli (n=98)**		**Klebsiella pneuoniae (n=19)**		**Acinetobacter baumannii (n=15)**		**Klebsiella oxytoca (n=10)**		**Enterococcus Faecalis (n=9)**		**Pseudomonas aeruginosa (n=7)**	
	S	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**
Amoxicillin	68.36	31.63	78.94	21.06	86.66	13.34	60	40	55.55	44.45	71.42	28.57
Ampicillin	59.18	40.82	73.68	26.32	80	20	50	50	55.55	44.45	57.14	42.85
Piperacillin & Tazobactam	70.40	29.6	73.68	26.32	**ND**	**ND**	50	50	44.44	55.56	57.14	42.85
Ceftriaxone	74.48	25.52	78.94	21.06	73.33	26.67	40	60	55.55	44.45	71.42	28.57
Cefotaxime	68.37	31.63	68.42	31.58	ND	ND	30	70	55.55	44.45	57.14	42.85
Cefoperazone	71.42	28.58	78.94	21.06	86.66	13.34	50	50	44.44	55.56	71.42	28.57
Cefazolin	70.40	29.59	73.68	26.32	**ND**	**ND**	40	60	55.55	44.45	57.14	42.86
Chloramphenicol	50	50	73.68	26.32	73.33	26.67	50	50	33.33	66.67	57.14	42.86
Nitrofurantoin	67.34	32.65	68.42	31.58	**ND**	**ND**	60	40	44.44	55.56	71.42	28.58
Cotrimoxazole	63.26	36.74	73.68	26.32	86.66	13.33	40	60	55.55	44.45	71.42	28.58
Doxycycline	41.83	58.17	63.15	31.58	**ND**	**ND**	50	50	44.44	55.56	57.14	42.86
Ciprofloxacin	47.95	52.17	68.42	31.58	80	20	60	40	55.55	44.45	71.42	28.58
Ofloxacin	47.95	52.17	68.42	31.58	86.66	13.33	40	60	44.44	55.56	57.14	42.86
Levofloxacin	56.12	43.12	73.68	26.32	73.33	26.66	40	60	66.66	33.34	71.42	28.58
Norfloxacin	50	50	68.42	31.58	86.66	13.33	50	50	55.55	44.45	57.14	42.86
Linezolid	76.53	23.47	78.94	21.06	73.33	26.67	40	60	66.66	33.34	57.14	42.86
Meropenem	82.65	17.35	68.42	31.58	80	20	50	50	44.44	55.56	71.42	28.58
Nalidixic acid	82.65	17.35	73.68	26.32	80	20	50	50	55.55	44.45	71.42	28.58

The anti-microbial agents of different classes against the six most frequent UTI pathogens are summarized in Table 2. Sensitivity to Piperacillin & Tazobactam, Cefazolin, Nitrofurantoin, and doxycycline to Acinetobacter baumannii were not tested as they have intrinsic resistance to those drugs. E.coli showed high sensitivity to Meropenam, Nalidixic acid(82.65%) followed by Linezolid(76.53%), cephalosporin group74.48% with good susceptibility to Piparacillin& Tazobactam(70.40%). Klebsiella oxytoca is highly sensitive to Amoxicillin, Cefoperazone, and linezolid (78.94%). Acinetobacter baumannii showed the highest sensitivity to Amoxicillin, Cefoperazone, Ofloxacin, and norfloxacin (86.66%). Klebsiella oxytocais highly sensitive to Amoxicillin, Nitrofurantoin, and Ciprofloxacin,(60%) Enterococcus Faecalisis highly sensitive to Cotrimoxazole, Norfloxacin(55.55%). Pseudomonas aeruginosa is highly sensitive to Nitrofurantoin, Amoxicillin(71.42%). The isolates show Low degree susceptibility to Doxycyclin (58.17%), Piperacillin, and tazobactam (55.56%).

Table 3 depicts the overall percentage of uropathogens sensitivity to antibiotics. More than 70% of the isolates were sensitive to Cefoperazone and amoxicillin, while 69% of isolates showed meropenem, followed by Linezolid (65%).

Table 3: Overall percentage of uropathogens sensitivity and resistance to Antibiotic

Antibiotics	**Sensitivity (%)**	**Resistance (%)**
Amoxicillin	70.155	29.841
Ampicillin	62.583	37.406
Piperacillin & Tazobactam	59.123	40.866
Ceftriaxone	65.62	34.888
Cefotaxime	55.896	44.102
Cefoperazone	74.076	38.14
Cefazolin	59.354	40.644
Chloramphenicol	56.246	43.753
Nitrofurantoin	62.324	37.674
Cotrimoxazole	65.095	34.903
Doxycycline	51.312	47.634
Ciprofloxacin	63.89	36.13

Ofloxacin	57.435	42.583
Levofloxacin	63.535	36.336
Norfloxacin	61.295	38.703
Linezolid	65.433	34.566
Meropenem	69.046	33.845
Nalidixic acid	68.883	31.116

DISCUSSION:

Urinary tract infections (UTIs) are a widespread bacterial infection affecting a significant number of individuals, with a higher prevalence among women compared to men. These infections pose a considerable financial strain on the healthcare system, given their frequent occurrence in both community and hospital settings. The escalating global issue of antibiotic resistance further complicates the management of UTIs, as bacterial strains with varying resistance patterns contribute to the challenge. Despite being a common infectious disease caused by bacteria, UTIs continue to impact a large number of people annually, emphasizing the urgent need for effective and sustainable solutions in medical research.

The results of this investigation provide insight into the patterns of antibiotic susceptibility and prevalence among bacterial strains that cause UTIs in a tertiary healthcare setting. In line with worldwide trends, Escherichia coli turned out to be the most common infection, underscoring the significance of comprehending local epidemiology for efficacious treatment approaches. Cefoperazone and amoxicillin have been shown to have good sensitivity, which implies that these antibiotics can be used empirically in this context for the initial care of UTIs. Furthermore, the significant sensitivity to Meropenem and Linezolid lends credence to their usefulness as alternatives, particularly when first-line antibiotics may not be as effective [9].

Because Escherichia coli exhibits a considerable sensitivity to both Meropenem and Nalidixic acid, it is important to customize antibiotic therapy according to the strains of bacteria being treated. Clinicians can use this information to help choose targeted medicines, improve patient outcomes, and reduce the likelihood of antibiotic resistance. The significant sensitivity to cefotaxime, doxycycline, and chloramphenicol that has been seen offers more

treatment choices and highlights the value of a varied antibiotic regimen in the fight against UTIs [10].

Yet this investigation also shines a spotlight on the increasing antibiotic resistance. For the treatment of dependably efficient UTIs, it's indispensable in this clinical environment to respond to antibiotic resistance as a new challenge in maintaining that current status. Still more significant is a growing threat: antibiotic resistance in urinary tract infections. Consequently, future studies should look towards understanding the foundation for resistance, and substitute treatment options.

CONCLUSION:

According to the study, the most widespread uropathogenic isolate is a simple Escherichia coli. It is most sensitive to Meropenem, Nalidixic acid, and Linezolid; among other drugs, it is the least sensitive. If we talk about Cephalosporin and Piperacillin Tzobactam, you can see it is slightly less sensitive as well. UTI-causing bacterial strains: This study provides important new information on the frequency of and trends in antibiotic susceptibility. In a tertiary healthcare setting. By detecting the common strains, it is possible to provide targeted therapy to those who are struggling mightily with this condition. Similarly, the considerable sensitivity of some medications--pardon the pun again! --can help doctors manage UTIs expertly. To use antibiotics with the best evidence base when justifiably needed in a clinical context, increasingly comes smoothly--the patterns of antibiotic resistance must be kept under constant scrutiny.

Future Directions for Proper Use of Antibiotic Treatment Courses

Antibiotic sensitivity and resistance patterns Our study underscores the pressing concern of rising antibiotic resistance in the context of UTIs within tertiary healthcare settings. The observed sensitivity patterns, while informative, revealed alarming trends in resistance among commonly prescribed antibiotics. This is particularly noteworthy in light of the implications for empirical treatment and patient outcomes[15].

Emerging resistance profiles the emergence of resistance, notably against first-line antibiotics such as trimethoprim-sulfamethoxazole and fluoroquinolones, poses significant challenges in clinical management. This observation aligns with global trends and necessitates a reevaluation of empirical treatment guidelines specific to our healthcare setting.

Multidrug resistance the prevalence of multidrug-resistant strains among UTI isolates is a critical concern highlighted by our study. Understanding these patterns of resistance becomes imperative in guiding clinicians towards appropriate antibiotic choices and in curbing the escalation of resistance.

Impact on Patient Care The implications of antibiotic resistance on patient care and outcomes cannot be overstated. Limited treatment options due to resistance compromise effective management and may result in prolonged illness, increased healthcare costs, and potential adverse events[14].

Antibiotic Stewardship Our findings accentuate the urgency for robust antibiotic stewardship programs within our healthcare facility. Strategies promoting judicious antibiotic use, such as targeted therapy based on susceptibility profiles and enhanced diagnostic approaches, are essential to mitigate further resistance escalation[16].

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