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A PROSPECTIVE STUDY ON ANTIBIOGRAM OF BACTERIAL UROPATHOGENS OF URINARY TRACT INFECTIONS FROM A TERTIARY CARE HOSPITAL

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ABSTRACT
A six-month prospective study at Tertiary Care Hospital in Kerala, India, analyzed 233 patient case records to determine the antibiotic sensitivity pattern of uropathogens and create an antibiogram. Urinary tract infections (UTIs) are common in general practice, accounting for about one-third of hospital-acquired infections. High recurrence rates and increasing antimicrobial resistance among uropathogens pose a significant economic burden. Antibiograms guide clinicians and pharmacists in selecting the best empiric antimicrobial treatment while awaiting microbiology culture and susceptibility results. They also help detect and monitor trends in antimicrobial resistance. The study observed a higher incidence of UTIs in females, especially those over 70 years old. Antibiotic sensitivity analysis revealed that Imipenem had the highest sensitivity, followed by meropenem and colistin.

KEYWORDS: UTI, Uropathogens, Antibiotics, Antibiogram.

INTRODUCTION
A UTI is defined as the presence of microorganisms in the urinary tract that cannot be accounted for by contamination. The organisms present have the potential to invade the tissues of the urinary tract and adjacent structures. Infection may be limited to the growth of bacteria in the urine, which frequently may not produce symptoms.[1] A UTI can present as several syndromes associated with an inflammatory response to microbial invasion and can range from asymptomatic bacteriuria to pyelonephritis with bacteremia or sepsis. UTIs are classified by several methods. Typically, they have been described by anatomic site of involvement. Lower tract infections include cystitis (bladder), urethritis (urethra), prostatitis (prostate gland), and epididymitis. Pyelonephritis is an infection involving the kidneys and represents Upper tract infection.[2,3,4] Also, UTIs are designated as uncomplicated or complicated. Uncomplicated infections occur in individuals who lack structural or functional abnormalities of the urinary tract that interfere with the normal flow of urine or voiding mechanism. These infections occur in females of childbearing age (15 to 45 years) who are otherwise normal, healthy individuals. Infections in males generally are not classified as uncomplicated because these infections are rare and most often represent a structural or neurologic abnormality. Complicated UTIs are the result of a predisposing lesion of the urinary tract, such as a congenital abnormality or distortion of the urinary tract, a stone, indwelling catheter, prostatic hypertrophy, obstruction, or neurologic deficit that interferes with the normal flow of urine and urinary tract defenses.[6] Complicated infections occur in both genders and frequently involve the upper and lower urinary tract. Recurrent UTIs in healthy non-pregnant women, three or more UTIs occurring within 1 year, are a common problem. They are characterized by multiple symptomatic infections with asymptomatic periods occurring between each episode and may be either reinfections or relapses. Reinfections are caused by a different organism than originally isolated and account for the majority of recurrent UTIs. Relapses are the development of repeated infections with the same initial organism and usually indicate a persistent infectious source. Asymptomatic bacteriuria is a common finding, particularly among those 65 years of age and older, when

there is significant bacteriuria (>105 bacteria/mL of urine) in the absence of symptoms.[7,8] Symptomatic abacteriuria or acute urethral syndrome consists of symptoms of frequency and dysuria in the absence of significant bacteriuria. This syndrome is commonly associated with Chlamydia infections. Significant abacteriuria is a term used to distinguish the presence of microorganisms that represent true infection versus contamination of the urine as it passes through the distal urethra prior to collection.[10,11,12]

Urinary tract infections (UTIs) are caused by a wide range of pathogens, including Gram-negative and Gram positive bacteria, as well as fungi. Uncomplicated UTIs typically affect women, children and elderly patients who are otherwise healthy. Complicated UTIs are usually associated with indwelling catheters, urinary tract abnormalities, immunosuppression or exposure to antibiotics. The most common causative agent for both uncomplicated and complicated UTIs is uropathogenic E.coli.[13]

The management of a patient with a UTI includes initial evaluation, selection of an antibacterial agent and duration of therapy, and follow up evaluation.[14] The initial selection of an antimicrobial agent for the treatment of UTI is based primarily on the severity of the presenting signs and symptoms, the site of infection, and whether the infection is determined to be uncomplicated or complicated. Other considerations include antibiotic susceptibility, side-effect potential, cost, and the comparative inconvenience of different therapies.

Antibiograms summarizes the cumulative proportions of pathogenic organisms that are susceptible to particular antimicrobials. This provides a profile of the susceptibilities of specific pathogenic bacteria to antimicrobial agents as tested in routine clinical microbiology practice. Producing annual cumulative antibiograms is a key strategy for antimicrobial stewardship as it provides a health service with information about which antimicrobials are more or less effective for different organisms, which informs antimicrobial choices for formularies and antimicrobial prescribing policies for health care services. Producing a series of antibiograms can be used to track changes in resistance patterns over time, .and can inform the development of therapeutic guidelines at the national, regional and local level.[15,16]

MATERIALS AND METHODS

Sample size determination

Total no. of 233 positive culture sensitivity report were collected over a period of 3 month for creating antibiogram.

INCLUSION CRITERIA

1. All patients admitted in hospital with UTI.
2. Patients of all gender.
3. Culture sensitivity done.
4. Patient received at least one antibiotic for UTI.

EXCLUSION CRITERIA

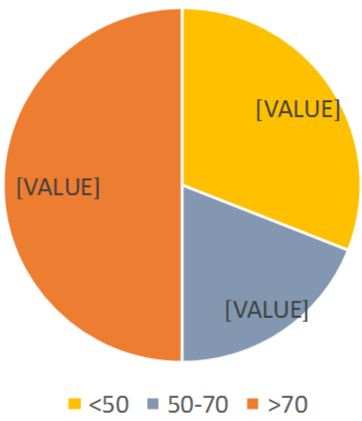
1. Patients with negative culture sensitivity reports.
2. Patients having infection other than UTIs.
3. UTIs caused by other than bacteria were excluded from study

A prospective study was conducted over a period of six months in a tertiary care hospital, Kerala, India. A total of 233 patient case records satisfying the inclusion criteria were analyzed to determine the prevalence of uropathogens causing UTI and also to determine antibiotic sensitivity pattern of uropathogens to various antibiotics to create antibiogram. All the relevant and necessary data of the patient were collected from patient's case record and microbiology department. The total data were collected over a period of 3 months to create an antibiogram.

RESULT AND DISCUSSION

Frequency and percentage distribution according to age group (N = 233)

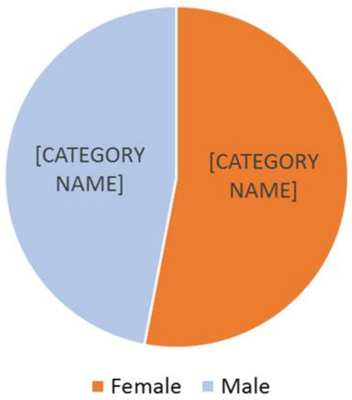
Age	Frequency (n)	Percentage (%)
<50	72	31
50-70	45	19
>70	116	50



Inference: This chart shows age wise distribution of UTI. It indicates that half of the UTI patients are over 70 years old The increased vulnerability to UTIs in this age group is caused by a number of factors, including hormonal changes, bladder dysfunction, catheter use, mobility challenges, chronic health disorders like diabetes mellitus kidney disease, and urine incontinence.

Frequency and percentage distribution according to gender (N = 233).

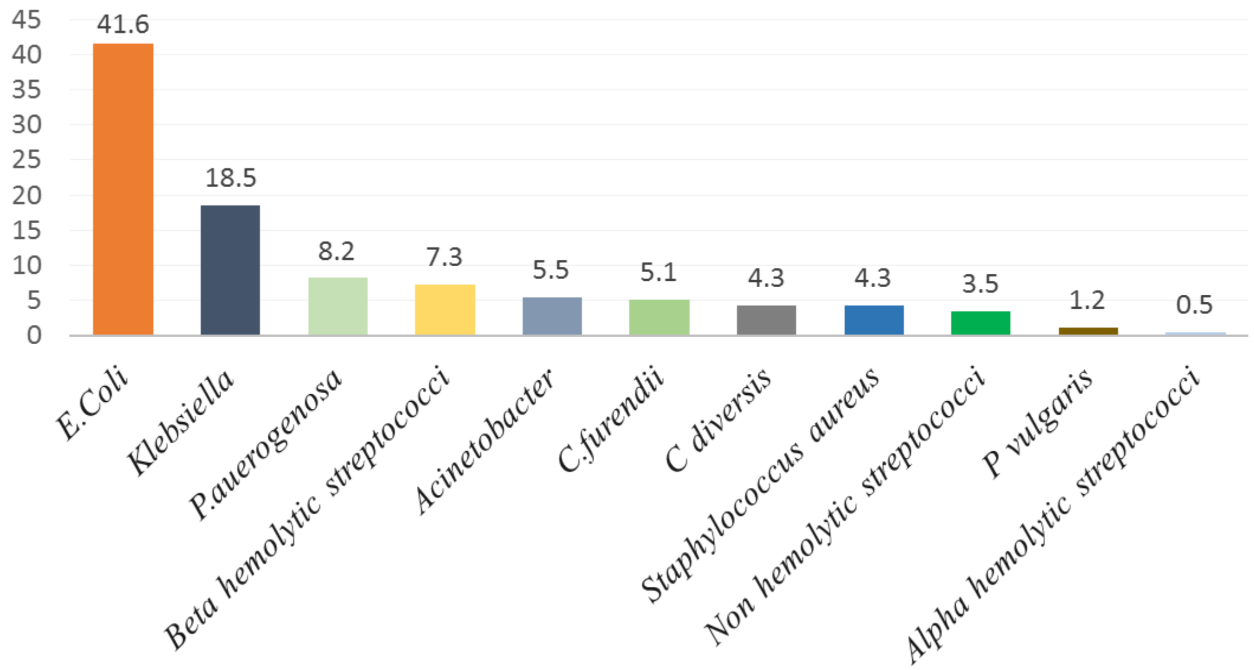
Gender	Frequency(n)	Percentage (%)
Female	123	53
Male	110	47



Inference: Based on this distribution, it may be inferred that a greater proportion of UTI patients are female (57%) than male (47%) for a variety of reasons, such as females shorter urethras and their close proximity to the anus, as well as hormonal changes during menstruation, pregnancy, and menopause.

Frequency and percentage distribution of uropathogens (233)

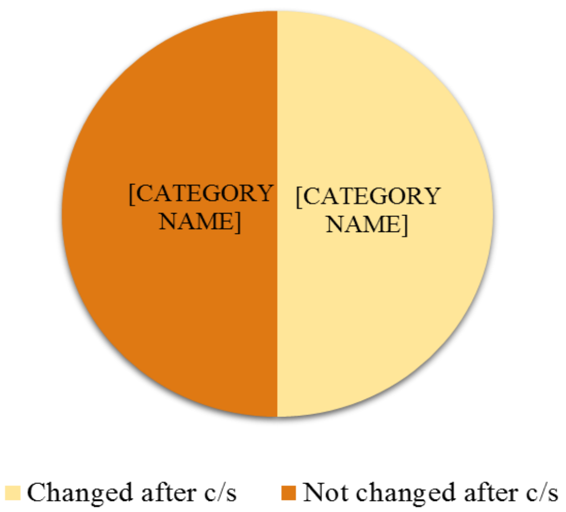
Organism	Frequency(n)	Percentage (%)
Escherichia coli	97	41.6
Klebsiella pneumoniae	43	18.5
Pseudomonas auerogenosa	17	8.2
Beta hemolytic streptococci	19	7.3
Acinetobacter	13	5.5
Citobacter freundii	10	5.1
Citrobacter diversus	8	4.3
Staphylococcus aureus	10	4.3
Non hemolytic streptococci	3	3.5
Proteus vulgaris	1	1.2
Alpha hemolytic streptococci	12	0.5



INFERENCE: This indicates that E.coli was the most prevalent bacteria

Percentage distribution of antibiotics changed and not changed after c/s (N=233)

Antibiotics	Percentage (%)
Changed after c/s	50
Not changed after c/s	50



INFERENCE: This chart indicates in 50% of the cases, the antibiotics were changed after conducting C/S. This suggests that the results of the C/S indicated a need to alter the antibiotic treatment. In the other 50% of the cases, the antibiotics were not changed after conducting C/S. This implies that the initial antibiotic treatment was appropriate based on the C/S results.

Antibiotic sensitivity pattern of uropathogens. N=233

Group	Organism		Cefuroxime	Ampicillin/Sulbactam	Cefoperazone/Sulbactam	Levofloxacin	Cefixime	Ceftriaxone	Sparfloxacin	Nalidixic acid	Ciprofloxacin	Nitrofurantoin	Cefotaxime	Meropenem	Cefipime	Tobramycin	Colistin
GRAM NEGATIVE	Escherichia coli	S	20.6	90.7	61.8	45	27.8	40	41.2	14.4	46.3	87.6	25.7	93.8	58.7	71.1	95.8
		M	12.4		25.7	9.2	9	8	9		7.2	6.1	17.5	2	18.5	13.4	
		R	67	9.2	12.3	45	62.8	52	49.4	85.5	46.3	6.1	56.7	4	22.6	15.4	4
	Klebsiella pneumoniae	S	18.6	53.4	23.2	37	27.9	33	37.2	27.9	37.2	25.5	20.9	62.7	51.1	51	100
		M	9	2	25.5		2	2		2.3	6.9	30.2	13.9	4	9	9	
		R	72	44.1	51.1	63	69.7	65	62.7	69.7	55.8	44.1	65.1	32.5	39.5	40	
	Pseudomonas aeruginosa	S	23.5	82.3	11.7	18	18	18	18		18	82.3	17.6	71	29.4	11.7	5.8
		M	6		11.7	5.8	18	18	5.8		6	6	11.7	5	5	11.7	
		R	70.5	17.6	76.4	76	64.7	65	76.4	100	76	11.7	70.5	23.5	64.7	76.4	94.1
	Acinetobacter	S		42.1	78.9	68	10.5	42	68.4	10.5	73.6	5.2	37.5	84.2	84.2	84.2	100
		M			5		5	26		15.7			31		5		
		R	100	57.8	15.7	32	84.2	32	32	73.6	26.3	95	31	15.7	10.5	15.7	
	Citrobacter diversus	S	15.3	100	100	62	15.3	23	53.8	46.1	53.8	15.3	7.6	92.3	100	76.9	92.3
		M	38.4			14	61.5	69	38.4	15.3	38.4		84.6			7	
		R	46.1			7.6	23	8	8	38.4	7.6	84.6	8	8		15.3	7.6
	Proteus vulgaris	S	80	100	90	10	70	80	10		10	100	80	100	100	100	70
		M	10		10	20	10	20	20	20	20		20				
		R	10			70	20		70	80	70						30
	Citrobacter freundii	S	50	62.5	50	38	50	50	38		38	50	50	50	50	37.5	25
		M				25			25	12.5	25	12.5		13		12.5	
		R	50	37.5	50	38	50	50	38	87.5	38	37.5	50	38	50	50	75
GRAM POSITIVE	Beta hemolytic streptococci	S	60	100	70	70	70	70	70	50	70	80	50	100	80	90	100
		M	10		20					10		10	20		10		
		R	30		10	30	30	30	30	40	30	10	30		10	10	
	Staphylococcus aureus	S	66.7	100	66.7	100	100	100	100	33.3	100	33.3	100	100	100	66.7	33.3
		M	33.3							33.3		66.7					
		R			33.3					33.3						33.3	66.7
	Non hemolytic streptococci	S	100	100	100		100	100					100	100	100		
		M														100	
		R				100			100	100	100	100					100
	Alpha hemolytic streptococci	S	50	91.7	66.8	92	66.7	75	91.7	75	91.7	75	75	91.7	91.7	66.8	100
		M	16.7		16.6	8.3		8.3	8.3	8.3	8.3	8		8.3		16.6	
		R	33.3	8.3	16.6		33.3	17		16.7		17	25		8.3	16.6	

Group	Organism		Gentamycin	Amikacin	Imipenem	Ofloxacin	Tetracycline	Cotrimoxazole	Norfloxacin	Ceftizoxime	Chloramphenicol	Piperacillin/Tazobactam	Nithilin	Methicillin	Cephalexin	Linezolid	Lincomycin	Amoxicillin/Clavulonic acid	Faropenem	Cefpodoxime	Ceftazidime	Tigecycline
GRAM NEGATIVE	Escherichia coli	S	73.1	82	94.8	43.2	32.9	44.3	44	40	95.8	31.9	95.8		26.8			20.6	43.2	10.3	30.9	90.7
		M	11.3	13	4	9.2	15.4	1	9	6	1	52.5			3			8		11.3	12.3	8
		R	15.4	4	1	47.4	51.5	54.6	46	54	3	15.4	4		70.1			71.1	56.7	78.3	56.7	11
	Klebsiella pneumoniae	S	65.1	67	62.7	37.2	25.5	48.4	34.8	28	58.1	16.2	67.4		18.6			19	9	9	30.2	39.5
		M	4.6	2.3	11.6		20.9	2.3	4.6	2.3	4.6	25.5	2		6.9			4	4	11.6	7	53.4
		R	30.2	30	25.5	62.7	53.4	48.8	60.4	70	37.2	58.1	30.2		74.4	100		76.7	86	79	62.7	7
	Pseudomonas aeruginosa	S	6	12	88.2	17.6	18	58.8	17.6	24	70.5	35.2	35		11.7	100	17.6	88.2	29.4	17.6	11.7	94.1
		M	23.5	24		5.8		5.8	6	6		23.5	24		5.8					82.3	12	6
		R	70.5	65	11.7	76.4	82.3	35.2	76.4	71	29.4	41.1	41		82.3		82.3	11.7	70.5	11.7	76.4	
	Acinetobacter	S	78.9	84	78.9	68.4	5.2	10.5	68.4	32	21	73.6	84.2					15.7	10.5		52.6	21
		M	5.2	5			10.5			21	5	10.5			5.2						21	
		R	15.7	11	21	31.5	84.2	89.4	31.5	47	73.6	15.7	15.7		94.7	100		84.2	89.4	100	26.3	78.9
	Citrobacter diversus	S	76.9	77	100	53.8	38	100	53.8	15	54	46.1	92.3					15.3	8		30.7	84.6
		M	7.6	15		38.4	38		38	54		54						46.1			46.1	15.3
		R	15.3	8		8	24		7.6	31	46.1		8					38.4	92.3	100	23	
	Proteus vulgaris	S	90	90	100	10	90	80	10	80	100	60	100	90	80	90	100	60	100	20	50	90
		M	10	10		20			20	20		30		10	20					30	50	10
		R				70	10	20	70			10				10		40		50		
	Citrobacter freundii	S	25	25	62.5	37.5	50	87.5	37.5	50	100	62.5	75		50	75	63	63	50	38	50	100
		M				25	12.5		25													
		R	75	75	37.5	37.5	37.5	12.5	37.5	50		37.5	25		50	25	38	38	50	63	50	
GRAM POSITIVE	Beta hemolytic streptococci	S	80	80	100	70	60	70	70	70	80	50	90		60			50	30	20	70	60
		M	10	10			10					50			10			20		40		20
		R	10	10		30	30	30	30	30	20		10		30	100		30	70	40	30	20
	Staphylococcus aureus	S	100	100	100	100	66.7	100	100	100	100	66.7	100		66.7			33.3	66.7	33.3	100	33.3
		M													33.3			66.7		33.3		33.3
		R					33.3					33.3				100			33.3	33.3		33.3
	Non hemolytic streptococci	S			100		100			100	100	100				100	100	100	100		100	100
		M	100	100									100		100					100		
		R				100		100	100													
	Alpha hemolytic streptococci	S	83.4	83	91.7	91.7	50	83.4	91.7	75	91.7	50	91.7		42			25		8.4	66.7	58.4
		M	8.3	8.3	8.3	8.3	17		8.3			16.7								41.6		41.6
		R	8.3	8.3			33	16.6		25	8.3	33.3	8.3		58	100		75	100	50	33.3	

INFERENCE: This chart shows antibiotics, such as Meropenem, Imipenem, and Colistin show high sensitivity rates indicating their effectiveness against most of the bacterial isolates. The antibiogram analysis reveals distinct variations in antimicrobial sensitivity patterns across different uropathogens. While certain antibiotics demonstrated consistently high efficacy particularly against Gram-positive organisms others showed marked resistance among Gram-negative isolates, notably *Escherichia coli* and *Klebsiella pneumoniae*. These findings highlight the critical role of local antibiograms in guiding empirical therapy, ensuring that antibiotic selection is tailored to prevalent resistance trends. Incorporating regular antibiogram updates into clinical practice can help optimize treatment protocols, reduce inappropriate antibiotic use, and improve patient outcomes in urinary tract infections.

Comparison of antibiotic use with antibiogram

Comparison of antibiotic use with antibiogram of E.coli

***E coli* N=97**		
Antibiotic	**Sensitivity %**	**Antibiogram%**
Nitrofurantoin	86	88
Meropenem	100	94
Piperacillin tazobactum	100	32
Faropenem	100	43
Ceftriaxone	60	40
Cefoperazone	100	62
Levofloxacin	100	45
Cefotaxime	67	26
Imipenem	100	95
Gentamycin	100	73
Ofloxacin	100	43

Ceftazidime	100	31
Ciprofloxacin	100	46
Ampicillin	100	91

Comparison of antibiotic use with antibiogram of Klebsiella pneumonia.

Klebsiella pneumonia **N=43**		
Antibiotics	**Sensitivity %**	**Antibiogram %**
Meropenem	100	63
Ampicillin	50	53
Cefuroxime	50	19
Faropenem	84	9
Ciprofloxacin	34	37
Cefotaxime	100	21
Linezolid	100	0
Imipenem	100	63
Levofloxacin	0	38
Cefixime	100	28

Comparison of antibiotic use with antibiogram of Beta Hemolytic Streptococci.

Beta Hemolytic Streptococci **N=19**		
Antibiotic	**Sensitivity %**	**Antibiogram%**
Meropenem	50	100
Ofloxacin	100	70
Imipenem	100	100
Ceftriaxone	0	70
Cefoperazone	0	70

Comparison of antibiotic use with antibiogram of Pseudomonas auroginosa.

Pseudomonas auroginosa **N=17**		
Antibiotic	**Sensitivity %**	**Antibiogram%**
Faropenem	34	30
Piperacillin	100	35
Ceftriaxone	100	18
Imipenem	100	88
Ampicillin	100	82
Meropenem	0	71

CONCLUSION

In this study, we observed that while minor differences existed between antibiotic sensitivity percentages and those reported in the antibiogram, the overall results were largely consistent. Due to the limited number of cases in which discrepancies were noted, statistical correlations could not be established.

These findings indicate that, in most instances, the choice of antibiotics aligns with microbial sensitivity patterns, though occasional deviations do occur. However, the small sample size restricts our ability to identify the underlying causes of these variations.

Further investigations involving larger cohorts are recommended to better characterize these differences and guide more precise antibiotic prescribing for urinary tract infections (UTIs). Such research could contribute to optimizing treatment strategies and improving clinical outcomes.

Moreover, the results highlight the need for individualized antibiotic selection based on sensitivity profiles particularly in elderly female patients to ensure effective management of UTIs.

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CONFLICT OF INTEREST

The authors declare no conflict of interest in conducting this study, the design, data collection, analysis, interpretation, reporting its findings or publication of this research.

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