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Original Article

Microbiology Section

Bacteriological Profile and Antibiogram of Urinary Tract Infections at a Tertiary Care Hospital in Kerala, India: A Retrospective Study

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ABSTRACT

Introduction: Urinary Tract Infections (UTIs) are caused by microbial invasion of the urinary tract, extending from the renal cortex of the kidney to the urethral meatus. Over the past years, resistance levels to the traditional drugs used for the treatment of UTIs have been gradually increasing. Therefore, a therapy based on the individual culture report and antibiotic sensitivity test is highly encouraged.

Aim: To determine the age-wise and sex-wise prevalence of UTI, as well as to determine the bacteriological profile and antimicrobial sensitivity pattern of isolated uropathogens.

Materials and Methods: This retrospective record-based study was conducted in the Department of Microbiology at Travancore Medical College in Kollam, Kerala, India. Samples were collected from patients with clinically suspected UTI attending the Outpatient Department (OPD) and Inpatient Department (IPD) of Travancore Medical College, Kollam, Kerela, India over a period of six months from July 2022 to December 2022. Both male and female patients with clinically suspected UTI were included in the study. The clinical diagnostic criteria included dysuria, frequency, urgency, and fever. Data were retrieved from the culture register maintained in the Microbiology laboratory, LIS (ELLIDER), and the WHONET software system. Urine culture was performed using a semiquantative technique. A growth of $>10^5$ Colony Forming Units (CFU)/mL was considered indicative of an active UTI with significant bacteriuria. Organisms were identified using Gram stain, motility testing, and biochemical reactions following standard microbiological techniques. Antimicrobial sensitivity testing was conducted using the Kirby-Bauer Disc diffusion method. The data were entered into a Microsoft Excel worksheet, and the results were analysed using simple descriptive statistics involving percentages and proportions using Statistical Package for Social Sciences (SPSS) software version 16.0.

Results: Of the total 2,794 samples, 319 (11.4%) samples yielded significant bacteriuria. Among the positive samples, 204 (64%) were from females and 115 (36%) were from males. UTIs were most commonly seen in the age group of 61-80 years. *Escherichia coli (E.coli)*, with 148 isolates (46.4%), was the predominant organism, followed by *Klebsiella pneumoniae* with 72 isolates (22.6%). *E. coli* showed the highest susceptibility to meropenem, with 137 isolates (92.6%), and imipenem, with 136 isolates (91.9%), followed by cefoperazone/sulbactam with 129 isolates (87.2%), and piperacillin/tazobactam with 128 isolates (86.5%). *Klebsiella pneumoniae* was most susceptible to imipenem, with 42 isolates (60%), followed by meropenem, with 29 isolates (41.4%). Most non fermenters were highly susceptible to carbapenems, cefoperazone/sulbactam, and piperacillin/tazobactam. Among the gram-positive organisms, *Enterococcus* spp. was the most frequently isolated, showing 100% sensitivity to vancomycin and linezolid.

Conclusion: In this study, UTI was found to be more prevalent among elderly females. Gram-negative organisms were the most commonly isolated pathogens in UTI, with *E. coli* being the most frequent agent. Urinary pathogens exhibited resistance to commonly used antibiotics such as ampicillin, cephalosporins, quinolones, and cotrimoxazole. Based on this study, it can be concluded that the resistance to commonly used antibiotics is very high. Due to the changing trends in the sensitivity patterns of various antibiotics, it is important to understand the antibiogram of common isolates in a specific area or hospital to ensure better empirical treatment.

Keywords: Antibiotic sensitivity test, Pyelonephritis, Urethritis, Uropathogens

INTRODUCTION

The urinary tract consists of the kidneys, ureters, bladder, and urethra. Based on the anatomical location of the infection: UTIs are either Upper (U-UTI) or Lower (L-UTI). Upper UTIs may manifest as ureters (ureteritis) or the renal parenchyma (pyelonephritis). Lower UTIs can present as asymptomatic bacteriuria, the urethra (urethritis), the bladder (cystitis), acute urethral syndrome, or the prostate in males (prostatitis) [1]. Pyelonephritis refers to inflammation of the kidney parenchyma, calyces, and the renal pelvis and is associated with systemic manifestations such as fever, flank pain, and vomiting. Asymptomatic bacteriuria means the patient is symptomless but is excreting bacteria in quantities equal to or greater than 10^5 CFU/mL. Clinical symptoms of urethritis include dysuria and frequency. The most common type of infection is cystitis, manifested as dysuria, frequency, urgency, tenderness over the bladder area, and sometimes bloody urine. Acute urethral syndrome is manifested as dysuria, frequency, and urgency in young sexually active women who excrete bacteria fewer than 10^5 CFU/mL in urine [2]. UTIs are the most common bacterial infections in humans, with an estimated 150 million UTIs occurring annually worldwide [3]. Recent use of a diaphragm with spermicide, frequent sexual intercourse, and a history of UTI are independent risk factors for acute cystitis. In healthy postmenopausal women, sexual activity, diabetes mellitus, and incontinence are risk factors for UTI [4]. UTIs are important complications of diabetes, renal disease, renal transplantation, and structural and neurologic abnormalities that interfere with urine flow. UTIs are a leading cause of gram-negative sepsis in hospitalised patients. *Escherichia coli* is the most frequent cause of community-acquired UTIs. Other bacteria frequently isolated from patients with UTIs are *Klebsiella* spp., other Enterobacteriaceae, *Acinetobacter* spp., Coagulase-negative *Staphylococcus*, *Staphylococcus aureus*, and Enterococci. *Proteus*, *Pseudomonas*, and *Klebsiella* spp. are responsible for complicated UTIs [1]. Bacteria invade the urinary tract mainly by two routes-ascending and descending routes.

Enteric endogenous bacteria enter the urinary tract via the ascending route, which is the most common route [1,2]. The descending route refers to the invasion of renal parenchyma through haematogenous seeding of the pathogen. If diagnosed early and treated adequately with antibiotic coverage, UTI is not alarming. However, if inadequately treated, it can cause significant morbidity and mortality. The aim of the study was to determine the age-wise and sex-wise prevalence of UTI and to determine the bacteriological profile and antimicrobial sensitivity pattern of isolated uropathogens, which may help in the management of UTI and guide medical practitioners to carry out empirical treatment.

MATERIALS AND METHODS

The present study was a retrospective study conducted in the Department of Microbiology at Travancore Medical College, Kollam, Kerala, India, over a period of six months from July 2022 to December 2022. Samples were collected from patients with clinically suspected UTI attending the OPD and IPD of Travancore Medical College, Kollam, Kerala, India. Ethics approval was obtained from the Travancore Medical College Ethics Committee, IEC No-149/23.

Inclusion criteria: Both male and female patients with clinically suspected UTI were included in the study. The clinical diagnostic criteria include dysuria, frequency, urgency, and fever.

Exclusion criteria: Patients with polymicrobial infections involving more than two bacterial species, patients with *Candida* spp. as the sole pathogen, and repeat samples received from the same patients on follow-up were excluded from the study.

Study Procedure

Patients with clinically suspected UTI were asked to collect fresh urine samples. A total of 2,794 clean-catch midstream urine samples were collected in a wide-mouthed sterile container from both outpatients and inpatients and immediately transported to the Microbiology laboratory for processing within two hours of collection. Specimens were collected using the standard "clean catch" mid-stream method for patients without a catheter in place. For catheterised patients, the sample was collected in a sterile, screw-capped, wide-mouth container after clamping the catheter. Before collecting the sample, male subjects were instructed to clean the genital parts with soap and water, while female patients were asked to wash the vulva and carefully separate the labia before voiding the urine into the sterile bottle.

The urine samples were inoculated on both blood and MacConkey agar using calibrated loops for a semiquantative method. An inoculating loop of standard dimensions was used to take up a small, approximately fixed, and known volume of mixed uncentrifuged urine, which was spread over a plate of agar culture medium. The plates were incubated aerobically at 37°C for 24 hours, and the number of colonies was counted to calculate the number of viable bacteria per mL of urine. Urine culture was performed using a semiquantative technique, where 0.01 mL of urine was cultured. A growth of $>10^5$ CFU/mL was considered as an active UTI with significant bacteriuria [5]. Gram stain of the colony was then performed, and all biochemical tests were conducted after overnight incubation at 37°C for 24 hours.

Antimicrobial susceptibility testing: The antibiotic sensitivity test was performed using the Kirby Bauer disc diffusion method according to Clinical and Laboratory Standards Institute (CLSI) guidelines [6]. All the media and antibiotics were purchased from HiMedia in Mumbai. The antibiotic discs used were as follows: ampicillin (10 µg), amoxicillin-clavulanic acid (20/10 µg), cefoperazone-sulbactam (75/30 µg), piperacillin-tazobactam (100/10 µg), cefuroxime (30 µg), ceftazidime (30 µg), cefotaxime (30 µg), cefepime (30 µg), cefixime (5 µg), cefpodoxime (10 µg), cephalexin (30 µg), imipenem (10 µg), meropenem (10 µg), amikacin (30 µg), gentamicin (10 µg), ciprofloxacin (5 µg), norfloxacin (10 µg), cotrimoxazole (1.25/23.75 µg), fosfomycin (200 µg), nitrofurantoin (300 µg), cefoxitin (30 µg), linezolid (30 µg), vancomycin (30 µg), and high-level gentamicin (120 µg).

STATISTICAL ANALYSIS

The data was entered into a Microsoft Excel worksheet, and the results were analysed using simple descriptive statistics, involving percentages and proportions, using SPSS software version 16.0.

RESULTS

The overall prevalence of UTI in both male and female patients was found to be 11.4%. Among the 2794 samples, 319 (11.4%) urine samples showed significant bacterial growth, comprising 115 (36%) samples from males and 204 (64%) from females. It was observed that in both sexes, the maximum number of uropathogens were isolated from patients in the age group 61-80 years, followed by the age group 21-40 years [Table/Fig-1].

Age group (years)	n (%)
<1	16 (5)
1-20	64 (20.1)
21-40	68 (21.3)
41-60	51 (16)
61-80	103 (32.3)
>80	17 (5.3)

[Table/Fig-1]: Age wise distribution of uropathogen.

Out of the 319 culture isolates as shown in [Table/Fig-2], *Escherichia coli* was the most common with 148 (46.4%), followed by *Klebsiella spp*. with 72 (22.6%), *Enterococcus* spp. with 44 (13.8%), *Pseudomonas* spp. with 25 (7.8%), and *Acinetobacter baumannii* with 13 (4.1%).

Gram positive and gram negative organisms	Number of isolates n (%)
Escherichia coli	148 (46.4)
Acinetobacter baumannii	13 (4.1)
Enterococcus spp.	44 (13.8)
Klebsiella pneumoniae	70 (21.9)
Klebsiella aeogenes	2 (0.6)
Proteus spp.	6 (1.9)
Pseudomonas aeroginosa	25 (7.8)
Staphylococcus aureus	4 (1.3)
Streptococcus spp.	4 (1.3)
Coagulase negative *Staphylococcus* spp.	3 (0.9)

[Table/Fig-2]: Distribution of uropathogens.

Based on the antibiotic sensitivity pattern analysis, *E. coli* showed higher sensitivity to fosfomycin with 148 (100%), imipenem with 136 (91.9.%), meropenem with 137 (92.6%), cefoperazone/sulbactam with 130 (87.8%), piperacillin/tazobactam with 129 (87.2%), amikacin with 116 (78.4%), and nitrofurantoin with 105 (70.9%), while it was resistant to ampicillin, cephalexin, cefuroxime, and cefpodoxime. *Klebsiella pneumoniae* showed higher sensitivity to imipenem with 42 (60%) and meropenem with 29 (41.4%), but was resistant to cephalexin and cefuroxime. *Proteus* spp. showed 6 (100%) sensitivity to imipenem and meropenem but was highly resistant to ampicillin, cephalexin, and cefuroxime [Table/Fig-3a,b].

Enterococcus spp. was highly sensitive to vancomycin with 44 (100%) and linezolid with 44 (100%), but resistant to ciprofloxacin with 17 (39.3%) and norfloxacin with 17 (38.6%). Nitrofurantoin and high-level gentamicin showed a sensitivity of 32 (72.7%) and 32 (72.7%), respectively [Table/Fig-4].

Staphylococcus spp. showed a higher level of sensitivity to vancomycin with 4 (100%), linezolid with 4 (100%) followed by nitrofurantoin with 3 (75%), but the highest resistance to ampicillin with 3 (75%) followed by cephalexin with 2 (50%) [Table/Fig-5].

Antibiotics	*E.coli* n (%S)	*E.coli* n (%R)	*Klebsiella pneumoniae* n (% S)	*Klebsiella pneumoniae* n (% R)
Ampicillin	11 (7.4)	137 (92.6)	-	
Amoxicillin/ Clavulanic acid	79 (53.4)	69 (46.6)	39 (55.7)	31 (44.3)
Cefoperazone/ Sulbactum	130 (87.8)	18 (12.2)	40 (57.1)	30 (42.9)
Piperacillin/ Tazobactum	129 (87.2)	19 (13)	39 (55.7)	31 (44.3)
Cefuroxime	44 (29.7)	104 (70.3)	15 (21.4)	55 (78.6)
Ceftazidime	57 (38.5)	91 (61.5)	22 (31.4)	48 (68.6)
Cefotaxime	59 (39.9)	89 (60.1)	21 (30)	49 (70)
Cefepime	68 (46)	80 (54)	22 (31.4)	48 (68.6)
Cefixime	59 (39.9)	89 (60.1)	21 (30)	49 (70)
Cefpodoxime	54 (36.5)	94 (63.5)	19 (27.1)	51 (72.9)
Cephalexin	27 (18.2)	121 (81.8)	12 (17.1)	58 (82.9)
Imipenem	136 (91.8)	12 (8.2)	42 (60)	28 (40)
Meropenem	137 (92.5)	11 (7.5)	29 (41.4)	41 (58.6)
Amikacin	116 (78.4)	32 (21.6)	37 (52.9)	33 (47.1)
Gentamicin	99 (66.9)	49 (33.1)	33 (47.1)	37 (52.9)
Ciprofloxacin	72 (48.6)	76 (51.4)	24 (34.3)	46 (65.7)
Norfloxacin	73 (49.3)	75 (51.7)	22 (31.4)	48 (68.6)
Cotrimoxazole	74 (50)	74 (50)	32 (45.7)	38 (54.3)
Fosfomycin	148 (100)	0	-	-
Nitrofurantoin	105 (71)	43 (29)	21 (30)	49 (70)

[Table/Fig-3a]: Antibiotic sensitivity pattern of uropathogens for *Escherichia coli* and *Klebsiella pneumonia*.

Antibiotics	*Klebsiella aerogenes* n (% S)	*Klebsiella aerogenes* n (% R)	*Proteus* spp. n (% S)	*Proteus* spp. n (%R)
Ampicillin	-		1 (16.7)	5 (83.3)
Amoxicillin/ Clavulanic acid	-		3 (50)	3 (50)
Cefoperazone/ Sulbactum	2 (100)	0	5 (83.3)	1 (16.7)
Piperacillin/ Tazobactum	2 (100)	0	5 (83.3)	1 (16.7)
Cefuroxime	1 (50)	1 (50)	4 (66.7)	2 (33.3)
Ceftazidime	2 (100)	0	4 (66.7)	2 (33.3)
Cefotaxime	2 (100)	0	3 (50)	3 (50)
Cefepime	2 (100)	0	4 (66.7)	2 (33.3)
Cefixime	2 (100)	0	3 (50)	3 (50)
Cefpodoxime	2 (100)	0	3 (50)	3 (50)
Cephalexin	2 (100)	0	1 (16.7)	5 (83.3)
Imipenem	2 (100)	0	6 (100)	0
Meropenem	2 (100)	0	6 (100)	0
Amikacin	1 (50)	1 (50)	5 (83.3)	1 (16.7)
Gentamycin	1 (50)	1 (50)	5 (83.3)	1 (16.7)
Ciprofloxacin	2 (100)	0	5 (83.3)	1 (16.7)
Norfloxacin	2 (100)	0	5 (83.3)	1 (16.7)
Cotrimoxazole	2 (100)	0	3 (50)	3 (50)
Fosfomycin	-	-	-	-
Nitrofurantoin	2 (100)	0	-	-

[Table/Fig-3b]: Antibiotic sensitivity pattern of uropathogens for *Proteus* spp. and *Klebsiella aerogenes*.

P. aeruginosa isolates showed higher sensitivity to amikacin with 19 (76%) and cefoperazone/sulbactam with 20 (80%), while being resistant to ceftazidime with 12 (48 %) and cefepime with 11 (44%) [Table/Fig-6].

Antibiotics	*Enterococcus* spp. n (% S)	*Enterococcus* spp. n (% R)
Ampicillin	23 (52.3)	21 (47.7)
Nitrofurantoin	32 (72.7)	12 (27.3)
Amikacin	35 (79.5)	9 (20.5)
High level gentamycin	32 (72.7)	12 (27.3)
Ciprofloxacin	17 (38.6)	27 (61.4)
Norfloxacin	17 (38.6)	27 (61.4)
Vancomycin	44 (100)	0
Linezolid	44 (100)	0

[Table/Fig-4]: Antibiotic sensitivity pattern of *Enterococcus spp.*

Antibiotics	*Staphylococcus aureus* n (% S)	*Staphylococcus aureus* n (% R)	CONS n (% S)	CONS n (%R)
Ampicillin	1 (25)	3 (75)	3 (100)	0
Cefoxitin	2 (50)	2 (50)	3 (100)	0
Cephalexin	2 (50)	2 (50)	3 (100)	0
Amikacin	3 (75)	1 (25)	3 (100)	0
Gentamicin	3 (75)	1 (25)	3 (100)	0
Norfloxacin	2 (50)	2 (50)	3 (100)	0
Trimethoprim/ sulfamethoxazole	3 (75)	1 (25)	3 (100)	0
Nitrofurantoin	3 (75)	1 (25)	3 (100)	0
Linezolid	4 (100)	0	3 (100)	0
Vancomycin	4 (100)	0	3 (100)	0

[Table/Fig-5]: Antibiotic sensitivity pattern of *Staphylococcus aureus* and CONS.

Antibiotics	*Pseudomonas aeruginosa* n (% S)	*Pseudomonas aeruginosa* n (% R)
Cefoperazone/Sulbactum	20 (80)	5 (20)
Piperacillin/Tazobactum	18 (72)	7 (28)
Ceftazidime	13 (52)	12 (48)
Cefepime	14 (56)	11 (44)
Imipenem	18 (72)	7 (28)
Meropenem	18 (72)	7 (28)
Amikacin	19 (76)	6 (24)
Ciprofloxacin	16 (64)	9 (36)
Levofloxacin	25 (100)	0
Norfloxacin	17 (68)	8 (32)
Colistin	25 (100)	0
Polymixin B	25 (100)	0

[Table/Fig-6]: Antibiotic sensitivity pattern of *Pseudomonas* aeruginosa.

Acinetobacter spp. demonstrated the highest sensitivity to Cotrimoxazole (100%) and the highest resistance to ceftazidime and cefepime [Table/Fig-7].

Antibiotics	*Acinetobacter baumannii* n (% S)	*Acinetobacter baumannii* n (% R)
Cefoperazone/sulbactum	9 (69.2)	4 (30.8)
Piperacillin/Tazobactum	9 (69.2)	4 (30.8)
Ceftazidime	3 (23.1)	10 (76.9)
Cefepime	5 (38.5)	8 (61.5)
Imipenem	10 (76.9)	3 (23.1)
Meropenem	10 (76.9)	3 (23.1)
Amikacin	8 (61.5)	5 (38.5)
Gentamicin	8 (61.5)	5 (38.5)
Ciprofloxacin	8 (61.5)	5 (38.5)
Norfloxacin	9 (69.2)	4 (30.8)
Cotrimoxazole	13 (100)	0

[Table/Fig-7]: Antibiotic sensitivity pattern of *Acinetobacter baumannii*.

Streptococcus spp. was highly sensitive to ampicillin with 4 (100%), ceftriaxone with 4 (100%), but resistant to ciprofloxacin with 2 (50%) and norfloxacin with 2 (50%) [Table/Fig-8].

Antibiotics	*Streptococcus* spp. n (% S)	*Streptococcus* spp. n (% R)
Ampicillin	4 (100)	0
Ceftriaxone	4 (100)	0
Ciprofloxacin	2 (50)	2 (50)
Norfloxacin	2 (50)	2 (50)
Vancomycin	4 (100)	0
Linezolid	4 (100)	0

[Table/Fig-8]: Antibiotic sensitivity pattern of *Streptococcus* spp.

DISCUSSION

UTI is a major health problem worldwide, and the pattern of antibiotic resistance varies in different regions. The judicious usage of higher antibiotics at the community level is making the situation more alarming. The present study provides an outlook on the prevalence and antibiogram of the uropathogens isolated in this part of South Kerala. In the present study, the prevalence of UTI was 11.4%, which was in concordance with the findings of similar studies conducted by Mehrishi P et al., (9.7%), Baveja CP et al., (10.2%), and Kumar A et al., (12.18%) [7-9]. A higher prevalence of 29% was found in a study by Agarwal A et al., [10]. The difference in prevalence might be due to geographical variation, sociocultural habits of the community, health awareness, and personal hygiene practices.

The rate of isolation was higher in females, with 204 (64%) cases, revealing the increased susceptibility of females to UTIs compared to males, with 115 (36%) cases, similar to various cited studies [11-13]. Females are more prone to UTIs due to a short urethra, proximity to the anus, absence of prostatic secretion, pregnancy, and easy contamination of the tract with faecal flora and urethral trauma during sexual intercourse. A study by Patil S showed that males were the most common gender compared to females. This finding does not match with present study [14].

The analysis of the age-wise data portrayed an increased prevalence in the 61-80 years age group with 103 (32.3%), which was in line with the findings of similar studies conducted by Manjunath GN et al., (43%) in the age group 50-79 years [15] and Barate DL and Ukesh C (42.85%) in the above 40 years age group [16]. In contrast, Akram M et al., reported a prevalence of 16.66% in the 50-80 years age group [17]. The increased vulnerability in the geriatric population may be attributed to age-related physiological and immunological changes and other infirmities like diabetes and enlarged prostate, as depicted in other studies [15,16,18].

In the present study, nine different types of organisms were isolated, with *E. coli* being the predominant one at 148 (46.4%), followed by *Klebsiella* spp. at 72 (22.6%). *Enterococcus* spp. and *Pseudomonas* spp. constituted 44 (13.7%) and 25 (7.8%) of the total urinary isolates, respectively. A study by Akter L et al., stated that *E. coli* (59.30%) was the leading bacteria, followed by *Enterococcus* spp. (11.56%), *Klebsiella* spp. (5.53%), *Pseudomonas* spp. (2.01%), and *Proteus* spp. (1.51%) [19]. A higher isolation rate of *E. coli* was noted in the study by Parveen R et al., at 64.49%, followed by 11.21% for *Klebsiella* spp. [20].

The data from the present study demonstrated that *E. coli* isolates were highly resistant to ampicillin (92.6). These findings support previous research by Achaarya D et al., who found that 87.5% of bacterial *E. coli* were sensitive to ampicillin [21]. In this study, *E. coli* isolates were most commonly resistant to cephalosporins, co-trimoxazole, ciprofloxacin, and norfloxacin. On the other hand meropenem (92.6%), imipenem (91.9%), and amikacin (78.4%) showed high potency against *E. coli* isolates as well as other gram-negative uropathogens tested in this study.

Organisms belonging to the Enterobacteriaceae family in this study showed resistance to ampicillin and cephalosporins such as cephalexin, cefuroxime, and cefotaxime, which aligns with the findings of studies conducted by Ahmed SM et al., who reported resistance towards amoxyclav (79.6%), fluoroquinolones ciprofloxacin (62.5%) and norfloxacin (71.6%), and cephalosporins cefuroxime (75.9%) and ceftriaxone (71.6%) [22]. In a study by Manjunath G et al., *E. coli* showed high resistance to ampicillin (80.4%), cephalexin (49.4%), cefuroxime (47.4%), and ceftriaxone (43.2%) [15]. Similarly, in a study by Barate DL and Ukesh C *E. coli* exhibited high resistance to amoxiclav (85%) and cephalexin (83%) [16], and in another study by Akram M et al., *E. coli* showed high resistance to cefuroxime (69%) and cefotaxime (56%) [17].

In this study, the majority of isolates showed a higher sensitivity pattern towards meropenem, imipenem, piperacillin/tazobactam, and amikacin. Most non fermenters were highly susceptible to carbapenems, cefoperazone/sulbactam, and piperacillin/tazobactam.

Due to irrational and prophylactic usage, as well as over-the-counter sale of easily available antibiotics, *Pseudomonas aeruginosa*, which is the most common cause of hospital-acquired UTI, showed higher resistance to ciprofloxacin (36%), norfloxacin (32%), and cephalosporins (ceftazidime 48%) compared to aminoglycoside (amikacin 24%). This aligns with the findings of a similar study by Bose S et al., in which *Pseudomonas* exhibited heavy resistance to ciprofloxacin (67.28%), ceftazidime (54.55%), and amikacin (23.64%) [3].

In the case of gram-positive bacteria, especially *Staphylococcus aureus*, sensitivity was observed towards vancomycin and linezolid, while resistance was seen towards ampicillin, cephalexin, and to some extent norfloxacin. Similar trends in antibiotic sensitivity patterns were reported in a study by More SK et al., where *Staphylococcus* strains were more resistant to amoxicillin (48.58%) and norfloxacin (31.43%) [23].

Nitrofurantoin is an effective drug against Enterococcal UTI and other microorganisms causing lower UTI. It is effective against both *E. faecalis* and *E. faecium*, including most Vancomycin-Resistant Enterococci (VRE) strains [24]. Nitrofurantoin can also be used in early pregnancy [4,25].

Due to the high incidence of multidrug-resistant uropathogens, the use of older antibiotics like nitrofurantoin and fosfomycin has increased in clinical practice. The reversion of susceptibility to nitrofurantoin and fosfomycin is likely due to the non usage of these drugs for an extended period. In this study, nitrofurantoin and fosfomycin were found to be very effective for treating MDR uropathogens. This finding was supported by another study by Kaase M et al., which found that 21 out of 107 strains of *E. coli* (19.6%; 95% CI, 12.6% to 28.4%) were classified as resistant to fosfomycin using CLSI criteria [26]. Gupta V et al., documented that the resistance rate of fosfomycin for both ESBL-positive and -negative isolates was nil using both disk diffusion and E-test methods [27].

Considering the above findings, there is a dire need to introduce new antimicrobial drugs for UTIs. Extended Spectrum Beta Lactamases (ESBL) have evolved significantly over the last 20 years, and antimicrobial resistance is likely to pose significant therapeutic challenges in the future. It is unlikely that many new antibiotic options will be available in the next 5 to 10 years to address such multiresistant infections.

Limitation(s)

In the present study, molecular studies were not conducted due to limited resources. Another limitation of the study is the small sample size. As it is a retrospective record-based study and data were not collected in a predesigned proforma according to the specific requirements of the study, some data may be missing.

CONCLUSION(S)

In the present study, most of the isolates showed resistance to commonly used antibiotics such as ampicillin, cephalosporins, quinolones, and cotrimoxazole, but were susceptible to beta-lactam/beta-lactamase inhibitor combinations and carbapenems. The study revealed an increasing trend of antibiotic resistance among patients with UTI. Drug resistance among pathogens is a dynamic process, so routine surveillance and monitoring are essential. This study has provided valuable insights into the common isolates and their antibiotic sensitivity and resistance patterns, aiding in the selection of appropriate drugs and ultimately reducing the burden of emerging antibiotic resistance in this hospital. Strict adherence to infection control policies and regulations on the over-the-counter sale of antibiotics without a physician's prescription is crucial in our country. Empirical treatment guidelines for UTI should be adjusted based on regional or institutional in-vitro susceptibility data.

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