Original Article

Contributory Factors Of Antimicrobial Resistance Among Females Presenting With Culture-Positive Urinary Tract Infections in a Tertiary Care Hospital

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Abstract

Objective: This study aimed to identify the frequency and associated factors of multidrug resistance-causing UTI in women presenting to the urology department of Shifa International Hospital, Islamabad.

Methods: This cross-sectional study was conducted from July to September 2025 at the Urology Department of Shifa International Hospital, Islamabad, using a sample of 317 cases. Non-probability consecutive sampling was used to select the samples. A structured questionnaire was used to collect data, including administrative details, sociodemographic information, clinical status, and urine culture results. Data were entered and analysed using the Statistical Package for the Social Sciences (SPSS) version 24. Bivariate analysis was performed for demographic variables and resistance patterns.

Results: Out of 317 cases of culture-positive urinary tract infection, the mean age of the respondents was 55.85 years. Escherichia coli was the most common organism (225 [70.98%]), followed by Klebsiella pneumoniae (43 [13.56%]). Multidrug resistance was observed in 218 (68.7%) of the cases. Significant associations were found between marital status, comorbid conditions, presence of blood in urine, antibiotic use history, and type of infecting microbe.

Conclusion: Antimicrobial resistance was observed in 218 (68.7%) women with culture-positive urinary tract infections. Regarding the microbe, the most common organism was Escherichia coli 225 (70.98%). Significant associated factors with MDR included marital status, diabetes, hypertension, frequent antibiotic use, and the presence of blood in urine and gram-negative organisms. To prevent the emergence of resistance and encourage the responsible consumption of antibiotics, the results highlight the critical need for enhanced antibiotic stewardship initiatives.

Keywords: Drug Resistance, Microbial, Urinary Tract Infections, Females

Introduction

Antimicrobial resistance (AMR) is an emerging threat to public health. Low-and middle-income countries contribute the most to the global burden.[1] It occurs when microbes that are responsible for causing infections stop responding to treatment. Urinary tract infections (UTIs) are the most common bacterial infections occurring in communities and hospitals. These are experienced disproportionately more by females than by males. Misuse of antibiotics, lack of surveillance, data collection, and reporting lead to AMR.[2] UTIs are mostly treated empirically and lead to the rising prevalence of AMR. The effectiveness of empirical treatment depends on the underlying prevalence of resistance in the most common causative pathogens. Gram-negative bacteria responsible for causing UTI commonly include Escherichia coli, Proteus species, Pseudomonas aeruginosa, Acinetobacter species, Klebsiella species, Enterobacter species, and Citrobacter species. Among gram-positive bacteria, Staphylococcus saprophyticus, Enterococcus species, and Coagulase-negative Staphylococcus are common, predictable bacteria that are responsible for causing UTIs.[3]

UTIs are among the most widespread bacterial infections, affecting more than 150 million people worldwide annually. More than 7 million people per annum are consulted by physicians with UTIs in the USA, and resistance to empirical treatment is reported from European countries, including Russia.[4] Medical consultations show that 1%–3% of all consultations are due to UTI in the United Kingdom(UK). It is the second most common reason for prescribing antibiotics in the UK.[5] UTI may sometimes lead to serious complications such as pyelonephritis, sepsis, or renal abscess, especially in immunocompromised hosts and extremes of age, leading to significant mortality and morbidity.

The WHO GLASS (Global Antimicrobial Resistance and Use Surveillance System) report from Pakistan indicates > 70% resistance to ceftriaxone (CRO) and ciprofloxacin (CFX) in *E. coli* isolated from samples of patients with UTI.[6] A study conducted in Karachi reported that the majority of organisms causing UTIs were gram-negative bacteria (82.93%), the most common causative agent being Escherichia coli (54.49%), followed by Klebsiella spp. (17.33%) and Enterococcus spp. (9.92%). Resistance rates were highest for the tested fluoroquinolones (70% for most species), trimethoprim-sulfamethoxazole, broad-spectrum penicillins, and cephalosporins, whereas fosfomycin, carbapenems, and colistin retained their sensitivity.[7,8] Another study on UTI from Karachi found ceftriaxone resistance in 49% of gram-positive and 57% of gram-negative bacteria.[9] Antibiotic resistance is a problem in Pakistan, and its prevalence is intensified because of antibiotic overuse and misuse. The lack of systematic national surveillance of antibiotic resistance and insufficient data repositories are worsening this problem.[10] This study aimed to detect UTI-causing pathogens and antimicrobial resistance of these pathogens in the clinical setting of Islamabad, which is essential for designing local

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LA FF SMU MN - Conception, Design
AS RMK - Acquisition, Analysis, Interpretation
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guidelines to improve the efficacy of empirical treatment. This study also aimed to identify the frequency and associated factors of multidrug resistance-causing UTI in women presenting to the urology department of Shifa International Hospital, Islamabad.

Materials And Methods

After approval by the Institutional Review Board, this cross-sectional study was conducted from July to September 2025 at the Urology Department of Shifa International Hospital, Islamabad, using a sample of 317 cases at a 95% confidence interval and 5% margin of error, with an anticipated multidrug resistance rate of 71%.[11] All female patients aged 18–75 years with a positive urine culture were included in the study. Females with known anatomical abnormalities of the urinary system, those who had any surgery related to the urinary system, and those with a history of antibiotic use within the previous week were excluded from the study. Samples were included using non-probability consecutive sampling.

A structured questionnaire was used to collect data. It comprised several sections, including administrative details (participant name and interviewer IDs, date of the interview, and urine sample ID), sociodemographic information (participant's educational background, work status, and tobacco use), clinical status, including questions related to menstrual status, marital status, number of vaginal deliveries, blood pressure, diabetes, and UTI-related symptoms. Finally, urine culture reports were entered in the last section, including the organism and sensitivity report. Non-susceptibility to at least one antimicrobial in three or more classes was considered to be multidrug resistance. After informed consent and ensuring confidentiality, data were collected during the interview with the respondents, while the last section was filled in by viewing the culture report.

Data were entered and analysed using the Statistical Package for the Social Sciences (SPSS) version 24. Mean and standard deviations were calculated for quantitative variables, and frequencies and percentages were calculated for categorical variables. Chi-square ($\chi 2$) was used to determine the association between demographic variables and multidrug resistance. Statistical significance was set at $P < 0.05$.

Results

This study included 317 cases of culture-positive urinary tract infections. The mean age of the participants was 55.85 years, with a standard deviation of 15.61 years. The sociodemographic characteristics of the study participants are shown in Table 1. Escherichia coli was the most common organism (225 patients, 70.98%), followed by Klebsiella pneumoniae (43 patients, 13.56%), as shown in Figure 1.

Table 1: Sociodemographic characteristics of study participants n=317

Variable	Category	Frequency (n)	Percent (%)
Age	Up to 40 years	57	18.0
	Above 40 years	260	82.0
Working Status	Government Employee	7	2.2
	Non-Government Employee	17	5.4
	Self-employed	234	73.8
	Non-paid	59	18.6
Menstrual Status	Regular periods	92	29.0
	Peri Menopausal	42	13.2
	Menopausal	183	57.7
Marital Status	Never Married	19	6.0
	Currently Married	298	94.0
Vaginal Deliveries	Up to 4	262	82.6
	More than 4	55	17.4
Ever Smoked Cigarette/Cigar/Pipe	No	299	94.3
	Yes	18	5.7
Current Smoking Status	No	297	93.7
	Yes	20	6.3
Urinary Symptoms	Painful Urination	220	69.4
	Lower Back Pain	108	34.1
	Blood in Urine	90	28.4
	Difficulty Emptying Bladder	122	38.5
Antibiotic Usage in the last year	0 Time	14	4.4
	1 Time	145	45.7
	2 or more Times	158	49.8
Gram Staining of Organism	Gram Positive	37	11.7
	Gram Negative	282	89.0

The antibiotic resistance patterns are shown in Table 2. High levels of resistance were observed for augmentin (62.1%), ceftriaxone (65.0%), cephazolin (65.3%), cefixime (66.2%), and ciprofloxacin (63.4%).

Multidrug resistance was observed in 218 (68.7%) of the patients. Bivariate analysis was done between multidrug resistance and associated factors. Significant associations were found between marital status, comorbid conditions, presence of blood in urine, antibiotic use history, and type of infecting organism. Among the marital statuses, individuals who were never married had a significantly higher proportion of non-susceptible cases (94.7%) than currently married individuals (67.1%; p=0.012). Regarding comorbid conditions, diabetes was associated with the highest proportion of non-susceptible cases (84.2%), whereas those with no comorbidities had a higher proportion of susceptible cases (35.4%; p=0.014).

Table 2: Antibiotic Resistance Patterns of Culture-positive urinary tract infection n=317

Antibiotic	Category	Frequency	Percent (%)
Augmentin	Sensitive	120	37.9
	Resistance	197	62.1
Ceftriaxone	Sensitive	111	35.0
	Resistance	206	65.0
Cephazolin	Sensitive	110	34.7
	Resistance	207	65.3
Cefixime	Sensitive	106	33.4
	Intermediate	1	0.3
	Resistance	210	66.2
Ciprofloxacin	Sensitive	107	33.8
	Intermediate	9	2.8
	Resistance	201	63.4
Cotriamaxozole	Sensitive	128	40.4
	Intermediate	2	0.6
	Resistance	187	59.0
Doxycycline	Sensitive	202	63.7
	Intermediate	9	2.8
	Resistance	106	33.4
Cephazolin	Sensitive	291	91.8
	Intermediate	5	1.6
	Resistance	21	6.6
Focin	Sensitive	294	92.7
	Intermediate	1	0.3
	Resistance	22	6.9
Gentamicin	Sensitive	257	81.1
	Resistance	60	18.9
Meronem	Sensitive	293	92.4
	Intermediate	3	0.9
	Resistance	21	6.6
Nitrofurantoin	Sensitive	270	85.2
	Intermediate	4	1.3
	Resistance	43	13.6
Tanzo	Sensitive	271	85.5
	Intermediate	7	2.2
	Resistance	39	12.3

The presence of blood in urine was strongly associated with non-susceptibility; 82.2% of such cases were non-susceptible compared with 63.4% in those without blood in urine (p=0.001). Antibiotic use history showed that individuals who had used antibiotics once in the past year had the highest proportion of non-susceptible cases (88.3%), whereas those with two courses had a higher proportion of susceptible cases (48.1%, p=0.000). Additionally, infections caused by Gram-positive organisms were more likely to be susceptible (64.9%), whereas Gram-negative organisms were predominantly associated with non-susceptibility (72.7%, p=0.000).

Discussion

This study aimed to examine the antimicrobial resistance patterns and factors associated with them among women with culture-positive community-acquired urinary tract infections (UTIs) at a tertiary care hospital in Islamabad. Our findings provide insights into antibiotic resistance, associated risk factors, and multidrug-resistant patterns. Most participants were older than 40 years (82.0%), self-employed (73.8%), and menopausal (57.7%), indicating that UTIs affect middle-aged and older women with varying sociodemographic characteristics. This finding is consistent with the previous studies showing that urinary tract infection is more common in middle-aged females.[12]

Multidrug resistance was observed in 218 (68.7%) of the cases. A study assessing the multidrug resistance of community-acquired urinary tract infections showed that 53.8% were resistant.[13] A study conducted in Bangladesh showed that 92% of urinary tract infections were caused by multidrug-resistant Escherichia coli.[14] Antimicrobial resistance, particularly in urinary tract infections, is a growing concern globally. High levels of resistance were observed for Augmentin (62.1%), ceftriaxone (65.0%), cephazolin (65.3%), cefixime (66.2%), and ciprofloxacin (63.4%). This highlights that urinary tract infection is resistant to commonly used first-line drugs. This calls for a " one health approach for the judicious use of antibiotics.[15] In our setting, antibiotics are available as over-the-counter drugs. Antibiotics should be used with a proper prescription, with appropriate dosage and schedule.[16,17] However, antibiotics, such as nitrofurantoin (85.2%), fosfomycin (92.7%), and meropenem (92.4%), demonstrated high susceptibility. This shows that they can be used in the case of multidrug-resistant urinary tract infection. To treat urinary tract infection, predisposing factors should be considered while prescribing antibiotics. Once the culture report is available, the regimen can be changed accordingly.[18]

Bivariate analysis was done to find the factors associated with multidrug resistance. The first factor was marital status, which showed that resistant urinary tract infection is more common in unmarried females. Secondly, the presence of comorbid conditions like diabetes and hypertension increases the chances of multidrug resistance significantly. A study done in Iran showed that diabetics have a high prevalence of multidrug resistance, which is linked to poor glycemic control.[19] This may be because diabetes weakens the immune system, increasing the chances of drug-resistant infections. Thirdly, blood in urine, both microscopic or frank hematuria, had significantly increased chances of multidrug-resistant

urinary tract infection. The rise of MDR pathogens complicates treatment, as these strains may lead to more severe symptoms, including hematuria.[20] Fourthly, females who had used antibiotics in the last year due to any reason had a higher prevalence of multidrug resistance.

Table 3: Bivariate analysis of Antibiotic susceptibility with associated factors

Variable	Categories	Susceptible n (%)	Non-Susceptible n (%)	Chi-Square (p-value)
Age	Less than 40	13 (22.8%)	44 (77.2%)	2.296 (p=0.130)
	More than 40	86 (33.1%)	174 (66.9%)	
Occupational Status	Government Employee	0 (0.0%)	7 (100.0%)	5.136 (p=0.162)
	Non-Government Employee	3 (17.6%)	14 (82.4%)	
	Self-employed	78 (33.3%)	156 (66.7%)	
	Non-paid	18 (30.5%)	41 (69.5%)	
Menstrual Status	Regular periods	24 (26.1%)	68 (73.9%)	2.142 (p=0.343)
	Peri Menopausal	16 (38.1%)	26 (61.9%)	
	Menopausal	59 (32.2%)	124 (67.8%)	
Marital Status	Unmarried	1 (5.3%)	18 (94.7%)	**6.346 (p=0.012)****
	Married	98 (32.9%)	200 (67.1%)	
Vaginal Deliveries	Less than 4	86 (32.8%)	176 (67.2%)	1.787 (p=0.181)
	More than 4	13 (23.6%)	42 (76.4%)	
Ever Smoked	Yes	3 (16.7%)	15 (83.3%)	1.885 (p=0.170)
	No	96 (32.1%)	203 (67.9%)	
Current Smoker	Yes	4 (20.0%)	16 (80.0%)	1.24 (p=0.263)
	No	95 (32.0%)	202 (68.0%)	
Comorbid Conditions	None	84 (35.4%)	153 (64.6%)	**8.569 (p=0.014)****
	Blood Pressure	6 (26.1%)	17 (73.9%)	
	Diabetes	9 (15.8%)	48 (84.2%)	
Urine Frequency	Yes	85 (32.2%)	179 (67.8%)	0.687 (0.407)
	No	14 (26.4%)	39 (73.6%)	
Urinary Urgency	Yes	80 (33.6%)	158 (66.4%)	2.525 (0.112)
	No	19 (24.1%)	60 (75.9%)	
Painful Urination	Yes	68 (30.9%)	152 (69.1%)	0.035 (0.853)
	No	31 (32.0%)	66 (68.0%)	
Difficulty in Emptying Bladder	Yes	34 (27.9%)	88 (72.1%)	1.043 (0.307)
	No	65 (33.3%)	130 (66.7%)	
Pressure	Yes	31 (33.3%)	62 (66.7%)	0.271 (0.603)
	No	68 (30.4%)	156 (69.6%)	
Lower Back Pain	Yes	34 (31.5%)	74 (68.5%)	0.005 (0.945)
	No	65 (31.1%)	144 (68.9%)	
Blood in Urine	Yes	16 (17.8%)	74 (82.2%)	**10.590 (0.001)****
	No	83 (36.6%)	144 (63.4%)	
Antibiotics Last Year	0	6 (42.9%)	8 (57.1%)	**47.509 (0.000)****
	1	17 (11.7%)	128 (88.3%)	
	2	76 (48.1%)	82 (51.9%)	
Gram Positive Organism	Yes	24 (64.9%)	13 (35.1%)	**22.065 (0.000)****
	No	75 (26.8%)	205 (73.2%)	
Gram-Negative Organism	Yes	77 (27.3%)	205 (72.7%)	**18.324 (0.000)****
	No	22 (62.9%)	13 (37.1%)	

The use of antibiotics previously can increase antimicrobial drug resistance.[21] Drug resistance is more common if a urinary tract infection is caused by gram-negative organisms than by gram-positive organisms. A previous study has shown that gram-negative bacteria have higher antimicrobial resistance.[22]

These findings highlight that it is the need of the hour to implement antibiotic stewardship. The overuse and misuse of antibiotics have contributed to the emergence of resistant strains of UTIs. Public health interventions, such as awareness, infection prevention approaches, and advocacy for antibiotic resistance, should be adopted. The limitations of this study are that it was a single-center study, which could limit the generalisability of the study. Second, a temporal relationship cannot be established, as it was a cross-sectional study. Further research should explore the impact of lifestyle, hygiene practices, and healthcare-seeking behaviour on UTI prevalence and resistance patterns.

Conclusions

Antimicrobial resistance was observed in 218 (68.7%) women with culture-positive urinary tract infections. Regarding the microbe, the most common organism was Escherichia coli 225 (70.98%). Significant associated factors with MDR included marital status, diabetes, hypertension, frequent antibiotic use, and the presence of blood in urine and gram-negative organisms. To prevent the emergence of resistance and encourage the responsible consumption of antibiotics, the results highlight the critical need for enhanced antibiotic stewardship initiatives.

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