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ANTIBIOTIC SUSCEPTIBILITY PATTERN OF E. COLI ISOLATED FROM THE URINE SAMPLES OF PATIENTS VISITED CIVIL HOSPITAL MADYAN SWAT

Original Research

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ABSTRACT

Background: Antibiotic resistance is a global challenge, particularly in urinary tract infections (UTIs) caused by *Escherichia coli* (*E. coli*), which is a leading pathogen in both nosocomial and community-acquired infections. Regular monitoring of antibiotic susceptibility profiles is essential due to the rising prevalence of drug-resistant bacteria. This study focused on evaluating the antibiotic susceptibility pattern of *E. coli* isolated from urine samples of patients attending Civil Hospital Madyan, Swat, to guide effective empirical therapy.

Objective: To determine the antibiotic susceptibility profile of *E. coli* isolated from urine samples of UTI patients visiting Civil Hospital Madyan, Swat.

Methods: A cross-sectional study was conducted from December 2022 to July 2023 in the Department of Microbiology, Government Degree College Madyan, Swat. A total of 450 mid-stream urine samples were collected from patients with suspected UTIs. The samples were cultured on MacConkey agar and incubated at 37°C for 24–48 hours under aerobic conditions. Isolated bacterial colonies were identified using gram staining, microscopy, and biochemical tests. Antibiotic susceptibility testing was performed on Mueller-Hinton agar using the Kirby-Bauer disc diffusion method with multiple antibiotic discs. The bacterial isolates were categorized into resistant (R), sensitive (S), or intermediate (I) groups by measuring inhibition zone diameters. Data were statistically analyzed and presented in figures and tables.

Results: Out of 450 urine samples, 125 (27.0%) were culture-positive, with *E. coli* being the most frequently isolated bacterium (60%). Culture positivity was higher in females (70%) than males (30%). Among hospital areas, samples from the outpatient department (70%) showed the highest culture positivity, followed by wards (25%) and the emergency department (5%). Antibiotic susceptibility testing revealed that *E. coli* exhibited the highest resistance to ampicillin (97.1%), ceftriaxone (92%), moxifloxacin (88.2%), cefixime (86%), and ceftazidime (80.1%). Conversely, the highest sensitivity was observed to fosfomycin (95.3%), sulzone (85.2%), imipenem (85.0%), and amikacin (78%).

Conclusion: This study confirmed that *E. coli* is the predominant pathogen causing UTIs and displayed significant resistance to commonly used antibiotics such as ampicillin, ceftriaxone, moxifloxacin, cefixime, and ceftazidime. However, fosfomycin, imipenem, and amikacin were found to be the most effective antibiotics against *E. coli*. These findings underscore the importance of conducting antibiotic susceptibility testing to guide effective therapy and combat antimicrobial resistance.

Keywords: Antibiogram, *E. coli*, drug resistance, imipenem, susceptibility, urinary tract infections, urine samples.

INTRODUCTION

Urinary tract infections (UTIs) encompass a spectrum of disorders affecting various components of the urinary system and are characterized by the presence of microorganisms, which can range in severity from cystitis to pyelonephritis (1). Among the causative agents, *Escherichia coli* (E. coli), a gram-negative, rod-shaped, facultative anaerobic bacterium, holds particular clinical significance. Belonging to the family *Enterobacteriaceae*, *E. coli* is a lactose fermenter and is one of the primary pathogens responsible for both nosocomial and community-acquired infections. This bacterium is frequently isolated from clinical specimens, including urine and blood, underscoring its importance in human health (2). Beyond UTIs, *E. coli* is also recognized as a predominant pathogen in gastrointestinal infections, further emphasizing its versatile pathogenic potential (3).

The challenge of antibiotic resistance among gram-negative bacteria such as *E. coli* has garnered global attention due to the increasing prevalence of multidrug-resistant strains. Resistance patterns among bacterial isolates are dynamic, influenced by temporal and environmental factors, necessitating routine surveillance to inform treatment protocols (4, 5). Regular monitoring of antibiotic susceptibility is particularly critical for geographically specific populations, as it forms the foundation for effective antimicrobial stewardship and policy-making (6). This is especially pertinent in the context of Pakistan, where the misuse and overuse of antibiotics have compounded the issue of resistance (8). Addressing these challenges requires a systematic approach to identify prevalent pathogens and evaluate their resistance profiles to commonly prescribed antibiotics in clinical settings (7, 9).

In light of these concerns, the present study aims to determine the antibiotic susceptibility patterns of *E. coli* isolates obtained from the urine samples of patients attending Civil Hospital Madyan Swat. By understanding the current trends in resistance, this research seeks to contribute to the optimization of empirical therapy, support evidence-based prescription practices, and improve patient outcomes in the region.

METHODS

The study was conducted in the Department of Microbiology, Government Degree College Madyan, Swat, from December 2022 to July 2023, following approval from the institution's ethical research committee. A total of 450 mid-stream urine samples were collected in sterile, closed containers from individuals presenting with urinary tract infection (UTI) complications at Civil Hospital Madyan, Swat. Samples were immediately transported to the microbiology laboratory at the college for further analysis. Culturing was performed on MacConkey agar using standard laboratory protocols, with incubation carried out at 37°C under aerobic conditions for 24 to 48 hours. Bacterial growth was deemed significant based on the Kass criteria, where colony-forming units (CFU) equal to or exceeding 10^5 per milliliter of urine were considered indicative of infection (10).

Isolated bacterial colonies were identified using a combination of gram staining, microscopy, and various biochemical tests to confirm the presence of *Escherichia coli*. Antibiotic susceptibility testing was performed using the Kirby-Bauer disc diffusion method on Mueller-Hinton agar. Inhibition zones were measured after incubation for 48 hours at 37°C, and results were interpreted according to the 2019 Clinical and Laboratory Standards Institute (CLSI) guidelines (11). A range of antibiotics was tested, including Amikacin (AKN), Tazocin (TZP), Ceftazidime (CAZ), Ampicillin (AMP), Ciprofloxacin (CIP), Ceftriaxone (CRO), Fosfomycin (FOS), Moxifloxacin (MXF), Cefixime (CFM), Sulzone (SCF), Nitrofurantoin (F), and Imipenem (IPM). Based on the measured inhibitory zone diameters, bacterial strains were categorized as resistant (R), sensitive (S), or intermediate (I). Statistical analyses of the data were carried out to ensure precision and reliability. Results were subsequently presented in the form of figures and tables to provide a comprehensive understanding of the findings.

RESULTS

A total of 450 urine samples were collected for antibiogram of E.coli from suspected UTIs participants. Out of which females were 65% and males were 35%. Out of the total samples examined 125(27.0%) were culture positive while the remaining 350(73.0%) yielded no growth as presented in figure 1.Most of the samples were obtained from OPD (70%) followed by different ward of hospital (25%) and

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Emergency department (5%) as presented in table 1.From both sexes the most frequent bacteria isolated was E.coli(60%) followed by the species of enterococcus (15%), Klebsiella spp(12%), Acinatobacter species (6%), Coliform spp. (5%) and S.aureus was (4%) as presented in table 2. E. coli was the most prevalent bacteria isolated. Females had the largest frequency (70%) compared to men (30%). the incidence of E. coli was higher in samples collected from from OPD patients (70 %) followed by wards (25%) and emergency unit (5%) respectively as displayed in table 3. The results of the antibiotics susceptibility profile evaluated that E.coli had high level of resistance to ampicillin (97.1%) followed by Ceftriaxone (92%), Moxifloxicin(88.2%) Cefixime (86%) and Ceftazidime (80.1%) respectively. This bacteria was most sensitive to Fosfomycin (95.3%), Sulzone(85.2%), Imepinem (85.0%) and Amikacin (78%) as shown in table 4.

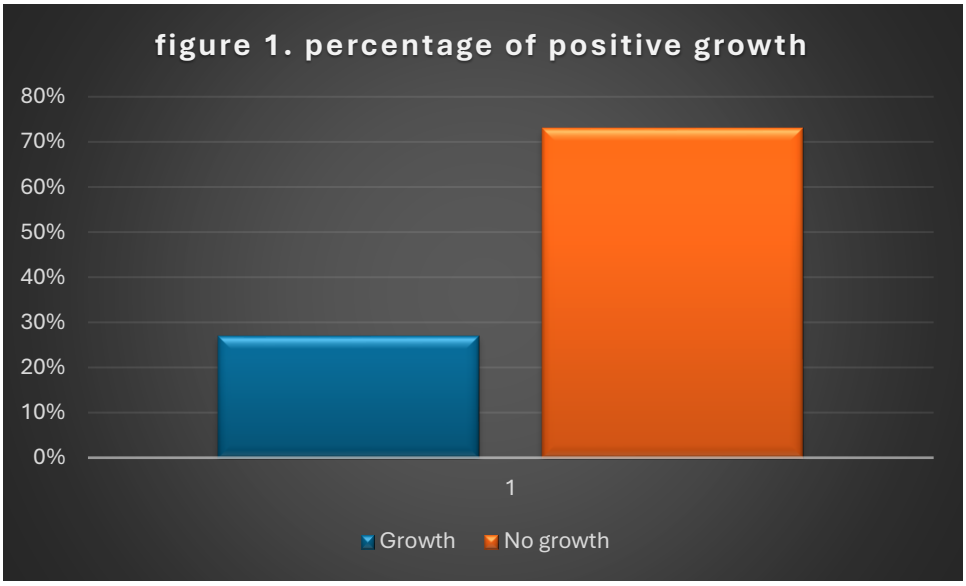

Table 1 Distribution of urine samples by percentage taken from different areas in hospitals.

Samples areas	Percentage
Emergency unit	5%
Outpatient door	70 %
Wards	25%

Table 1 presents the distribution of urine samples collected from various hospital areas, showing that the majority were obtained from the outpatient department (70%), followed by wards (25%) and the emergency unit (5%).

Table 2 Different bacteria isolated from urine samples (%)

Bacteria	Frequency
E.coli	60%
Enterococcus species	15%
Klebsiella species	12%

Bacteria	**Frequency**
Coliform group	5%
Acinatobacter species	6%
S.aureus	4%

Table 2 shows the bacterial distribution isolated from urine samples, with *E. coli* being the most common (60%), followed by *Enterococcus* species (15%), *Klebsiella* species (12%), the coliform group (5%), *Acinetobacter* species (6%), and *S. aureus* (4%).

Table 3 Frequency of UTI caused by E. coli in our patients

Site	**(%)**
Emergency	5
Emergency unit	70
Wards	25

Table 3 illustrates the frequency of urinary tract infections caused by *E. coli* across hospital sites, with the majority of cases originating from the outpatient department (70%), followed by wards (25%) and the emergency unit (5%).

Table 4 Antibiogram of E.coli

Antibiotics	**Codes**	**Antibiogram**		
		Sensitive	Intermediate	Resistant
Ampicilin	AMP	2.9 %	-	97.1%
Ceftriaxone	CRO	8%	-	92%
Cefixime	CFM	14%	-	86%
Ceftazidime	CAZ	14.5%	-	80.5%
Cefotaxime	CTX	18%	-	88%
Moxifloxacin	MXF	10.%	2.0	88.2%
Fosfomycin	FOS	95.3%	-	4.7%
Sulzone	SCF	85.2%	8.0%	7.3%
Imipenem	IPM	85.0%	7%	8.0%
Amikacin	AKN	80%	2%	18%
Tazocin	TZP	76.5%	21.1	2.4%
Meropenem	MRP	64.9%	-	35.1%
Nitrofurantion	F	60%	-	40%
Ciprofloxacin	CIP	38.2%	3%	58.8%

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Table 4 presents the antibiogram of *E. coli* isolates, showing high resistance to ampicillin (97.1%), ceftriaxone (92%), and moxifloxacin (88.2%), while demonstrating the highest sensitivity to fosfomycin (95.3%), sulzone (85.2%), imipenem (85%), and amikacin (80%). Intermediate susceptibility was observed for sulzone (8.0%) and imipenem (7.0%), with variable patterns for other antibiotics.

DISCUSSION

The increasing bacterial resistance to antimicrobial agents remains a pressing global health concern, particularly due to the empirical prescription of antibiotics without culture sensitivity testing. This practice has significantly contributed to the resistance of bacteria to commonly available drugs. The current study evaluated the antibiotic susceptibility profile of *Escherichia coli* isolated from mid-stream urine samples of patients attending Civil Hospital Madyan, Swat. Out of 450 urine samples collected, 125 (27.0%) were culture-positive for bacterial growth, while 350 (73.0%) showed no growth. The majority of culture-positive cases were observed among female participants (65%) compared to males (35%). These findings align with previous studies such as that of Santhosh et al. (12), further underscoring the predominance of UTIs in females, a trend attributed to anatomical and physiological factors.

In the current study, *E. coli* was the most frequently isolated bacterium, accounting for 60% of the total isolates, followed by *Enterococcus* species (15%). These results are consistent with findings by Shivani Gupta et al. (13) and Malik et al. (14), who similarly reported the dominance of *E. coli* in urinary isolates. A higher prevalence of *E. coli* was noted among women compared to men, consistent with other regional studies. These findings emphasize the critical need to monitor antimicrobial susceptibility patterns to inform effective treatment strategies, particularly for common pathogens such as *E. coli*. Despite being sensitive to certain antibiotics, *E. coli* has demonstrated increasing resistance to several drugs due to widespread misuse, which exacerbates treatment challenges. The study also highlights the alarming prevalence of resistance to cephalosporins and penicillin in Pakistan, findings that align with previous research, while contrasting with European studies that report higher sensitivity to these antibiotics (18, 19).

Quinolones, particularly ciprofloxacin, have historically been widely used for treating *E. coli* infections; however, the current findings revealed that *E. coli* exhibited significant resistance to ciprofloxacin (58.8%), a result supported by Mavroidi et al. (20). Conversely, *E. coli* showed high sensitivity to fosfomycin (95.3%), sulzone (85.2%), imipenem (85.0%), and amikacin (78%). These results are consistent with findings from studies conducted by Mangaiark (21) and Sharma (22), reaffirming the efficacy of these antibiotics against *E. coli* infections. These findings emphasize the importance of incorporating these agents into treatment protocols for UTIs in settings with high resistance to other antibiotic classes. The strengths of this study include its comprehensive approach to evaluating a large sample size, its focus on a clinically significant pathogen, and the use of standardized protocols for antimicrobial susceptibility testing. However, limitations should be acknowledged. The study was geographically restricted to a single hospital, which may limit the generalizability of the findings to other regions. Additionally, the resistance patterns observed were not correlated with patient-specific factors such as prior antibiotic use, comorbidities, or hospital stay duration, which could provide a deeper understanding of resistance mechanisms.

A recent study conducted by Kalal et al. (2022) in India evaluated the antibiotic susceptibility patterns of *E. coli* isolates from urinary tract infections in a tertiary care hospital. Their findings revealed high resistance rates to commonly used antibiotics such as ceftriaxone (85%) and ciprofloxacin (68%), which are consistent with the current study's findings. However, they reported slightly lower resistance to ceftazidime (72%), suggesting regional variations in antimicrobial resistance patterns. Kalal et al. also found that fosfomycin (92%) and imipenem (87%) were among the most effective antibiotics, further emphasizing their utility in managing *E. coli*-related UTIs. These similarities underscore the urgent need for localized antibiotic stewardship programs and routine susceptibility testing to ensure effective empirical treatment, especially in developing countries where antibiotic misuse is prevalent (23). The findings of this study underscore the urgent need for robust antimicrobial stewardship programs and the regular surveillance of resistance patterns to ensure effective treatment strategies. By emphasizing the judicious use of antibiotics and tailoring empirical therapy based on local susceptibility data, this study contributes to the growing body of evidence advocating for targeted interventions to combat antibiotic resistance.

CONCLUSION

The findings of the current study highlighted that *Escherichia coli* was the most prevalent bacterium isolated from urine samples of patients with urinary tract infections. The study revealed significant resistance of *E. coli* to commonly used antibiotics such as ampicillin,

ceftriaxone, moxifloxacin, and ceftazidime, while antibiotics like fosfomycin, imipenem, and amikacin demonstrated high efficacy against the isolated strains. These results underscore the importance of performing antibiotic susceptibility testing prior to initiating therapy to ensure effective treatment and to combat the growing issue of antimicrobial resistance.

Author Contributions

Author	Contribution
Salim Ullah*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Habib Salam	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Muhammad Israr Ullah	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Imran Khan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Azam Khan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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