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A Retrospective study on Prevalence and Analysis of antibiogram of E. coli isolated from various clinical samples at Tertiary Care Hospital, Nadiad

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ABSTRACT

Background: E. coli is a leading cause of nosocomial infections, including urinary tract infections (UTIs), sepsis, and wound infections. The growing prevalence of antimicrobial resistance, particularly among strains producing extended-spectrum beta-lactamases (ESBLs), poses substantial challenges to infection management. This study investigates the prevalence and resistance patterns of E. coli in clinical samples at a tertiary care hospital in Nadiad.

Materials and Methods: This retrospective study, conducted at Dr. N. D. Desai Faculty of Medical Science and Research, Nadiad, assessed various clinical specimens, including urine, sputum, pus, swab and blood. The study included all patients across age groups who submitted initial clinical samples for bacteriological culture and sensitivity testing. Samples were cultured on standard media, and bacterial isolates were identified using conventional microbiological methods. Antimicrobial susceptibility was determined through the Kirby-Bauer disk diffusion method, adhering to CLSI guidelines. Statistical analysis was performed using Microsoft Excel and SPSS.

Results: E. coli isolates were most prevalent in urine samples and among females. Carbapenems (Meropenem) and Gentamicin showed high sensitivity, while significant resistance was observed for Ampicillin and Fluoroquinolones. Nitrofurantoin and Fosfomycin were most effective for urine isolates. The highest positive cases were reported from Surgery and Medicine departments.

Conclusion: The study highlights urine as the primary source of *E. coli* infections, with higher prevalence in females. Carbapenems and Nitrofurantoin showed excellent efficacy, while resistance to Ampicillin and Fluoroquinolones was significant. These findings emphasize the need for targeted antibiotic stewardship and infection control measures, particularly in Surgery and Medicine departments.

Key Words: Escherichia coli, Antimicrobial Resistance, Hospital Infections, Urinary Tract Infections

INTRODUCTION

The genus Escherichia was named after Theodor Escherich, who first identified and described the colon bacillus under this name in 1885. Escherichia coli (E. coli) is further categorized into different biotypes and serotypes based on its biochemical characteristics and antigenic properties. Morphologically, E. coli is a straight, rod-shaped bacterium that stains gram-negative and is typically found singly or in pairs. Its motility stems from peritrichous flagella, which enhance its adaptability to various environments. It is metabolically versatile, functioning as both an obligate aerobe and a

facultative anaerobe, and thrives best at 37°C. The bacterium demonstrates strong growth on various culture media, which makes it ideal for isolation and identification in microbiology labs [1].

E. coli plays dual roles: as a commensal organism and a pathogen. It is a key component of the intestinal microbiota in humans and animals, where it exists without causing harm. Its presence in the gastrointestinal tract makes it an effective indicator of fecal contamination in food and water, underscoring its importance in public health and epidemiology. However, E. coli is also one of the leading causes of nosocomial infections, which pose significant challenges to healthcare systems worldwide [2].

This bacterium is classified as an obligate parasite, primarily inhabiting the intestines of humans and warm-blooded animals. Despite this specificity, E. coli demonstrates remarkable versatility as a pathogen, responsible for a variety of infections. It is the most common cause of urinary tract infections (UTIs) globally and is frequently linked to sepsis, wound infections, otitis media, and other conditions, illustrating its adaptability and pathogenic potential [3-5].

A growing concern is the rapid development of antimicrobial resistance in E. coli. This resistance complicates the management of infections, particularly UTIs, where strains resistant to first-line antibiotics are becoming more prevalent. Notably, strains producing extended-spectrum beta-lactamases (ESBLs) and those resistant to Cotrimoxazole significantly reduce treatment options. These trends highlight the urgency of ongoing surveillance and the development of new antimicrobial strategies [6,7]. The study focused on examining the prevalence and resistance patterns of E. coli isolates from clinical samples at a tertiary care hospital in Nadiad.

MATERIAL AND METHODS

This retrospective study, conducted over a year from June 2023 to May 2024, aimed to investigate the prevalence and antimicrobial susceptibility patterns of E. coli isolated from various clinical specimens in the Microbiology Laboratory of Dr. N. D. Desai Faculty of Medical Science and Research, Nadiad, Gujarat, India. Common specimens included urine, sputum, pus, swab and blood.

Patients of all age groups who submitted clinical specimens for bacteriological culture and sensitivity testing at the hospital were included in the study population. Only the first sample from each patient site was included in the analysis. Samples yielding fungal pathogens and repeat samples from the same patient site were excluded.

All samples received for aerobic culture and sensitivity testing during the study period were included in the sample size. Samples were cultured on standard media (Blood agar, MacConkey agar, and Nutrient agar) and incubated for 24-48 hours. Aerobic bacterial isolates were identified using standard microbiological techniques. All bacterial isolates were subjected to antibiotic susceptibility testing using the Kirby-Bauer disk diffusion method. Results were interpreted according to established guidelines. The study adhered to CLSI guidelines for antimicrobial susceptibility testing.

Data was collected and analyzed using Microsoft Excel and SPSS version 22 software. Descriptive statistics were employed to calculate frequencies and percentages for categorical variables such as specimen type, isolation site, and antibiotic resistance patterns.

RESULTS

Among 569 positive E. coli cases, the majority were observed in females, with males accounting for a smaller proportion (Table 1).

Table 1: Gender wise distribution of Positive E. Coli samples

Gender	No. of Positive E. Coli samples
Male	254
Female	315
Total	569

Positive E. coli cases were predominantly isolated from urine samples, followed by swabs, pus, sputum, and blood. Urine samples showed the highest positivity rate, while blood samples demonstrated the lowest (Table 2).

Table 2: Total received and positive samples for E. Coli

Total Samples received=6067			**Total Positive samples=569**	
Sample site	**Total Sample received**	**%**	**Total Positive samples**	**%**
Urine	2001	32.98	324	16.19
Swab	896	14.76	104	11.6
Pus	611	10.07	50	8.18
Sputum	996	16.41	78	7.83
Blood	1398	23.04	13	0.93

The Surgery and Medicine departments reported the highest numbers of positive cases, with notable contributions from Pediatrics, Emergency, and OB-GY. Minimal positive cases were reported from ENT, Ophthalmology, Psychiatry, and Skin departments (Table 3).

Table 3: Department wise distribution for positive samples for E. Coli

DEPARTMENT	**OPD**	**IPD**	**TOTAL**
EMERGENCY	18	69	87
ENT	2	4	6
MEDICINE-ICU	0	1	1
MEDICINE	26	118	144
OB-GY	29	32	61
OPHTHALMOLOGY	4	0	4
ORTHOPEDICS	7	1	8
PEDIATRIC	7	49	56
PSYCHIATRIC	2	0	2
SKIN	1	0	1
SURGERY	22	133	155
TBCD	4	40	44

Carbapenems, particularly Meropenem, demonstrated high sensitivity across most sample types, with gentamicin also showing consistent effectiveness. In contrast, significant resistance was observed for ampicillin and Fluoroquinolones. Nitrofurantoin and Fosfomycin were highly effective against urine isolates (Table 4).

Table 4: Antibiotic Susceptibility for E. Coli Isolated from Various Samples [Number of Samples Sensitive to antibiotics (%)]

List of Antibiotics	**Blood E. Coli AST Total=13**	**Sputum E. Coli AST Total=78**	**Swab E. Coli AST Total=104**	**Pus E. Coli AST Total=50**	**Urine E. Coli AST Total=324**
	Sensitivity %	**Sensitivity %**	**Sensitivity %**	**Sensitivity %**	**Sensitivity %**
Ampicillin (10 µg)	0	7.69	8.65	18	8.95
Ampicillin/Sulbactam (10 µg/10 µg)	46.15	37.17	29.80	60	49.69
Piperacillin/Tazobactam (100 µg/10 µg)	53.84	33.33	31.73	48	43.20
Aztreonam (30 µg)	30.76	20.51	19.23	34	Not Tested
Cefazolin (30 µg)	Not Tested	Not Tested	Not Tested	Not Tested	6.17
Cefuroxime (30 µg)	0	16.66	11.53	28	16.97

Ceftriaxone (30 µg)	0	19.23	12.5	26	18.20
Ceftazidime (30 µg)	0	19.23	15.38	62	18.20
Cefepime (30 µg)	23.07	17.94	12.5	30	19.44
Cefoxitin (30 µg)	30.76	48.71	33.65	44	51.23
Imipenem (10 µg)	30.76	46.15	36.53	58	43.20
Meropenem (10 µg)	61.53	76.92	62.5	84	70.98
Levofloxacin (5 µg)	38.46	17.94	18.26	28	24.07
Ciprofloxacin (5 µg)	30.76	14.10	13.46	28	18.82
Tobramycin (10 µg)	53.84	48.71	46.15	66	60.80
Tetracycline (30 µg)	53.84	44.87	35.57	48	Not Tested
Gentamicin (10 µg)	61.53	60.25	64.42	78	64.50
Co-trimoxazole (1.25 µg/23.75 µg)	46.15	38.46	33.65	50	41.66
Nitrofurantoin (300 µg)	Not Tested	Not Tested	Not Tested	Not Tested	91.35
Fosfomycin (200 µg)	Not Tested	Not Tested	Not Tested	Not Tested	97.53
Not Tested – Antibiotic sensitivity not tested for that Pathogen as per CLSI guidelines					

DISCUSSION

This study explored the distribution and antibiotic resistance patterns of Escherichia coli isolates across various clinical samples. Among the 569 confirmed cases, a higher proportion was observed in females compared to males, aligning with the known susceptibility of women to urinary tract infections (UTIs) similar to earlier studies [8-10]. Urine was the predominant source, showing a positivity rate of 16.19%, while blood samples had the lowest positivity at 0.93%. Other sources, such as swabs, pus, and sputum, also contributed to the total isolates as reported previously [11,12]. The majority of cases were reported in patients from the Surgery and Medicine departments, with significant contributions from Pediatrics, Emergency, and Obstetrics and Gynecology (OB-GY), emphasizing the widespread clinical burden of E. coli infections [11,13].

Carbapenems, especially Meropenem, demonstrated excellent efficacy, with 70.98% of isolates showing sensitivity. Gentamicin also performed well, with 64.5% sensitivity among urinary isolates. Nitrofurantoin and Fosfomycin were particularly effective against urinary isolates, achieving sensitivities of 91.35% and 97.53%, respectively. In contrast, resistance to Ampicillin (8.95%) and Fluoroquinolones, including Ciprofloxacin (18.82%) and Levofloxacin (24.07%), was notably high. This resistance is likely due to the widespread and often unregulated use of these antibiotics in the community [14-16].

The findings highlight the need for sustained antimicrobial resistance monitoring and targeted antibiotic stewardship programs to address these trends. Additionally, department-specific infection management strategies are crucial, particularly in high-burden areas like Surgery and Medicine. The consistent efficacy of Nitrofurantoin and Fosfomycin against urinary isolates underscores their role in empirical UTI treatment [17-20].

CONCLUSION

The findings from this study highlight urine as the most common source of E. coli infections, with a higher prevalence observed among females. Carbapenems, particularly Meropenem, and Nitrofurantoin were found to be highly effective against E. coli isolates, while significant resistance was noted to Ampicillin and Fluoroquinolones. These results call for a reassessment of empirical antibiotic therapy protocols, emphasizing the importance of rationalizing antibiotic use and strengthening antibiotic stewardship programs to address the rising issue of resistance. Further research should explore the molecular basis of antibiotic resistance in E. coli, along with the development and evaluation of alternative therapeutic strategies. Regular surveillance studies are recommended to monitor evolving resistance patterns.

Additionally, focused interventions in high-burden departments such as Surgery and Medicine could help improve patient care and infection control outcomes.

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