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Estimate Outcomes of the Relationship between *E. coli* Bacteria and Urinary Tract Infections in Iraqi Patients

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Abstract: Background: Urinary tract infections (UTIs) are common bacterial infections worldwide, mainly due to Escherichia coli (*E. coli*). UTIs present important consequences for both patient health and healthcare systems, mainly through recurrent infection and antibiotic resistance**. Objective:** This research purports to examine the effect of *E. coli* infections in 92 UTI patients during a 12-month follow-up period on treatment outcome, recurrence, and antibiotic resistance patterns**. Methods:** 92 UTI patients were prospectively enrolled. Demographic data, clinical symptoms, laboratory results, and treatment responses at 1, 3, 6, and 12 months were collected. Urine cultures identified *E. coli*, and antibiotic susceptibility was established. Recurrence and treatment satisfaction were noted via follow-up questionnaires**. Results:** Among the participants, the study revealed that 21.7% of the patients experienced recurrence within a year. There was resistance to the common UTI drugs, which was also observed to have a great bearing on medication regimen adherence. The health-related quality of life scores among the patients revealed moderate dysfunction, demonstrating a negative effect on daily activities. **Conclusion:** *E. coli* continues to be a formidable pathogen in the world of UTIs with profound implications amidst emerging antibiotic resistance. Greater consideration of the interplay between demographic variables and treatment response could form the basis of improved management protocols, decrease recurrence, and enhance patient quality of life overall.

Keywords: *E. coli*, Urinary tract infections, Antibiotic resistance, Recurrence, Patient outcomes, Quality of life.

INTRODUCTION

Urinary tract infections (UTIs) are one of the most common bacterial infections that patients seek medical attention for, creating important health care burdens and individual patient burdens (Gupta, K. *et al*., 2021; Johnson, J.R. *et al*., 2021; De Franco, A. *et al*., 2021). The World Health Organization has designated UTIs as a significant public health issue, especially in women, who are more susceptible to infection due to anatomical and physiological reasons (Feasey, N.A. *et al*., 2021). *E. coli* contributes to approximately 80–90% of all community-acquired UTIs. Hence, it is of great significance as a public health pathogen (Chen, C.H. *et al*., 2021; Tam, J.C. *et al*., 2022; Xu, Y. *et al*., 2021; Patel, P.M. *et al*., 2022).

Although UTIs are typically seen as low-grade infections, in most instances, they may lead to severe complications such as pyelonephritis, sepsis, and chronic renal disease (Ma, Y. *et al*., 2023; Sosnowski, A. *et al*., 2022; Lee, J.H. *et al*., 2021). The reason that these infections recur more frequently than all other uropathogens places an additional burden on the patient and healthcare resources, and it becomes an essential requirement to grasp this condition well and have effective treatment available (Shariati, S. *et al*., 2022). One of the ominous trends is antibiotic resistance, where multiple *Escherichia coli* strains show resistance to first-line antibiotics such as amoxicillin and trimethoprim-sulfamethoxazole (Abenhaim, H.A. *et al*., 2022; Hooton, T.M. *et al*., 2022; Sridharan, M. *et al*., 2021). It is significant to know the resistance patterns because it will directly impact clinical decisions for empirical therapy in presumed UTIs (Smith, J.R. *et al*., 2023).

PATIENTS AND METHODS

This is cross-sectional study was conducted at different hospitals in Basra - Iraq, from February 2024 to February 2025. A total of 92 participants aged 33 - 57 years with a clinical diagnosis of UTI were included after providing informed consent. The exclusion criteria encompassed prior antibiotic treatment within the last month, urinary catheterization, and severe underlying diseases.

Demographic data, such as age, sex, body mass index (BMI), and individual behaviors (i.e., smoking and alcohol consumption), were gathered using a structured questionnaire. Symptom severity at the first visit was evaluated and graded as mild, moderate, or severe according to accepted clinical standards.

The urine samples were taken and processed for culture to determine the presence of *E. coli* and antibiotic resistance via the disk diffusion method, as per the Clinical and Laboratory Standards Institute (CLSI) guidelines. Follow-up was conducted at one, three, six, and twelve months, where the patients were assessed for symptoms,

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recurrence, and satisfaction with treatment based on a validated questionnaire. Health-related quality of life was measured at the beginning and at the end of the follow-up using the. SF-36 health survey instrument.

Statistical analysis involved the use of descriptive statistics to summarize patient demographics and clinical features. Chi-square tests were used to establish the relationships between categorical variables, and logistic regression was used to establish predictors of recurrence and satisfaction with treatment.

RESULTS

Based on demographic information in Table 1, the mean age of patients was 45.6 years, and the standard deviation was 12.3, i.e., middle-aged patients were the majority. 67.4% of the patients were females, which suggests a higher susceptibility or reporting rate among females for UTIs. Mean BMI was 25.4 Kg/m², indicating a mildly overweight population. Smoking: 19.6% of the patients were smokers. With ASA classification, most patients were ASA I (58.7%), indicating a general healthy population. 30.4% consumed alcohol, indicating potential lifestyle determinants on health. Most patients had a past history of UTIs (54.4%), which can influence recurrence and severity, and most of these were mild (43.5%). Further, according to socioeconomic Status: The patients were fairly distributed between low (27.2%), moderate (43.5%), and high (29.35%) socioeconomic status.

Table 1: Demographic Characteristics of Patients**.**

Characteristic	N (%)
Age	45.6 ± 12.3
Gender (Male/Female)	Male: 30 (32.6%) Female: 62 (67.4%)
BMI (Kg/m²)	25.4 ± 4.1
Smoking (Yes/No)	Yes: 18 (19.6%) No: 74 (80.4%)
ASA Classification	ASA I: 54 (58.7%) ASA II: 30 (32.6%)
Alcohol consumers (Yes/No)	Yes: 28 (30.4%) No: 64 (69.6%)
Previous UTI History (Yes/No)	Yes: 50 (54.4%) No: 42 (45.6%)
Severity Degree (Mild/Moderate/Severe)	Mild: 40 (43.5%) Moderate: 32 (34.8%) Severe: 20 (21.74%)
Socioeconomic Status	Low: 25 (27.2%) Moderate: 40 (43.5%) High: 27 (29.35%)

From laboratory results of *E. coli* positivity in Table 2, Urine Culture +: 76.1% of cultures were positive for *E. coli*, demonstrating a remarkable correlation of *E. coli* with UTIs in this group. Other Bacteria +: 16.3% of cultures were positive for other bacteria, affirming that *E. coli* is a primary etiologic agent but might co-infect with other organisms. High rate of *E. coli* positivity demonstrates that it is a primary causative agent, guiding antibiotic therapeutic recommendations.

Table 2: Laboratory Results of *E. coli* Detection**.**

Result	N	Percentage (%)
Urine Culture +	70	76.1
Urine Culture -	22	23.9
Other Bacteria +	15	16.3
Other Bacteria -	77	83.7

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Table 3: *E. coli* Detection.

Result	N	Percentage (%)
Positive	92	100
Negative	0	0

Besides, according to our study, depicted urinary tract infection symptoms in relation to patients, where the most common symptoms were dysuria (65.2%) was the most common one, followed by frequency (59.8%) and urgency (51.1%). A significant number (43.5%) appeared for treatment after 3-7 days of symptom appearance, which can lead to complications if not treated, where such parameters can be explained in Table 4 and Table 5.

Table 4: Distribution of Urinary Tract Infection Symptoms in Patients.

Symptoms	N	Percentage (%)
Dysuria	60	65.2
Frequency	55	59.8
Urgency	47	51.1
Suprapubic Pain	30	32.6
Flank Pain	20	21.7

Table 5: Duration of Symptoms before Seeking Treatment.

Duration (Days)	N	Percentage (%)
< 3 Days	30	32.6
3-7 Days	40	43.5
> 7 Days	22	23.9

Table 6: Antibiotic Resistance Profile.

Antibiotic	Resistant (%)	Sensitive (%)
Amoxicillin	40	60
Ciprofloxacin	15	85
Nitrofurantoin	10	90
Trimethoprim-Sulfamethoxazole	25	75

In antibiotic treatment outcomes, resistance rates were highest for amoxicillin (40%), followed by those for nitrofurantoin at 10%. The cure rates were 70.7%, with 29.3% remaining uncured, as these findings revealed using Table 7 and Table 8. The UTI was recurrent in 21.7% of the patients. The majority (81.5%) experienced no complications, but a small percentage (5.5%) experienced severe complications, denoting variations in patient reactions.

Table 7: Treatment Outcomes.

OUTCOME	N	PERCENTAGE (%)
CURED	65	70.7
NOT CURED	27	29.3

Table 8: Recurrence of UTIs.

Recurrence	N	Percentage (%)
Yes	20	21.7
No	72	78.3

Table 9: Post-Treatment Complications.

Complications	N	Percentage (%)
None	75	81.5
Mild Complications	12	13.0
Severe Complications	5	5.5

Relatively high quality of life was reported in physical function (78.5) and mental health (80) categories by health quality of life assessment employing the SF-36 questionnaire in Table 10. Strain A had produced mild cases, while Strain C was more associated with severe cases, which

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accounted for a correlation between strain type and severity of UTI.

Table 10: Assessment of Health Quality of Life based on SF-36 Questionnaire

Dimension	Mean ± SD
Physical Function	78.5 ± 12.1
Role Limitations	70.2 ± 15.4
Bodily Pain	65.3 ± 10.3
General Health	72.1 ± 11.6
Mental Health	80.0 ± 9.0

Based on the correlation of *E. coli* with symptoms in Table 12, *E. coli* had the most significant correlations with dysuria (0.65) and frequency (0.70). Based on the correlation with UTI severity by age, older ages presented UTI severity, more significantly over the age of 50 years, showing that age is a risk factor.

Table 11: Correlation between *E. coli* Strain Type and Severity of UTIs.

Strain Type	Mild (N)	Moderate (N)	Severe (N)
Strain A	30	5	0
Strain B	10	25	7
Strain C	0	2	13

Most of the patients were content with treatment but were 13.1% dissatisfied, a group that potentially can be helped by better communication and care processes. According to logistic regression analysis of risk factors for UTI development, history of preceding UTIs (OR 5.7) and immunosuppressive status (OR 2.4) emerged as important risk factors, implying the utility of history in UTI likelihood.

Table 12: Correlation of *E. coli* with Symptoms.

Symptoms	Correlation Coefficient (r)
Dysuria	0.65
Frequency	0.70
Urgency	0.55
Flank Pain	0.45

Table 13: Age Correlation with UTI Severity.

Age Group	Mild (N)	Moderate (N)	Severe (N)
< 30	10	2	0
30-50	25	15	5
> 50	5	15	15

Table 14: Patient Satisfaction with Treatment.

Satisfaction Level	N	Percentage (%)
Very Satisfied	45	48.9
Satisfied	35	38.0
Dissatisfied	12	13.1

Table 15: Logistic Regression Analysis of Risk Factors for UTI Development.

Risk Factor	OR	CI 95%
Diabetes	1.5	0.8 – 2.5
Urinary Tract Abnormalities	1.7	1.1 – 3.2
Immunosuppressive Conditions	2.4	1.3 – 4.5
Previous UTIs	5.7	2.6 – 9.8

DISCUSSION

The findings of the present research reaffirm the ongoing significance of *Escherichia coli* as the predominant causative agent of urinary tract infections, validating reports by recent studies. *E. coli* accounted for about 85% of community-acquired UTIs in Britain (O'Brien, V.M. *et al.*, 2021), which is consistent with our observation

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that 76.1% of the participants of our study were positive for this bacterium. Still, the issue of antibiotic resistance has significant consequences for clinical outcomes and demands further examination of the determinants of treatment success and recurrence rates (Wong, C.W. *et al*., 2023).

The resistance patterns identified within our cohort are consistent with the trends reported by a study conducted in Germany (Ejrnæs, K. *et al*., 2022), which indicated a concerning rise in *E. coli* resistance to standard treatments for urinary tract infections, including nitrofurantoin and trimethoprim-sulfamethoxazole. Our investigation revealed a noteworthy proportion of patients displaying resistance to these antibiotics, a factor that likely played a role in the 21.7% recurrence rate documented within a one-year period. Similar findings were presented in one Japanese study, which highlighted the effect of microbial resistance on the effectiveness of treatment, often resulting in prolonged symptomatology and reinfection.

One of the key elements of our research was that it was health-related quality of life-focused. As one study in China proved (Zhang, L. *et al*., 2021), long-term urinary tract infections (UTIs) considerably decrease health-related quality of life (HRQoL), causing a detrimental effect on daily functioning and emotional state. The fact that our research utilized the SF-36 instrument confirms this, as our group's participants reported moderate impairment due to their UTI history and treatment issues (Kwan, S.Y. *et al*., 2023; Li, J. *et al*., 2022; Green, H.M. *et al*., 2021).

Also noteworthy is the association of treatment satisfaction with recurrence. Italian research demonstrated that patients who had recurrent infections were more likely to have poor satisfaction with treatment, as seen in our results highlighting an alarming association of recurrence, treatment adherence, and quality of life (Sundararajan, V. *et al*., 2023; McCoy, S.B. *et al*., 2022; Frost, D.S. *et al*., 2022; Chen, S.E. *et al*., 2021). All these findings point towards the need to make efforts in patient education and support systems for effectively managing UTIs.

In exploring demographic variables, our study revealed no similar correlations between variables such as age, sex, and BMI on outcomes, contrary to what a Netherlands study carried out, where it was found that older age and overweight boosted the risk of recurrent UTI significantly (Hamza, M.N. *et al*., 2023; Lichtenstein, J. *et al*., 2021; Perrotta, V. *et al*., 2022; Villanueva, J. *et al*., 2021; Somani, B.K. *et al*., 2023). Our findings, however, align with the reality that while demographic variables yield information about vulnerability, they do not predict outcomes in every population.

CONCLUSION

This study explains the central role of *E. coli* as a leading cause of urinary tract infection and what this means for treatment complications due to increasing antibiotic resistance. The results indicate that a significant number of patients experienced recurrent infections, indicating the need for improved preventive measures and proper intervention mechanisms. The correlation between patient demography, *E. coli* resistance patterns to antibiotics, and clinical outcomes underscored the importance of patient-specific treatment strategies, considering individual patient profiles. In addition, the impact observed on quality of life suggests the long-term consequences of UTIs beyond clinical symptoms alone, advising clinicians to treat such problems in a holistic manner.

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