Urinary Tract Infections among Patients of Selected Private Medical Laboratories in Okigwe Lga, Imo State (2020-2024)

Uka-Kalu, Ezinne Chioma., Uwaeme, ThankGod C., Elekeh, Rosemary Ichita

Department of Public Health, Abia State University, Uturu

DOI: https://doi.org/10.51244/IJRSI.2025.120700159

Received: 26 June 2025; Accepted: 03 July 2025; Published: 13 August 2025

ABSTRACT

Urinary tract infections (UTIs) are considered one of the most common bacterial infections in the United States, accounting for an estimated 7 million outpatient clinic visits, 1 million emergency department visits, and approximately 100,000 hospital admissions annually. This retrospective study examined the distribution and microbial profile of urinary tract infections (UTIs) among patients who attended selected private laboratories in Okigwe Local Government Area, Imo State, Nigeria, between 2020 and 2024. The research employed a sample size of 357 medical records systematically selected from a population of 3,313 records retrieved from three major laboratories—Immanuel (1,202), Vigreat (1,006), and Unique (1,105). Data were collected using a structured proforma and analyzed with SPSS version 23.0, using descriptive and inferential statistics. Findings revealed that out of the 357 patients sampled, 282 (79.0%) had bacterial UTIs, while 75 (21.0%) had fungal UTIs. The annual distribution showed an increasing trend in fungal UTIs, peaking at 8.4% in 2024, compared to 1.7% in 2020. Females represented the majority of UTI cases, accounting for 254 (71.1%), whereas males accounted for 103 (28.9%). The age group 20–29 years had the highest prevalence with 114 (31.9%) of the cases, followed by 30–39 years with 82 (23.0%). Bacterial isolates were dominated by *Escherichia coli* (41.5%), *Staphylococcus aureus* (24.9%), and *Klebsiella* species (11.2%), while *Candida albicans* (17.9%) led among fungal isolates. Antimicrobial sensitivity testing showed that ciprofloxacin (89.6%) and ceftriaxone (83.3%) were the most effective antibiotics, while ampicillin (28.2%) and nalidixic acid (35.9%) showed low sensitivity. Among fungal isolates, fluconazole showed the highest sensitivity (81.4%). A chi-square analysis revealed a significant association between gender and UTI occurrence (χ^2 = 11.642, p = 0.001), and between age group and UTI type (χ^2 = 13.274, p = 0.039), indicating that younger age groups and female patients were more susceptible. The study concludes that UTIs remain prevalent in Okigwe, predominantly bacterial in nature, though there is an emerging rise in fungal infections. The findings underscore the need for targeted public health interventions, enhanced laboratory diagnostics, and continuous antimicrobial resistance surveillance to improve patient outcomes and reduce UTI burden in the region.

Keywords: Urinary Tract Infection (UTIs), Microbial Pathogens, Staphylococcus spp. Candida albicans, Bacterial and fungal Infection.

INTRODUCTION

Urinary tract infections (UTIs) are among the most prevalent bacterial infections globally. According to the Global Burden of Disease (GBD) 2019 analysis, UTIs affected approximately 405 million individuals and resulted in nearly 237,000 deaths worldwide, with a 10.9% rise in incidence rates between 1990 and 2019 (Zeng et al., 2022). The GBD 2021 study further confirms this upward trend, with a 66% increase in UTI incidence since 1990 and a comparable age-standardised rate of 5,532 cases per 100,000 individuals (He et al., 2025). UTI burden disproportionately affects low- and middle-income countries, particularly in sub-Saharan Africa, where rates often exceed the global average (Zeng et al., 2022).

In Nigeria, UTI prevalence remains alarmingly high. A community-based study in rural Okada reported a 39.7% prevalence, with *Escherichia coli* (65%) and *Staphylococcus aureus* (20%) as the most frequent

pathogens; female patients had over six times higher odds of UTI than males (Oladeinde et al., 2011). In a similar Southeast Nigeria hospital-based study from Awka, 89% of symptomatic female patients had significant bacteriuria, with pathogens such as *E. coli* (28.5%), *S. aureus* (28%), *Salmonella spp* (22.8%), and *Pseudomonas aeruginosa* (20.5%); levofloxacin**,** meropenem and aztreonam were most effective against these organisms (Oli et al., 2017). Despite the high burden and evolving resistance, there is limited data from private diagnostic laboratories in Imo State, particularly Okigwe Local Government Area, that tracks trends in UTI screening, symptomatology, pathogen profile, demographic correlations, and antibiograms over time.

Furthermore, according to recent research by Mafuyai et al. (2021), urinary tract infections (UTIs) and their associated complications result in approximately 150 million deaths worldwide each year. UTIs affect a significant proportion of the population, with 40-50% of women and 5% of men at risk of developing the condition. The study concluded that healthcare professionals and facilities have a responsibility to disseminate information about UTIs to individuals, particularly females, to raise awareness about the causes, risk factors, symptoms, and prevention practices of the infection. Based on the findings, it was recommended that awareness campaigns be implemented to educate adults, females, and other communities about UTIs, and that educational programs be designed and implemented to increase awareness and susceptibility among females. Additionally, healthcare professionals should educate individuals about the causes of UTIs (Mafuyai et al., 2021).

The high prevalence of UTIs in Nigeria, particularly among pregnant women and adolescents, poses a significant public health concern. The World Health Organization (WHO) estimates that 150 million people worldwide suffer from UTIs annually, with Nigeria contributing significantly to this burden. The absence of recent and localized studies on UTIs in Okigwe Local Government Area creates a knowledge gap that this study aims to bridge. Understanding the prevalence, causes, and consequences of UTIs in this specific region will inform targeted interventions and policy decisions. This study will also provide valuable insights into the antimicrobial susceptibility patterns of UTI-causing pathogens in Okigwe Local Government Area, informing antibiotic stewardship programs and helping combat antibiotic resistance. The study's outcomes will inform health education and awareness programs, empowering patients and healthcare providers to take proactive measures against UTIs.

METHODOLOGY

In this study, a retrospective research design was employed due to the study's requirement for medical health records. A retrospective research design is most effective when examining past events, conditions, or exposures to determine associations or outcomes. This approach was especially valuable for this study on urinary tract infections among patients in private laboratories.

The population of this study included all patients who visited these laboratories within the specified period from 2020 to 2024. This group encompassed individuals who were diagnosed with or screened for UTIs. The total population for the study was 3,313, with Immanuel Lab contributing 1,202 medical records; Vigreat Lab providing 1,006 medical records; and Unique Lab supplying 1,105 medical records retrieved for the study.

Instrument of Data Collection

A well-structured proforma was developed and used to collect data for this study on urinary tract infections among patients who visited private laboratories and were diagnosed and screened for any UTI at Okigwe Local Government Area, Imo State, from 2020 to 2024. Section A contained the demographic profile of urinary tract infection patients who visited selected private laboratories in Okigwe Local Government Area, Imo State. Sections B, C, and D consisted of the number of screened patients, causative agents, and clinical symptoms of urinary tract infections among patients who visited selected private laboratories in Okigwe Local Government Area, Imo State. Section D included the association between the demographic factors and individuals who were positively screened for urinary tract infections that visited selected private laboratories in Okigwe Local Government Area, Imo State. Finally, Section E identified the antimicrobial sensitivity pattern of microbial pathogens of urinary tract infections among individuals who visited selected private laboratories.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

Method of Data Collection

The researcher collected data with the assistance of the Chief Medical Records Officer and the nurse in charge, using the proforma. This approach ensured that the researcher had a clear understanding of the data from the medical records.

Method of Data Analysis

The method of data analysis used descriptive statistics such as frequency distribution and percentages, while the data were presented in tables and charts. The data were cleaned, coded, and entered into the computer for analysis using the Statistical Package for Social Sciences (SPSS) program version 23.0. All analyses of the data were conducted and reviewed.

Ethical Clearance

Ethical clearance for the study was obtained from the Ethical Clearance office in the Research and Publications department of Abia State University. This clearance was secured after a clear explanation of the study's purpose, and the consent of the hospital management was acquired using the ethical clearance letter obtained from the University.

RESULTS AND DISCUSSION

Demographic Characteristics of Patients

Table 1: Demographic Characteristics of Patients in Selected Private Laboratories

	2020 (n=36)	2021 (n=71)	2022 (n=66)	2023 (n=91)	2024 (n=93)	Total (n=357)
Age						
0-9 years	3 (0.8)	6 (1.7)	6 (1.7)	7 (2.0)	8 (2.2)	30 (8.4)
10-19years	3 (0.8)	6 (1.7)	7 (2.0)	9 (2.5)	8 (2.2)	33 (9.2)
20-29 years	8 (2.2)	15 (4.2)	15 (4.2)	19 (5.3)	22 (6.2)	79 (22.1)
30-39 years	6 (1.7)	12 (3.4)	12 (3.4)	15 (4.2)	17 (4.8)	62 (17.4)
40-49 years	4 (1.1)	9 (2.5)	7 (2.0)	13 (3.6)	12 (3.4)	45 (12.6)
50-59 years	4 (1.1)	8 (2.2)	6 (1.7)	10 (2.8)	11 (3.1)	39 (10.9)
60-69 years	5 (1.4)	10 (2.8)	9 (2.5)	12 (3.4)	12 (3.4)	48 (13.4)
≥70 years	3 (0.8)	5 (1.4)	4 (1.1)	6 (1.7)	3 (0.8)	21 (5.9)
Gender						
Male	8 (2.2)	11 (3.1)	11 (3.1)	19 (5.3)	17 (4.8)	66 (18.5)
Female	28 (7.8)	60 (16.8)	55 (15.4)	72 (20.2)	76 (21.3)	291 (81.5)

*Percentages are in parentheses

Type of UTI

The distribution of the type of urinary tract infections (UTIs) among patients who attended selected private laboratories in Okigwe Local Government Area, Imo State, from 2020 to 2024 is presented in Fig. 1. In 2020, out of 36 participants, 30 (8.4%) had bacterial UTIs, while 6 (1.7%) had fungal UTIs. In 2021, out of 71 participants, 59 (16.5%) had bacterial UTIs, while 12 (3.4%) had fungal UTIs. In 2022, out of 66 participants, 50 (14.0%) had bacterial UTIs, while 16 (4.5%) had fungal UTIs. In 2023, out of 91 participants, 80 (22.4%) had bacterial UTIs, while 11 (3.1%) had fungal UTIs. In 2024, out of 93 participants, 63 (17.6%) had bacterial UTIs, while 30 (8.4%) had fungal UTIs.

Overall, the total number of participants across the five years was 357. The type of UTIs showed that 282 (79.0%) were bacterial and 75 (21.0%) were fungal. This detailed breakdown shows the distribution of UTI types over the five-year period, with bacterial UTIs being more prevalent than fungal UTIs in each year.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

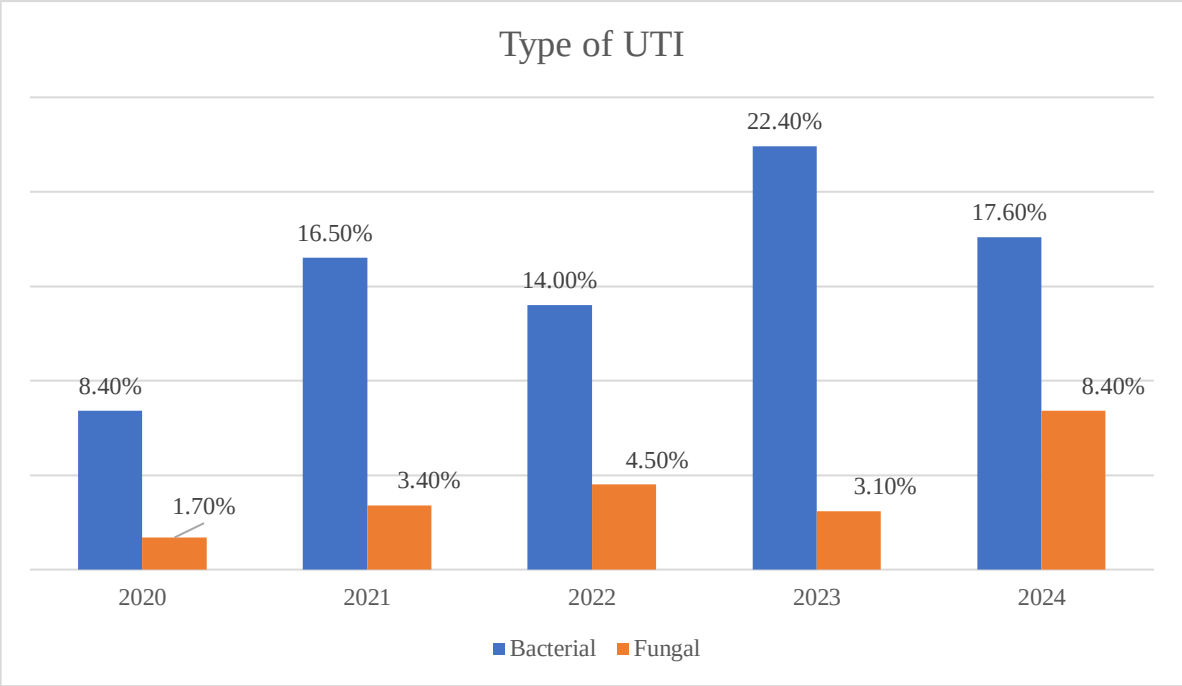

Figure 1: Type of UTI by Year

Microbial Pathogens and Clinical Symptoms Distribution by Year

Table 2: Microbial Pathogens and Clinical Symptoms by Year among Patients

	2020 (n=36)	2021 (n=71)	2022 (n=66)	2023 (n=91)	2024 (n=93)	Total (n=357)
Microbial Pathogens						
Escherichia coli	10 (2.8%)	18 (5.0%)	11 (3.1%)	17 (4.8%)	8 (2.2%)	64 (17.9%)
Klebsiella spp.	9 (2.5%)	5 (1.4%)	12 (3.4%)	20 (5.6%)	20 (5.6%)	66 (18.5%)
Staphylococcus spp.	10 (2.8%)	22 (6.2%)	18 (5.0%)	28 (7.8%)	25 (7.0%)	103 (28.9%)
Enterococcus spp.	1 (0.3%)	8 (2.2%)	4 (1.1%)	8 (2.2%)	5 (1.4%)	26 (7.3%)
Proteus spp.	0 (0.0%)	5 (1.4%)	5 (1.4%)	7 (2.0%)	5 (1.4%)	22 (6.2%)
Candida albicans	6 (1.7%)	13 (3.6%)	16 (4.5%)	11 (3.1%)	30 (8.4%)	76 (21.3%)
Clinical Symptoms						
Painful urination	13 (3.6%)	16 (4.5%)	15 (4.2%)	29 (8.1%)	24 (6.7%)	97 (27.2%)
Frequent urination	6 (1.7%)	13 (3.6%)	17 (4.8%)	26 (7.3%)	25 (7.0%)	87 (24.4%)
Blood in urine	10 (2.8%)	32 (9.0%)	23 (6.4%)	25 (7.0%)	28 (7.8%)	118 (33.1%)
Abdominal pain	7 (2.0%)	10 (2.8%)	11 (3.1%)	11 (3.1%)	16 (4.5%)	55 (15.4%)

Demographic Factors that influence the occurrence of Microbial Pathogens

Age

Table 3: Distribution and Association of Microbial Pathogens by Age Group among Patients

	Age Group (in years)									
Microbial Pathogens	**0-9**	**10-19**	**20-29**	**30-39**	**40-49**	**50-59**	**60-69**	**≥70**	**Total**	**Chi-square**
Escherichia coli	3 (0.8)	7 (2.0)	18 (5.0)	11 (3.1)	5 (1.4)	5 (1.4)	12 (3.4)	3 (0.8)	64 (17.9)	
Klebsiella spp.	2 (0.6)	6 (1.7)	11 (3.1)	10 (2.8)	14 (3.9)	10 (2.8)	10 (2.8)	3 (0.8)	66 (18.5)	*X= 52.659*
Staphylococcus spp.	10 (2.8)	8 (2.2)	19 (5.3)	22 (6.2)	11 (3.1)	14 (3.9)	9 (2.5)	10 (2.8)	103 (28.9)	*df = 35*

Enterococcus spp.	3 (0.8)	0 (0.0)	12 (3.4)	3 (0.8)	1 (0.3)	1 (0.3)	5 (1.4)	1 (0.3)	26 (7.3)	*p=0.028*
Proteus spp.	0 (0.0)	5 (1.4)	6 (1.7)	3 (0.8)	1 (0.3)	3 (0.8)	2 (0.6)	2 (0.6)	22 (6.2)	
Candida albicans	12 (3.4)	7 (2.0)	13 (3.6)	13 (3.6)	13 (3.6)	6 (1.7)	10 (2.8)	2 (0.6)	76 (21.3)	
Total	30 (8.4)	33 (9.2)	79 (22.1)	62 (17.4)	45 (12.6)	39 (10.9)	48 (13.4)	21 (5.9)	357 (100.0)	

***Percentages are in parentheses**

Gender

Table 4: Distribution and Association of Microbial Pathogens by Gender among Patients

Microbial Pathogens	Male	Female	Total	Chi-square
Escherichia coli	10 (2.8%)	54 (15.1%)	64 (17.9%)	
Klebsiella spp.	10 (2.8%)	56 (15.7%)	66 (18.5%)	*X= 19.507*
Staphylococcus spp.	12 (3.4%)	91 (25.5%)	103 (28.9%)	*df = 5*
Enterococcus spp.	3 (0.8%)	23 (6.4%)	26 (7.3%)	*p=0.002*
Proteus spp.	4 (1.1%)	18 (5.0%)	22 (6.2%)	
Candida albicans	27 (7.6%)	49 (13.7%)	76 (21.3%)	
Total	66 (18.5%)	291 (81.5%)	357 (100.0%)	

Relationship between Microbial Pathogens and Clinical Symptoms

Table 5: Relationship between Microbial Pathogens and Clinical Symptoms among Patients

Microbial Pathogens	Painful urination	Frequent urination	Blood in urine	Abdominal pain	Total	Chi-square
Escherichia coli	26 (7.3%)	10 (2.8%)	19 (5.3%)	9 (2.5%)	64 (17.9%)	
Klebsiella spp.	19 (5.3%)	20 (5.6%)	21 (5.9%)	6 (1.7%)	66 (18.5%)	*X= 36.840*
Staphylococcus spp.	26 (7.3%)	25 (7.0%)	41 (11.5%)	11 (3.1%)	103 (28.9%)	*df = 15*
Enterococcus spp.	6 (1.7%)	8 (2.2%)	10 (2.8%)	2 (0.6%)	26 (7.3%)	*p=0.001*
Proteus spp.	9 (2.5%)	5 (1.4%)	6 (1.7%)	2 (0.6%)	22 (6.2%)	
Candida albicans	11 (3.1%)	19 (5.3%)	21 (5.9%)	25 (7.0%)	76 (21.3%)	
Total	97 (27.2%)	87 (24.4%)	118 (33.1%)	55 (15.4%)	357 (100.0%)	

Microbial Pathogens by Sensitive Antibiotics

Table 6: Microbial Pathogens by Sensitive Antibiotics among Patients

Microbial Pathogens	Ampicillin (AMP)	Ciprofloxacin (CIP)	Erythromycin (ERY)	Gentamicin (GEN)	Total	Chi-square
Escherichia coli	21 (5.9%)	25 (7.0%)	1 (0.3%)	17 (4.8%)	64 (17.9%)	
Klebsiella spp.	17 (4.8%)	22 (6.2%)	1 (0.3%)	26 (7.3%)	66 (18.5%)	*X= 11.328*
Staphylococcus spp.	34 (9.5%)	30 (8.4%)	1 (0.3%)	38 (10.6%)	103 (28.9%)	*df = 15*
Enterococcus spp.	11 (3.1%)	6 (1.7%)	0 (0.0%)	9 (2.5%)	26 (7.3%)	*p=0.729*
Proteus spp.	8 (2.2%)	4 (1.1%)	0 (0.0%)	10 (2.8%)	22 (6.2%)	
Candida albicans	31 (8.7%)	23 (6.4%)	0 (0.0%)	22 (6.2%)	76 (21.3%)	
Total	122 (34.2%)	110 (30.8%)	3 (0.8%)	122 (34.2%)	357 (100.0%)	

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

Microbial Pathogens by Resistant Antibiotics

Table 7: Microbial Pathogens by Resistant Antibiotics among Patients

Microbial Pathogens	Ampicillin (AMP)	Ciprofloxacin (CIP)	Erythromycin (ERY)	Gentamicin (GEN)	Total	Chi-square
Escherichia coli	17 (4.8%)	35 (9.8%)	0 (0.0%)	12 (3.4%)	64 (17.9%)	
Klebsiella spp.	23 (6.4%)	34 (9.5%)	1 (0.3%)	8 (2.2%)	66 (18.5%)	*X= 7.748*
Staphylococcus spp.	28 (7.8%)	58 (16.2%)	1 (0.3%)	16 (4.5%)	103 (28.9%)	*df = 15*
Enterococcus spp.	8 (2.2%)	16 (4.5%)	0 (0.0%)	2 (0.6%)	26 (7.3%)	*p=0.933*
Proteus spp.	6 (1.7%)	14 (3.9%)	0 (0.0%)	2 (0.6%)	22 (6.2%)	
Candida albicans	21 (5.9%)	47 (13.2%)	0 (0.0%)	8 (2.2%)	76 (21.3%)	
Total	103 (28.9%)	204 (57.1%)	2 (0.6%)	48 (13.4%)	357 (100.0%)	

DISCUSSION OF FINDINGS

This chapter presented the results of the study on urinary tract infections (UTIs) among patients who attended selected private laboratories in Okigwe Local Government Area, Imo State, from 2020 to 2024. The study included 357 participants, with a majority being female (81.5%, n=291) compared to males (18.5%, n=66). The largest age group was 20-29 years (22.1%, n=79), followed by 30-39 years (17.4%, n=62) and 60-69 years (13.4%, n=48). The number of participants increased over the years, with the highest number recorded in 2024 (n=93). Bacterial UTIs were more prevalent (79.0%, n=282) than fungal UTIs (21.0%, n=75), with the proportion of bacterial UTIs highest in 2023 (22.4%, n=80) and fungal UTIs peaking in 2024 (8.4%, n=30).

The most common microbial pathogens identified were *Staphylococcus spp.* (28.9%, n=103), followed by *Klebsiella spp.* (18.5%, n=66), *Escherichia coli* (17.9%, n=64), and *Candida albicans* (21.3%, n=76). *Staphylococcus spp.* was consistently the most prevalent pathogen across all years. The most frequently reported clinical symptom was blood in urine (33.1%, n=118), followed by painful urination (27.2%, n=97), frequent urination (24.4%, n=87), and abdominal pain (15.4%, n=55). Blood in urine was most prevalent in 2021 (9.0%, n=32).

The distribution of microbial pathogens varied by age group, with *Staphylococcus spp.* most common in the 30-39 years age group (6.2%, n=22) and *Candida albicans* most prevalent in the 0-9 years age group (3.4%, n=12). A significant association was found between microbial pathogens and age groups ($X^2 = 52.659$, df = 35, p = 0.028). Females had a higher prevalence of microbial pathogens compared to males, with *Staphylococcus spp.* identified in 25.5% (n=91) of females compared to 3.4% (n=12) of males. A significant association was found between microbial pathogens and gender ($X^2 = 19.507$, df = 5, p = 0.002).

Staphylococcus spp. was associated with the highest prevalence of blood in urine (11.5%, n=41), while *Candida albicans* was associated with the highest prevalence of abdominal pain (7.0%, n=25). A significant association was found between microbial pathogens and clinical symptoms ($X^2 = 36.840$, df = 15, p = 0.001). The most commonly sensitive antibiotics were Ampicillin (34.2%, n=122) and Gentamicin (34.2%, n=122), while Ciprofloxacin showed the highest resistance (57.1%, n=204). No significant association was found between microbial pathogens and sensitive antibiotics ($X^2 = 11.328$, df = 15, p = 0.729) or resistant antibiotics ($X^2 = 7.748$, df = 15, p = 0.933).

Overall, the findings of this study highlight the demographic, clinical, and microbiological characteristics of UTIs in Okigwe LGA. Bacterial UTIs were more common than fungal UTIs, with *Staphylococcus spp.* being the most prevalent pathogen. Females and young adults (20-29 years) were the most affected groups. Blood in urine was the most frequently reported symptom, and antibiotic resistance, particularly to Ciprofloxacin, was a notable concern. These findings provide suitable evidence for healthcare providers and policymakers in addressing UTIs in the region.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

CONCLUSION

This study has revealed important insights into the microbial profile and distribution patterns of urinary tract infections (UTIs) among patients attending selected private laboratories over a five-year period. The findings demonstrated that bacterial UTIs were significantly more prevalent than fungal UTIs across all age groups, genders, and years under review. Staphylococcus spp., Escherichia coli, Klebsiella spp., and Candida albicans emerged as the dominant pathogens, with variations in prevalence across different demographic categories. The highest burden of microbial pathogens was observed among individuals aged 20–39 years, with females disproportionately affected, possibly due to anatomical and behavioral factors.

The distribution trends across the years also indicated a consistent rise in the incidence of both bacterial and fungal UTIs, with a notable peak in fungal cases in 2024. This may reflect changes in healthcare-seeking behavior, antibiotic usage patterns, or underlying health conditions. Statistically significant associations between age, gender, and microbial pathogens suggest that demographic characteristics play a key role in infection susceptibility and pathogen type. Importantly, the study found that fungal pathogens—particularly *Candida albicans*—were not only present but showed a rising trend, peaking significantly in 2024. This suggests a possible increase in immunocompromised individuals, such as diabetic or elderly patients, or widespread use of broad-spectrum antibiotics which may predispose patients to opportunistic fungal infections. The marked increase in fungal UTI cases in 2024 demands more attention to fungal diagnostics and antifungal resistance monitoring in laboratory and clinical settings.

The statistically significant associations between both age and gender with microbial pathogen distribution and the type of UTI (bacterial vs. fungal) further reinforce the multifactorial nature of infection vulnerability. This stresses the importance of adopting age- and gender-sensitive strategies in public health interventions, as well as tailoring treatment approaches based on local pathogen prevalence.

Furthermore, the year-by-year analysis reflected fluctuations in UTI incidence, with 2023 recording the highest number of bacterial UTIs and 2024 showing a sharp increase in fungal UTIs. These trends may be attributed to environmental, behavioral, or even diagnostic factors within the region. It underscores the necessity for dynamic infection surveillance systems that can detect such temporal shifts and respond accordingly with updated clinical protocols and awareness campaigns.

In summary, this study provides a comprehensive epidemiological and microbiological mapping of UTI cases in Okigwe LGA over five years, identifying critical demographic trends, microbial patterns, and pathogen-specific burdens. The data supports the urgent need for evidence-based antimicrobial stewardship, improved diagnostic capabilities, and focused public health strategies to mitigate the burden of UTIs in the region and similar settings.

REFERENCES

1. Mafuyai, J. M., Gaknung, B., Hosea, G., Peter, U., Patience, K., Shikpup, N., Jidauna, D. & David, S. (2019). Assessment of knowledge and prevention practices of urinary tract infection (UTI) among female students' residence in university of Jos. (n.d.). International Research Journal of Public and Environmental Health. https://doi.org/10.15739/irjpeh.19.011.
2. Oladeinde, B., MSc, M., Aimls, A., Omoregie, R., MPhil, M., Fimls, F., Olley, M., MSc, M., Aimls, A., Anunibe, J., MSc, M., & Aimls, A. (2011). Urinary tract infection in a rural community of Nigeria. North American Journal of Medical Sciences, 75–77. https://doi.org/10.4297/najms.2011.375
3. Oli, A. N., Akabueze, V. B., Ezeudu, C. E., Eleje, G. U., Ejiofor, O. S., Ezebialu, I. U., Oguejiofor, C. B., Ekejindu, I. M., Emechebe, G. O., & Okeke, K. N. (2017). Bacteriology and antibiogram of urinary tract infection among female patients in a tertiary health facility in south eastern Nigeria. The Open Microbiology Journal, 11(1), 292–300. https://doi.org/10.2174/1874285801711010292
4. Zeng, Z., Zhan, J., Zhang, K., Chen, H., & Cheng, S. (2022). Global, regional, and national burden of urinary tract infections from 1990 to 2019: an analysis of the global burden of disease study 2019. World Journal of Urology, 40(3), 755–763. https://doi.org/10.1007/s00345-021-03913-0