

A Study on The Antibiotic Use Pattern Among Patients with Urinary Tract Infections at a County Referral Hospital in Kenya

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Abstract

Urinary tract infections are a prevalent cause of hospital visits, particularly among females and the elderly. Timely diagnosis and adherence to clinical guidelines are crucial for effective management. This study aimed to evaluate antibiotic usage patterns in urinary tract infection patients at Thika Level 5 Hospital, providing insights into prescribing practices and guideline adherence. A cross-sectional study enrolled 308 participants using purposive sampling. Data were extracted from patient files and supplemented with information on clinical guideline availability and supplies for UTI diagnosis and treatment. Descriptive analysis was conducted using Microsoft Excel, with strict adherence to ethical data protection protocols. The study found that a significant proportion of participants (n=78, 25.4%) fell within the 39-49 years age group. Patients under 49 years old constituted the majority (n=200, 65.1%). Cystitis (41.4%) was the most common specific urinary tract infection diagnosis, followed by pyelonephritis (23.5%) and urethritis (18.9%). Common comorbidities included diabetes mellitus (n=31, 27.0%), benign prostatic hyperplasia (BPH) (n=16, 13.9%), and hydrocele (n=11, 9.6%). Ceftriaxone was the predominant antibiotic prescribed in both outpatient (single STAT doses) and inpatient settings, followed by cefixime (n=105, 34.2%) and azithromycin (n=70, 22.8%). Notably, most prescribed antibiotics belonged to the World Health Organization Watch list. Among the 307 prescriptions reviewed, only 112 (36.7%) adhered to Kenyan Clinical Management and Referral Guidelines Volume III. Non-compliant prescriptions involved incorrect antibiotic choice, inappropriate duration and lack of indication. However, prescription frequency, route of drug administration and total dose generally aligned with recommendations.

Keywords: adherence; comorbidities; cystitis; pyelonephritis; urethritis

Introduction

Urinary tract infections (UTIs) occur when microorganisms invade the urinary tract. UTIs are among the most common infections globally, affecting over 400 million people and causing approximately 236,000 deaths annually [1]. Additionally, UTIs contribute to approximately 5.2 million DALYs worldwide. Notably, Southern Sub-Saharan Africa recorded one of the lowest age-standardized death rates at 0.8 per 100,000 persons in 2019 [2]. The number of deaths, incidences, and DALYs has increased significantly by 60.4% from 1990 to 2019, from 252.3 million to 404.6 million [3]. Similarly, the mortality rate has risen by 1240.2%, from 98,590 in 1990 to 236,279 in 2019 [2]. UTIs are ranked as the second most common infections globally, causing a health burden of more than \$6 billion annually [4].

Appropriately prescribing antibiotics for UTIs reduces the chances of resistance, recurrence,

complications and cost [5]. However, incorrect selection, duration, dosing of antibiotics for treating UTIs, as well as misuse, could lead to the development of antimicrobial resistance and clinical complications. Currently, antimicrobial resistance is a major global concern driven by the inappropriate use of antibiotics by healthcare providers and patients [6]. Using evidence-based guidelines enables healthcare providers to optimize available antibiotics judiciously. International standards require clinicians to use urine culture and sensitivity testing as the gold standard for diagnosis [7]. Accurate diagnosis would support clinicians in using the most effective and narrow-spectrum antibiotics that target specific sensitive microorganisms [8]. However, many clinicians opt for empirical treatment with broad-spectrum coverage due to various limitations. Auditing antibiotic use is essential for improving therapeutic standards, with the goal of evaluating and suggesting improvements in prescribing habits among clinicians [5].

Urinary tract infections (UTIs) rank among the most prevalent bacterial infections globally, impacting approximately 150 million individuals annually [9]. The incidence and mortality from UTIs have risen globally over the past three decades. The absolute number of cases of UTIs increased by 60.40% from 252.25 million in 1990 to 404.61 million in 2019 [3]. UTIs are associated with a significant economic and clinical burden, as well as a reduced quality of life. The disability-adjusted life years and mortality rates associated with UTIs have been increasing worldwide [10]. Among them is the growing burden of chronic kidney disease (CKD), a serious public health concern in the twenty-first century. UTIs in patients with CKD are considered complicated. Urosepsis, a clinically manifested severe infection of the urinary tract, can lead to kidney damage [11]. The global prevalence of UTIs is about 25% [12] which closely resembles the estimated prevalence in Kenya [13].

In Kenya, most of the treatment approaches are empirical and vary across practitioners [14]. Although UTIs have been quite responsive to treatment for a long time, this has been quickly overturned by the emerging antibiotic resistance of uropathogens [15]. The indiscriminate exposure to antibiotics through misuse or inappropriate use has accelerated the development of resistance to the commonly used, available and affordable antibiotics. This has made UTIs less responsive to common treatments, costlier to treat and more severe [16]. Most clinicians lack access to up-to-date clinical guidelines based on antibiotic sensitivity data [17]. Therefore, UTIs are becoming a burden on the healthcare system, necessitating the need for a review of current treatment patterns.

Material & Methods

Study Design and Site

This was a cross-sectional study that was conducted at Thika Level 5 Hospital (TL5H), which is a regional referral hospital located at Thika town, in Kiambu County. The county covers an area of 2,538 km² with a population of approximately 2,417,735 individuals and 795,241 households [18]. About 80% of residents in this county have access to improved sanitation and more than three-quarters have access to improved water sources. This county referral hospital serves a population of 3-5 million people from Kiambu and neighboring counties and has a capacity of 265 beds, catering for approximately

20,000 inpatients annually. According to 2015 records, the hospital saw more than 217,000 patients, averaging 1,935 patients per month. The study population comprised adult inpatients and outpatients diagnosed with UTI at TL5H in the study period.

Sampling and Sample Size

Purposive sampling was employed to collect data from 307 individuals, comprising 30% of the participants from inpatient files and 70% from outpatient files. The sample size of 307 was determined using the Cochran formula:

$$n = (Z^2 * p * (1 - p)) / E^2$$

Where: n (the desired sample size) was calculated with a confidence interval (Z) of 1.96 (for a 95% confidence level) and a prevalence rate (p) of 27.6%, as reported by Wanja et al. in 2021 [13].

Data Collection

Data were collected from patient records using a standardized questionnaire. The variables under investigation included specific diagnoses, the sociodemographic profiles of patients, comorbidities and prescribed medications. Additionally, we gathered supplementary information from departmental heads in clinical, laboratory and pharmaceutical departments to assess the availability of clinical guidelines for UTI's medications, diagnostic tests, and capacity-building activities.

Ethical Considerations

Authorization for the study was granted by the Mount Kenya University Institutional Ethics and Research Committee (Approval Number 1731). Additional permissions were obtained from NACOSTI (NACOSTI/P/23/25491) and the Thika Level 5 Ethics Committee. To protect participant information, data were anonymized, questionnaires were securely stored and digital copies were password-protected.

Data Analysis

Data were entered into Microsoft Excel and analyzed descriptively including percentages, means, graphs, and tables. Patient profiles, commonly prescribed antibiotics and prescribing patterns were summarized. Antibiotics were classified according to the WHO Aware classification [19], and cumulative results were presented in the form of percentages.

Results

Sociodemographic Profile of the Participants

From the sample size of 307 participants, there was an almost equal distribution of patients between the inpatient and outpatient settings. Most of these

patients were female (n=175, 57.0%), among whom 15 (4.9%) were pregnant (Table 1). The basis of diagnosis was mainly through microscopy (n=199, 64.8%) followed by the dipstick method (n=65, 21.2%). None of the sampled patients benefited from culture and sensitivity testing.

Table 1: Sociodemographic Characteristics of the Patients Diagnosed with Urinary Tract Infections

Variable	Frequency (%)
Setting Outpatient/Inpatient	158 (51.5%)
Gender	149 (48.5%)
Male	132 (43.0%)
Female	175 (57.0%)
Pregnant	
No	292 (95.1%)
Yes	15 (4.9%)
Laboratory Tests	
Dipstick	65 (21.2%)
Microscopy	199 (64.8%)
Microscopy and Dipstick	31 (10.1%)
Not done	12 (3.9%)
Culture & Sensitivity	0

Most of the participants (n=78, 25.4%) were aged 39 to 49 years (Figure 1). Patients below 49 years old (n=200, 65.1%) constituted the majority in this study.

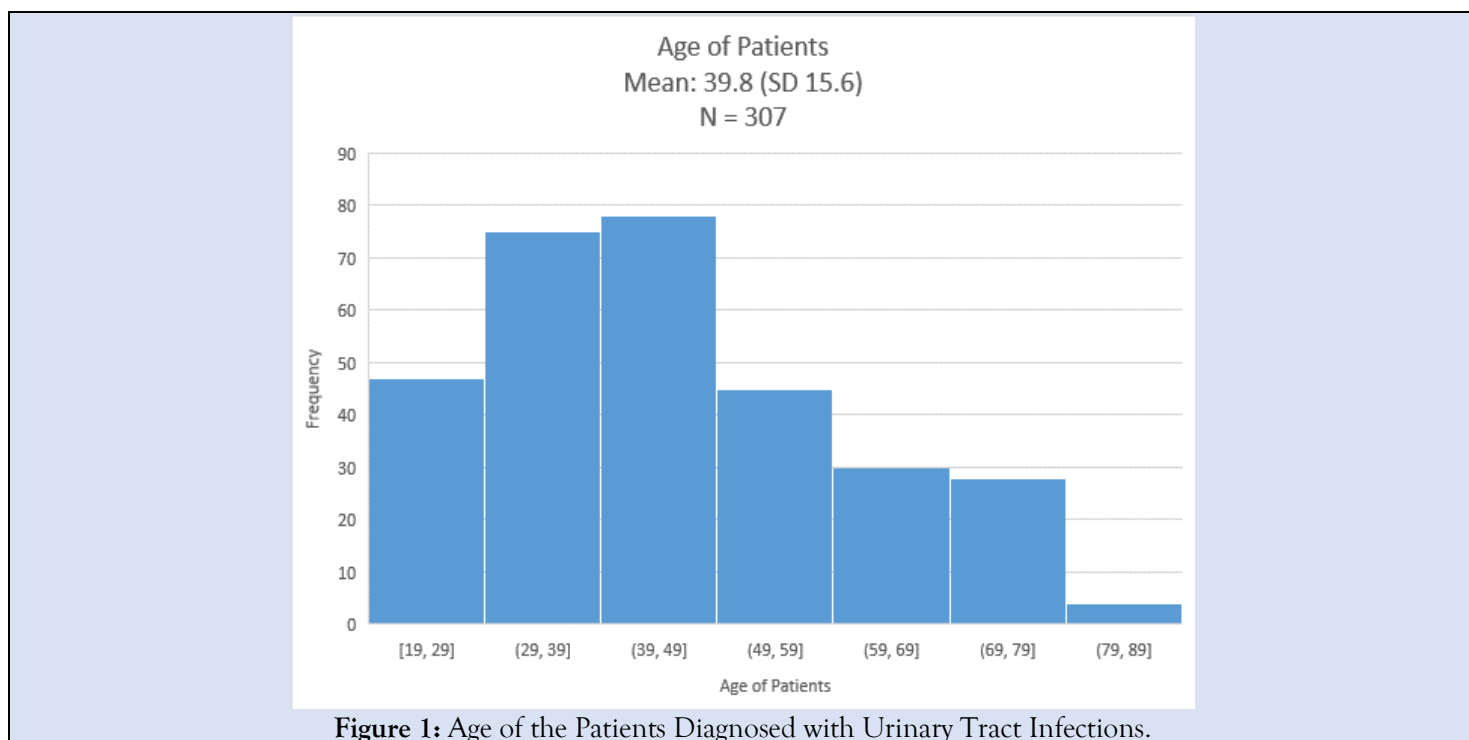


Figure 1: Age of the Patients Diagnosed with Urinary Tract Infections.

From the analysis of the specific UTI diagnosis, cystitis (41.4%) was the most common, followed by pyelonephritis (23.5%) and urethritis (18.9%) (Figure 2).

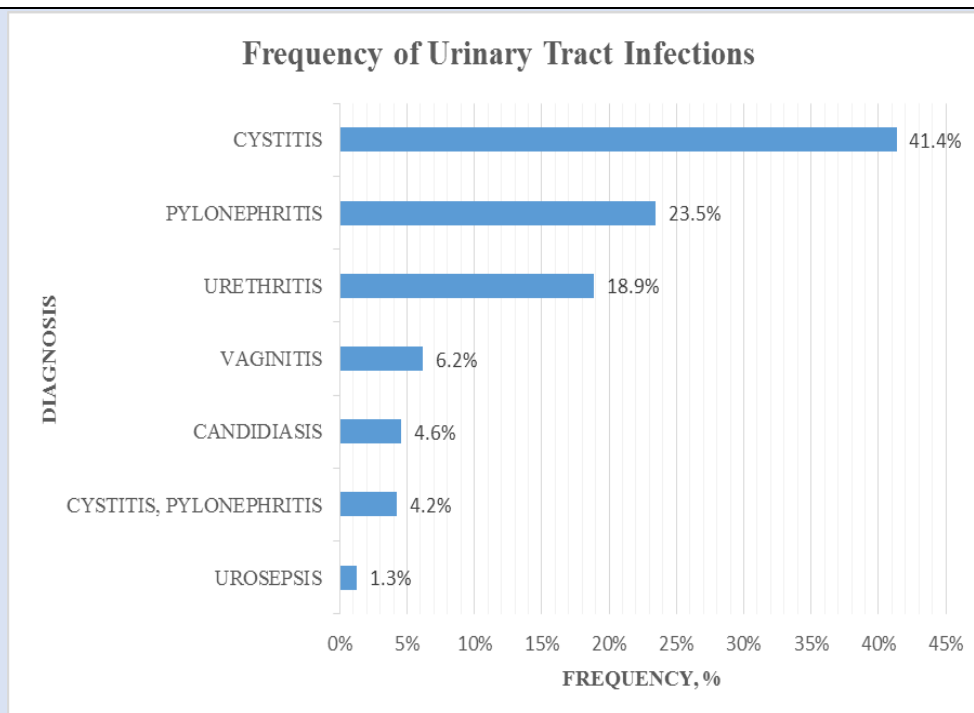


Figure 2: Frequency of the Urinary Tract Infections.

The most common comorbidities among the patients with UTIs were diabetes mellitus (n=31, 27.0%),

benign prostatic hyperplasia (BPH) (n=16, 13.9%) and hydrocele (n=11, 9.6%) (Table 2).

Table 2: Most Common Comorbidities among Patients with Urinary Tract Infections

Comorbidities	Frequency (%)
Diabetes Mellitus	31(27.0%)
Benign prostatic hyperplasia	16(13.9%)
Hydrocele	11 (9.6%)
Hypertension	9 (7.8%)
Retroviral disease	8 (7.0%)
Septicaemia	7 (7.0%)
Incomplete abortion	6 (5.2%)
<i>Cervical cancer</i>	5 (4.3%)
Tuberculosis	4 (3.5%)
Pelvic Inflammatory Disease	3 (2.6%)
Chronic wound	2 (1.7%)

Commonly Prescribed Antimicrobial Agents

Ceftriaxone was the most frequently prescribed drug, both in the outpatient setting (single STAT doses) and

for inpatients. Other antibiotics included cefixime (n=105, 34.2%) and azithromycin (n=70, 22.8%) (Table 3)

Table 3: List of the most Prescribed Antimicrobials

Drug name	frequency (%)
Ceftriaxone	123(40.1%)
Cefixime	105(34.2%)
Azithromycin	70(22.8%)
Metronidazole	49(16.0%)
Ciprofloxacin	46(15.0%)
Amoxiclav	22(7.2%)
Clotrimazole	20(6.5%)
Fluconazole	17(5.5%)
Amoxicillin	16(5.2%)
Levofloxacin	16(5.2%)
Gentamicin	15(4.9%)
Flucloxacillin	14(4.6%)
Nitrofurantoin	13(4.2%)
Cefuroxime	10(3.3%)
Doxycycline	7(2.3%)
Norfloxacin	5(1.6%)
Amikacin	1(0.3%)

Aware Classification of Prescribed Antibiotics

Majority of the prescribed antibiotics were from the WHO Watch list of antibiotics (Table 4). None of the drugs was from the Reserve category of antibiotics.

Table 4: WHO AWaRe Classification for the Prescribed Antibiotics

Who classification	Drugs	Frequency
ACCESS	Amoxicillin	137 (44.6%)
	Amoxicillin/Clavulanic acid	
	Doxycycline	
	Flucloxacillin	
	Metronidazole	
	Nitrofurantoin	
	Gentamicin	
	Amikacin	
WATCH	Azithromycin	200 (64.9%)
	Cefixime	
	Ceftriaxone	
	Cefuroxime	
	Levofloxacin	
	Norfloxacin	
	Ciprofloxacin	
RESERVE	-	0

Characteristics of Prescriptions

Out of the 307 prescriptions reviewed 112 (36.7%) adhered to the Kenyan Clinical Management and Referral Guidelines Volume III. The majority of non-compliant prescriptions included one or more of the following issues: the use of an antibiotic not

recommended, incorrect antibiotic duration, inappropriate choice of antibiotic for a specific patient and the absence of an indication for the prescribed drug. Nevertheless, all the prescriptions followed the recommended guidelines for frequency, route of drug administration, and total dose (Table 5).

Table 5: Prescribing Pattern of Drugs for Urinary Tract Infections

Drug	Total Daily Dose (mg)	Frequency	Route of administration	Duration of therapy
Ceftriaxone	2000	STAT/OD/BD	IV	STAT-5 DAYS
Cefixime	400	OD	PER ORAL	5 DAYS
Azithromycin	500	OD	PER ORAL	3 DAYS
Metronidazole	1200	TDS	IV/PER ORAL	5 DAYS
Ciprofloxacin	800-1000	BD	PER ORAL/IV	5-14 DAYS
Amoxicillin/Clavulanic acid	1250	BD	PER ORAL	5-7 DAYS
Clotrimazole	200-500	OD	PER VAGINAL	1-6 DAYS
Fluconazole	200	STAT	PER ORAL	STAT
Amoxicillin	1500-2000	TDS/BD	PER ORAL	5-7 DAYS
Levofloxacin	750-1000	OD/BD	PER ORAL	5-7 DAYS
Gentamicin	3MG/KG	OD	IV	5-7 DAYS
Flucloxacillin	2000	QID	PER ORAL	5 DAYS
Nitrofurantoin	200	BD/TDS	PER ORAL	5-7 DAYS
Cefuroxime	1000	BD	PER ORAL/IV	5 DAYS
Doxycycline	200	BD	PER ORAL	5 DAYS
Norfloxacin	800MG	BD	PER ORAL	STAT
Amikacin	15MG/KG	OD	PER ORAL/IV	5-7DAYS

Discussion

From the sample size of 307 participants, the majority of the patients were female, accounting for 57.0%. The higher prevalence of UTIs among females correlates with a study conducted in India, where the prevalence of UTIs among females was 73.57% compared to 35.14% in males [20]. These findings are also supported by a study carried out in a hospital in Peru from 2017 to 2019, which reported a UTI prevalence in women of 79.82% [21]. This observation can be explained by female anatomy, where the urethra is close to the anus, allowing easier entry of bacteria from the anus into the urethra and bladder. Additionally, females have a shorter urethra compared to males, making it easier for bacteria to reach the bladder [8]. In our study, it was found that the most common comorbidity among the patients with UTIs was diabetes mellitus, affecting 27.0% of the participants. This finding is consistent with a study from 2017-2018, where 46.81% of patients had diabetes [21]. Diabetic patients often have poor metabolic control, compromised immune systems and incomplete bladder emptying due to autonomic neuropathy, all contributing to an increased risk of urinary tract infections. Other factors include weakened white blood cells, poor blood supply, and glucosuria [21].

Ceftriaxone was the most prescribed antibiotic, accounting for 40% of prescriptions, both in the outpatient and inpatient settings. These results are similar to a study conducted in Singapore, where

ceftriaxone was prescribed as empirical treatment for UTIs in 36.6% of cases. In contrast to our study, cefixime was the second most prescribed antibiotic at 34.2%, with azithromycin ranking third at 22.8%. The Singapore study reported that co-amoxiclav was the second most prescribed antibiotic for UTIs, followed by piperacillin tazobactam and ciprofloxacin [22]. These differences may be attributed to variations in antimicrobial resistance patterns between the two countries and differences in clinical practice guidelines. Most prescribed antibiotics belonged to the WHO Watch list of antibiotics. Access antibiotics accounted for 44.6% of prescriptions, while watch antibiotics were prescribed in 64.9% of cases. None of the drugs fell under the Reserve category of antibiotics. These results align with a study conducted in India, where the percentage of patients on access antibiotics (35%) was lower than those on watch antibiotics (78.7%), with reserve antibiotics being prescribed to the fewest patients (0.1%) [23]. The reverse usage of watch antibiotics compared to the WHO's target for using access antibiotics for 60% of patients raises concerns. Notably, third generation cephalosporins, particularly ceftriaxone, were excessively used among the antibiotics for treating UTIs. The overuse of third generation cephalosporins (**Watch**) is alarming, as it is considered a contributing factor to the emergence of extended-spectrum beta-lactamase (ESBL) producing microorganisms. Among the 307 prescriptions reviewed, 112 (36.7%) adhered to the Kenyan Clinical Management and

Referral Guidelines. This indicates that most prescribers did not follow the Kenyan guidelines for UTI treatment [16]. Non-compliant prescriptions often included the use of non-recommended antibiotics, incorrect antibiotic durations, inappropriate antibiotic choices for specific patients and the absence of an indication for the prescribed drug. These findings highlight irrational prescribing practices and a lack of standardization in UTI treatment, which could lead to drug misuse, adverse reactions and drug shortages at health facilities [24]. However, all prescriptions adhered to the recommendations regarding frequency, route of administration and total dosage.

Conclusion

This study revealed inadequate adherence to WHO recommendations for the treatment of urinary tract infections [25]. Most patients (78.7%) were prescribed WATCH antibiotics, particularly third generation cephalosporins, which raises concerns about the emergence of drug-resistant microorganisms, treatment failures, and increased therapy costs. Additionally, irrational prescribing practices were observed, with many patients receiving inappropriate antibiotics and incorrect treatment durations.

Declarations

Acknowledgement

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Author's contribution

Doris Kithuka designed the study and collected data. The manuscript was written by Wainaina Samuel, and corrections and proofreading were carried out by Dennis Opwoko.

Conflict of interests

The authors declare that there is no conflict of interest in this published work.

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