

Article

A Situation Analysis of Diagnostic and Management Strategies for Gestational Urinary Tract Infections (UTIs) in Kisumu County, Kenya: Maternal Health Implications and Opportunities for Diagnostic Improvement

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Abstract

Urinary tract infections (UTIs) are linked to adverse pregnancy outcomes, yet epidemiological data on gestational UTIs in Kenya are limited. This study assessed diagnostic and management practices in Kisumu County to inform diagnostic and antimicrobial stewardship. A hospital-based retrospective study was conducted from February 2020 to February 2021 among 416 records of pregnant women at Chulaimbo and Nyahera Sub-County Hospitals. Socio-demographic, laboratory, and clinical history data were collected using structured forms and analysed in STATA 16.0. Statistical methods included chi-square, multivariate logistic regression, and Spearman's rank correlation ($p \leq 0.05$). Dipstick-based presumptive proportion of UTIs was 57.9% (241/416). Only 1.4% (6/416) had microbiological confirmation despite infections being recorded. The mean maternal age was 23.92 years, parity two, mean antenatal visits two, and mean haemoglobin 10.73 ± 1.8 g/dL. The first antenatal care attendance occurred at varying gestational ages in 56% (233/416). Antibiotics prescribed were 60% from WHO 'Access' group and 40% from 'Watch' group. Gestational UTIs in Kisumu County were frequently managed without confirmatory diagnosis, increasing antimicrobial resistance risk. Strengthening management requires better laboratory capacity, sustained financial investment, improved antibiotic access, and adherence to WHO AWaRe guidelines to protect maternal and neonatal health.

Keywords: gestational UTI; clinical diagnosis; therapeutic management



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1. Introduction

Urinary tract infections (UTIs) are one of the most common bacterial infections during pregnancy. UTI can manifest as either symptomatic or asymptomatic, leading to high

morbidity and mortality rates in low- and middle-income countries (LMIC) [1,2]. According to established international guidelines, UTI during pregnancy is classified as asymptomatic bacteriuria (ASB), acute cystitis, and acute pyelonephritis. ASB presents without symptoms, lower urinary tract symptoms, characterised by acute cystitis, and acute pyelonephritis involves upper urinary tract symptoms. The most common pathogen associated with both symptomatic and ASB is *Escherichia coli*. Untreated ASB lead to 30% of mothers developing acute pyelonephritis, with an increased risk of multiple maternal and neonatal complications, such as preeclampsia, preterm birth, intrauterine growth restriction and low birth weight. UTI is a common, but preventable, cause of pregnancy. Therefore, analysing urine samples through urine culture or new technologies, such as high-throughput DNA sequence-based analyses, should be used to improve antenatal screening of pregnant women. In the foetus, research indicates that UTIs can result in intrauterine growth restrictions, prematurity, low birth weight, and, in extreme cases, foetal mortality [3].

The prevalence of UTI in pregnancy varies between countries and regions, ranging from 3% to 35%, with higher rates observed in Africa and Asia [4,5]. In Kenya, UTI was reported to have a prevalence of 27% in the general population, underscoring its significant public health importance [6,7]. Previous findings have noted a 15.7–21.5% prevalence of UTI among pregnant women in Kenya [7], and 11.9% in children aged 2 months in rural settings [8,9]. Similarly, different studies have reported the prevalence of gestational UTIs in other African countries, with Ethiopia standing at 11.5–35.3% [10,11], 21–28.0% in Tanzania [12], 35% in Uganda [13], and 10.6–61.0% in Nigeria [14], 16.4% in Somalia [15] and 39.8% in Ghana [16]. Studies have suggested that gestational UTI contributes to a substantial proportion of adverse pregnancy outcomes, leading to various maternal and neonatal morbidity complications and deaths in Kenya [8]. Additionally, previous findings [10] indicate a general association between UTI and pregnancy-related complications among women in Ethiopia. Untreated UTIs pose a high risk of pyelonephritis, premature delivery and foetal mortality among pregnant women, conditions that are also associated with impaired renal function and end-stage renal disease among paediatric patients [17,18]. Although previous findings report on pregnancy-related mortality in Kenya [19–22], the prevalence rates of UTI-associated maternal complications experienced annually are yet to be investigated. Early screening, improved hygiene, and effective antibiotic treatment of gestational UTI hold great potential to reduce maternal and neonatal morbidities and mortalities in Kisumu County. The need to understand the epidemiology and biology of UTI-associated complications among pregnant women in Kisumu County calls for a robust analysis of the diagnostic, management and treatment strategies currently employed in gestational UTIs.

The management and treatment of UTIs have become increasingly challenging due to the global emergence of antimicrobial resistance-associated infections. This is particularly true for UTIs caused by extended-spectrum β -lactamase (ESBL)-producing Enterobacterales, methicillin-resistant *Staphylococcus aureus* (MRSA), carbapenem- and fluoroquinolone-resistant *Pseudomonas* spp., and vancomycin-resistant *Enterococcus* (VRE) spp. [23–25]. The continuous emergence and rise in antimicrobial resistance (AMR) have led to the development and implementation of several strategies to tackle this global threat. These include the Global Action Plan (GAP), National Action Plans (NAPs), antimicrobial stewardship (AMS) programmes, and the adoption of the World Health Organisation (WHO) Access, Watch, and Reserve (AWaRe) classification of antimicrobials [26–29]. In the WHO AWaRe framework, antibiotics are categorised based on their spectrum of activity, toxicity, and risk for the emergence of resistance [30]. The appropriate implementation of the AWaRe framework reduces indiscriminate antibiotic prescription and inappropriate use, thereby helping to mitigate the risks of AMR emergence and spread [26,30]. A study [31] reported that

sub-Saharan Africa had the highest rates of AMR burden in 2019. This high rate of AMR burden in sub-Saharan Africa has been attributed to the excessive and inappropriate use of antibiotics, a lack of access to laboratory diagnosis, poor-quality antimicrobials, limited capacity building for trained healthcare professionals, and inadequate healthcare facility infrastructure [32,33]. Understanding the pattern of antibiotic prescribing according to the WHO AWaRe framework can contribute to improving antimicrobial optimisation policies and surveillance systems for monitoring antimicrobial use (AMU) and AMR [31] in the study area.

This study conducted a situational analysis of the diagnostic and management strategies currently used to assess the burden of gestational urinary tract infections (UTIs) in Kisumu County, Kenya, with the aim of promoting the principles of diagnostic and antimicrobial stewardship. Note that the presented work here is part of a broader project, including a qualitative study that will be reported separately. In the presented work, the Chulaimbo and Nyahera Sub-County Hospitals were selected, as these hospitals serve a semi-urban population and host the second-largest population in the County. Therefore, these hospitals served as a model to establish specific clinical and laboratory diagnosis, and identify therapeutic management strategies for UTIs among pregnant women seeking maternal and child health (MCH) services within Kisumu County, Kenya.

2. Materials and Methods

2.1. Ethical Considerations and Consent to Participate in the Study

The study protocol received approval from the Maseno University Ethical Review Committee (MUERC) (Approval reference number: MUERC/00959/21). The Ministry of Health (MOH) local authorities also obtained an approval letter, granting permission to access the hospital facility's health records. Confidentiality measures were also applied to safeguard the privacy of hospital data. Only study identification numbers were used for anonymity and to avoid personal identification.

2.2. Study Type

This hospital-based study summarised in Figure 1 below, employed a cross-sectional design, involving the extraction of data from health records of pregnant women attending MCH services at Chulaimbo and Nyahera Sub-County Hospitals in Kenya. These facilities served as a model to establish specific clinical diagnoses and identify therapeutic management strategies for UTIS among pregnant women seeking maternal-child health (MCH) services within Kisumu County, Kenya.

2.3. Study Area

This study was carried out within the hospital settings of Kisumu County, Kenya. Kisumu County spans an area of 2085 km², with a total population of 1,081,485, as per the 2018 census, resulting in a population density of 495 people/Km² [34]. Administratively, the county is divided into seven Sub-Counties, including Kisumu Central (78,737 people), Kisumu East (69,988 people), Kisumu West (61,187 people), Nyando (65,751 people), Muhoroni (67,955 people), Seme (46,063 people) and Nyakach (62,024 people). The majority of residents in this county reside in rural areas, with 461,189 people compared to 429,354 in urban areas. Environmental indicators reveal that 52% of the population has access to safe water, while 47% have access to improved sanitation. Kisumu County reports a high fertility risk of 60% in women aged 20–29 and those younger than 20 years, with fertility risk inequalities apparent across all socio-demographic and socio-economic strata [34]. Health-seeking behaviour is affected by distance to healthcare facilities [32]. In Kisumu County, 42% of women face distance-related challenges in accessing health services, sur-

passing the national rate of 20% [34]. Despite a high utilisation of antenatal care (ANC) in Kisumu County (70%), as recommended by the WHO, only 27% of women receive all the recommended ANC components. These components include blood pressure measurements, blood and urine screening, tetanus vaccination, intermittent preventive treatment of malaria in pregnancy (IPTp), deworming treatment and iron-folic acid supplements [20]. Each Sub-County is equipped with a sub-county-level hospital capable of providing ANC services, conducting sufficient microbiology diagnostic assays, and running antibiotic susceptibility tests, revealing notable multidrug resistance (MDR).

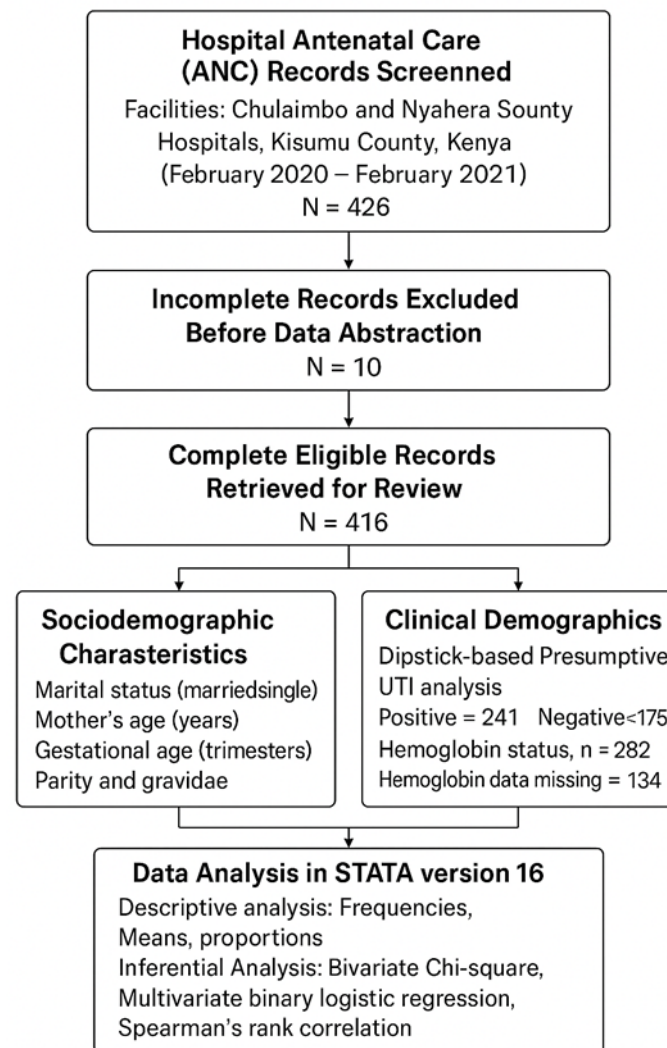


Figure 1. Flow Diagram depicting the study method.

Data collection was conducted at Chulaimbo and Nyahera Sub-County hospitals in Kisumu East Sub-County, as they are the locations hosting the second-largest population in the County. In addition, these hospitals serve a semi-urban population. They offer enhanced health services, which are attributed to the presence of the Academic Model Providing Access to Healthcare (AMPATH) programme.

2.4. Study Population and Sample Size Determination

This hospital-based study employed a cross-sectional study design, involving the extraction of data from health records of pregnant women attending MCH services. This study was conducted over a period of one year, specifically from February 2020 to February 2021. The study population included datasets from all pregnant women who attended

MCH services from Chulaimbo and Nyahera Sub-County hospitals within Kisumu County during the specified period. The sample size was determined using Fisher's formula [33] based on a 50% prevalence rate of UTIs [34], resulting in $N = 365$. As a precautionary measure, an attrition rate of 10% ($N = 36.5$) was considered, resulting in a final sample size of $N = 402$. The study collected a total of 416 MCH datasets over a one-year duration.

2.5. Inclusion and Exclusion Criteria

Inclusion in the study was based on the availability of data from pregnant women who permanently reside in Kisumu County and do not have any chronic infections. These pregnant women attended MCH services at Chulaimbo and Nyahera Sub-County hospitals, and presented with dipstick-positive presumptive UTI (nitrite and/or leukocyte esterase and/or bacteriuria field positive) from February 2020 to February 2021. Conversely, the exclusion criteria were determined by incomplete datasets from pregnant women and data from non-pregnant women deemed ineligible for the study.

2.6. Sampling Technique

Before data collection, electronic data capturing forms underwent a pre-test using ten [10] MCH ANC datasets from Chulaimbo Sub-County Hospital, which were excluded from the final analyses. Following the pilot phase, adjustments were made to the electronic data-capturing form (Supplementary Materials) to enhance clarity and consistency. Thereafter, data from health records were extracted from Chulaimbo and Nyahera Sub-County hospital records through purposive sampling. Serialised electronic data-capturing forms were used to collect socio-demographic and clinical data. Health records were reviewed to assess the clinical diagnosis of gestational UTI and the corresponding therapeutic management.

2.7. Data Analysis

The collected data was recorded and safely stored in Excel 2016 spreadsheets (Microsoft, Redmond, WA, USA). For analysis, these were exported to STATA version 16.0 (StataCorp, College Station, TX, USA). Using the Chi-square test, univariate analysis was performed to examine the relationship between socio-demographic factors and UTI and/or anaemia. Also, multivariate logistic regression was applied to identify the factors associated with UTI and anaemia. Furthermore, Spearman's Rank correlation analysis was employed to calculate the correlation coefficient between pairs of variables, investigating the strength and direction of their association. All numeric or quantitative variables were calculated and expressed as frequencies, proportions, means, and standard deviations. Descriptive analysis was used to summarise the demographic characteristics of the study population, with the descriptive statistics of variables presented by using frequency tables. A p -value of ≤ 0.05 at a 95% confidence level was considered statistically significant for all analyses.

3. Results

3.1. Demographic Characteristics of Pregnant Women

The demographic characteristics of the pregnant women attending the antenatal clinic in Kisumu County, Kenya is shown in Table 1. The study population had a mean of two (2) ANC visits ($SD \pm 1.14$; Min 1–Max 7), a mean mothers age of 23.92 years old ($SD \pm 6$; Min 10–Max 43), a mean parity of 2 ($SD \pm 2$; Min 0–Max 8), mean gravidae of 3 ($SD \pm 2$, Min 1–Max 10), and mean gestational age of 24.5 weeks ($SD \pm 7.7$ Min 3–max 38). Specifically, 56% of the pregnant women attended their first ANC visit at varying gestational ages during their pregnancy, predominantly between 24 and 28 weeks (Table 1).

Table 1. The demographic characteristics of the study participants.

S/NO	Variable	Categories	Frequency	Percent
1	First Visit	No	182	43.75
		Yes	234	56.25
2	Marital Status	Married	296	71.15
		Single	120	28.85
3	Gestation (trimesters)	First trimester	44	10.6
		Second trimester	212	51.08
		Third trimester	159	38.31
4	Gravidae	1–2	261	62.74
		3–4	108	25.96
		5–6	35	8.41
		7+	12	2.88
5	Parity	0–2	330	79.33
		3–5	76	18.27
		6+	10	2.4
6	Number of antenatal visits	1–2	337	81.01
		3–5	74	17.79
		6+	5	1.2
7	Mother's Age (years)	10–17	46	11.1
		18–24	209	50.2
		25–29	73	17.5
		30–34	61	14.7
		35–39	24	5.8
		≥40	3	0.7

3.2. Prevalence of Anaemia Among the Study Participants

The haemoglobin (Hb) level of pregnant women attending the antenatal clinic was assessed (Figure 2). A total of 282 out of 416 pregnant women (67.79%) had their haemoglobin (Hb) data available, whereas 134 pregnant women (32.21%) had no Hb data available in their hospital records. Of those with available Hb data, the mean Hb level was 10.73 g/dL (SD: 1.8), with a minimum Hb level of 5.0 g/dL and a maximum Hb level of 15.0 g/dL. Figure 3 shows that the prevalence of anaemia was 49.30%, whereas 143 (50.70%) pregnant women had normal haemoglobin levels (Hb 11.0–16.0 g/dL). Following the WHO classification of anaemia [35], 8 (2.84%) had severe anaemia (Hb < 7.0 g/dL), 39 (13.83%) had moderate anaemia (Hb 8.0–10.9 g/dL), whereas 92 (32.62%) had mild anaemia (Hb 11.0–11.9 g/dL).

3.3. Distribution of Gestational Urinary Tract Infection

Only 1.4% (6/416) of the records included a clinical history indicating that microbiological testing for UTI had been performed. In contrast, the dipstick-positive presumptive UTI (screen-positive) proportion was 57.9% (241/416), based on routine antenatal care (ANC) profile dipstick urinalysis (Figure 4). The classification of dipstick-positive presumptive UTI was derived from urinalysis results showing bacteriuria and/or positive leucocyte esterase and nitrites reactions, which are indirect indicators of possible infection. The proportion of pregnant women with dipstick-positive presumptive UTI (screen-positive) was 57.9% (241/416) and this was significantly higher (χ^2 , $p < 0.001$) compared to those with negative UTI status (screen negative) 42.1% (175/416). Microbiological urine culture was conducted for only 2.5% (6/241) of the dipstick screen-positive cases, which were subsequently treated empirically with broad-spectrum antibiotics. The remaining 97.5% (235/241) had no recorded clinical history or urine culture results captured and no

documentation on the appropriate antibiotics treatment administered, a clear indication of reliance on presumptive management. When stratified by trimester (Figure 5), the dipstick-positive presumptive proportion was highest, (Figure 5), the dipstick-positive presumptive UTI (screen-positive) Dipstick-positive presumptive UTI (screen-positive) proportion was highest during the second trimester (49%) followed by third trimester (37.8%), while the first trimester had the lowest proportion Dipstick-positive presumptive UTI (screen-positive) proportion (13.2%).

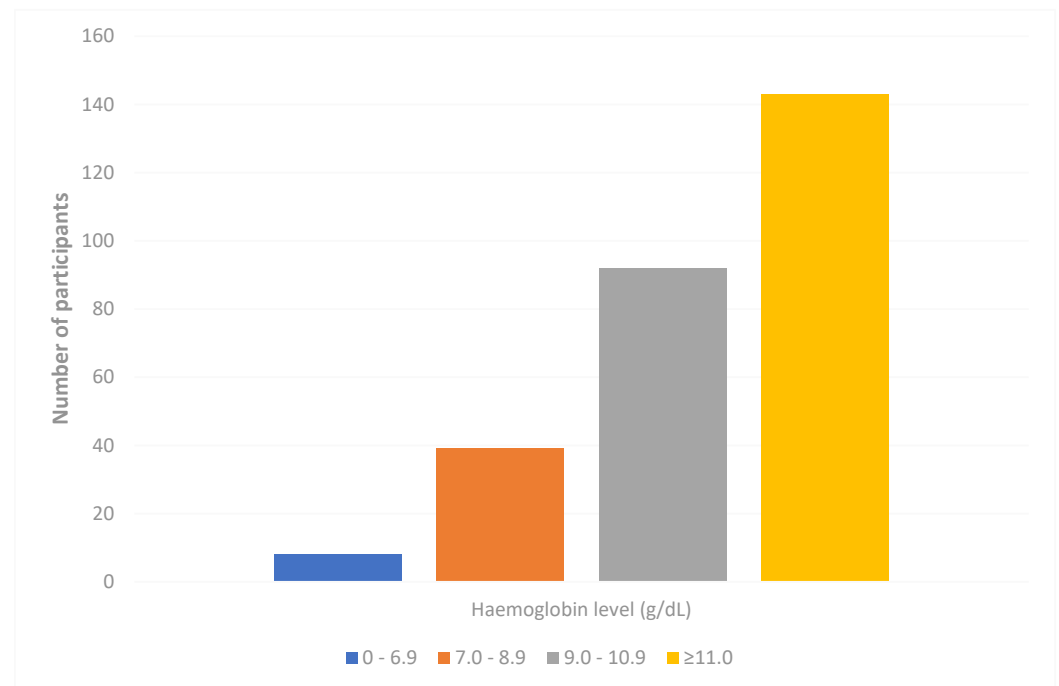


Figure 2. Distribution of haemoglobin concentration among the pregnant women.

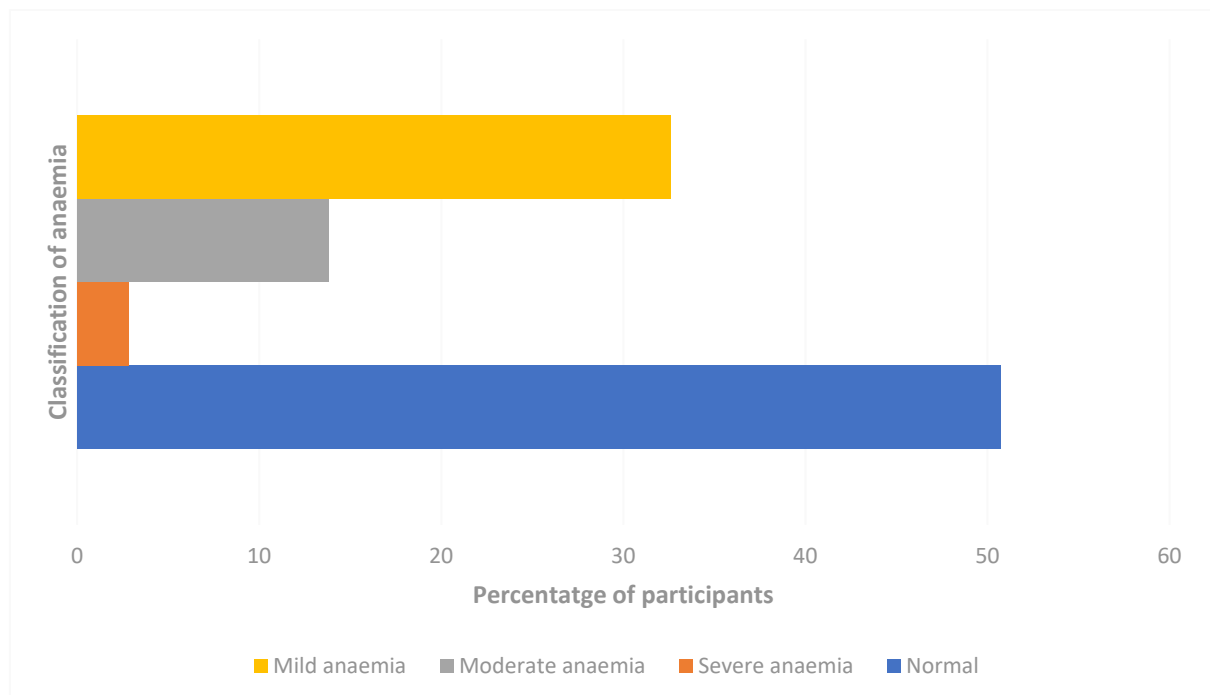


Figure 3. Prevalence of anaemia among pregnant women attending the antenatal care clinics.

Dipstick-Based Presumptive Gestational UTI

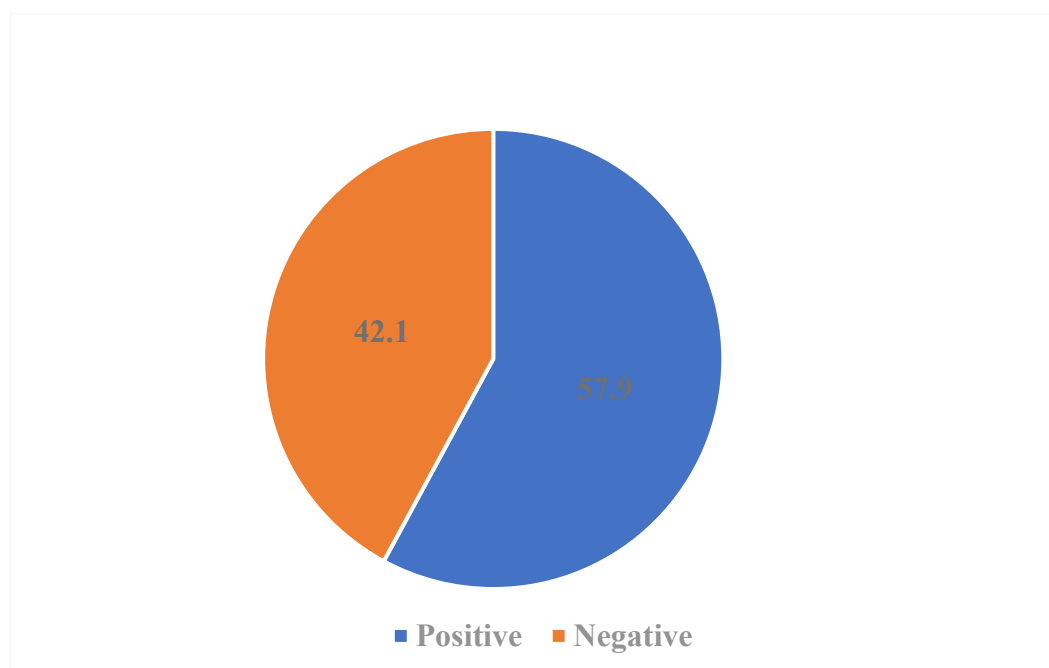


Figure 4. Pie chart showing the prevalence of dipstick-based presumptive gestational urinary tract infection.

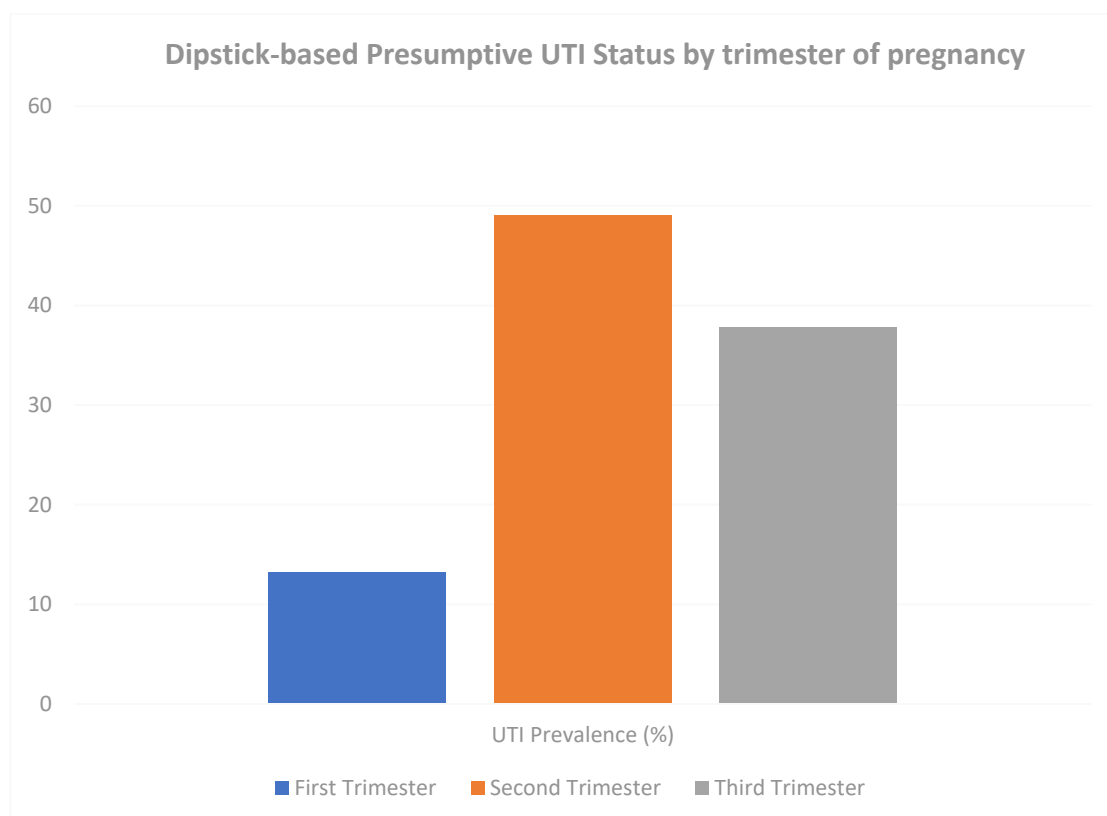


Figure 5. The Prevalence of Dipstick-based Presumptive Gestational Urinary Tract Infection by Trimester of Pregnancy.

3.4. Risk Factors Associated with Gestational Urinary Tract Infection (UTI)

Several factors known to increase the risk of developing a gestational UTI were assessed in this study. These factors included gestation age, marital status, parity, gravidity, number of ANC visits and haemoglobin level. A chi-squared association test was conducted to examine the association between the dependent variable, UTI, and the categorical variables (Table 2). The *p*-values in Table 2 indicate no statistically significant evidence of a relationship between UTI status and any categorical variables, at the 5% significance level. The closest association is observed between UTI status and Gravidae (*p* = 0.066), which would reach significance at the 10% significance level.

Table 2. Summary results for the chi-squared test of association between UTI status (dependent variable) and the predictors.

Variable	N	Chi-square (χ^2)	<i>p</i> -Value
Haemoglobin level	282	2.34	0.504
Number of antenatal visits	416	4.01	0.135
Marital status	416	0.30	0.587
First visit	416	0.47	0.491
Parity	416	3.71	0.156
Gravidae	416	7.19	0.066
Gestation	415	4.64	0.098

Additionally, multivariate logistic regression was employed to predict the likelihood of a UTI-positive status (Table 3). In this analysis, UTI status (1 = positive, 0 = negative) served as the binary outcome variable, with other variables of interest acting as predictors. The *p*-values associated with the coefficients for the variables used in the logistic regression analysis did not reveal strong predictors of UTI (Table 3). Most sociodemographic and clinical variables were not statistically significant. Gravidae of seven or more pregnancies was associated with significantly lower odds of UTI (AOR = 0.02, 95% CI: 0.00–0.70, *p* = 0.031), although this result should be interpreted cautiously due to small cell sizes. Other predictors such as gestational trimesters, haemoglobin levels, parity, and number of visits showed trends but did not reach statistical significance. Furthermore, model evaluation indicated modest performance (Table 4). The Hosmer–Lemeshow test suggested acceptable calibration ($\chi^2(8) = 7.61$, *p* = 0.472). The model correctly classified 60.1% of cases, with high sensitivity (86.2%) but poor specificity (21.9%), indicating a tendency to over-predict UTI. The area under the ROC curve (AUC = 0.633) confirmed limited discrimination. Overall, while the model fits adequately, its predictive power remains weak, and findings should be interpreted with caution. The model was also checked for multicollinearity using variance inflation factor (VIFs) and reported (Table 5). It was observed that all VIF values are below the conventional cutoff of 10, suggesting no evidence of problematic multicollinearity.

Note that although the study population is 416, the above analysis is based on 281 participants with complete data for all variables.

We also performed Spearman's rank correlation analysis to calculate the correlation coefficient between pairs of variables, aiming to investigate the strength and direction of their association (Table 6). It was observed that there were strong positive correlations between gravidae and parity (0.82) and between gravidae and mother's age (0.73). The association between the mother's age and parity is also relatively strong and positive, with a correlation coefficient of 0.67. Additionally, there are reasonably strong but negative correlations between the first visit and the number of antenatal visits (−0.52) and between marital status and the mother's age (−0.508). These negative correlations align with expectations, as individuals with more antenatal visits are less likely to be on their first visit, and older mothers are more likely to be married than single.

Table 3. The multivariate logistic regression analysis of the potential factors associated with gestational UTI.

Variable	AOR	95% CI	p-Value
Marital Status			
Single (ref)	1.00	–	–
Married	0.89	[0.48, 1.67]	0.728
Gestation Trimester			
First trimester (ref)	1.00	–	–
Second trimester	0.43	[0.16, 1.12]	0.083
Third trimester	0.50	[0.18, 1.39]	0.186
Haemoglobin level			
Non-anaemic (ref)	1.00	–	–
Severe anaemia	1.55	[0.33, 7.27]	0.575
Moderate anaemia	1.65	[0.76, 3.58]	0.208
Mild anaemia	1.59	[0.90, 2.80]	0.112
First Visit			
No (ref)	1.00	–	–
Yes	0.86	[0.46, 1.62]	0.643
Mother's Age	1.00	[0.93, 1.09]	0.900
Number of Visits			
0–2 visits (ref)	1.00	–	–
3–5 visits	0.58	[0.26, 1.31]	0.192
6+ visits	0.41	[0.05, 3.45]	0.413
Parity			
0–2 (ref)	1.00	–	–
3–4	2.33	[0.74, 7.31]	0.148
5+	7.85	[0.48, 129.07]	0.149
Gravidae			
0–2 (ref)	1.00	–	–
3–4	1.00	[0.44, 2.29]	1.000
5–6	0.29	[0.06, 1.41]	0.125
7+	0.02	[0.00, 0.70]	0.031 *
Constant	2.68	[0.39, 18.64]	0.318
Observations	281		
LR chi2(15)	15.98 ($p = 0.383$)		
Pseudo R ²	0.042		

* Significant at $p < 0.05$; AOR = Adjusted Odds Ratio; CI = Confidence Interval.**Table 4.** Model evaluation statistics for multivariate logistic regression (Model 1).

Metric	Value
AIC	395.51
BIC	453.73
Correctly classified	60.1%

Table 4. *Cont.*

Metric	Value
Sensitivity	86.2%
Specificity	21.9%
Positive predictive value	61.8%
Negative predictive value	52.1%
Area under ROC curve (AUC)	0.633
Hosmer–Lemeshow test	$\chi^2(8) = 7.61, p = 0.472$

AIC: Akaike Information Criterion; BIC: Bayesian Information Criterion.

Table 5. Variance Inflation Factor (VIF) Results.

Variable	VIF	1/VIF
Gravidae categories	3.68	0.272
Parity categories	3.25	0.308
Mother's age	2.90	0.345
First visit	1.54	0.647
Marital status	1.45	0.691
Number of visits	1.41	0.708
Gestation trimesters	1.19	0.839
Hb mild anaemia	1.17	0.853
Hb moderate anaemia	1.11	0.901
Hb severe anaemia	1.06	0.941
Mean VIF	1.88	

Hb: Haemoglobin.

Table 6. Spearman's rank correlation analysis of the potential factors affecting gestational UTI.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) UTI status	1.000								
(2) Haemoglobin level	−0.054	1.000							
(3) Number of antenatal visits	−0.098 *	−0.064	1.000						
(4) Parity	−0.078	−0.032	0.066	1.000					
(5) Gestation trimester	−0.090	−0.151 *	0.262 *	0.098 *	1.000				
(6) Mother's age	−0.072	0.025	0.064	0.671 *	0.090	1.000			
(7) Gravidae	−0.101 *	−0.011	0.078	0.820 *	0.127 *	0.734 *	1.000		
(8) First visit	0.034	0.040	−0.521 *	−0.092	−0.347 *	−0.156 *	−0.141 *	1.000	
(9) Marital status	0.027	−0.049	−0.064	−0.298 *	−0.025	−0.508 *	−0.378 *	0.144 *	1.000

* $p < 0.1$.

4. Discussion

The objectives of this study were to determine the clinical diagnosis and therapeutic management strategies used for gestational UTI in Kisumu County, Kenya. Data on socio-demographics, laboratory results, and clinical history were extracted from the health records of 416 pregnant women attending MCH services at Chulaimbo and Nyahera Sub-County hospital facilities from February 2020 to February 2021. The data extraction was performed using pre-designed data collection forms to ensure systematic and comprehensive information capture.

4.1. High Dipstick-Positive Presumptive UTI (Screen-Positive) Proportion During Pregnancy

In Kenya two main urine dipstick procedures are used for presumptive screening of urinary tract infections (UTI) in pregnancy. The DIRUI H-100 Urine Analyser (DIRUI Industrial Co. Ltd., Changchun, China), commonly used in well-established private and mission hospitals. The H100 analyser provides automated, semi-quantitative readings with

reported sensitivities of 72–90% and specificities of 55–80% compared to culture-confirmed bacteriuria [36,37].

In contrast, most public hospitals rely on Urine Dipsticks (10-parameter strips). The 10-parameter strips are routinely used in Maternal and Child Health (MCH) laboratories for antenatal profiling, whereas 3-parameter strips (leukocytes, nitrite, and protein) are used in labour wards for rapid screening during delivery. Manual interpretation introduces variability, yielding sensitivity of 65–85% and specificity of 50–75% relative to urine culture [38–40]. Although both methods offer low-cost, rapid screening, they remain presumptive tools; the Kenyan Ministry of Health recommends urine culture and antimicrobial susceptibility testing for definitive diagnosis [41].

However, culture and sensitivity testing remain limited in Kenya due to inadequate laboratory infrastructure, shortages of trained microbiologists, long turnaround time (48–72 h), high costs, and poor specimen transport and storage conditions. Many lower-level facilities lack the necessary equipment and reagents, making confirmatory testing inaccessible. Consequently, clinicians often rely on dipstick screening and empirical antibiotic therapy, contributing to overdiagnosis and antimicrobial resistance despite national guideline recommendations [42].

Polymerase Chain Reaction (PCR) provides a rapid and highly sensitive method for detecting uropathogens and antimicrobial resistance genes directly from urine, yielding results within hours and maintaining effectiveness even after antibiotic exposure. Nevertheless, its routine application in Kenya is constrained by high costs, limited equipment, and a lack of skilled personnel. Expanding access to molecular diagnostic capacity would strengthen UTI detection, surveillance, and targeted therapy, complementing conventional culture-based methods [43].

Current research findings on UTI during pregnancy revealed a Dipstick-positive presumptive UTI (screen-positive) proportion of 57.9% (241/416), providing nonspecific findings of UTI-associated bacterial agents. High gestational UTI prevalence confirmed by urine culture has been reported in previous studies with 81% in Pakistan [44], 10.6–61.0% in Nigeria [45–47] and 53.5% in Saudi Arabia [48]. However, the current rate of Dipstick-based positive presumptive UTI (screen-positive) proportion during pregnancy in our study is higher compared to the 27.6% reported in the general population among adults attending medical care at Kiambu level 5 hospital [6] and 21.5% among pregnant women attending ANC in Nairobi, Kenya [7]. A systematic review of studies on the prevalence of gestational uro-pathogens and their antimicrobial resistance patterns in developing countries in Asia and Africa reported an overall rate of 13.5% [5]. Gram-positive bacteria accounted for 15.9%, and Gram-negative bacteria accounted for most infections (83.7%), with *Escherichia coli* being the most predominant uropathogen in all 26 studies included in the review [5]. The systematic review further reported resistance to antimicrobial drugs commonly used in developing countries, with a high level of resistance to ampicillin (67.2%). However, all the identified uro-pathogens showed relative sensitivity to ciprofloxacin (71.2%), nitrofurantoin (65%) and ceftriaxone (74.1%) [5]. These previous observations are comparable to our findings. The variation in the rate of gestational UTI among different populations was attributable to various factors, including parity, maternal age, gestational age, level of education, and cultural practices [18]. However, other similar hospital-based studies in Sub-Saharan Africa have shown varying prevalence rates of gestational UTIs in Uganda [49], Ethiopia [10], and Ghana [50]. The difference could be because these studies used urine culture and biochemical analysis of all their samples during their investigations. In contrast, the prevalence reported in our study was based on dipstick urinalysis to presumptively determine urinary infection.

4.2. Inappropriate Gestational UTI Diagnosis

The current study highlights a significant omission of UTI status from the mothers' clinical history following laboratory antenatal care (ANC) profiling. Only 2.5% (6/241) of the datasets had a clinical history and microbiological tests that captured a UTI, out of a total dipstick-based presumptive prevalence of 57.9% (241/416) with a positive UTI diagnosis by urinalysis. A review of the diagnostic and therapeutic challenges in the management of gestational UTI revealed that specific detection and effective treatment remain vital clinical problems in low- and middle-income countries (LMICs) [18]. In addition, previous studies recommend repeating cultures every trimester for improved detection rates of asymptomatic bacteriuria [51,52]. Despite the Kenyan Ministry of Health's standard microbiological diagnostic procedures, which include bacterial culture and sensitivity tests, the surveyed hospitals have continued to perform presumptive dipstick urinalysis for ANC profiling. These laboratory findings remain uncertain, particularly in accurately identifying asymptomatic, potentially pathogenic gestational bacteriuria. The lack of adequate UTI history in clinical records poses a significant challenge to clinicians, hindering appropriate medication. Consequently, cases presenting with unidentified asymptomatic and uncharacterised symptomatic UTI go unnoticed, posing a future risk of gestational UTI-associated complications. These observations show that treatment appropriateness in our setting is often limited by lack of microbiological confirmation, leading to reliance on empirical therapy, which our data show occurred in over 97% of cases without confirmatory testing.

4.3. Notably High Gestational Anaemia

In this study, we demonstrated that the prevalence of anaemia is 49.30% among pregnant women attending antenatal care at Chulaimbo and Nyahera Sub-County hospitals in Kisumu, Kenya. Globally, an estimated 40.1% of pregnant mothers develop anaemia during the gestation period [53], with prevalence in sub-Saharan Africa standing at 57%, South-East Asia at 48%, and South America at 24.1% [54]. Similarly, the report has shown a 56% prevalence of anaemia during gestation in low- and middle-income countries due to several underlying precipitating factors [55]. The prevalence of anaemia among pregnant women was shown to be 38% in Uganda [56], which is also similar to the results of our study. Gestational anaemia in low-middle-income countries has been associated with several factors, including nutritional deficiencies of iron, folate, vitamins A and B12, UTI in pregnancy, parasitic infections or other chronic infections [57–60]. The use of haematinics during pregnancy is highly recommended, as it has been shown that their intake is protective against developing gestational anaemia. This is corroborated by [61], who demonstrated that the daily iron and folic acid supplementation in pregnancy lowered the risk of gestational anaemia by 73%.

Assessment of gestational UTI-associated risk factors is highly advisable due to the unmet challenges in implementing ideal bacterial diagnostics for effective surveillance and proper clinical and therapeutic management [62]. Adequate attention is missed, which may lead to recurrent UTI reinfections and ultimate life-threatening gestational UTI-associated complications. Previous reviews [63,64] have reported no significant UTI association with primary pregnancy outcomes, including pyelonephritis, preterm birth and secondary pregnancy outcomes, including low birth weight and Apgar score. On the contrary, some study findings report an increasingly positive association of gestational UTI with maternal anaemia, acute pyelonephritis, preterm labour, septicaemia and even possible death of the mother, intra-uterine growth restrictions, prematurity, and low birth weight of the foetus and foetal mortality [3]. Gestational asymptomatic bacteriuria (ASB) has been associated with premature and low birth weight, a relationship that is not supported by other studies [65–67]. Including microbiological analysis of urine samples and UTI

status as a variable, combined with the ANC laboratory profile, may effectively reduce the prevalence of UTIs in pregnant women, which could be an effective management strategy for reducing the prevalence of UTIs in women in this county. Current findings report no clear follow-up strategies to ensure compliance and re-testing of women who test UTI-positive. There is a need for the proper, up-to-date implementation of standard UTI diagnostic and management policies to ensure effective antibiotic therapy and ultimately healthier populations.

As mentioned earlier, misdiagnosis and inappropriate characterisation of asymptomatic and symptomatic UTIs may lead to symptomatic treatment using broad-spectrum antibiotics, posing a significant risk for developing multidrug-resistant (MDR) bacterial strains [68,69]. Previous studies have indicated a future potential for the development of multidrug resistance [70], particularly attributed to specific UTI bacterial aetiological agents [71,72], following poor clinical and therapeutic management. This may explain the increasing incidences of UTI-associated complications in sub-Saharan African populations, where conclusive confirmatory tests recommended by Ministry of Health guidelines are not implemented due to limited resources.

4.4. Regulated Access to Antibiotic Prescriptions

In this study, it was observed that most of the prescribed antibiotics for managing gestational UTI belong to the 'access' group (60%). In contrast, those on the 'watch' list contributed 40% of the prescriptions. There were no prescriptions of antibiotics from the 'reserve' group, as antibiotics belonging to this group are not readily available in such hospital setups. In a multi-country WHO AWaRe survey of paediatric patients, it was observed that Access to antibiotic prescription was 61.2% in Slovenia, 59.8% (Spain), 59.0% (Chile), 50.0% (Mexico), 52.9% (Nigeria), 33.3% (South Africa), and 7.8% in China [27]. A different study in three hospitals in three Caribbean countries found that antibiotics in the access group ranged from 57.6% to 71.0% [23]. In a study using the England-adapted AWaRe index, it reported that access group antibiotics represented the majority of antibiotics prescribed in England (60.9%), followed by Watch (37.9%) and Reserve (0.8%), whereas 0.4% of antibiotics remained unclassified [26]. These reports on the use of access to antibiotics agree with our study. However, our findings differ from those of [31], which reported that the percentage of watch antibiotic use was 77.3% in Iran, 74.1% in China, 71.4% in Montenegro, and 70.4% in Macedonia. Our results also disagree with a study in Bangladesh, in which 64.0% of patients were prescribed Watch group antibiotics, and 35.6% received Access group antibiotics [73]. In contrast, only 0.1% were treated with Reserve group antibiotics [73]. In another study in Japan, 43.1% of patients were prescribed access group antibiotics, 54.4% had watch antibiotics, and 0.4% received Reserve antibiotics [74]. In a more recent study in Zambia [75], antibiotics were prescribed in 55.5% of patients in the Access group, followed by the Watch group (43.1%), and lastly, the Reserve group (1.4%). These observations are also in tandem with those of our study. Overall, our findings and those from similar studies indicate a varied trend or pattern in antibiotic prescribing based on the WHO AWaRe antibiotics framework. The variations in antibiotic prescribing patterns across different studies could be attributed to variations in clinical laboratory infrastructure, antibiotic availability and affordability, the presence of regulatory guidelines for antibiotic prescription and use, the type of infection, patient population, and adherence to prescribing patterns by clinicians. In this study, cefixime, nitrofurantoin, sulfamethoxazole-trimethoprim, meropenem, gentamicin, ceftriaxone, erythromycin, and clindamycin were commonly prescribed antibiotics. Other African studies have also found that sulfamethoxazole-trimethoprim, meropenem, gentamicin, and ceftriaxone are the most frequently prescribed antibiotics [75,76]. It is worth noting that a high prescription

of broad-spectrum antibiotics for UTI is observed in the studied population, which may compromise future interventions due to the suspected development of resistant bacterial strains to readily available broad-spectrum antibiotics [77,78].

5. Limitations of the Study

The study has a few limitations. Firstly, haemoglobin data were missing for 32% of women, which could have impacted the overall anaemia prevalence reported in this study. Secondly, the diagnosis of gestational UTI was generally based on urine dipstick tests rather than microbiological culture, which could lead to overestimating the prevalence of gestational UTI, thereby impacting the validity of the overall prevalence in this study. Therefore, caution should be exercised when directly comparing these findings to culture-based studies. The purposive sampling approach limits the possibility of generalising these findings. The study period coincided with the COVID-19 pandemic's service disruptions.

6. Conclusions

Our findings reveal a high dipstick-based presumptive prevalence of gestational UTI (57.9%) based on a urine dipstick test, which may not be a general representation, as the test is not confirmatory. However, only a few of these cases receive appropriate, timely medication following clinical and therapeutic management. There is a general lack of conclusive diagnostic test results in line with the Kenyan Ministry of Health guidelines, which recommend bacterial culture and antibiotic sensitivity tests. This lack of specific diagnostic information leads to an inability to identify UTI-specific bacterial etiological agents, prompting the use of broad-spectrum antibiotic medications, which poses a significant risk for future development and the emergence of antibiotic resistance. Therefore, training clinical and laboratory personnel on the importance of microbiological testing in suspected UTI cases is essential, as it will improve diagnostic stewardship and pregnancy outcomes. There is a paucity of information about common UTI-associated aetiological bacterial agents in the target population. Such clinical data will be vital in addressing the future threat of antibiotic resistance in populations at risk and, ultimately, in reducing the burden of gestational UTIs and the associated poor pregnancy outcomes.

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Informed Consent Statement: Patient consent was waived because this research is a retrospective study. The manuscript only considered health records and not human participants. The Ministry of Health (MOH) local authorities also obtained an approval letter, granting permission to access the hospital facility's health records. Confidentiality measures were also applied to safeguard the privacy of hospital data. Only study identification numbers were used for anonymity and to avoid personal identification.

Data Availability Statement: The original data presented in the study are included in the article/Supplementary Materials. Further data inquiries can be directed to the corresponding or first author upon reasonable request.

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Conflicts of Interest: The authors declare that they have no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

AMPATH	Academic Model Providing Access to Healthcare
ANC	Antenatal Care
ASB	Asymptomatic Bacteriuria
CMR	Child Mortality Rate
SD	Standard Deviation
GCRF	Global Challenge Research Fund
IMR	Infant Mortality Rate
IPTp	Intermittent Preventive Treatment of Malaria in Pregnancy
LMIC	Low- and Middle-Income Countries
MCH	Maternal Child Health
MDR	Multidrug Resistance
MMR	Maternal Mortality Rate
MOH	Ministry of Health
NMR	Neonatal Mortality Rate
MUERC	Maseno University Ethical Review Committee
UTI	Urinary Tract Infections
WHO	World Health Organisation
AWaRe	Access, Watch, and Reserve

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