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Can the Urine Dipstick Test Be an Alternative in the Screening of Urinary Tract Infections for Inpatients in the Context of a Low-Income Country?

André Nagalo[1,2*], Odilon D. Kaboré[1], Senkaye-Lagom Aimée Kissou[3], Hervé Kafando[4], Boukary Kabré[5], Emmanuel Zongo[1], Cheick Ahmed Ouattara[6], Yacouba Sawadogo[1], Aoua Semdé[7], Jacques Zoungrana[8], Armel Poda[8], Sylvain Godreuil[9], Abdoul-Salam Ouédraogo[1]

[1]Bacteriology-Virology Laboratory, Sourô Sanou University Hospital, Bobo-Dioulasso, Burkina Faso
[2]Biomedical Analysis Laboratory, Regional University Hospital of Ouahigouya, Ouahigouya, Burkina Faso
[3]Department of Medical Pediatrics, Sourô Sanou University Hospital, Bobo-Dioulasso, Burkina Faso
[4]Bacteriology-Virology Laboratory, Yalgado Ouedraogo University Hospital, Ouagadougou, Burkina Faso
[5]Department of Urology-Andrology, Regional Hospital of Tenkodogo, Tenkodogo, Burkina Faso
[6]Information, Epidemiology, Research and Planning Department, Sourô Sanou University Hospital, Bobo-Dioulasso, Burkina Faso
[7]Department of Nephrology-Hemodialysis, Sourô Sanou University Hospital, Bobo-Dioulasso, Burkina Faso
[8]Department of Infectious Diseases, Sourô Sanou University Hospital, Bobo-Dioulasso, Burkina Faso
[9]Laboratory of Bacteriology of the Arnaud de Villeneuve University Hospital, Montpellier, France
Email: *nagaloandre@gmail.com

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Abstract

Background: Urinary Tract Infection (UTI), a prevalent bacterial infection in adults, heavily relies on cytobacteriological examination of urine (CBEU) for diagnosis. However, in resource-limited countries, accessibility to CBEU remains hindered by cost and availability. This study aims to assess the utility of the Urinary Dipstick Test (UDT) in diagnosing UTIs among hospitalized patients in the context of limited resources. **Methods**: A cross-sectional study was conducted from February to May 2019, encompassing hospitalized patients who underwent CBEU at the bacteriology unit of Sourô Sanou University Hospital. UDT and CBEU were concurrently performed, and UDT's analytical and diagnostic performance was evaluated against CBEU, considered the gold standard. **Results**: A total of 274 CBEU requests were registered, involving 274 patients (159 males) with a mean age of 45.8 ± 21.3 years (ranging from 1 to 90 years). UTI was confirmed in 90 patients, yielding a frequency of 32.85%. The UTI bacteriological profile was dominated by Enterobacteriaceae (75.23%), primarily *Escherichia coli* (60.55%). Nitrite and Leukocytes were positive in 54 (19.8%) and 157 (53.6%) of the samples tested.

Among patients with confirmed UTI, Nitrite, and Leukocytes were positive in 30 (33%) and 71 (79%) patients respectively. UDT demonstrated variable performance based on nitrite and leukocyte combination: Sensitivity (57% - 82%), Specificity (7% - 98%), Positive Predictive Value (PPV) (43% - 57%), Negative Predictive Value (NPV) (43% - 67%). UDT performed slightly better in women (NPV = 88%) and inpatients without urinary catheters (NPV = 75% and PPV = 80%). **Conclusion**: This study underscores UDT's potential utility in excluding UTIs among women, younger patients, and inpatients without urinary catheters, albeit with limited confidence. The UDT emerges as a complementary tool for UTI screening, particularly in resource-limited settings.

Keywords

Urine Dipstick Test, Urinary Tract Infection, LMICs, Burkina Faso

1. Introduction

The Cytobacteriological examination of urine (CBEU), a cornerstone of medical bacteriology laboratories, stands as the gold standard test for confirming urinary tract infections (UTIs) [1]. Notably, according to the Burkina Faso AMR surveillance annual reports, UTI accounted for approximately half of the analysis requests [2]. Nevertheless, resource-limited countries grapple with the substantial cost and availability barriers associated with CBEU utilization. Such constraints compel clinicians facing clinical suspicion of UTIs to initiate presumptive antibiotic treatments that often lack precision, thereby fostering the escalation of antibiotic resistance [3] [4].

In this context, the urinary dipstick test (UDT) emerges as a potential alternative [5]. A meta-analysis conducted in 2004 found that UDT has moderate sensitivity (48%) and better specificity (91%) in detecting UTIs. Sensitivity is higher in inpatients (58% vs. 45%), while specificity is greater in outpatients (96% vs. 85%) [6]. Semi-quantitative urine dipsticks encompass key markers such as leukocyte esterase, nitrite (an indicator for enterobacteria), and secondary proteins that indicate UTI. Implementation of this test offers the prospect of initiating or withholding treatment while awaiting CBEU results, where applicable [7] [8] [9]. In our resource-constrained setting, scant investigations have delved into the assessment of UDT's contribution to UTI diagnosis, particularly among inpatients. Given the dynamic nature of infectious epidemiology, our study endeavors to assess the role of urine dipsticks in detecting UTIs among patients admitted to Sourô Sanou University Hospital.

2. Patients and Methods

2.1. Study Design and Setting

This analytical cross-sectional study was conducted at the Bacteriology-Virology

laboratory of Sourô Sanou University Hospital (SSUH), a tertiary hospital in Bobo Dioulasso, Burkina Faso. The study spanned from February to May 2019.

2.2. Study Population

The study encompassed patients who were hospitalized and underwent CBEU at the bacteriology laboratory during the specified timeframe. This was an exhaustive sampling involving systematic recruitment based on routine CBEU activities. The sample size was calculated using Open Epi software with an estimated prevalence of urinary tract infections (UTI) at the SSUH bacteriology laboratory of 31.7%, as reported by Sanou K. in 2012 [10]. The number of subjects required after adjustment for non-compliant samples was 330. Exclusion criteria comprised samples of non-fresh urine received after more than 2 hours of preservation at room temperature.

2.3. Techniques

2.3.1. Samples Collection Conditions

Preferably, urine samples were collected prior to the initiation of antibiotic therapy. In instances where the patient had already commenced antibiotic treatment, a therapeutic window of 48 - 72 hours was observed. Additionally, if the patient was on antibiotics, the current antibiotic regimen was specified on the prescription requesting the CBEU.

2.3.2. Samples Collection Techniques

Samples were taken after careful cleansing of the meatus or vulva and the perimeter area The "on-the-fly", or "midstream" collection method was employed for urine collection in self-reliant patients capable of voluntary urination. In select cases, such as specific patient conditions, indwelling catheter urine collection techniques were utilized. In children able to control their micturition, midstream urine was collected in a sterile bottle. In infants, we used adhesive bag-type urine collectors.

2.3.3. Sample Transportation

Urine samples collected outside the laboratory were promptly transported to the laboratory. Samples that could not be immediately analyzed were stored at a temperature of +4˚C in a refrigerator for a maximum of 4 hours.

2.3.4. Analysis and Interpretation of Cytobacteriological Examination Urine (CBEU)

Each urine sample underwent a routine cytobacteriological examination (CBEU) in accordance with the standard operating procedures available in the bacteriology laboratory. This comprehensive assessment included a cytological study and a bacteriological study. Prior to these analyses, a macroscopic examination was conducted to record the visible characteristics of the received sample.

Cytological Examination: The cytological examination comprised both quantitative and qualitative assessments. Quantitative cytology was conducted using

the KOVA cell method as per the manufacturer's guidelines. Qualitative cytology involved analyzing the urine pellet obtained through centrifugation at 2500 g for 5 minutes.

Bacteriological Examination

- **Culturing and Bacteriuria Assessment**: The bacteriological examination encompassed the cultivation of urine samples and subsequent determination of bacteriuria. The culture media employed in this process were as follows: CLED (Cystine Lactose Electrolyte Deficient) agar, EMB (Eosin Methylene Blue) agar, and Sabouraud agar supplemented with chloramphenicol in instances where an abundance of yeasts was reported in the urine pellet. The calibrated loop technique was employed for both plating and bacteriuria assessment on the CLED medium, aided by a designated reading chart.
- **Interpretation of Urinary Tract Infections (UTIs)**: The diagnosis of UTIs was made based on the Kass criteria, as adapted by the French Society of Microbiology (SFM) [11]. The identification of bacteria was accomplished through an analysis of cultural and biochemical characteristics. This comprehensive approach ensured accurate determination of the presence of bacterial pathogens in the urinary specimens.

2.3.5. Analysis and Interpretation of the Urine Strip Examination

Urine Strip Usage and Reading: Standard Diagnostic brand urine strips (SD UroColor 10, Inc Korea, Ref: 10UK10) were employed for all participants. Following proper homogenization, the urine strip was fully immersed in the urine sample for approximately one second. The interpretation was carried out in accordance with the manufacturer's guidelines. Specifically, the moistened strip was visually compared to the colorimetric range indicated on the packaging after a lapse of 60 seconds.

Determination of Urine Strip Performance: The assessment of the urine dipstick involved a comprehensive analysis of both intrinsic and extrinsic characteristics. The intrinsic attributes of significance encompassed sensitivity (Se), specificity (Sp), the Youden Index (Y), and the positive (LR(+)) and negative (LR(−)) likelihood ratios. Extrinsic characteristics encompassed the positive predictive value (PPV), negative predictive value (NPV), Diagnostic Odds Ratio (DOR), and diagnostic efficiency (DE). It is noteworthy that the CBEU was designated as the "gold standard" for confirming the presence of UTI.

2.4. Data Analysis

The collected data underwent entry and analysis utilizing Epi Info (version 7.1.5.0) and Stata (version 15.1) software. The level of significance was established at $p \leq 0.05$. Categorical variables were compared using Pearson's chi-square test or Fisher's exact test, while quantitative variables were compared using Student's t-test. Both bivariate and multivariate logistic regression analyses were conducted. Odds ratios (OR) were computed alongside their corresponding 95% confidence intervals (CI 95%).

2.5. Ethical Considerations

Stringent ethical considerations were observed throughout the study. Anonymity and confidentiality were rigorously maintained for all data extracted from the CBEU requests. The urine specimens integrated into the study underwent the requisite biological analysis as indicated by the laboratory team. It is noteworthy that the study did not engender any adverse repercussions on patient management.

3. Results

3.1. Epidemiological Aspects

Between February and May 2019, the bacteriology laboratory at SSUH conducted 274 CBEU from 274 patients for UTI diagnosis. The study participants exhibited an average age of 45.84 ± 21.28 years, with ages ranging from 1 to 90 years. Most of the participants were male (58.76%). Among all urine samples received, UTI was diagnosed in 90 patients, representing a prevalence of 32.85%. The occurrence of UTI was observed in 35.24% of women and 32.21% of men ($p = 0.615$), with a notable increase in frequency associated with advancing age ($p = 0.038$).

The Nephrology department accounted for the highest proportion of CBEU requests (31%), followed by the Urology department (21%). Among these patients, 39.39% were undergoing urinary catheterization, while 42.22% were on antibiotic therapy at the time of urine collection. Prior to urine sampling, third-generation cephalosporins (3GC) were the most frequently prescribed antibiotics (67.65%), followed by penicillin (23.53%) and fluoroquinolones (8.82%).

3.2. Bacteriological Aspects

The epidemiological characterization of UTIs is illustrated in Table 1, revealing a prominent presence of Enterobacteriaceae (75.3%), trailed by non-fermentative Gram-negative bacilli (GNB) (9.17%), yeasts (8.26%), and Gram-positive cocci (GPC) (7.34%). Notably, *Escherichia coli* (60.55%) and *Klebsiella pneumoniae* (10.09%) constituted the most frequently isolated microorganisms.

3.3. Determination of UDT Parameters Predicting UTI

As elucidated in Table 2, parameters encompassing nitrite tests, leukocyte esterase, hematuria, and proteinuria exhibited statistically significant associations ($p < 0.002$) with the presence of UTI. Multivariate analysis, as presented in Table 3, reveals that the combination of nitrite, leukocyte, and protein parameters exhibited superior predictive capability for UTI compared to the combination of leukocytes and nitrite alone ($p = 0.008$).

3.4. Performances of UDT in UTI Screening

The efficacy of diverse UDT parameters, either in isolation or in conjunction, in

Table 1. Distribution of germs isolated at CBEU and UDT detection errors according to the bacteria isolated in the urine.

Types of germs	Species isolated		*False positive Nitrite* (+) n (%)	*False negative Nitrite* (−) n (%)
GNB enterobacteria	*E. coli*	66 (60.55)	-	43 (75)
	K. pneumoniae	11 (10.09)	-	11 (19)
	E. cloacae	4 (3.67)	-	3 (4)
	P. mirabilis	1 (0.92)	-	1 (2)
Non-fermentative GNB	*Acinetobacter sp*	6 (5.5)	2 (50)	-
	Pseudomonas sp	4 (3.67)	2 (50)	-
Gram-positive cocci	*S. aureus*	1 (0.92)	0	-
	S. epidermidis	4 (3.67)	0	-
	S. saprophyticus	3 (2.75)	0	-
Yeast	*C. albicans*	9 (8.26)	0	-
Error rate			4.5%	49.5%

GNB: Gram-negative bacilli.

Table 2. Urine dipstick parameters associated with UTI.

	Urinary tract infection n (%)		OR IC 95%	p-value
	Presence	Absence		
Nitrites				
Positive	30 (55.56)	24 (44.44)	3.33 [1.77: 6.28]	<0.001
Negative	60 (27.27)	75 (72.73)		
Leukocytes				
Positive	71 (48.30)	76 (51.70)	5.31 [2.84: 9.94]	<0.0001
Negative	19 (14.96)	109 (85.4)		
Red blood cells				
Positive	75 (42.13)	103 (57.87)	3.93 [2.05: 7.54]	<0.0001
Negative	15 (15.63)	85 (84.38)		
Proteinuria				
Positive	45 (44.12)	57 (55.88)	2.21 [1.30: 3.75]	0.002
Negative	45 (26.32)	126 (73.68)		
Glycosuria				
Positive	4 (25.00)	12 (75.00)	0.67 [0.21: 2.13]	0.49
Negative	86 (33.33)	172 (66.67)		
Acidiuria				
Positive	53 (32.32)	111 (67.68)	0.94 [0.56: 1.57]	0.82
Negative	37 (33.64)	73 (66.36)		
Urine density				
Positive	69 (32.24)	145 (67.76)	0.88 [0.48: 1.62]	0.69
Negative	21 (35.00)	39 (65.00)		
Bilirubinuria				
Positive	11 (30.56)	25 (69.44)	0.88 [0.41: 1.89]	0.75
Negative	79 (33.19)	159 (66.81)		

OR: Odds Ratio; IC 95%: 95% confidence interval.

Table 3. UDT parameters that best predict UTI using multivariate analysis.

	DOR	IC 95%
Model 1: LE, N		
N	2.01	[1.04; 3.88]
LE	4.46	[2.43; 8.18]
Model 2: LE, N, Prot		p-value LR test (Model 2 vs Model 1): 0.008
N	2.44	[1.24; 4.83]
LE	3.89	[2.09; 7.24]
Prot	2.17	[1.22; 3.86]
Model 3 saturated: LE, N, H, Prot		p-value LR test (Model 2 vs Model 3): 0.06
N	2.29	[1.16; 4.55]
LE	3.33	[1.76; 6.31]
Prot	1.82	[1.00; 3.32]
H	1.94	[0.95; 3.97]

N: Nitrites, LE: Leukocyte esterases, H: hematuria, Prot: Proteinuria, LR test: Likelihood Ratio test, DOR: Diagnostic Odds Ratio.

Table 4. Performances of UDT parameters in UTI screening.

Analytical characteristics	Intrinsic				Extrinsic				
	Se%	Sp%	LR+	LR−	*PPV*%	*NPV*%	*DOR*	*Y*	*E*
N+	33	87	2.6	0.8	56	73	3.3	0.20	0.69
LE+	79	59	1.9	0.4	48	85	5.3	0.38	0.65
N+, LE−	**3**	97	**1.5**	1.0	**43**	**67**	**1.6**	**0.01**	0.67
N−, LE+	49	70	1.6	0.7	44	74	2.2	0.18	**0.63**
N+ or LE+	**82**	**57**	1.9	**0.3**	48	**87**	**6.0**	**0.39**	0.65
N+ and LE+	30	89	2.8	0.8	**57**	72	3.5	0.19	**0.70**
N+, LE+, H+	24	91	**2.7**	0.8	56	71	3.2	0.15	0.69
N+, LE+, Prot+	8	**98**	2.4	**1.0**	54	68	2.5	0.05	0.68
N+, LE+, H+, Prot+	7	98	2.0	1.0	50	68	2.1	0.03	0.67

N: Nitrite, LE: Leukocyte esterase, H: Hematuria, Prot: Proteinuria, "+": Positive, "−": Negative, LR: Likelihood ratio, PPV: Positive predictive value, NPV: Negative predictive value, "bold": Extreme values, PPV: Positive predictive value, NPV: Negative predictive value, DOR: Diagnostic Odds Ratio, Y: Youden's Index, E: Diagnostic efficiency, LR: likelihood ratios.

detecting UTIs is consolidated in Table 4. Noteworthy variations in the performance of nitrite and leukocyte parameters in UTI detection concerning epidemiological characteristics and therapeutic considerations are expounded in Table 5.

Table 5. Variation in UDT performances in UTI screening according to epidemiological characteristics of the population and therapeutic aspects.

Analytical characteristics		Se %	Sp %	PPV %	NPV %	DOR	E
Sex							
N+ or LE+	M	81	53	48	84	4.8	0.63
	F	**83**	57	48	**88**	**6.7**	**0.66**
N+ and LE+	M	31	**90**	**60**	73	4.1	**0.71**
	F	30	88	58	70	3.2	0.68
Age							
N+ or LE+	<40 years	69	70	47	**85**	5.2	**0.70**
	>40 years	**86**	54	57	84	7.0	0.67
N+ and LE+	<40 years	19	**95**	63	75	5.0	**0.74**
	>40 years	27	94	**75**	64	5.3	0.66
Urinary catheterization							
N+ or LE+	Yes	**90**	21	55	67	2.4	0.56
	No	62	62	46	**75**	2.6	**0.62**
N+ and LE+	Yes	30	89	75	55	3.6	0.59
	No	19	**97**	**80**	69	**8.9**	**0.70**
Antibiotics treatment in progress							
N+ or LE+	Yes	**82**	56	43	**88**	**5.6**	0.63
	No	74	48	53	70	2.6	0.60
N+ and LE+	Yes	18	**100**	**100**	75	-	**0.76**
	No	26	93	75	61	4.8	0.63
Hospitalization in Nephrology or Urology							
N+ or LE+	Yes	**84**	45	55	78	4.2	0.62
	No	79	62	41	**90**	**6.2**	0.66
N+ and LE+	Yes	25	**93**	**74**	61	4.4	0.63
	No	31	87	45	79	3.1	**0.73**

Se: Sensitivity, Sp: Specificity N: Nitrite, LE: Leukocyte esterase, H: Hematuria, Prot: Proteinuria, "+": Positive, "−": Negative, PPV: Positive predictive value, NPV: Negative predictive value, DOR: Diagnostic Odds Ratio, E: Diagnostic Efficacy, "bold": extreme values.

4. Discussion

The aim of our study was to assess the potential of UDT in screening for UTIs among hospitalized patients within the resource-constrained context of low-income countries.

UDT parameters that best predict UTI: Leukocyte esterase and the nitrite test are two markers traditionally examined for UTI screening [12]. Notably, the

nitrite test displayed relatively low sensitivity (33%), while the leukocyte esterase test exhibited modest specificity (59%), findings aligned with those of various studies [12] [13] [14] [15]. Our multivariate analysis further corroborates these observations, revealing that the combined assessment of nitrites, leukocytes, and protein yields superior predictive power for UTI, surpassing the performance of leukocytes and nitrites alone ($p = 0.008$). Incorporating hematuria, however, did not yield additional insight into UTI occurrence ($p = 0.06$). In the existing literature, several authors have advocated for combining nitrite and esterase screenings as a screening approach [12] [16]. In the broader population, transient proteinuria has been linked to UTI [17] [18]. Our bivariate analysis concurs, exhibiting a statistically significant association between proteinuria and UTI ($p = 0.002$). Hematuria's significance varies in upper urinary tract infections, particularly in diagnosing cystitis. Its presence is often indicative of UTIs associated with lithogenic bacteria, such as *Proteus mirabilis*, *Klebsiella spp.*, or *Corynebacterium urealyticum*, which are less prominent in our study cohort [19] [20].

Intrinsic performances of UDT: Sensitivity ranged between 3% and 82%, while specificity varied from 57% to 98%, contingent upon the specific parameters assessed. Notably, the most robust performance was observed with the combination of nitrite and leukocyte assessments. Particularly, the greatest sensitivity (82%) was achieved when UTI was defined as the presence of either leukocytes or nitrites on the UDT. The simultaneous presence of leukocytes, nitrites, and proteins resulted in enhanced specificity (98%). The analytical performance of urine strips in our study mirrors that of the study of Kayalp *et al*. in 2013 in a microbiology laboratory in Ankara, Turkey [21]. This study reported a sensitivity and specificity of up to 78.8% and 97.8%, respectively.

Nonetheless, other analytical parameters such as likelihood ratios demonstrated weaker outcomes compared to findings from several other investigations [12] [16] [22]. The diagnostic gains, assessed through likelihood ratios (LR+ and LR−), ranged from 1.9 to 2.8 and 0.3 to 0.8, respectively. Likelihood ratios, derived from the interplay of sensitivity and specificity, offer insight into the likelihood of accurately confirming or ruling out UTIs based on UDT results. Our study's diagnostic gain, although relatively modest, is consistent with the established analytical performance of UTI screening, which generally remains moderate across diverse populations. Comparatively, findings from a systematic review by John *et al*. in the United States indicated more robust diagnostic gains, with LR+ ranging from 4.27 to 29.3 and LR- from 0.22 to 0.54 [16].

Variations in UDT performance in UTI screening according to epidemiological factors: The performance of UDT displayed marginal disparities based on sex, age, urinary catheterization, and ongoing antibiotic therapy. Minor elevations in sensitivity (83% vs. 81%) and NPV (88% vs. 84%) were noted in women as opposed to men. Inherent characteristics like sensitivity and specificity, distinct from urine dipsticks, remain relatively unswayed by disease preva-

lence [23]. Predictive values, representing post-test probabilities, accommodate these variables, particularly the prevalence of UTI [24]. This discrepancy could underpin the superior NPV exhibited in women. The findings of Yusuf *et al.* in a parallel study also documented a higher NPV in women than in men (94.7% vs. 83.3%) [9]. These findings align with established literature where multiple studies endorse UDT application in women due to its enhanced capability to exclude UTI [9] [12] [16]. Contrastingly, in men, UDT's relatively lower NPV restricts its capacity to confidently exclude UTI, thereby rendering its PPV more valuable in practice. The elevated PPV in men (60% vs. 58%), as noted by other researchers, can be attributed to the heightened occurrence of upper UTIs, particularly prostatitis, characterized by elevated bacteriuria [20]. UDT's efficacy was more pronounced among younger patients than their elderly counterparts. Diagnosed efficiency was indeed greater (0.75) among the young demographic, accompanied by a slightly higher NPV (85% vs. 84%). Yusuf *et al.* also highlighted UDT's better performance in younger patients, especially in terms of NPV compared to adults (97.1% vs. 94.9%) [9]. Correspondingly, UDT's aptitude for excluding UTI, notably among the youth and even in asymptomatic children, where a negative UDT can confidently eliminate UTI, reinforces its clinical utility [20] [25]. Our study revealed a higher diagnostic efficiency in non-catheterized patients (E = 0.70 vs. 0.59) and individuals not hospitalized in high-risk units (Nephrology and Urology) (E = 0.73 vs. 0.63). Notably, UDT's proficiency is more adept at detecting community acquired UTIs than nosocomial ones. The primary advantage of urine strip screening in hospitalized patients lies not in its performance, as it's less sensitive than culture, especially in cases of low bacteriuria and antibiotic usage, common in this patient category. Instead, it's the convenience of bedside application that holds value [24]. In patients with urinary catheters, the prevalence of UTI is notably high, escalating with the duration of catheterization to stabilize around the 30th day. Moreover, UTIs in this population often involve microorganisms that lack nitrate reductase production, such as staphylococci, enterococci, *Candida* spp., or *Acinetobacter* spp. [19]. Consequently, UDT is specifically indicated in these cases for asymptomatic infection screening, particularly in preoperative evaluations for invasive procedures within the genitourinary sphere. In these contexts, UDT, driven by specificity and NPV, cannot substitute CBEU, which necessitates an immediate execution [9] [24] [26].

Limitations of the urine dipstick Test: The limitations observed in the Urine Dipstick Test (UDT) performance can be attributed to several factors.

- **Detection Threshold and Sensitivity:** UDTs highlight leukocytes through the detection of leukocyte esterase from both intact and lysed leukocytes. However, their detection threshold is around 10 leukocytes per mm^3, which is relatively higher compared to the sensitivity of microscopy cytology, capable of detecting less than 10 leukocytes/mm^3 [19] [27]. The UDT model used in our study only identifies nitrites when bacteriuria exceeds 10^5 elements/mm^3,

a threshold considerably higher than CBEU's ability to detect bacteriuria from 10^3 elements/mm^3. This disparity results in false negatives for bacteriuria levels ranging between 10^3 and 10^5 elements/mm^3, which corresponds to the pathogenicity threshold for group 1 and 2 uropathogens, including enterobacteria, commonly isolated in our study [17] [19] [27].

- **Nitrate Reductase Production and Specificity**: The exclusive production of nitrate reductases by enterobacteria contributes to the test's poor sensitivity and low negative predictive value (NPV). Nitrites are present in urine only when bacteria with nitrate reductase activity, particularly enterobacteria, convert dietary nitrates into nitrites [13] [20]. This limitation renders UDT capable of detecting only enterobacteria and not Gram-positive bacteria such as staphylococci and non-fermentative Gram-negative bacilli, constituting about 25% of the isolated strains in our study [17]. While this characteristic contributes to the high specificity of up to 98%, it restricts the scope of the test.
- **Interference from Chemical Substances**: Interference from various chemical substances can influence UDT parameters, particularly in a specific population. Antibiotic usage, which was reported in 42% of patients in our study, could potentially decrease the sensitivity of UDT in detecting leukocyte esterase. Metabolites of drugs with oxidative potential, including cephalosporins, tetracyclines, nitrofurantoin, doxycycline, and gentamicin, may lead to false negatives when testing for leukocyte esterase [17] [19] [20].
- **Optical Reading and Standardization**: Optical (naked eye) reading of test strips, as employed in our study, may introduce variations and limitations in accuracy. The accuracy of UDT heavily depends on strictly adhering to reading times. Automatic reading methods utilizing spectrophotometers have been reported to offer superior results. By enabling standardized readings, these techniques enhance analytical characteristics like repeatability and reproducibility, indirectly influencing the analytical performance of the tests [19] [22] [28].

5. Conclusion

This study sheds light on the predictive potential of the combined nitrite, leukocyte, and protein test results in urinary tract infection (UTI) screening using the UDT. UDT demonstrated higher specificity than sensitivity, with consistent performance across various epidemiological characteristics of UTI. Particularly, UDT was found to be more effective in excluding UTI in specific groups, such as women, young patients, or those without urinary catheters. Our findings underscore the importance of using UDT judiciously due to its propensity for false negatives, which can impact its reliability as a UTI diagnostic tool. Furthermore, we affirm that UDT, even when positive, serves primarily as a reference test aimed at reducing unnecessary treatments, and should not be regarded as a definitive method for diagnosing UTI. A study encompassing a larger population,

particularly focusing on outpatients, and incorporating spectrophotometric strip reading, holds promise for evaluating UDT's potential in excluding CBEU. Such research would contribute to optimizing diagnostic resources in our resource-constrained setting and guide informed clinical decision-making.

Contribution of the Authors

Abdoul-Salam Ouédraogo: Initiation, design, and scientific guarantor of the study; André Nagalo: file review, data entry, data analysis, bibliographic research, and writing of the article; Odilon D. Kaboré, Senkaye-Lagom Aimée Kissou and Boukary Kabré: first reading and reorientation of the manuscript; the other authors reviewed the manuscript and made corrections. All authors read and approved the final version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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