



Diagnostic Reliability of Urine Dipstick vs Culture in the Diagnosis of Urinary Tract Infection: A Retrospective Cross-Sectional Study at a Tertiary Care Hospital in Bengaluru.

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Abstract

Background: Urinary tract infection (UTI) is a common bacterial infection. Urine culture, the reference standard, takes 24-72 hours, which can delay treatment. Urine dipstick testing is a rapid, inexpensive screening alternative, but its accuracy varies across studies. **Objective:** To evaluate the diagnostic performance of urine dipstick parameters (protein, nitrite and leukocyte esterase), individually and in combination, against urine culture for diagnosing UTI. **Methods:** This retrospective cross-sectional study was conducted in the Department of Microbiology, Command Hospital, Bangalore, using records from February 2024 to January 2025. Patients of all ages and both sexes who had both dipstick analysis and urine culture were included. Those with incomplete records or antibiotic use within 72 hours before sample collection were excluded. Sensitivity, specificity, positive and negative predictive values (PPV, NPV) and accuracy were calculated, and associations were tested with the Chi-square test ($P < 0.05$). **Results:** Of 1,037 samples, 616 (59.4%) were from females, and 477 (46.0%) were culture-positive. *Escherichia coli* (57.9%) was the most common isolate, followed by *Klebsiella* spp. (26.6%). Nitrite had the highest specificity (97.32%) and PPV (89.51%) but low sensitivity (26.83%). Leukocyte esterase had the highest sensitivity (64.78%), and protein performed moderately. Nitrite plus leukocyte esterase gave the highest accuracy among the combinations (63.45%), with 98.39% specificity and 92.24% PPV. The protein-nitrite and triple-positive combinations reached 99.64% specificity and 97.01% PPV, but sensitivity fell to 13.63%. A completely negative dipstick had an NPV of only 47.98%. **Conclusion:** Dipstick testing is best used as a rule-in tool, since positive nitrite-based results strongly suggest UTI. A negative dipstick cannot reliably exclude infection. Dipstick findings should support early clinical decisions but not replace urine culture, especially in symptomatic and high-risk patients.

Keywords: urinary tract infection, urine dipstick, nitrite, leukocyte esterase, urine culture, diagnostic accuracy.



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INTRODUCTION

Urinary tract infection (UTI) is one of the most common bacterial infections encountered in clinical practice and represents a significant public health concern worldwide. It affects individuals of all age groups, with nearly half of the population experiencing at least one episode during their lifetime. UTIs account for a substantial proportion of outpatient consultations and emergency department (ED) visits, contributing considerably to healthcare costs and antibiotic utilization.¹

The risk of UTI is influenced by several host-related factors, including female sex, pregnancy, extremes of age, diabetes mellitus, urinary tract abnormalities, catheterization, bladder dysfunction, and immunocompromised states. Women are more susceptible because of anatomical factors that facilitate ascending bacterial infection.² During pregnancy, physiological changes predispose women to both symptomatic UTI and asymptomatic bacteriuria (ASB), which affects approximately 2–10% of pregnant women. If left untreated, ASB may progress to pyelonephritis and is associated with adverse maternal and foetal outcomes, emphasizing the importance of routine screening during pregnancy. In children, UTIs may indicate underlying congenital urinary tract anomalies or vesicoureteral reflux and, if inadequately treated, can result in recurrent infections, renal scarring, hypertension, and chronic kidney disease.³

The clinical presentation of UTI varies depending on the severity of infection. Common symptoms include dysuria, urinary frequency, urgency, suprapubic pain, and fever, although no single symptom is sufficient to establish the diagnosis.⁴ *Escherichia coli* is the predominant causative organism, while *Klebsiella pneumoniae*, *Proteus mirabilis*, *Enterococcus*

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faecalis, Staphylococcus saprophyticus, Staphylococcus aureus, and Pseudomonas aeruginosa are also frequently implicated.^{5,6}

Early and accurate diagnosis is essential for appropriate antimicrobial therapy and prevention of complications. Urinalysis is widely used as an initial screening test but to avoid unnecessary antibiotic use Urine culture remains the reference standard for confirming UTI because it enables pathogen identification and antimicrobial susceptibility testing.⁶ Nevertheless, the turnaround time of 24–72 hours may delay targeted treatment, particularly in emergency settings. Therefore, rapid screening methods with acceptable diagnostic accuracy are needed to facilitate early clinical decision-making.^{7,8}

The present study was undertaken to evaluate the diagnostic performance of routinely used urine dipstick parameters by comparing their findings with urine culture, the reference standard for UTI diagnosis, and to determine their utility as rapid screening tools in patients with suspected urinary tract infection.

Rationale

Prompt diagnosis of urinary tract infection (UTI) is essential for timely treatment and appropriate antimicrobial use. Urine dipstick testing is a rapid, simple, and cost-effective screening method; however, its diagnostic accuracy remains variable when compared with urine culture, the gold standard for UTI diagnosis. Therefore, this study was conducted to evaluate the diagnostic performance of urine dipstick parameters against urine culture and determine their usefulness as rapid screening tools for suspected UTI.

Objective

To evaluate the diagnostic performance of urine dipstick parameters (protein, nitrite, and leukocyte esterase) in comparison to urine culture for the diagnosis of urinary tract infection.

METHODOLOGY

This retrospective cross-sectional study was conducted in the Department of Microbiology, Command Hospital, Bangalore, after obtaining approval from the Institutional Ethics Committee (EC: CHAFB/IEC/71/2025). Laboratory records of eligible participants from February 2024 to January 2025 were reviewed, and relevant demographic and laboratory data were extracted for analysis.

The study included patients of all age groups and either gender who had undergone both urine dipstick analysis and urine culture for suspected urinary tract infection. Participants with incomplete laboratory records or those who had received antibiotic therapy within 72 hours prior to urine sample collection were excluded from the study. Urine culture was considered the reference standard for the diagnosis of urinary tract infection.

Statistical analysis plan

Sample size calculation: The sample size was calculated by using previously reported estimates of the sensitivity and specificity of the urine dipstick test from the study by Gurung et al.⁸ The expected sensitivity and specificity were assumed to be 44% and 78%, respectively. Assuming a disease prevalence of 20%, an absolute precision of 10%, and a 99% confidence level, the minimum required sample size was calculated to be 818 participants based on sensitivity. After adjusting for an anticipated 25% dropout or incomplete records, the final required sample size was 1,023 participants. A total of 1,037 participants were included in the present study, satisfying the calculated sample size requirement.

Statistical Analysis: The diagnostic performance of urine dipstick parameters (protein, nitrite, and leukocyte esterase), individually and in combination, was evaluated by determining their sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy. The association between dipstick findings and urine culture results was assessed using the Chi-square test, with a P value of <0.05 considered statistically significant.

RESULTS

A total of 1,037 urine samples were analysed, of which 616 (59.4%) were obtained from female patients. Urine culture was positive in 477 (46.0%) samples, while 560 (54.0%) samples showed no bacterial growth. Among the 477 culture-positive samples, Escherichia coli was the predominant uropathogen followed by Klebsiella spp. and Enterococcus spp. (**Table:1**)

This study assessed the diagnostic performance of individual and combined urine dipstick parameters by comparing their sensitivity, specificity, PPV, and NPV with urine culture findings. The results showed that the diagnostic performance of urine dipstick testing varied according to the individual marker or combination of markers assessed.

Table:1: Distribution of bacterial isolates recovered from urine cultures (N = 477)

S. No.	Organism	Number of Isolates (n)	Percentage (%)
1	Escherichia coli (E. coli)	276	57.86
2	Klebsiella	127	26.62
3	Enterococcus	32	6.71
4	Enterobacter	16	3.35
5	Citrobacter	5	1.05
6	Staphylococcus spp.	7	1.47
7	Coagulase-negative staphylococci (CoNS)	5	1.05
8	Morganella	4	0.84
9	Proteus	3	0.63
10	Providencia	2	0.42
	Total	477	100.00

Diagnostic performance of individual urine dipstick parameters:

All three individual urine dipstick parameters showed a statistically significant association with urine culture positivity (Protein: $P = 0.003$; Nitrite: $P < 0.001$; Leucocyte esterase: $P < 0.001$) (Table 2). Among the individual parameters, leucocyte esterase showed the highest sensitivity (64.78%), while nitrite demonstrated the highest specificity (97.32%), positive predictive value (89.51%), and overall diagnostic accuracy (64.90%). Protein showed moderate diagnostic performance. (Table:2)

Diagnostic performance of combined urine dipstick parameters:

Among the combined urine dipstick parameters, Nitrite+/Leucocyte Esterase+, Protein+/Nitrate+, and Triple Dipstick Positive (Protein+/Nitrite+/Leucocyte Esterase+) showed a statistically significant association with urine culture positivity ($P < 0.001$) (Table 2). The Nitrite+/Leucocyte Esterase+ combination demonstrated the highest diagnostic accuracy (63.45%) among the combined tests, with a specificity of 98.39% and a PPV of 92.24%. Protein+/Nitrate+ and Triple Dipstick Positive showed the highest specificity (99.64%) and PPV (97.01%), although both had a low sensitivity of 13.63%. In contrast, the Protein+/Leucocyte Esterase+ combination was not significantly associated with urine culture positivity ($P = 0.087$). (Table:2)

Diagnostic performance of a negative dipstick:

A completely negative dipstick (protein–/nitrite–/leucocyte esterase–) demonstrated poor diagnostic performance for excluding urinary tract infection, with a sensitivity of 13.63%, specificity of 67.86%, PPV of 26.53%, NPV of 47.98%, and an overall accuracy of 42.91%.

Table 2: The diagnostic performance of individual and combined urine dipstick parameters

Test Name	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)	P value
Protein+	51.15	58.04	50.94	58.24	54.87	0.003
Nitrate Reductase	26.83	97.32	89.51	60.96	64.90	<0.001
Leucocyte Esterase	64.78	60.00	57.97	66.67	62.20	<0.001
Protein + Leucocyte Esterase	20.55	83.57	51.58	55.25	54.58	0.087
Nitrate + Leucocyte Esterase	22.43	98.39	92.24	59.83	63.45	<0.001
Protein + Nitrate+	13.63	99.64	97.01	57.53	60.08	<0.001
Triple Dipstick Positive	13.63	99.64	97.01	57.53	60.08	<0.001
Negative Dipstick	13.63	67.86	26.53	47.98	42.91	<0.001

DISCUSSION

Urinary tract infection (UTI) is among the most frequently encountered bacterial infections in clinical practice. While urine microscopy offers a rapid but limited preliminary screen, urine culture remains the diagnostic reference standard, albeit with a turnaround time of approximately 48 hours that can delay clinical decision-making. Rapid urine dipstick analysis therefore continues to hold value as a point-of-care screening tool, particularly in emergency settings, where timely results can guide prompt initiation of therapy, reduce the risk of complications such as sepsis, and support antimicrobial stewardship by limiting unnecessary antibiotic use. Despite its widespread adoption, the diagnostic accuracy of the urine dipstick relative to culture remains debated, prompting the present evaluation of individual and combined dipstick parameters.

Of the 1037 participants included, 616 (59.4%) were female, and urine culture was positive in 477 samples (46.0%). The female predominance observed is consistent with the known anatomical predisposition to UTI related to a shorter urethra.

Escherichia coli was the most common uropathogen isolated ($n = 263$), followed by *Klebsiella* spp. ($n = 119$), corroborating findings from Foxman et al.,⁵ Almuhanha et al.,⁶ and Gurung et al.⁸

Individual urine dipstick parameters (Table:3)

All three dipstick parameters evaluated — protein, nitrite, and leukocyte esterase — showed a statistically significant association with culture positivity (protein: $P = 0.003$; nitrite: $P < 0.001$; leukocyte esterase: $P < 0.001$). This pattern mirrors observations by Adem et al.⁷ in children ≤ 5 years and Muthusamy et al.³ in patients ≤ 15 years, where nitrite consistently demonstrated high specificity with modest sensitivity, while leukocyte esterase showed the reverse profile.

Nitrite test: In the present study, nitrite demonstrated a sensitivity of 26.83%, specificity of 97.32%, positive predictive value (PPV) of 89.51%, negative predictive value (NPV) of 60.96%, and an overall diagnostic accuracy of 64.96% (Table 3). These findings indicate that nitrite is a highly specific but poorly sensitive marker for the diagnosis of UTI.

The high specificity observed in our study is consistent with several previous reports. Adem et al.⁷ reported a specificity of 94.6%, Muthusamy et al.³ reported 100%, Hemapriya et al.⁹ reported 97.2%, Almuhanha et al.⁶ reported 93.0%, and Demilie T et al.¹² reported specificities ranging from 96.7% to 98.2% among pregnant women with symptomatic UTI, asymptomatic bacteriuria, and the overall study population. Although Gurung et al.⁸ reported a comparatively lower specificity (77.51%), it remained substantially higher than the corresponding sensitivity, supporting the overall trend of greater specificity than sensitivity for the nitrite test. Similarly, the meta-analysis by Moragas et al.¹¹ reported a pooled specificity of 91% (95% CI, 80–96%), further reinforcing the consistently high specificity of nitrite across diverse populations.

The sensitivity of nitrite remained low in the present study (26.83%), consistent with the findings of Adem et al.⁷ (16.7%), Almuhanha et al.⁶ (18.0%), Muthusamy et al.³ (38.0%), Dinesh A. et al.¹⁰ (36.62%), and Demilie T et al.¹² (35.7%–57.1%). Although Gurung et al.⁸ (43.75%), Hemapriya et al.⁹ (64.7%), and the pooled meta-analysis by Moragas et al.¹¹ (60%; 95% CI, 54–65%) reported comparatively higher or moderate sensitivities, these values remained consistently lower than their respective specificities. This pattern suggests that, despite variability in sensitivity across different study populations, nitrite consistently performs better as a rule-in test than as a rule-out test for UTI.

Overall, the evidence from the present study and previous literature demonstrates that nitrite possesses excellent specificity but limited sensitivity. Therefore, a positive nitrite result strongly supports the diagnosis of UTI, whereas a negative nitrite result cannot reliably exclude infection, reinforcing the need for urine culture when clinical suspicion remains high.

Leukocyte esterase: Leukocyte esterase demonstrated a sensitivity of 64.78%, specificity of 60.90%, PPV of 59.97%, NPV of 66.67%, and an overall diagnostic accuracy of 62.20% in the present study (Table 3). These findings were comparable to those reported by Adem et al.⁷, who also observed moderate sensitivity and specificity (59.8% and 75.9%, respectively). Muthusamy et al.³ reported a higher sensitivity (100%) but substantially lower specificity (19.5%), whereas Dinesh A. et al.¹⁰ and Hemapriya et al.⁹ demonstrated both higher sensitivity and specificity than the present study. Similarly, Demilie T et al.¹² reported moderate sensitivity (51.4%) with high specificity (88.9%) in the overall cohort of pregnant women. A meta-analysis by Moragas et al.¹¹ also demonstrated that leukocyte esterase was more sensitive than nitrite for detecting urinary tract infection. Collectively, these findings indicate that leukocyte esterase is a useful screening marker because of its relatively higher sensitivity; however, its variable specificity limits its use as a standalone confirmatory test.

Protein test: Proteinuria showed intermediate performance (sensitivity 51.1%, specificity 58.04%, PPV 50.94%, NPV 58.24%, accuracy 58.87%) (Table 3). Almuhanha et al.⁶ reported somewhat higher sensitivity and specificity for dipstick protein (66.0% and 73.0%, PPV 45.0%, NPV 87.0%), and Hemapriya et al.⁹ found comparable sensitivity (46.4%) but markedly higher specificity (93.1%) and predictive values. Because proteinuria can arise from numerous non-infectious causes fever, dehydration, exertion, or intrinsic renal disease — it lacks specificity as a standalone marker and is best interpreted alongside nitrite, leukocyte esterase, and clinical context.

Combined Dipstick Parameters (Dipstick (Table :5)

Combining parameters generally increased specificity and PPV at the cost of sensitivity.

The nitrite–leukocyte esterase combination demonstrated the highest diagnostic accuracy among the combined dipstick parameters in the present study (63.45%), with high specificity (98.39%) and PPV (92.24%) (Table 4).

Table3: Diagnostic performance of individual urine dipstick parameters compared across studies

Parameter	Metric	Our study	Adem et al. ⁷	Muthusamy et al. ³	Gurung et al. ⁸	Almuhanna et al. ⁶	Dinesh A. et al. ¹⁰	Hemapriya et al. ⁹	Moragas et al. ¹¹	Demilie T et al. ¹²
	population	All age groups	0-5yrs	≤15 Yrs	Adults	1month - 3Yrs	0-17 Yrs	Adults	SRMA (Older adults)	Pregnant
Nitrite	Sensitivity (%)	26.83	16.7	38.0	43.75	18.0	36.62	64.7	60	42.9
	Specificity (%)	97.32	94.6	100	77.51	93.0	100	97.2	91	98.2
	PPV (%)	89.51	75.0	100	35.59	47.0	100	90.8	—	71.4
	NPV (%)	60.96	53.0	28.77	82.91	78.0	63.4	86.7	—	94.2
	Accuracy (%)	64.96	55.4	50.48	64.96†	—	68.8	—	—	—
Leukocyte esterase	Sensitivity (%)	64.78	59.8	100	—	—	91.55	77.1	—	57.1
	Specificity (%)	60.90	75.9	19.5	—	—	84.62	94.1	—	96.7
	PPV (%)	59.97	71.3	83	—	—	84.42	85.5	—	80
	NPV (%)	66.67	65.4	100	—	—	91.62	90.7	—	90
	Accuracy (%)	62.20	67.9	83.81	—	—	87.2	—	—	—
Protein	Sensitivity (%)	51.1	—	—	—	66.0	—	—	—	—
	Specificity (%)	58.04	—	—	—	73.0	—	—	—	—
	PPV (%)	50.94	—	—	—	45.0	—	—	—	—
	NPV (%)	58.24	—	—	—	87.0	—	—	—	—
	Accuracy (%)	58.87	—	—	—	—	—	—	—	—

Moragas et al.¹¹ nitrite figures (60%/91%) are the pooled estimate across studies in older adults; a separate pooled figure for leukocyte esterase alone was not reported in the excerpt available and is therefore shown as "—" here (the study does note that nitrite's pooled sensitivity was considerably lower than that of leukocyte esterase). Pregnant-women study¹² figures are reported for three subgroups: asymptomatic bacteriuria (ABU), symptomatic UTI, and the "Overall UTI" pooled analysis (n = 367); PPV/NPV were only reported for the Overall UTI analysis.

Gurung et al.⁸ reported a single overall dipstick accuracy figure (64.96%) rather than parameter-specific accuracy; it is listed here under nitrite since their reported sensitivity/specificity/PPV/NPV are nitrite-specific, per their paper's discussion and conclusion.

Almuhanna et al.⁶ did not report a standalone **dipstick** leukocyte esterase result in their published tables — only leukocyte esterase in combination with protein or nitrite (see Table 4), plus a separate **urinalysis** (not dipstick) leukocyte esterase figure of 68.0% sensitivity, 81.0% specificity, 10.0% PPV, 89.0% NPV, which is a different specimen-processing method and not directly comparable to the dipstick figures used elsewhere in this table.

Similar findings were reported by Adem et al.⁷, Muthusamy et al.³, and Hemapriya et al.⁹, all of whom observed high specificity despite variable sensitivity for this combination. Likewise, Demilie T et al.¹², in a cohort of pregnant women from Ethiopia, reported low sensitivity (22.9%) but excellent specificity (99.1%), supporting the utility of this combination as a rule-in test for urinary tract infection. Comparable findings were observed in the meta-analysis by Moragas et al.¹¹, which reported a pooled sensitivity of 62% (95% CI, 36–82%) and specificity of 96% (95% CI, 87–99%) for the nitrite–leukocyte esterase combination. In contrast, when either nitrite or leukocyte esterase positivity was considered sufficient for a positive result (OR rule), sensitivity increased substantially at the expense of specificity, as demonstrated by Moragas et al.¹¹ (sensitivity 90%, specificity 56%) and Demilie T et al.¹² (sensitivity 71.4%, specificity 97.0%). These findings indicate that the diagnostic performance of combined urine dipstick testing is influenced not only by the parameters included but also by the combination strategy employed. Although Almuhanna et al.⁶ reported 100% sensitivity and 0% specificity for the nitrite–leukocyte esterase combination, this finding was based on a very small number of positive cases and should be interpreted with caution.

The **protein–nitrite** combination achieved the highest specificity (99.64%) and PPV (97.01%) of all parameter pairings in this study, though sensitivity remained poor (13.63%) indicating that a positive result is highly confirmatory, but a negative result cannot exclude infection. Not many studies are available.

The protein–leukocyte esterase combination demonstrated poor diagnostic performance in the present study, with a sensitivity of 20.55%, specificity of 60.00%, and no significant association with urine culture positivity ($P = 0.087$), limiting its clinical utility (Table 4). Similarly, Almuhan et al.⁶ reported low sensitivity (13%), which is comparable to the findings of the present study. However, the two studies differed considerably in terms of specificity. While the present study demonstrated a specificity of 60.00%, suggesting modest rule-in value, Almuhan et al.⁶ reported a specificity of only 1%. Interestingly, despite this extremely low specificity, Almuhan et al. reported both the PPV and NPV as 100%. This apparent discrepancy is likely attributable to the very small number of cases evaluated for this parameter combination in their study, where a few concordant observations could markedly influence the predictive values despite poor specificity. The observed differences between the two studies may also reflect variations in patient characteristics, the prevalence of non-infectious proteinuria in adult populations, and the threshold used to define protein positivity on urine dipstick testing. Collectively, these findings suggest that, unlike the nitrite–leukocyte esterase combination, the protein–leukocyte esterase combination demonstrates inconsistent diagnostic performance across different study populations and should be interpreted with caution, particularly in studies with small sample sizes

When all three parameters (leukocyte esterase, nitrite, and protein) were combined, specificity and PPV were further improved (99.64% and 97.01%, respectively) but sensitivity fell to 13.63%, with an overall accuracy of 60.08% (Table 5) broadly consistent with the triple-combination data reported by Hemapriya et al.⁹ (sensitivity 32.7%, specificity 97.2%), who similarly found that combining all three parameters improved specificity and predictive value at the expense of sensitivity in their pediatric cohort. (Table:5)

Diagnostic Performance of a Completely Negative

A completely negative dipstick demonstrated poor diagnostic performance for excluding UTI in the present study, with a sensitivity of 13.63%, specificity of 67.86%, positive predictive value (PPV) of 26.53%, negative predictive value (NPV) of 47.98%, and an overall accuracy of 42.91%. The low NPV indicates that nearly half of the patients with a negative dipstick result were still found to have culture-confirmed UTI, highlighting the risk of missed infections if dipstick negativity alone is used to exclude UTI. These findings are consistent with previous literature cautioning against the use of a negative dipstick as a standalone rule-out test in symptomatic patients. An emergency department-based study done by Rehmani et al.,¹³ reported that a negative dipstick result does not reliably exclude UTI when clinical symptoms and signs suggest infection. Collectively, these observations emphasize that urine culture remains essential when clinical suspicion persists despite a negative dipstick result, particularly among symptomatic individuals, pregnant women, and other high-risk populations where delayed diagnosis may lead to adverse outcomes.

Table 4. Diagnostic performance of combined urine dipstick parameters compared across studies

Combination	Metric	Our study	Ade m et al. ⁷	Muthusa my et al. ³	Almuhan et al. ⁶	Hemapriya et al. ⁹	Ramy a G. et al. ¹⁴	Morag as et al. ¹¹	Demilie T et al. ¹²
	population	All age groups	0-5yrs	≤15 Yrs	1month 3Yrs	Adults	1-12 Yrs	SRMA (Older adults)	Pregnant
Nitrite+ Leukocyte esterase	Sensitivity (%)	22.43	14.3	38	100*	57.2	68.57	62	22.9
	Specificity (%)	98.39	94.6	100	0*	97.2	80.0	96	99.1
	PPV (%)	92.24	72.7	100	100*	83.8	88.89	—	72.7
	NPV (%)	59.83	52.5	28.7	0*	94.6	52.17	—	92.4
	Accuracy (%)	63.45	54.5	—	—	—	—	—	—
Protein+ Nitrite	Sensitivity (%)	13.63	—	—	—	—	—	—	—
	Specificity (%)	99.64	—	—	—	—	—	—	—
	PPV (%)	97.01	—	—	—	—	—	—	—

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	NPV (%)	57.53	—	—	—	—	—	—	—
	Accuracy (%)	60.80	—	—	—	—	—	—	—
Leukocyte esterase+ Protein	Sensitivity (%)	20.55	—	—	13	—	—	—	—
	Specificity (%)	60.00	—	—	1	—	—	—	—
	PPV (%)	57.97	—	—	100	—	—	—	—
	NPV (%)	66.67	—	—	100	—	—	—	—
	Accuracy (%)								

Note on combination logic: most rows in this table (our study, Adem, Muthusamy, Almuhanha, Hemapriya, Ramya G.) report an "AND" combination — both parameters must be positive — which typically raises specificity at the cost of sensitivity. The Moragas et al.¹¹ OR-row figures reflect an "either positive" combination, reported both overall (16 studies) and for the symptomatic-UTI subgroup (4 studies) of their meta-analysis (the AND row uses the pooled figure from 3 studies), while the pregnant-women study¹² figures for both rows come from its Overall UTI analysis (n = 367).

* Almuhanha et al.⁶'s nitrite+leukocyte esterase (AND) figures are based on a single dipstick-positive case in their cohort (as explicitly noted in their published table), so the 100%/0% result reflects a sample size of one rather than a stable estimate — treat as illustrative of population variability rather than a comparable data point.

Correction note: the Leukocyte esterase + Protein PPV and NPV for Almuhanha et al.⁶ were corrected from 1/1 to 100/100 — the published values are 1.00 (i.e., 100%) for both PPV and NPV, not 1%. Specificity (1%) was already correctly transcribed.

Table 5. Diagnostic performance of the triple combination (Leukocyte esterase + Nitrite + Protein)

Metric	Our study All age groups	Hemapriya et al. ⁹ (Adults)
Sensitivity (%)	13.63	32.7
Specificity (%)	99.64	97.2
PPV (%)	97.01	83.3
NPV (%)	57.53	77.4
Diagnostic Accuracy (%)	60.08	—

Clinical Implications

Taken together, these findings indicate that individual and combined dipstick parameters are most valuable as rule-in tools: a positive nitrite, or a positive combination involving nitrite, strongly supports a diagnosis of UTI given the consistently high specificity and PPV observed both here and across comparator studies (Tables 3–5). However, the modest-to-poor sensitivity of all parameters and combinations, together with the poor performance of a fully negative dipstick (Table 6), means that a negative dipstick result cannot reliably exclude infection. Consequently, urine dipstick testing should be regarded as a rapid adjunct for early clinical decision-making rather than a replacement for urine culture, which remains the reference standard for definitive diagnosis. The variability in diagnostic performance across studies further highlights the influence of population age, disease prevalence, and laboratory methodology on dipstick accuracy, and underscores the need for judicious, context-specific interpretation of dipstick results in clinical practice.

CONCLUSION

Urine dipstick testing remains a valuable, rapid, and cost-effective adjunct for the initial screening of urinary tract infection, but it cannot substitute for urine culture as the reference standard. Among the individual parameters assessed, nitrite offered high specificity and positive predictive value, making a positive result a strong indicator of true infection, whereas leukocyte esterase provided greater sensitivity and is therefore better suited to screening than to confirmation. Proteinuria showed only intermediate and non-specific performance and should not be relied upon in isolation. Combining parameters, particularly nitrite and leukocyte esterase together, improved specificity and positive predictive value at the expense of sensitivity, reinforcing the role of combined positivity as a rule-in rather than a rule-out strategy. Critically, a completely negative dipstick failed to reliably exclude infection, with nearly half of culture-positive cases going undetected, a pattern corroborated by comparable studies across diverse populations including children, older adults, and pregnant women.

These findings indicate that dipstick results should guide, but not replace, clinical judgment and confirmatory culture, especially in symptomatic patients and high-risk groups where a missed diagnosis could lead to serious complications.

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Judicious, context-specific use of the urine dipstick interpreted alongside clinical presentation and risk profile can support timely antimicrobial decision-making while urine culture results are awaited.

Strengths

A key strength of this study is its relatively large sample size (n = 1037), which allowed stable estimation of sensitivity, specificity, predictive values, and diagnostic accuracy for both individual and combined dipstick parameters.

The study evaluated all three commonly used dipstick parameters nitrite, leukocyte esterase and protein both individually and in combination, including a specific analysis of the completely negative dipstick, providing a comprehensive picture of dipstick performance that is directly comparable to the wider published literature across pediatric, adult, older-adult, and pregnant populations.

Limitations

Several limitations should be considered when interpreting these findings. The data were derived retrospectively from microbiology records, which precluded correlation of dipstick and culture results with clinical symptoms, prior antibiotic exposure, urine collection technique, or bladder incubation time factors known to influence dipstick performance, particularly nitrite sensitivity.

As the study combined all age groups rather than stratifying by pediatric, adult, or elderly subgroups, age-specific variation in diagnostic accuracy, which was evident across comparator studies, could not be fully explored in the present cohort.

The single-center, retrospective design may also limit the generalizability of these findings to other populations and laboratory settings.

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