e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2025; 17(1); 1099-1104

Original Research Article

Analysing the Diagnostic Efficacy of Rapid Urine Screening Tests in Diagnosis of Symptomatic Urinary Tract Infections

Davasumani D[1], Vanathi S[2], Sofiya C[3], Malini P[4]

[1]Tutor, Department of Pathology, Government Medical College, Karur Tamilnadu, India

[2]Associate Professor, Department of Microbiology, Government Medical College, Pudukkottai. Tamilnadu, India

[3]Associate Professor, Department of Pathology, Thanjavur Medical College, Thanjavur, Tamilnadu, India

[4]Associate Professor, Department of Microbiology, Government Medical College, Nilgiris, Tamilnadu, India

Received: 25-10-2024 / Revised: 23-11-2024 / Accepted: 26-12-2024

Corresponding Author: Dr. Malini P

Conflict of interest: Nil

Abstract:

Introduction: Urinary tract infection is the most common bacterial infection in all age groups. By delaying the administration of antibiotics there is decrease in survival by 8% every hour. So the aim of the study is to analyse the rapid diagnostic tests like Urine microscopy and Dispstick assays by comparing with urine culture.

Materials and Methods: This is a prospective study where 1081 urine samples of suspected UTI cases were included for analysis. Dipstick assays like Urine nitrate and Leukocyte esterase, Urine microscopy and Culture results of these patients were obtained. All these parameters were compared statistically by using excel.

Results and Discussion: Out of the 231 culture positive cases 23.8% were nitrate positive, 30.7% were leukocyte esterase positive and 56.7% were positive in urine microscopy. The sensitivity increased to 64.9% if all the three tests considered together. The sensitive of rapid diagnostic tests were highest in Enterobacteriaceae family (73.8%). Similar studies by Taneja et al and Sadika et al showed still higher sensitivity values.

Conclusion: Combination of Urine microscopy and dipstick tests improve the sensitivity of detecting urinary tract infection.

Introduction

Urinary tract infection (UTI) is one of the most common bacterial infections affecting 150 million people per year in clinical practice both in community and hospital settings in older man and in infant boys and in female of all age groups. Hence early and prompt treatment of UTI is essential because it consider as a risk factor for renal insufficiency and end stage renal disease (ESRD).

Incident of UTI caused by multi drug resistant is increasing now a days. Clean catch, mid-stream urine for culture and sensitivity testing is considered the gold standard method to diagnose UTI. The most widespread reference method for UTI diagnosis is the conventional urine culture in which a finding of 100,000 colony forming units per milliliter (CFU/mL) of urine is considered as significant. Several rapid screening techniques such as urinalysis (microscopic Pyuria), enhanced urinalysis (white blood cell [WBC] count per cubic millimeter) plus gram stain, urine dipstick (leukocyte esterase or nitrate) and uriscreen (catalase test) tests have been used in diagnosis of UTI. A nitrite test is a standard component of a urinary test strip. A positive nitrite test indicates that bacteria may be present in significant numbers in urine. A positive nitrite test also indicates that nitrite has been produced from reduction of nitrate by enteric bacteria, most commonly by the Enterobacteriaceae family [1]. Additionally, we can test leucocyte esterase, which is a combination, produced from WBC destruction [2].

Many researches aimed at reducing mortality from sepsis due to UTI via early goal-directed therapy. By delaying the administration of antibiotics, there is decrease in survival rate by 8% every hour [3]. The standard turnaround time (TAT) for urine culture Preliminary reports within 24-48hrs and final report can take 3-5 days, as bacteria needs time to grow, and AST(Antibiotic Susceptibility Testing) adds extra time to get the results, the use of simpler and faster diagnostic methods such as enhanced urinalysis (WBC count per cubic millimeter) and dipstick test can be useful to guide the early initial diagnosis especially in an emergency context, so that treatment can be initiated at the earliest [4].

Aims/ Objectives:

To analyse the diagnostic accuracy of dipstick urinalysis (nitrite and leukocyte esterase) enhanced urinalysis (WBC count per cubic millimeter) by comparing them with gold standard test, urine culture in the diagnosis of symptomatic urinary tract infection.

Methodology:

Type of study: Prospective study

Place of study: Department of Pathology and Microbiology, Government Medical College, Karur.

Sample size: 1081 clean catch mid-stream urine samples were collected in a separate sterile containers for WBC count, dipstick and culture as per standard operating procedure (SOP) for urine sample collection methods.

Urine dipstick chemical analysis: Fresh uncentrifuged urine sample is examined for urine nitrite and leucocyte esterase by using urine dipstick. Nitrite is considered as positive if there is a change in colour of dipstick from colourless to pink. Leukocyte esterase is considered as positive if there is a change in colour of dipstick from off-white to purple.

Urine culture & AST: All the 1081 samples collected in a sterile containers were received and processed within 4 hrs of collection.

Direct gram stain: Direct gram stain is significant because it provides immediate information about the presence of pus cells which indicates inflammation often due to infection, presence of epithelial cells which suggests contamination from the skin or genital tract, presence of bacteria and yeast cells which helps in identifying the type of organisms and Direct gram stain also helps to identify the severity of infection and helps clinicians to start empirical therapy.

Semi quantitative Urine Culture Method: The urine samples were streaked Semi quantitatively in CLED Agar plate by using a calibrated loop of 0.01ml and incubated at 37^{o} C for 24 hrs. After 24 hrs of incubation, culture is considered positive if there is more than 10^5 colony forming unit per ml (CFU/mL) of a single organism.

The colonies were subjected to colony Gram stain, panel of biochemical test & Antibiotic Susceptibility Testing.

Enhanced Urinalysis:

Microscopic examination: Fresh uncentrifuged urine sample is examined for number of WBCs per cubic millimeter. Equal proportion of urine is mixed with methylene blue and one drop is placed on a glass slide and cover slip is placed over. Number of WBCs is counted per high power field. >5 cells per high power field is considered abnormal [13].

Inclusion criteria

- Midstream clean catch urine samples of all clinically symptomatic UTI patients.

Exclusion criteria:

- Patients who had taken antibiotics in the past 72hrs.
- Patients who had indwelling Foley catheters.

Observation and Results:

We received 1081 samples in the department of microbiology for urine culture of suspected UTI patients during our study period. Out of which culture positive was 231 cases (21.4%).

Among culture positive cases, 147 (63.6%) were females and 84 (36.3%) were males. Out of 147 culture positive female cases, 28 showed nitrate positivity, 36 showed leukocyte esterase positivity, 78 showed microscopic positivity and 88 showed any of the three positivity.

Out of 84 culture positive male cases, 27 showed nitrate positivity, 35 showed leukocyte esterase positivity, 53 showed microscopic positivity and 62 showed any of the three positivity.

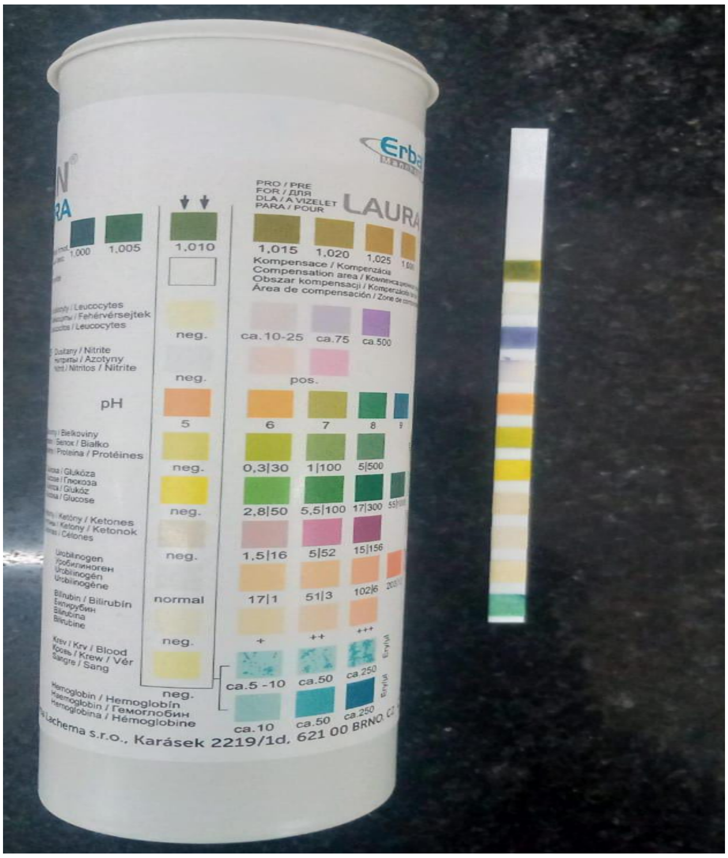

Figure 1: Dipstick showing Leucocyte esterase positivity

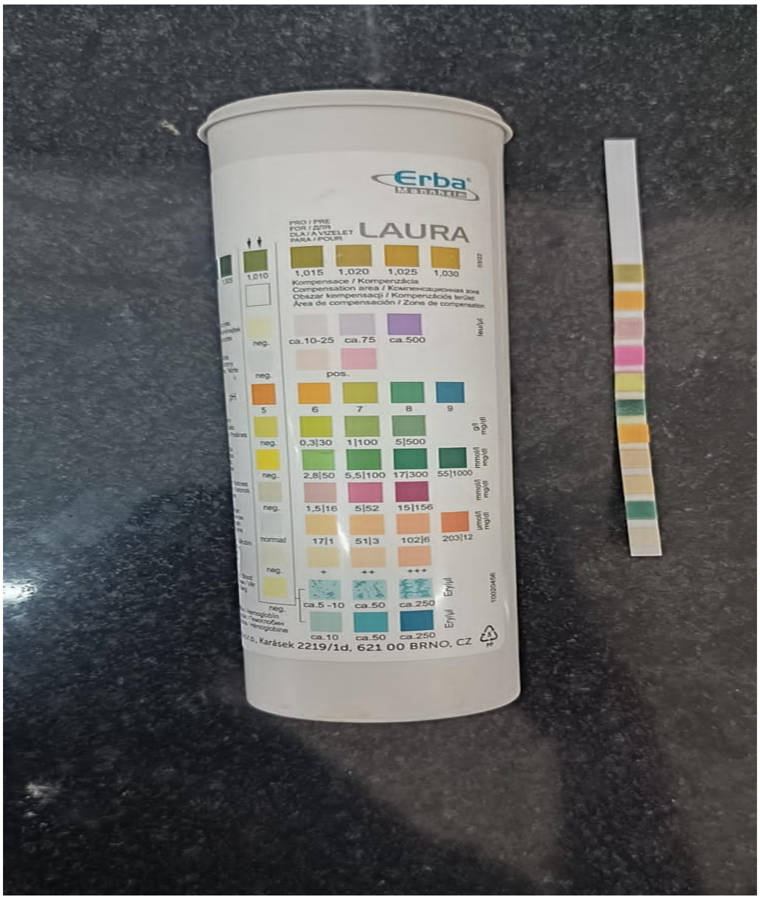

Figure 2: Dipstick showing Nitrate positivty

Table 1: Sex distribution of Culture Positive Cases

	Number of cases	Nitrate positive	Leukocyte esterase positive	Urine microscopy positive	Any of the three positive
Female	147	28	36	78	88
Male	84	27	35	53	62
Total	231	55	71	131	150
Percent		23.8%	30.7%	56.7%	64.9%

Hence, the false negative rates for Nitrate test is 76.2%, Leukocyte esterase test is 69.3%, urine microscopic test is 43.3% and Combination of all tests is 36.1%. Out of the 231 culture positive cases, 113 were positive for Escherichia coli, 56 for Enterococcus, 36 for Klebsiella, 14 for Non fermenting gram negative rods, 7 for Acinetobacter, 3 for Proteus and 1 for Staphylococcus.

Among the 113 Escherichia coli culture positive cases, 41 (36.3%) were positive for nitrate test, 30 (26.5%) were positive for Leukocyte esterase test and 72 (63.7%) were positive for microscopic analysis and 83 (73.5%) were positive for any of the three tests.

Among the 56 Enterococcus culture positive cases, none were positive for nitrate test, 21 (37.5%) were positive for Leukocyte esterase test and 30 (53.6%) were positive for microscopic analysis and 33 (58.9%) were positive for any of the three tests. Among the 36 Klebsiella culture positive cases, 12 (33.3%) were positive for nitrate test, 16 (44.4%) were positive for Leukocyte esterase test and 24 (66.6%) were positive for microscopic analysis and 27 (75%) were positive for any of the three tests. Among the 14 Non fermenting gram negative rods culture positive cases, none were positive for nitrate test, 2 (14.3%) was positive for Leukocyte esterase test and 1 (7.1%) was positive for microscopic analysis and 2 (14.3%) were positive for any of the three tests.

Among the 7Acinetobacter culture positive cases, none were positive for nitrate test, 1 (14.2%) were positive for Leukocyte esterase test and 2 (28.6%) were positive for microscopic analysis and 2 (28.6%) were positive for any of the three tests.

Among the 3 Proteus culture positive cases, 2 (66.6%) were positive for nitrate test, 1 (33.3%) were positive for Leukocyte esterase test and 2 (66.6%) were positive for microscopic analysis and 2 (66.6%) were positive for any of the three tests. And the 1 Staphylococcus culture positive case, none of the tests were positive.

Table 2: Sensitivity of Urine dipstick and microscopic tests among various micro-organisms.

Name of the organism	Number of cases	Nitrate positive	Leukocyte esterase positive	Urine microscopy positive	Any of the three positive
Escherichia coli	113	41 36.3%	30 26.5%	72 63.7%	83 73.5%
Klebsiella species	36	12 33.3%	16 44.4%	24 66.7%	27 75%
Pseudomonas species	14	0	2 14.3%	1 7.1%	2 14.3%
Acinetobacter species	7	0	1 14.2%	2 28.6%	2 28.6%
Proteus species	3	2 66.7%	1 33.3%	2 66.7%	2 66.7%
Enterococcus species	56	0	21 37.5%	30 53.6%	33 58.9%
Staphylococcus species	1	0	0	0	0

Hence, the false negative rate (MISS RATE) for Nitrate test among Escherichia coli is 63.7%, Enterococcus 100%, Klebsiella 66.7%, Non fermenting gram negative rods 100%, Acinetobacter 100%, Proteus 33.3% and Staphylococcus 100%.

The False negative rate (MISS RATE) for Leukocyte esterase test among Escherichia coli is 73.5%, Enterococcus 62.5%, Klebsiella 55.6%, Non fermenting gram negative rods 85.7%, Acinetobacter 85.8%, Proteus 66.7% and Staphylococcus 100%. The False negative rate (MISS RATE) for Urine microscopic test among Escherichia coli is 36.3%, Enterococcus 46.4%, Klebsiella 33.3%, Non fermenting gram negative rods 92.9%, Acinetobacter 71.4%, Proteus 33.3% and Staphylococcus 100%. The False negative rate (MISS RATE) for Combination of all three tests among Escherichia coli is 26.5%, Enterococcus 41.1%, Klebsiella 25%, Non fermenting gram negative rods 85.7%, Acinetobacter 71.4%, Proteus

33.3% and Staphylococcus 100%.

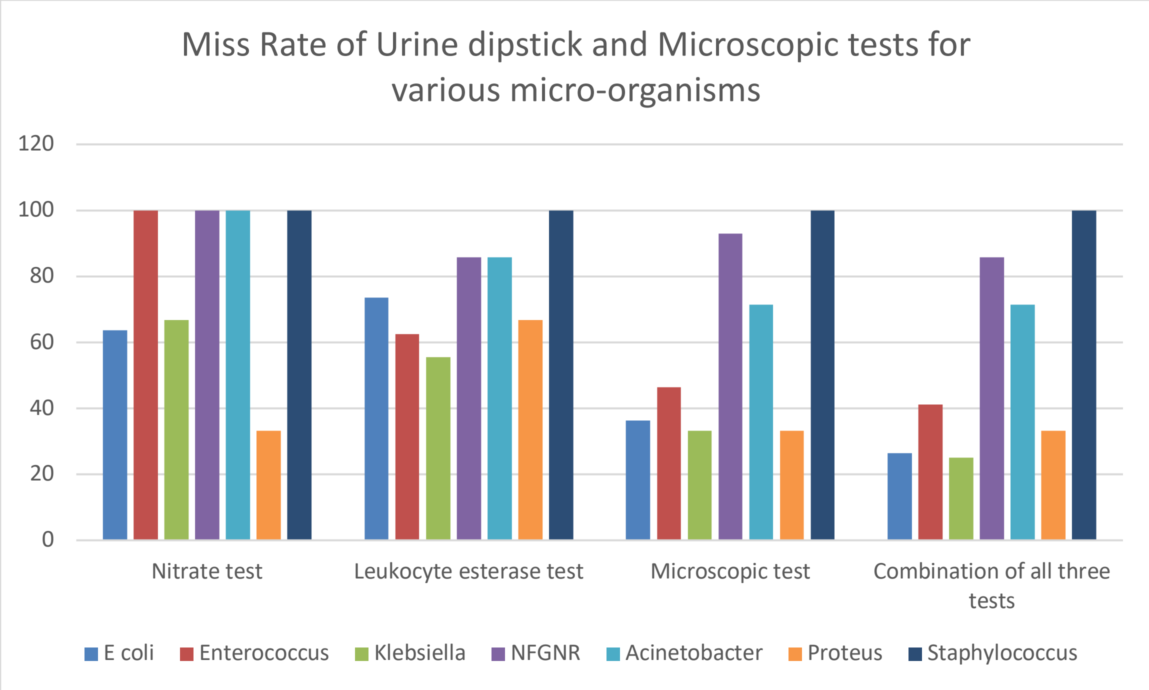

Figure 3:

Discussion:

Several rapid screening tests are used to make a presumptive diagnosis of UTI, including dipstick analysis of urine for nitrites or leukocyte esterase, as well as microscopic examination of urine. Several studies have been published concerning the usefulness of these rapid screening tests in diagnosing UTI1. Among the 231 culture positive cases, 147 (63.6%) were females and 84 (36.3%) were males, which corresponds to the study done by Fernandes DJ et al [5]. The sensitivity of the nitrate dipstick test is different in different studies. In the current study, the sensitivity of nitrate test is 23.8%, which corresponds to the study done by Muna M et al [6]. Whereas several other studies shows a higher specificity in contrast to the present study [1].

Low sensitivity for nitrite may be due to the random collection of urine specimen for urine dipstick test, as a minimum of 4 hours is required for pathogenic bacteria to reduce nitrate to nitrite5. So the nitrate test is likely to be in the random urine sample than the first morning voided samples [7]. The sensitivity of leukocyte esterase test is 30.7% in the current study, whereas it is 42.1% in the study done by Fernandes DJ et al [5].

Table 3: Sensitivity of urine dipstick tests (Nitrate and Leukocyte esterase) in various studies.

Study	Sensitivity of Nitrate test	Sensitivity of Leukocyte esterase test
Our study	23.8%	30.7%
Ali M et al [7]	39.3%	83.7%
Sadika et al [9]	38.2%	85.4%
Loher et al [10]	37.3%	79.4%
Ayazi and Daneshi [11]	56%	69%

The sensitivity of urine microscopic test is 56.7% in the current study, whereas it is 36% in the study done by Baral R et al [8] and 73.7% according to Fernandes DJ et al [5].

Table 4: Sensitivity of urine microscopic test in various studies

Study	Sensitivity of Urine microscopic test
Our study	56.7%
Taneja N et al [12]	68.4%
Baral et al [8]	36%
Fernandes et al [5]	73.7%
Goldsmith BM et al [14]	82%

This disparity in the study results may be due to the inappropriate technique for collection and storage of urine sample [5]. Among the culture positive cases, Escherichia coli is the predominant one followed by Enterococcus and Klebsiella. Similar findings were seen in Rangaiahagari A et al [1] and Fernandes DJ et al [5]. The sensitivity of nitrate dipstick test is more for Enterobacteriaceae family like Escherichia coli, proteus and Klebsiella, whereas it is negative for other organisms. It is because nitrate test is positive only in organisms that reduce nitrate to nitrite [1]. The sensitivity of leukocyte esterase and urine microscopic test does not have any differences depending on the organisms. As the sensitivity of urine microscopy is better than urine dipstick test for nitrite or leukocyte esterase, a positive urine microscopy is more helpful in diagnosing UTI [5]. As the Miss rate for Nitrate test is low in organisms that reduce nitrate, a negative nitrite in urine dipstick test is more helpful in ruling out UTI. The sensitivity of identifying UTI increases to 64.9% by combining all three tests. Hence by combining dipsticks tests and Urine microscopy which can be done immediately, we can identify UTI earlier and antibiotics can be started earlier which reduce the prevalence of sepsis and morbidity and mortality related to UTI. The differences in sensitivity of these tests are due to variety of factors including specimen contamination, certain organism, timing of specimen collection, interfering substances (urobilinogen, glucose, ascorbic acid, drugs, urine cells, bacteria) other urine properties (specific gravity, PH, concentration) and biological factors (exercise, cold exposure, prolonged recumbency, medical illness)7. Hence a standard protocol should be formulated for collection to reduce confounders.

Conclusion:

Even though urine culture is considered the gold standard for UTI, A combination of urine direct microscopic examination and dipstick tests (nitrite and leukocyte esterase) improve the sensitivity of detecting urinary tract infections. They can be used as rapid screening tests in symptomatic UTI patients. This would be helpful to start the treatment early and reduce the mortality of the patients.

References:

1. Rangaiahagari A, Nyirabanzi J, Uwizeyimana JP, E. Ngoga, Wane J. Comparison of urine culture and urine dipstick nitrite test in diagnosis of Urinary Tract Infection. RMJ Vol.72 (1); March 2015
2. Carias B, Orillaza A, Llanera F. Utility of Nitrate and Leukocyte esterase Tests for Laboratory Detection of Urinary Tract Infection in a General Population at the Philippine Heart Center: A Prospective Study. Philippine Journal of Microbiology and Infectious Diseases, 35:3(2006).
3. Shimoni Z, Salah M, Kasem A, Hermush V, Froom P. Bacterial Resistance to Cephalosporin Treatment in Elderly Stable patients Hospitalized with a Urinary Tract Infection. Am J Med Sci. 2020 Sep; 360(3):243-247.
4. Patel HD, Livsey SA, Swann RA, Bukhari SS. Can urine dipstick testing for urinary tract infection at point of care reduce laboratory workload. J Clin Pathol. 2005; 58(9):951-4.
5. Fernandes DJ, Jaidev MD, Castelino DN. Utility of dipstick test (nitrite and leukocyte esterase) and microscopic analysis of urine when compared to culture in the diagnosis of urinary tract infection in children. Int J Contemp Pediatr 2018; 5:156-60.
6. Muna M. Buzayan, Rajab S.Tobgi, (2008), Comparison of Urine Culture, Microscopy and Nitrite Dipstick Tests in the Detection of Urinary Tract Infection. JBMS Journal of the Bahrain Medical Society,Vol 20, No. 3
7. Ali M. Comparative study of dipstick, urine microscopy and urine culture in the diagnosis of urinary tract infection in children under 5 years. Karbala J Med. 2010; 3(2):822-8.
8. Baral R, Kumar M. Rapid nitrite dipstick versus urine culture for diagnosis of urinary tract infections (UTI). Int J Med Res. 2017; 8(4)204-9.
9. Sadika, H.; Abdul Rahman,M.;Eman,K.; Hanan,A.; Samera,A. Reliability of rapid dipstick test in detecting of urinary tract infection in symptomatic children. kwait Med.J. (2007), 39(1):36-38.
10. Lohr, J. A; Portella, M.G.; Gender, T.C. et al .Making presumptive diagnosis of urinary tract infection by using urinalysis performed in an on –site laboratory, J. Pediatr.(1993);122:22-25.
11. Ayazi, P.; Daneshi, M.M. Comparison of urine culture and urine dipstick analysis in diagnosis of urinary tract infection Acta. Medica.I ranica. (2007); 45(6):501 504.
12. Taneja N, Chatterjee SS, Singh M, Sivapriya S, Sharma M, Sharma SK. Validity of quantitative unspun urine microscopy, dipstick test leucocyte esterase and nitrite tests in rapidly diagnosing urinary tract infections. J Assoc Physicians India. 2010; 58:485-7.
13. Revised statement on management of urinary tract infections, Indian Society of Pediatric Nephrology. Indian Pediatr. 2011; 48:709-17.
14. Goldsmith BM, Campos JM. Comparison of urine dipstick, microscopy, and culture for the detection of bacteriuria in children. Clin Pediatr (Phila). 1990 Apr; 29(4):214-8.