

# Evaluation of the Leukocyte Esterase and Nitrite Urine Dipstick Screening Tests for Detection of Bacteriuria in Women with Suspected Uncomplicated Urinary Tract Infections

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**A positive dipstick urinalysis (i.e., leukocyte esterase test and/or nitrite test) did not reliably detect significant bacteriuria in 479 ambulatory women with suspected uncomplicated urinary tract infection; 18.9% of the urine samples that demonstrated significant bacteriuria would have been rejected by the laboratory based on a negative urinalysis screen.**

Physicians in our region frequently order a dipstick urinalysis to screen for the presence of pyuria and significant bacteriuria in women with suspected uncomplicated urinary tract infection, and a culture is requested only when the urinalysis is positive. The Chemstrip-10 dipsticks (Roche Diagnostics, Montreal, Quebec, Canada) detect leukocyte esterase (LE) activity as an indicator of pyuria and urinary nitrite (NIT) production as an indicator of bacteriuria. Although use of both the NIT and LE tests has been shown to improve detection of significant bacteriuria (i.e., colony count  $\geq 10^5$  CFU/ml) (1–3, 5, 7, 8, 11), it was of interest to focus our study on women with uncomplicated urinary tract infection, whose urine colony counts may be as low as  $10^3$  CFU/ml (4, 9, 10).

Each of 479 ambulatory women aged 15 to 65 years submitted a fresh, morning first-void mid-stream urine sample in a sterile container. A fresh, random mid-stream urine sample was also accepted. A Chemstrip-10 (Boehringer Mannheim) urinalysis (2-min procedure) to detect LE and NIT was immediately performed according to the manufacturer's instructions. A positive urinalysis result occurred when either the LE test or NIT test or both were positive. A positive NIT test indicates that nitrite has been produced from the reduction of nitrate by enteric bacteria, most commonly by genera of the *Enterobacteriaceae* family (practical sensitivity limit, 0.05 mg/dl or 11 mmol/liter). The LE test is an indirect measure of pyuria since it detects the production of this enzyme by the host's polymorphonuclear cells.

A calibrated 0.001-ml bacteriologic loop was used to inoculate urine onto 5% Columbia blood agar (P1350) and MacConkey agar plates within 30 min of collection (P1800) (PML, Seattle, Wash.). The inoculated plates were incubated overnight aerobically at 37°C for up to 24 h (a minimum of 18 h). Uropathogens included genera of the *Enterobacteriaceae* family, group D enterococci, *Staphylococcus saprophyticus*, group B streptococci, and staphylococci other than *S. saprophyticus* when the patient was symptomatic. Urine colony counts were recorded as follows: (i) no growth, (ii) no significant growth ( $<10^3$  CFU/ml), and (iii) significant bacteriuria ( $\geq 10^3$  CFU/ml). Urines that grew contaminants (i.e., coagulase-negative staphylococci, lactobacilli, diphtheroids, and *Streptococcus* spp.

other than group D spp.) were reported as demonstrating normal periurethral flora. Mixed growth was recorded for urines that grew multiple organisms (two or more). Significant urine bacterial isolates were identified by conventional biochemical procedures (6).

Urinalysis results were correlated to results of urine cultures. Urine cultures demonstrating significant bacteriuria (i.e., one or two uropathogens) were separated by the following colony count breakpoints for the performance analyses: (i)  $\geq 10^3$  to  $10^4$  CFU/ml, (ii)  $\geq 10^4$  to  $10^5$  CFU/ml, and (iii)  $\geq 10^5$  CFU/ml. Performance of urinalysis tests was evaluated by calculating, using standard methods, sensitivity, specificity, and positive and negative predictive values.

The average age of the 479 women was 36.6 years (range, 15 to 65 years). Most of the women were young, were not pregnant, and had a urine culture requested because they had symptoms suggestive of a urinary tract infection. All of the urine samples were mid-stream collections, but only 5% were first-void specimens. Only 90 (18.8%) urine cultures had a pure growth of one or two potential uropathogens, while 203 (42.4%) showed either no growth (60 cultures [29.9%]) or no significant growth (143 cultures [29.9%]). The rest of the urine cultures either grew contaminants or showed mixed growth.

Table 1 outlines the performance of the urinalysis tests for detection of significant bacteriuria at varying colony counts. Urinalysis had the highest sensitivity for urine colony counts that were greater than  $10^5$  CFU/ml. At this colony count, the detection of both pyuria and bacteriuria (positive results for both LE and NIT) or pyuria alone (positive result for LE) had much better sensitivity than the detection of bacteriuria alone (positive result for NIT). The positive predictive value of a positive urinalysis result was poor at the lower colony counts and improved only when both pyuria and bacteriuria (positive results for both LE and NIT) were detected by urinalysis. Detection of bacteriuria (positive result for NIT) and pyuria (positive result for LE) had excellent specificity and negative predictive value for all colony counts. Overall, a positive urinalysis had a sensitivity of 81.1%, a specificity of 59.4%, positive and negative predictive values of 31.6% and 93.2%, respectively, and an overall agreement of 63.5% for detection of significant bacteriuria at any colony count greater than  $10^3$  CFU/ml.

Most infections were due to *Escherichia coli* or members of other genera in the *Enterobacteriaceae* family (74 infections [82.2%]), and a smaller number were due to *S. saprophyticus*

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TABLE 1. Performance of the LE and NIT urinalysis tests in screening for significant bacteriuria<sup>a</sup>

Screening test(s)	Sensitivity (%) at colony counts of:			Specificity (%) at colony count of:			Predictive value (%) at colony counts of:					
							Positive predictive value			Negative predictive value		
	10 <sup>3</sup>	10 <sup>4</sup>	10 <sup>5</sup>	10 <sup>3</sup>	10 <sup>4</sup>	10 <sup>5</sup>	10 <sup>3</sup>	10 <sup>4</sup>	10 <sup>5</sup>	10 <sup>3</sup>	10 <sup>4</sup>	10 <sup>5</sup>
LE	71.4	76.9	84.4	59.4	59.4	59.4	3.1	16.0	19.4	99.1	96.3	97.1
NIT	0	7.9	43.6	96.6	96.6	96.6	0	27.3	75.0	99.1	86.8	88.2
LE and NIT	0	25	84	98.3	98.3	98.3	0	42.9	84	99.1	96.3	98.3

<sup>a</sup> Colony counts for significant bacteriuria are expressed in CFU of one or two bacteria defined as uropathogens (see Materials and Methods) per milliliter.

and other gram-positive organisms (16 infections [17.8%]). Group B streptococci were the only potential uropathogen isolated in nine patients, and all of these women had positive urinalysis results (i.e., they had positive result for LE). Urinalysis tests detected significantly more gram-negative infections (63 of 74 infections [85.1%]) than those due to gram-positive bacteria (10 of 16 infections [62.5%]) because the NIT test did not detect the presence of gram-positive pathogens.

The results of this study confirm and expand the previous findings, of Stamm et al. (9, 10), that many women with urinary tract symptoms have bacterial counts in their urine of less than 10<sup>5</sup> CFU/ml. Furthermore, the report by Kunin et al. (4) suggests that women with bacteriuria with very low count (>10<sup>2</sup> to 10<sup>4</sup> CFU/ml) may be in the early phase of urinary tract infection that is possibly localized to the urethra. If this is the case, then pyuria may not be present in the urine until the bacterial count in the bladder reaches very high counts (>10<sup>5</sup> CFU/ml). In this study, the combination of positive LE and NIT tests gives better overall performance than either test alone in detecting bacteriuria at higher colony counts (≥10<sup>5</sup> CFU/ml). Although the presence of bacteriuria alone is not diagnostic of a urinary tract infection, all of the women had urine cultures done because they had symptoms suggestive of acute cystitis. However, the decreased sensitivity of urine dipstick tests in detecting lower colony counts limits the utility of this method in diagnosing uncomplicated urinary tract infections in women. If the laboratory cultured only urine samples with a positive urinalysis result this policy would eliminate 51.8% of all urine cultures. Although this approach would save the laboratory considerable time and expense, approximately one of every five women with symptoms of a urinary tract infection and positive urine cultures would be missed. Alternatively, negative urinalysis results (for both LE and NIT), due to the high specificity and negative predictive value of these tests, could be used to screen for urines that do not need to be cultured. This approach would have missed 17 (18.9%) samples from symp-

tomatic women who had significant bacteriuria due to gram-positive organisms other than *S. saprophyticus*. Group B streptococci have been previously shown to cause bacteriuria, and detection is particularly important in pregnant women (12). Use of a positive dipstick urinalysis result as the only screening method for urinary tract infection and performance of a urine culture in this population are not recommended.

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