

Diagnosis and treatment of urinary tract infections across age groups



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Urinary tract infections are the most common outpatient infections, but predicting the probability of urinary tract infections through symptoms and test results can be complex. The most diagnostic symptoms of urinary tract infections include change in frequency, dysuria, urgency, and presence or absence of vaginal discharge, but urinary tract infections may present differently in older women. Dipstick urinalysis is popular for its availability and usefulness, but results must be interpreted in context of the patient's pretest probability based on symptoms and characteristics. In patients with a high probability of urinary tract infection based on symptoms, negative dipstick urinalysis does not rule out urinary tract infection. Nitrites are likely more sensitive and specific than other dipstick components for urinary tract infection, particularly in the elderly. Positive dipstick testing is likely specific for asymptomatic bacteriuria in pregnancy, but urine culture is still the test of choice. Microscopic urinalysis is likely comparable to dipstick urinalysis as a screening test. Bacteriuria is more specific and sensitive than pyuria for detecting urinary tract infection, even in older women and during pregnancy. Pyuria is commonly found in the absence of infection, particularly in older adults with lower urinary tract symptoms such as incontinence. Positive testing may increase the probability of urinary tract infection, but initiation of treatment should take into account risk of urinary tract infection based on symptoms as well. In cases in which the probability of urinary tract infection is moderate or unclear, urine culture should be performed. Urine culture is the gold standard for detection of urinary tract infection. However, asymptomatic bacteriuria is common, particularly in older women, and should not be treated with antibiotics. Conversely, in symptomatic women, even growth as low as 10^2 colony-forming unit/mL could reflect infection. Resistance is increasing to fluoroquinolones, beta-lactams, and trimethoprim-sulfamethoxazole. Most uropathogens still display good sensitivity to nitrofurantoin. First-line treatments for urinary tract infection include nitrofurantoin, fosfomycin, and trimethoprim-sulfamethoxazole (when resistance levels are $<20\%$). These antibiotics have minimal collateral damage and resistance. In pregnancy, beta-lactams, nitrofurantoin, fosfomycin, and trimethoprim-sulfamethoxazole can be appropriate treatments. Interpreting the probability of urinary tract infection based on symptoms and testing allows for greater accuracy in diagnosis of urinary tract infection, decreasing overtreatment and encouraging antimicrobial stewardship.

Key words: antibiotic resistance, asymptomatic bacteriuria, diagnostic performance, dipstick urinalysis, likelihood ratio, microscopic urinalysis, symptoms, urinary tract infection, urine culture, women

Introduction

Urinary tract infections (UTI) are the most common outpatient infections

encountered in the United states.¹ UTIs result in 8.6 million health care visits and an estimated cost of 1.6 billion dollars

each year.^{1,2} Complications of UTI include pyelonephritis requiring hospitalization and can result in permanent renal damage. UTI is most commonly caused by uropathogens from fecal flora (predominantly *Escherichia coli*) that ascend the urethra to infect the bladder.³

Normal defense mechanisms against UTIs include complete voiding, which removes bacteria from the bladder; urinary acidification from concentrated urea and other excreted organic acids; vesicoureteral valves, which prevent reflux of the bacteria to the upper urinary tract; leukocyte phagocytosis; and IgA production.⁴ Women are especially prone to UTIs because of their shorter urethral length, frequent vaginal colonization, and interference of urine flow and complete bladder emptying from prolapse and urinary retention. Other risk factors include anatomic and functional urologic abnormalities, sexual activity, history of UTIs (especially age <15 years), urinary incontinence, and physical limitations.^{5,6}

An estimated 11% of women report at least 1 physician-diagnosed UTI per year, and 20-30% report multiple recurrences.^{7,8} UTIs are a common concern throughout the lifespan. Young women who are sexually active are particularly vulnerable. In pregnancy, bacteriuria can lead to complications such as pyelonephritis, urosepsis, and increased risk of preterm birth.⁹ Additionally, the prevalence of UTI increases with age, such that prevalence increases to 20% in women age of >65 years.¹⁰ This makes UTI an important issue in our increasingly aging population.

UTIs can be difficult to diagnose because they may present differently in different subgroups, and commonly used office and laboratory testing may further confuse the picture. In this review, we explore the evidence behind the use of signs, symptoms, and urinary testing in prediction of UTI in

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TABLE 1
Summary of diagnostic performance of symptoms

Study	Test or symptom	Sensitivity	Specificity	LR +	LR–
Bent et al, ¹¹ 2002	Self-diagnosis			4	0
	Dysuria			1.5	0.5
	Frequency			1.8	0.6
	Hematuria			2.0	0.9
	Lower abdominal pain			1.1	0.9
	Fever			1.6	0.9
	Vaginal discharge			0.3 (self-reported); 0.7 (on examination)	3.1 (self-reported); 1.1 (on examination)
	Dysuria + frequency and no vaginal discharge			24.6	
	No dysuria and + vaginal discharge			0.3	
Giesen et al, ¹² 2010	Dysuria	80%	38%	1.3	0.51
	Frequency	88%	20%	1.1	0.6
	Hematuria	25%	85%	1.72	0.88
	Nocturia	59%	55%	1.3	0.75
	Urgency	67%	45%	1.22	0.73
	Vaginal discharge	15%	77%	0.65	1.1
Medina-Bombardó and Jover-Palmer, ¹³ 2011	Dysuria			1.09	0.8
	Frequency			1.03	0.83
	Vaginal discharge			0.63	1.18
	Nocturia			1.28	0.72
	Urgency			1.18	0.75
	Sexual activity			1.14	0.66
	Urgency and dysuria			1.53	0.44
Older population					
Woodford and George, ¹⁵ 2009	Any UTI symptom	48.7%	89.6%		

LR, likelihood ratio; UTI, urinary tract infection.

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women across age groups. We also discuss treatment guidelines, with special focus on older women and pregnancy.

Clinical manifestations

Although the probability of UTI can be estimated from laboratory testing, accurate diagnosis requires careful consideration of the individual's symptoms alongside test results. Pretest and posttest probability play important roles in decisions for additional testing or

empiric treatment. Pretest probability takes into account the probability of UTI based on presenting symptoms, and is calculated by dividing the sum of true positives and false negatives by the total sample size. Pretest probability can significantly influence the probability of UTI after diagnostic testing is performed (posttest probability); for instance, a patient with a high risk of UTI based on symptoms still has a significant chance of having a UTI even if testing is negative, while the risk of UTI in a patient with

low risk of UTI based on symptoms is only moderately elevated in the presence of positive testing. The most common UTI symptoms are urgency, frequency, and dysuria. Other symptoms include suprapubic, vaginal, and urethral tenderness, as well as hematuria. It is important to note that systemic symptoms, such as nausea, vomiting, flank pain, upper back pain, and fevers may indicate ascension of infection to the upper urinary tract and should not be treated as uncomplicated UTI.

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