Diagnosis And Management Of Urinary Tract Infections In The Emergency Department

Abstract

Urinary tract infections are a heterogeneous group of disorders, involving infection of all or part of the urinary tract, and are defined by bacteria in the urine with clinical symptoms that may be acute or chronic. Approximately 1 million urinary tract infections are treated every year in United States emergency departments. The female-to-male ratio is 6:1. Urinary tract infections are categorized as upper versus lower tract involvement and as uncomplicated versus complicated. The emergency clinician must carefully categorize the infection and take into account patient host factors to optimally treat and disposition patients. A working knowledge of local or at least national susceptibility patterns of the most likely pathogens is essential. A variety of special populations exist that require special management, including pregnant females, patients with anatomic abnormalities, and instrumented patients.
Case Presentations

It is a typical day in the ED: you finish taking sign out from your partner, sign on to the computer, and see the broad spectrum of complaints awaiting you on the tracking board. The first patient seems like a quick disposition: a 21-year-old woman with dysuria. She describes 3 days of dysuria and urgency and has mild suprapubic pain. But before you write her for antibiotics, you ask if she is having any gynecologic symptoms . . .

In the next room, you meet a pleasant 38-year-old woman, mother of 4 boys. She has had kidney stones in the past and a tubal ligation. She complains of persistent fever with a recent UTI, despite starting a second course of antibiotics. She has never complained of back pain, and currently she is afebrile. The patient looks well and her vitals are normal except for a slight tachycardia. While you say, “Let me grab our ultrasound machine, and I will be right back,” you wonder if this is just a case of antibiotic resistance or something else . . .

You sigh as you read the chief complaint on the next patient to be seen: a 45-year-old nursing home patient with weakness. He is a bed-bound patient with a history of a spinal cord injury, who has a Foley catheter. His vitals reveal a fever of 38.3°C, a pulse of 130 beats/min, and a blood pressure of 100/50 mm Hg. The nursing home note says only that he has become increasingly weak. The Foley is not well cared for; there is foul-smelling urine that is cloudy, with sediment in the collection bag. You begin your physical examination while having the nurse contact the nursing home for some more history . . .

You pick up 1 more patient, a 23-year-old woman with fever, left flank pain, and recent dysuria. She denies any previous medical problems, and she has no other complaints. Her examination is benign except for a slight tachycardia. While you note says only that he has become increasingly weak. The Foley is not well cared for; there is foul-smelling urine that is cloudy, with sediment in the collection bag. You begin your physical examination while having the nurse contact the nursing home for some more history . . .

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Less than an hour into your shift and the theme is set: UTIs. You reflect on the broad spectrum of clinical presentations for UTIs and the accompanying challenges.

Introduction

The diagnosis and management of urinary tract infection (UTI) seems, at first, like an ordinary task; however, effective management of the full spectrum of urinary tract conditions and their mimics presents a variety of challenges even for the most seasoned emergency clinician. Urinary tract symptoms are frequent presenting complaints, and knowing how to manage them properly will lower failures, bounce-backs, and complications. Knowing the atypical presentations and when to do a more extensive workup will maximize outcomes and minimize errors in management.

UTIs are divided into those involving the lower tract and those of the upper tract. Lower tract infection is confined primarily to the urinary bladder and is termed cystitis. Infection of the upper urinary tract is termed pyelonephritis, and it involves the kidneys and ureter. Pyelonephritis is characteristically more severe than cystitis, and patients with pyelonephritis frequently have systemic symptoms and appear more ill.

UTIs are also classified as uncomplicated versus complicated. This classification is not specifically anatomic or physiologic, but more generally attempts to discern which patients are most likely to recover uneventfully with therapy (uncomplicated) versus patients who are at an increased risk of treatment failure (complicated). Patient comorbidities are the primary determinants of whether a UTI is complicated versus uncomplicated.1

The frequency and relatively benign course of most UTIs may lull the emergency clinician into the false sense that these are easy cases. While most UTIs are straightforward to diagnose, patient comorbidities, local bacterial susceptibility patterns, and available antibiotic choices and costs must be taken into account to assure an optimal outcome.

This issue of Emergency Medicine Practice takes an evidence-based approach to answering the key questions for the patient with a possible UTI:
• Is this an uncomplicated or a complicated UTI?
• What is the appropriate antibiotic to use?
• Is the patient a normal host?
• Is there an anatomic or functional abnormality?
• Is this a mimic? Could this be an abdominal aortic aneurysm or another life-threatening condition?
• Is this patient best treated as an inpatient or outpatient?
• Could the patient be septic?

Critical Appraisal Of The Literature

A literature search was performed on PubMed and MEDLINE® using the following terms: urinary tract infection, combined with imaging, diagnosis, treatment, emergency department management, epidemiology, and incidence of urinary tract infections. To limit the results, filters were set: journal articles, review articles, and practice guidelines. Titles, abstracts, and full articles were reviewed for content. Within the practice guidelines, primary sources of literature were reviewed. The Cochrane Database of Systematic Reviews were also referenced. Important practice guidelines reviewed include the Infectious Diseases Society of America (IDSA) publication on uncomplicated cystitis and pyelonephritis. Findings from 6 randomized controlled trials, 6 laboratory studies, 27 prospective observational studies, 15 retrospective studies, 2 meta-analyses, 2 systematic reviews, 6 guidelines, 26 reviews, 3 textbook chapters, 2 case
reports, and 2 editorials are included here. The total number of patients enrolled in included prospective and retrospective studies was 1,846,871.

The literature on UTI is extensive. No particular specialty dominates the literature on UTI. The literature spans the disciplines of emergency medicine, internal medicine, family practice, obstetrics and gynecology, urology, and infectious disease. The advantages of split ownership are volume and coverage: there is a large amount of literature, and most scenarios have been addressed. The disadvantage of split ownership is the lack of authoritative, multidisciplinary studies and consensus statements that outline specific management options for clinicians. Additionally, many of the studies of antibiotics compare in vitro susceptibilities between antibiotics but do not compare clinical efficacy.

Future evidence-based clinical guidelines and research for UTIs should include:
1. Authoritative multidisciplinary consensus statements on resistance patterns and recommended empiric therapy.
2. Regional studies to establish the geography of bacterial resistance patterns and changes in resistance patterns.
4. More studies on the role of antibiotic stewardship programs.

Anatomy And Pathophysiology

Bacteriology
The surface of the perineum is covered with normal flora, predominantly Staphylococcus epidermidis, followed by its more virulent cousin, Staphylococcus aureus, and bacteria found in deeper structures, including Propionibacterium and Peptococcus species. Normally, urine remains sterile while in the bladder and throughout the majority of the urinary tract. Once urine passes through the urethra, it picks up organisms, including S epidermidis, nonhemolytic Streptococcus and Staphylococcus saprophyticus (found around genital tract skin), among others. Escherichia coli, coliforms (E coli, Klebsiella, Enterobacter, Citrobacter, Serratia) and Enterococcus species are among the most common UTI-causing organisms and are found in high numbers on and around the perineum.2

A meta-analysis of the published data on the effect of circumcision on the risk of UTIs in males concluded that, although circumcision reduces the risk of UTI, this net effect is more beneficial in those with a high risk of developing a UTI, in particular, males with recurrent UTI and those with vesicoureteric reflux.3 Skin conditions that promote increased bacterial growth (such as immunosuppression and diabetes) are associated with increased risk of UTI. Other risk factors include pregnancy, neurogenic bladder, indwelling Foley catheters, prostatic hypertrophy, hospitalization, sexual intercourse, and recurrent UTIs (defined as 3 or more UTIs within a year).

UTI-causing organisms migrate from enteric flora to colonize the perineum and urethra. E coli is the dominant pathogen, causing 75% to 90% of uncomplicated acute infections in all UTI infections. S saprophyticus is the second most common organism, comprising 5% to 15% of cases of uncomplicated acute infections in young, sexually active females; however, it is present in low numbers on normal skin and in the perineal region. Less frequent but significant pathogens for acute uncomplicated UTIs include: Proteus, Streptococcus, Klebsiella, Enterobacter, Pseudomonas, Enterococcus, Staphylococcus, Providencia, Serratia, Morganella, Citrobacter, Salmonella, Shigella, Haemophilus, Mycobacterium tuberculosis, and fungi.89

Uncomplicated UTIs are infections without structural or functional abnormalities in the urinary tract/kidney. Typically, uncomplicated infections are dominated by E coli, in contrast to complicated UTIs, which are more likely to be caused by Enterobacteriaceae, Pseudomonas, Acinetobacter, and S aureus. Nosocomial UTIs are caused most commonly by S epidermidis, S aureus, coagulase-negative Staphylococci, and Enterococcus faecalis.210

Physiology Of Urination
Urine formation begins at the nephron, which consists of the renal tubule and glomerulus. The glomerulus, formed by the conglomeration of the renal afferent and efferent arteriole, forms filtrate through the receiving end of the renal tubule called the Bowman capsule. The filtrate is then concentrated in the loop of Henle, and urine is formed in the collecting ducts where sodium and water are reabsorbed. The formed urine then passes through the renal cortex and empties into the renal pelvis. A series of regular peristaltic contractions moves urine down the ureters where it pools in the bladder. From an anatomical standpoint, obstruction (either from an extrarenal mass or intrarenal stone) can cause urinary stasis and development of an infection. Vesicoureteric reflux increases the risk of UTIs by 27% versus the 1% standard risk in males without reflux. Vesicoureteric reflux is the result of abnormal retrograde flow of urine into the ureters and kidneys from incompetent or misplaced valves, and it increases the risk of recurrent UTIs, pyelonephritis, and renal scarring.4

The act of urination is a complex series of neural stimulation and feedback loops. The lower urinary tract consists of parasympathetic, sympathetic, and somatic nervous systems. Afferent stretch fibers of the bladder wall sense increases in intravesicular pressure and, once fully distended, will stimulate the parasympathetic efferent nerve fibers. Parasympathetic axons then release acetylcholine, which stimulates muscarinic bladder receptors leading
to bladder wall contractions through the detrusor muscle. Sympathetic pathways are stimulated to release norepinephrine-eliciting contractions of the bladder base and urethral smooth muscle. Somatic efferent neurons release acetylcholine and act on the external striated urethral muscle (external urethral sphincter) and pelvic floor muscles. During the act of micturition, voluntary efforts relax the external urethral sphincter and pelvic floor muscles, and urine is relieved. Dysfunction in this process can lead to urinary retention, decreased velocity of emptying, decreased bladder emptying, and consequent development of a UTI. Common causes include neurogenic bladder from a spinal cord injury or peripheral neuropathy.

Physiology Of Bladder And Ureter Function
The ureters contain smooth, irregular muscles in a helical arrangement and join the kidneys with the bladder. These muscles are continuous with the renal pelvis, and they undergo regular, peristaltic contractions every 5 minutes, which helps transfer urine to the bladder. The ureters are constricted in 3 different zones, which correspond with the common areas of stone obstruction: (1) the renal pelvis, (2) pelvic brim, and (3) ureterovesicular junction. The ureters pass through the bladder posteroinferiorly at an oblique angle, which helps to prevent urinary reflux and opens up to the trigone of the bladder.

The bladder is an extraperitoneal retroperitoneal organ that serves as the reservoir for urine; under normal conditions, it can hold in excess of 750 mL, although the urge to urinate occurs around 300 to 450 mL. The apex of the bladder is dome-shaped, and when it is distended, it extends superiorly toward the pubic symphysis. The detrusor muscle contains 3 indistinguishable smooth muscle layers arranged in circular and longitudinal orientation patterns that are responsible for bladder wall contraction, once stimulated. The neck is the inferior-most portion of the bladder and marks the transition into origin of the urethra. The bladder musculature is continuous with the urethra and functions as the internal urethral sphincter. Infection-causing pathology in the bladder includes urethral strictures, stones, bladder cancer, or intravesicular blood clots.

Differential Diagnosis
Unclean Specimen
An accurate diagnosis of UTI requires having a good urine sample. A “clean catch” urine specimen requires proper hand washing, sterilization of the urethra and glans penis (in males) or labia (in females) with wipes, stopping the initial urine midstream, and then catching the rest of the urine in the collecting cup until it is roughly half-full. When improperly performed, the urine can become contaminated with normal flora from the skin, urethra, and vagina. This is less of a problem with males, as it is easier to sterilize the urethral meatus than it is with females. Uncircumcised males are thought to have more colonization of skin flora under the foreskin, but the risk of a contaminated specimen is minimized when the foreskin is retracted prior to obtaining a sample and clean-catch guidelines are strictly adhered to. Urine samples from females are frequently prone to contamination from vaginal leukocytes and vaginal secretions as well as normal flora.

Sterile Pyuria
A urinalysis with white blood cells (WBCs) in the absence of bacteria is referred to as sterile pyuria. Sterile pyuria is a challenge to interpret and has a wide differential of clinically significant pathologies. The differential diagnosis must be considered, since some etiologies require specific additional evaluation and treatment. For example, in a nonrandomized case series of 500 patients undergoing surgery for acute appendicitis, one-third of these subjects had urinary symptoms, including right flank pain with dysuria with sterile pyuria, most commonly in the group between 15 and 19 years of age. The etiology is the presence of the inflamed appendix lying on the ureter, causing irritation and leukocytosis from the ureter. Any form of enteritis, including diverticulitis, can also cause sterile pyuria by causing external inflammation of the urinary tract. Intrinsic renal pathologies causing this finding include perinephric abscess, renal tuberculosis, renal papillary necrosis, renal sarcoidosis, polycystic kidney disease, nephrolithiasis, nephropathy, transplant rejection, fungal infections, and nephritis. Certain infiltrative disorders (such as lymphoma or leukemia) can involve the tubules and interstitium, causing mild to moderate pyuria along with proteinuria and hematuria.

Noninfectious Dysuria
On the other end of the spectrum, diagnosing dysuria without other signs or symptoms of UTI can be a daunting task. In these cases, it is important to take a thorough history and consider other variables in your differential. In postmenopausal women, reduction in endogenous estrogen levels leads to atrophic vaginitis, dryness, and vaginal inflammation that causes dysuria and frequency. Other causes in women include urethral trauma from intercourse and irritation from commonly used scented soaps, sprays, creams, or other hygiene products. In men, consider that benign prostatic hypertrophy, especially in men aged > 70 years, results in urethral obstruction which then leads to dysuria and frequency. In both sexes, dysuria can also be the result of urethral strictures from previous sexually transmitted infections or prior urethral instrumenta-
Prehospital Care

There have been studies of telemedicine protocols to manage uncomplicated UTI. In a recent retrospective study of 273 women, approximately 50% were successfully treated without urinalysis or culture or visit to a healthcare facility. A recent case series of 499 women with uncomplicated UTI in Switzerland showed 78% resolution after telemedicine consultation and treatment. To date, there have been no studies of prehospital resources in the management of UTI. That being said, prehospital personnel can provide valuable information to the emergency clinician based on their history and physical examination, with particular attention to septic patients with indwelling catheters, the immunocompromised, and the elderly. In terms of indwelling catheters, emergency medical services should focus on tubing and collecting systems; looking for buildup, sediment, or blood; asking about decreased urine output; and noting the color and any foul-smelling odors from the bag. These questions and findings can help guide the provider towards a diagnosis and expedite patient care.

Emergency Department Evaluation

Proper evaluation of emergency department (ED) patients with suspected UTIs starts with a careful history and physical examination. The evaluation is directed at answering a number of key questions:

1. Is this patient’s symptom the result of a UTI, or could there be an alternative diagnosis?
2. Does this patient have a lower or upper tract UTI?
3. Is the patient possibly pregnant?
4. Has there been any exposure to sexually transmitted infections?
5. Is this an uncomplicated or complicated UTI?
6. What is the proper disposition?

The classic symptoms of acute cystitis are dysuria, frequency, urgency, and suprapubic discomfort. However, these symptoms are not specific to UTIs and they overlap with other entities such as sexually transmitted infections, vulvovaginitis, or exposure to irritants such as allergens, chemicals, or trauma. In a retrospective systematic review of the literature looking at 9 of 464 studies published between 1966 and 2001, the combination of more than 2 of the classic symptoms of UTI, without vaginal discharge or itching, make the probability of a UTI > 90%. Although this study has not been validated, patients should be asked about symptoms suggesting a UTI mimic and a pelvic examination should be considered. Female patients will often present to the ED with a self-diagnosis of UTI. In a prospective cohort study enrolling 50 patients, there was a poor correlation between the emergency physician’s clinical diagnosis and the patient’s self-diagnosis.

Lower Versus Upper Urinary Tract Infection

Upper UTIs are often distinguished from lower UTIs by the presence of systemic symptoms such as fever, nausea, vomiting, chills, and back pain. However, in practice, there is often considerable overlap between these entities. Understanding the importance of a rectal temperature to diagnose fever and a careful percussion of the costovertebral angle is useful in diagnosing pyelonephritis. Fever is commonly present and, in a retrospective cohort study of 304 patients from a single-center, patients without fever were more likely to have other diagnoses, such as pelvic inflammatory disease, diverticulitis, or cholecystitis. Again, the emergency clinician must be aware of the wide spectrum of clinical manifestations of pyelonephritis. Ask about recent antipyretics, the duration of illness, recent antibiotics, and comorbidities. Patients can present with atypical features, such as upper abdominal pain, no pain, or headache. Because acute pyelonephritis is a clinical diagnosis, consider that subclinical pyelonephritis is seen more often in patients with recurrent UTIs, prolonged symptoms ( > 7 days duration), male sex, diabetes mellitus, pregnancy, immunosuppression, and old age. Although this makes intuitive sense, there is a paucity of evidence to support this.

Complicated Versus Uncomplicated Urinary Tract Infection

Distinguishing between an uncomplicated and a complicated UTI is important because it will influence management and patient disposition. An uncomplicated UTI is acute cystitis or pyelonephritis in a nontoxic, healthy, premenopausal, nonpregnant female with normal urogenital anatomy. All other patient subsets are deemed to have complicated UTIs, such as the elderly, males, patients with moderate to severe diabetes, the immunocompromised, patients with kidney stones, or patients who are pregnant. It should be routine to screen every premenopausal woman with UTI symptoms for pregnancy. In addition, all patients should be asked about comorbidities or a history of kidney stones, recent genitourinary procedures, or recent antibiotic use in order to assess risk factors.

Recognizing Severity

A critical role of the emergency clinician when evaluating the patient with a UTI is to recognize the severity of the patient’s illness. Patients with severe sepsis or shock need to be identified early, as they will need intervention and source control. It is
important to recognize the signs of systemic inflammatory response syndrome (SIRS), which include hyperthermia/hypothermia, leukocytosis, leukopenia, tachycardia, and tachypnea. These is especially important for the at-risk patient populations, which include the elderly, the immunocompromised, and patients with comorbid conditions (such as indwelling catheters or urethral obstruction). Early imaging studies are recommended in these patients.1,26,27

Physical Examination
The physical examination of a patient with a suspected UTI should aid in confirming your pretest probability of a UTI or in ruling out in other entities. A systematic review of the literature from 1965 to 2012 that included 948 studies confirmed that there is no specific historical symptom or physical examination finding that can accurately rule in or

<table>
<thead>
<tr>
<th>Table 1. Adult Urinary Tract Infection Definitions And Patient Subsets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uncomplicated UTI</strong>¹</td>
</tr>
<tr>
<td>• Lower UTI (cystitis) in nonpregnant female</td>
</tr>
<tr>
<td><strong>Complicated UTI</strong>²</td>
</tr>
<tr>
<td>• Upper UTI (pyelonephritis)²</td>
</tr>
<tr>
<td>• Male</td>
</tr>
<tr>
<td>• Pregnant female</td>
</tr>
<tr>
<td>• Moderate or severe diabetes mellitus</td>
</tr>
<tr>
<td>• Anatomic abnormalities</td>
</tr>
<tr>
<td>• Cancer, chemotherapy, immunosuppression</td>
</tr>
<tr>
<td>• Impaired micturition</td>
</tr>
<tr>
<td>• Catheter, stent, or tube in urinary system</td>
</tr>
<tr>
<td>• Obstructive stone</td>
</tr>
<tr>
<td>• Hospital-associated UTI</td>
</tr>
<tr>
<td>• Treatment failure</td>
</tr>
</tbody>
</table>

¹Urine culture not necessary
²Urine culture necessary
³Pyelonephritis in nontoxic, healthy, young women can be treated as "uncomplicated." (See text, page 5.)

Table 2. Risk Factors For Complicated Urinary Tract Infections²

- Pregnancy
- Male sex
- Moderate to severe diabetes or other immunosuppressed state
- Structural abnormalities of urinary tract (kidney stones, renal and perinephric abscess, emphysematous pyelonephritis, or polycystic kidney disease)
- Functional abnormality of urinary tract (vesicoureteral reflux, spinal cord injury, neurogenic bladder)
- Hospital-acquired infections
- Presence of external catheters (urethral, suprapubic, or nephrostomy tubes)

rule out a UTI in symptomatic women.28 This study reported specificity ranging from 52% to 58% for dysuria, 60% for frequency, 78% to 88% for urgency, 69% to 91% for fever, 19% for abdominal pain, and 76% to 77% for back pain. Evaluation for fever (including a rectal temperature, when necessary) or signs of systemic toxicity (including tachycardia) can aid in differentiating lower UTI from a complicated UTI. A genitourinary examination may be necessary in women who have vaginal complaints and in all men with suspected UTIs. A careful abdominal examination may also help in diagnosing other UTI/pyelonephritis mimics such as appendicitis or diverticulitis.1,20,22-27,29-31

Diagnostic Studies

Laboratory Studies

Basic Laboratory Tests
A WBC count may be warranted if the emergency clinician suspects systemic illness, as this may guide treatment regimen. A creatinine level may be required before sending a patient for a computed tomography (CT) scan with contrast. If prior laboratory values have been obtained, the trending creatinine and blood urea nitrogen (BUN) values may give the emergency clinician insight as to the severity of renal pathology. There is no support in the literature to routinely order “basic” laboratory testing for patients presenting to the ED suspected of having an uncomplicated UTI. For complicated UTIs, including patients with comorbidities and immunosuppression, laboratory testing may be warranted, at the discretion of the emergency clinician.

Urine Dipstick Versus Microscopic Urinalysis
The quick turn-around of the point-of-care urine dipstick versus laboratory urinalysis has made diagnosing a UTI in the ED more efficient. The urine dipstick has a sensitivity and specificity comparable to microscopic urinalysis.32-34 The most sensitive value from the urine dipstick is the leukocyte esterase, while the presence of nitrates is the most specific. When combining these 2 pieces of data from the urine dipstick, the specificity reaches 100% and the positive likelihood ratio nears infinity.33 In a prospective study of 343 patients by Lammers et al, the diagnostic capabilities of the urine dipstick and urinalysis were compared to a gold standard of a urine culture with > 100,000 cfu/mL.32 Table 3 (page 7) summarizes the findings of this study.

Additional prospective studies also compared urine dipstick and urinalysis.32-34 (See Table 4, page 7) The urine collected from each study was a midstream clean-catch urine specimen. According to the pooled data, the presence of blood, leukocyte esterase, or protein from the urine dipstick was very sensitive; the only specific finding from the urine
Urine culture has been the gold standard for the diagnosis of UTI, but due to the length of time to return results, it is difficult for a urine culture to be the gold standard for ED decision making. According to 2010 IDSA guidelines, urine cultures were ordered on patients with treatment failure, the complicated UTI, or the pyelonephritis patient. Historically, urine cultures have proven to be cost-ineffective and would rarely change patient outcomes. In the past several decades, resistance to standard UTI therapies has increased. In a retrospective study of 12,870 patients, there was a treatment failure in 441 patients due to resistance to commonly prescribed antibiotics. Treatment failure was most prevalent in the high-risk population. Commonly, hospital antibiograms are based on urine cultures obtained from

**Table 3. Positive And Negative Predictive Values Of Urine Dipstick And Microscopic Urinalysis With Corresponding Overtreatment And Undertreatment Rates**

<table>
<thead>
<tr>
<th>Testing Modality</th>
<th>PPV (%)</th>
<th>NPV (%)</th>
<th>Overtreatment Rate (%)</th>
<th>Undertreatment Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Urine Dipstick</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LE or N or blood</td>
<td>51</td>
<td>94</td>
<td>49</td>
<td>6</td>
</tr>
<tr>
<td>LE &gt; 2 and N</td>
<td>88</td>
<td>52</td>
<td>13</td>
<td>48</td>
</tr>
<tr>
<td><strong>Microscopic Urinalysis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RBC or WBC</td>
<td>50</td>
<td>93</td>
<td>50</td>
<td>7</td>
</tr>
<tr>
<td>RBC &gt; 50 or WBC &gt; 10</td>
<td>64</td>
<td>74</td>
<td>37</td>
<td>25</td>
</tr>
</tbody>
</table>

Abbreviations: LE, leukocyte esterase; N, nitrate; NPV, negative predictive value; PPV, positive predictive value; RBC, red blood cell; WBC, white blood cell.


**Table 4. Sensitivity, Specificity, And Likelihood Ratio For Urine Dipstick And Microscopic Urinalysis**

<table>
<thead>
<tr>
<th>Testing Modality</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>Positive LR (%)</th>
<th>Negative LR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Urine Dipstick</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LE</td>
<td>75-91</td>
<td>41-87</td>
<td>1.59-5.6</td>
<td>0.2-0.4</td>
</tr>
<tr>
<td>N</td>
<td>34-42</td>
<td>94-98</td>
<td>7.5-24.6</td>
<td>0.6-0.7</td>
</tr>
<tr>
<td>Blood</td>
<td>92</td>
<td>42</td>
<td>2.6</td>
<td>0.2</td>
</tr>
<tr>
<td>Protein</td>
<td>83</td>
<td>44</td>
<td>2.1</td>
<td>0.3</td>
</tr>
<tr>
<td>LE + N</td>
<td>30-38</td>
<td>91-100</td>
<td>3.4 to infinity</td>
<td>0.6-0.8</td>
</tr>
<tr>
<td>LE or N</td>
<td>91-92</td>
<td>39-41</td>
<td>1.5-1.6</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Microscopic Urinalysis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WBC &gt; 5</td>
<td>57-90</td>
<td>47-89</td>
<td>1.7-5</td>
<td>0.2-0.5</td>
</tr>
<tr>
<td>Bacteria &gt; 0</td>
<td>9-83</td>
<td>59-72</td>
<td>2.3-2.9</td>
<td>0.1-0.5</td>
</tr>
<tr>
<td>RBC &gt; 5</td>
<td>59-63</td>
<td>67-74</td>
<td>1.8-2.4</td>
<td>0.5-0.6</td>
</tr>
<tr>
<td>WBC or bacteria</td>
<td>100</td>
<td>39</td>
<td>1.6</td>
<td>0</td>
</tr>
<tr>
<td>WBC and bacteria</td>
<td>58</td>
<td>81</td>
<td>3</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Abbreviations: LE, leukocyte esterase; LR, likelihood ratio; N, nitrate; NPV, negative predictive value; PPV, positive predictive value; RBC, red blood cell; WBC, white blood cell.

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the high-risk patient who presents to the ED and is admitted to the hospital. Although not cost-effective, the argument has been made to better tailor treatment to the general population, with antibiograms representing all patients who present to the ED.\textsuperscript{41}

**When To Get A Urine Culture**

When to obtain a urine culture in an uncomplicated UTI varies in the literature. The general consensus is to obtain a urine culture if symptoms do not resolve following treatment.\textsuperscript{24,41,42} If the pretest probability is high and a urine dipstick is negative, it is advisable to obtain a urine culture.\textsuperscript{24} It is generally agreed in the literature that, when a patient is considered to have a complicated UTI or pyelonephritis, cultures should be obtained.\textsuperscript{24,41,42} A positive urine culture is defined as > 105 colony-forming units.\textsuperscript{1}

**Blood Culture**

In the uncomplicated UTI, blood cultures are not warranted. For the patient with uncomplicated pyelonephritis, blood cultures have not proven to change the course of treatment, including in pregnant patients.\textsuperscript{45-47} For patients who are considered to have complicated infections or are postmenopausal, blood cultures have proven beneficial.\textsuperscript{48} A large recent meta-analysis of studies on the utility of blood cultures concluded that they are of limited benefit except in patients with pneumonia and sepsis.\textsuperscript{49} This is due to the overwhelming mortality associated with bacteremic patients, so tailoring antibiotics can aid in targeted therapy.\textsuperscript{49}

**Testing For Sexually Transmitted Infections**

The patient’s history will play a key part in determining whether to look beyond a diagnosis of simple cystitis. Diagnoses to be considered are urethritis in men and women and pelvic inflammatory disease, cervicitis, tubal ovarian abscess, and vaginitis in women. Characteristics for each infectious process and historical clues are:\textsuperscript{35}

- **Cystitis**: Dysuria, hematuria, increased urinary frequency, abrupt onset of symptoms, severe symptoms, suprapubic/low back pain or suprapubic tenderness.
- **Other infections**: Gradual onset of symptoms, mild symptoms, vaginal discharge/bleeding, lower abdominal pain, new sexual partner, cervicitis/vulvovaginal herpetic lesions on examination, vaginal discharge/odor, pruritus, dyspareunia, external dysuria, and absence of increased frequency or urgency.

For patients with signs, symptoms, physical findings, or historical clues inconsistent with cystitis, further investigations are warranted. This would include investigations for sexually transmitted diseases, vaginitis, yeast infections, and urethritis or prostatitis in men.

**Imaging**

Imaging is not necessary in cases of uncomplicated UTIs. If a renal pathology is suspected, the options for imaging include plain-film abdominal radiography, ultrasound, and CT scan. Plain-film abdominal radiography (kidneys, ureters, and bladder [KUB]) is of limited use by itself, with a sensitivity of 45\% to 59\% and specificity of 77\% for detecting renal pathology.\textsuperscript{50} An abdominal radiograph may show the presence of renal calculi or gas; however, the sensitivity is lower than that of CT scan (92\%-96\%)\textsuperscript{51-54} and does not demonstrate complications such as ureteral obstruction or hydronephrosis.\textsuperscript{48} (See Figure 1.)

**Intravenous Urethrogram**

Intravenous urethrogram has fallen out of favor, but it may have a place in diagnosing the pregnant female with a renal stone and an equivocal ultrasound.\textsuperscript{55} The intravenous urethrogram is conducted by injecting contrast intravenously and taking abdominal x-rays at 1 minute and 15 minutes, and then any additional films needed.\textsuperscript{56} There is also support for only a 30-minute single-shot film.\textsuperscript{57} An intravenous urethrogram has a higher sensitivity and specificity than an abdominal radiograph in diag-

**Figure 1. X-Ray Displaying Bilateral Renal Calculi**

Arrows point to calculi.

Used with permission under the Creative Commons Attribution 2.0 license by Bill Rhodes from Asheville (CC-BY-2.0 [http://creativecommons.org/licenses/by/2.0]), via Wikimedia Commons. Available at: http://upload.wikimedia.org/wikipedia/commons/6/66/Kidney_stones_abdominal_X-ray.jpg
nosing urinary calculus disease as the cause of acute flank pain (64% vs 97% and 92% vs 94%, respectively).\(^{55,58,59}\) Compared to a CT scan, the intravenous urethrogram does have a lower level of radiation exposure, but due to the nature of the examination, the intravenous urethrogram can take longer to conduct, advocating for the CT scan.\(^{60}\) (See Figure 2.)

**Magnetic Resonance Imaging**

MRI has been considered a second-line imaging modality if ultrasound is equivocal in the pregnant patient.\(^{61}\) MRI cannot directly identify calcifications, and it relies on signal void for the diagnosis of calculi.\(^{62}\) MRI is also very expensive, can take several hours to conduct and to be read, and may not be available in all facilities. Unenhanced magnetic resonance urography (MRU) can accurately assess for the presence, degree, and level of urinary tract obstruction, but it has low sensitivity and specificity in identifying stones.\(^{63,64}\) The half-fourier single-shot turbo-spin echo (HASTE) MRU, without contrast, is a technique that has emerged in the last decade as an accurate method for stone diagnosis, and it is safe during pregnancy. HASTE MRU sensitivity and specificity for stone diagnosis is comparable to CT scan.\(^{65}\) The gA gadolinium-enhanced MRU has better diagnostic capabilities than the unenhanced MRU (with respect to calculus identification), but it comes with increased cost and risk of allergic reactions.\(^{62}\)

**Ultrasound**

Ultrasound is noninvasive, does not involve irradiation, is cost-effective, and can provide valuable clinical information immediately. Ultrasound can reveal complications such as hydronephrosis, renal or extrarenal abscesses, and distal hydroureter.\(^{31,66,67}\) (See Figure 3.) In 2 prospective studies of > 125 patients examined by an emergency physician with bedside ultrasound for confirmation of nephrolithiasis, the sensitivities and specificities were 72% to 80% and 37% to 73%, respectively.\(^{67,68}\) This argues that ultrasound is a good option for a patient who cannot undergo a CT scan, but the ultrasound must be performed by skilled personnel, as diagnostic accuracy varies based on the provider’s skill.

For men who are at risk for benign prostatic hypertrophy, ultrasound should be part of the work-up to determine whether there is obstructive uropathy. Benign prostatic hypertrophy is common in elderly males, and it can lead to obstruction uropathy resulting in hydronephrosis, placing the patient at higher risk for a UTI.\(^{69}\) Common characteristics of benign prostatic hypertrophy include men over the age of 60 years with lower urinary tract symptoms. Lower urinary tract symptoms include urgency,

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**Figure 2. Intravenous Urethrogram Demonstrating Contrast Filling The Renal Pelvis, Ureters, And Bladder**

![Image](http://upload.wikimedia.org/wikipedia/commons/f/f5/Ivu_1.jpg)

Arrows point out the contrast filling of the renal pelvis, ureters, and bladder.


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**Figure 3. Ultrasound Displaying Hydronephrosis**

![Image](http://www.radiopaedia.org)

hesitancy, frequency, pain with urination, nocturia, weak stream, dribbling, or incomplete voiding. Before starting any medications, infection should be ruled out and imaging should be performed to assess for the degree of obstruction.69,70 Ideal imaging modalities for the prostate and urinary include ultrasound,69,70 {

Computed Tomography
A noncontrast CT scan can accurately localize renal calculi, hydronephrosis, gas, and renal abscesses. The addition of contrast can better assess renal perfusion and for renal artery occlusion, renal vein thrombosis, and renal infarction and abscess. The literature has shown that, for the evaluation of flank pain, ultrasound has better sensitivity (24%–77%) versus CT (92%–96%).51-54 Given the increased sensitivity and ability to diagnose a multitude of pathologies, compared to ultrasound, a CT scan has proven to be the imaging modality of choice for renal pathology.53,55,71-73 In pregnancy, a low-dose CT scan is an attractive newer modality, with a lower fetal radiation dose than standard CT (4 mGy vs 25 mGy); however, it does still entail the use of radiation, which is preferably avoided in the pregnant state. In a prospective study of 109 pregnant women, the sensitivity and specificity of low-dose unenhanced helical CT were 96% and 97%, respectively, with a 99% positive predictive value and 90% negative predictive value, respectively.74

Imaging Pearls
Overall, there are no formal guidelines for when to use imaging to diagnose a UTI or for the type of imaging to use. If a structural abnormality or a renal pathology (such as renal abscess, urolithiasis, emphysematous pyelonephritis, or pyelonephrosis), is suspected, imaging is warranted. An abdominal plain film will accurately diagnose a renal stone only 59% of the time.50 An ultrasound has variable sensitivity and is dependent on the size of the stone for more accurate diagnosis,75 but it is a first-line option for a pregnant woman. An intravenous urethrogram should be reserved for women with a negative ultrasound who are strongly suspected of having nephrolithiasis.72 A CT scan has the highest sensitivity and specificity and has the capability to diagnose other pathology, unlike other imaging modalities.26,72,76 The clinical utility and cost-effectiveness of performing routine imaging in all patients with UTI with suspected renal involvement needs further prospective evaluation.

Treatment
Several factors must be considered when choosing antibiotic therapy. Indiscriminate use of “big gun” broad-spectrum antibiotics is not advised due to high cost, collateral damage to the patient’s normal bacterial biome, and resistance development. Indiscriminate use of broad-spectrum antibiotics is associated with higher incidence of general resistance in a community and with Clostridium difficile infection. National guidelines, books or pamphlets, or mobile device applications are not likely to reflect all community environments.87,77-79

Resistance to trimethoprim-sulfamethoxazole (TMP-SMX) and fluoroquinolones is now very common, and according to multiple comprehensive literature reviews, varies between 10% and 20% in many communities.79,80 This trend is common around the world, with resistance to TMP-SMX in Turkey peaking at 50%, and drugs such as ampicillin having resistance rates up to 100% in Europe and Africa.81 Resistance patterns change over time, and they also vary from community to community, so it is important for the emergency clinician to be acquainted with local antibiograms for pathogens associated with UTI. National antibiogram reports lag behind local antibiograms and may not even be representative of local antibiograms.

A recent study covering 16 European countries and Canada showed clinical resistance to trimethoprim approaching 30% and sulfamethoxazole approaching 50%. Another investigation in Seattle demonstrated an increase in TMP-SMX resistance from 8% to 16% in 4 years, and Michigan found similar numbers over a 6-year period. Those at risk for resistance included patients with recent antibiotic exposure, recent hospitalization, diabetes, 3 or more UTIs in the past year and, possibly, the use of oral contraceptives.82

Treatment Of Lower Urinary Tract Infection
Treatment for UTIs depends on a multitude of different variables, including host factors, presentation, degree of infection, and local resistance patterns. Traditionally, the literature shows that a 3-day course of trimethoprim is the first-line choice of drug therapy for uncomplicated UTI. A 3-day course eliminates 94% of infections. Single-dose treatment is less effective than the 3-day course, eliminating only 87% of cases, and longer courses have not been shown to be more effective.24,83,84 Interestingly, trimethoprim can cause hypersensitivity reactions that may be falsely attributed to sulfa when given in combination. Fluoroquinolones are an acceptable alternative if local TMP-SMX resistance reaches 15% to 20%, as they are found to be active against the main offending bacteria, including gram-negative organisms and S saprophyticus. However, small studies of TMP-SMX have shown clinical cure rates of up to 60% in patients with known resistant strains.24 Ofloxacin (or ciprofloxacin) is also an accepted form of treatment, but there are concerns about promoting bacterial resistance and the high cost
burden to the patient. With increasing resistance to TMP-SMX and fluoroquinolones, nitrofurantoin (Macrobid®, Macrodantin®, Furadantin®, and fosfomycin have emerged as first-line therapies in many communities. With the exception of patients with an allergy, nitrofurantoin is the first-line agent in pregnant women with cystitis. Although nitrofurantoin typically has very low resistance patterns, it is known to be active predominantly toward E coli and less active toward other gram-negative organisms. A single 3 g dose of fosfomycin is approved for use to treat uncomplicated UTIs, but the efficacy is lower than TMP-SMX or fluoroquinolones. However, resistance is extremely rare, so it may serve as a useful drug in the patient with multidrug allergies or who has a multidrug-resistant UTI. Outside of obstetrics-gynecology circles, fosfomycin is not as well known as the other agents. That being said, it is on many hospital formularies and can be ordered at commercial outpatient pharmacies. Fosfomycin has an attractive compliance profile because it is a 1-time dose, and it has demonstrated good effectiveness.

Typically, a 3-day course of antibiotics for uncomplicated cystitis cures the infection; however, in situations where the therapy fails, urine cultures and a 14-day course of antibiotics are recommended. For example, prostatitis is a complication of an ascending UTI requiring a minimum of 2 weeks of outpatient antibiotics. Treatment typically involves a fluoroquinolone (such as ciprofloxacin 500 mg twice per day). Another example of a complication requiring an extended duration of treatment is with hospital-acquired UTIs.

Acute pyelonephritis can be treated with oral ciprofloxacin 500 mg twice per day for 7 to 14 days with or without an initial 400 mg intravenous dose. As an alternative to a fluoroquinolone, 1 g IV ceftriaxone dosed every 24 hours or gentamicin dosed every 24 hours can also be used until the patient can be converted to oral therapy. Generally, this treatment regimen is recommended over oral or intravenous fluoroquinolones if the local resistance pattern exceeds 10%. If there is a known susceptibility to TMP-SMX, a 14-day course may be appropriate as well. When local resistance to TMP-SMX and fluoroquinolones is higher than 10% to 20%, cefuroxime 500 mg twice daily for 7 to 10 days or cefpodoxime 400 mg twice daily for 7 to 10 days may be used.

Cranberry juice is a strategy commonly employed for treatment and prevention of UTIs. Studies show that there may be some beneficial effect to this strategy, as the cranberry contains 3 proanthocyanidin chemical compounds that were shown in the laboratory to prevent adherence of E coli to the uroepithelial cells. Randomized studies demonstrate that 200 to 750 mL of cranberry juice daily or daily cranberry tablets can reduce infection rates by up to 20%.

### Treatment With Intravenous Fluids

Intravenous fluids (IVF) are generally indicated for pyelonephritis with vomiting, when a fluid deficit is present on physical examination, when a patient appears dehydrated, or if systemic infection is being considered. To date, no trials of intravenous hydration in pyelonephritis are available. It is important to consider that tachycardia is one of the criteria for sepsis, so IVF are useful in helping distinguish dehydration from sepsis in pyelonephritis. Resolution of the tachycardia with IVF makes the patient feel better, and it is also important in screening for sepsis, as persistent tachycardia is one of the criteria for the diagnosis of sepsis.

### Pain And Nausea Control

UTIs can be painful and, when severe, they are often accompanied with nausea. Acute uncomplicated UTIs do not cause renal insufficiency, so nonsteroidal anti-inflammatory drugs as well as opioids are reasonable treatments for pain. Nausea frequently accompanies pyelonephritis, and it is best to treat it aggressively so that the patient can start drinking and taking the appropriate medications as soon as possible.

Phenazopyridine HCl (Pyridium®) is used to treat the urethral and bladder irritation associated with a UTI, and it is fairly effective, although it loses effectiveness in 2 to 3 days. It can cause methemoglobinemia, and overdose is very serious, thus it is generally prescribed for only 2 to 3 days. Other potential side effects of phenazopyridine include urine discoloration, pruritus, nausea, and contact lens discoloration. Anaphylactoid reaction is a rare, but serious, reaction to phenazopyridine.

### Treatment For Men

UTIs are uncommon in men, due to the longer length and narrower caliber of the male urethra. Because UTIs are atypical in males, prostatitis and sexually transmitted infections must be considered. The gestalt from the literature is that UTIs in men are considered complicated and, therefore, cultures are generally indicated even in equivocal cases (such as trace leukocytes or just trace blood). In sexually active men, urethral swabs for gonorrhea and Chlamydia trachomatis should be considered when urethritis is the predominant symptom.

Another complicating factor with a UTI in males is the development of acute bacterial prostatitis as a result of an ascending infection. E coli is the causative organism in 87% of these cases, with Proteus mirabilis, Pseudomonas, Klebsiella, and Enterococcus comprising roughly the remainder of cases. Neisseria gonorrhoeae should typically be considered in young sexually active men. In rare cases and in immunocompromised patients, tuberculosis has been implicated in acute infection. Males with prostatitis will generally present as a febrile UTI with pain reported.
Clinical Pathways For Antibiotics For Urinary Tract Infection In The Emergency Department

Lower urinary tract infection

Local TMP-SMX susceptibility 80%-90%?

NO OR UNKNOWN

YES

TMP/SMX-allergic?

NO

LOCAL TMP-SMX susceptibly 80%-90%?

NO

TMP/SMX-allergic?

YES

Nitrofurantoin-allergic?

NO OR MILD

YES (ANAPHYLAXIS)

Penicillin-allergic?

NO OR MILD

Yes

Ciprofloxacin or ofloxacin, 3-5 day course† or Fosfomycin PO, 1 dose (Class II)

NO OR MILD

Ciprofloxacin-allergic?

NO OR MILD

YES

Gentamicin IV, qd 5-7 days (Class II)

NO OR MILD

NO

TMP-SMX PO, 10-14 day course* (Class II)

OUTPATIENT UPPER URINARY TRACT INFECTION

Local TMP-SMX susceptibility > 90%?

NO/UNKNOWN

YES

TMP/SMX-allergic?

NO

Ciprofloxacin-allergic?

YES

Second- or third-generation cephalosporin PO, 10-14 days (Class II)

NO OR MILD

YES

First or second-generation cephalosporin, 3-5 day course* (Class II)

OUTPATIENT UPPER URINARY TRACT INFECTION

Abbreviations: bid, 2 times per day; IV, intravenous; PO, by mouth; qd, 1 time per day; TMP-SMX, trimethoprim-sulfamethoxazole.

*Do not use in third trimester of pregnancy.
†Do not use in pregnancy.

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For Class of Evidence Definitions, see page 13.
in the abdomen, perineum, or rectum. They may also present with chills, or vomiting. Severe cases may include changes in mentation. If changes in mentation are present, sepsis should be considered.

**Special Circumstances**

**Pregnant Patients**

Pregnancy is associated with decreased ureteral motility and mild hydronephrosis. Therefore, there is an increased risk of both lower and upper UTI. Given the increased materno-fetal morbidity associated with pyelonephritis, traditional practice calls for inpatient treatment. Due to the considerable risk to patient/fetus, most emergency clinicians and obstetricians admit pregnant women for parenteral antibiotics such as a second- or third-generation cephalosporin, gentamicin, or aztreonam. There is some evidence (1b) to suggest an outpatient option for these patients. The patients were mild to moderately ill, and received 2 doses of intramuscular ceftriaxone prior to discharge with very close follow-up (48-72 hours).

### Upper Urinary Tract Infection In Pregnancy

Bacteriuria with or without symptoms has been reported to be as high as 20% in pregnancy, and, if left untreated, it is associated with a 20% to 30% risk of developing pyelonephritis, which can be a serious threat to mother and fetus, increasing the risk of premature labor and low birth weight. Given the significant risk of maternal/fetal morbidity, a consensus guideline recommends treatment, as well as a culture, for all pregnant women with suspected UTIs. Asymptomatic bacteriuria is also treated, generally with a 3-day course of antibiotics, and a urine culture is generally indicated. The recommended antibiotic treatment regimens for pregnant women are similar to nonpregnant women, as there is no clear evidence that any particular antibiotic or dosing regimen has any advantage in pregnancy. There are no prospective studies that address the risk of treatment to the fetus using common antibiotic regimens in UTI, such as nitrofurantoin, TMP-SMX, penicillins, or cephalosporins. TMP-SMX is a Category C drug in pregnancy and should not be used in the first trimester because it inhibits folate metabolism and may lead to neural tube defects. Also, in the third trimester, TMP-SMX has shown a clear link to the development of kernicterus. Aminoglycoside, a Category D drug, will cross the placenta and could, theoretically, lead to renal and ototoxicity. Fluoroquinolones and tetracycline are Category C and D, respectively, and are also not recommended due to their potential for toxicity to the fetus. Adherence to local resistance patterns applies as in nonpregnant women.

### Duration Of Therapy in Pregnancy

A 2011 Cochrane systematic review looked at duration of treatment of asymptomatic bacteriuria in pregnant patients. The 1622 subjects from 13 studies were compared with single-dose versus 4- to 7-day treatments. Although the studies were of limited quality, it was generally found that single-dose drug therapy was less effective than short- or full-course treatments, even when trials were compared with the similar antibiotics. The current recommendation is to continue standard treatment for 5 to 7 days, depending on the antibiotic.

**Patients With Indwelling Catheters**

Catheter-associated UTI (CA-UTI) is the most common cause of nosocomial infections and the leading cause of gram-negative sepsis in hospitals. A large number of these patients are asymptomatic; however, 10% to 25% may develop signs and symptoms of infection and would require treatment. Candida is becoming a common complication in indwelling catheter-related infections, especially in ICU patients receiving broad-spectrum antibiotics. Again, treatment of candiduria should be reserved for all symptomatic patients and should include the use of fluconazole for simple infection and amphotericin...
for severely ill patients. All patients with catheter-related infections should have their catheters replaced and reevaluated for necessity. Patients with indwelling catheters frequently present to the ED, and UTIs in these patients represent the most common healthcare-associated infection worldwide. The diagnosis of UTIs in these patients can be quite challenging for a number of reasons. Patients with indwelling catheters will often have bacteriuria and pyuria, and all patients with catheters indwelling for more than 1 month will be colonized. Furthermore, these patients are more frequently elderly or nursing home patients with a number of comorbidities and are often not able to verbalize their symptoms. This patient population will also often present atypically or will have other sources for fever. The IDSA has developed evidence-based guidelines for the diagnosis and treatment of UTIs in patients with indwelling catheters. These guidelines suggest that the presence or degree of pyuria and the presence of odorous or cloudy urine should not be used to diagnose UTI. Ideally, if a UTI is suspected, the catheter should be replaced before the urine is analyzed or the culture is sent, although this may not always be practical in the ED setting. Also, patients who have their catheters replaced prior to treatment of their UTI will get better faster and are more likely to be cured. (Grade B recommendation from the Scottish Intercollegiate Network)

Signs and symptoms compatible with CA-UTI include new-onset or worsening fever, rigors, altered mental status, or malaise or lethargy with no other identifiable cause; flank pain or costovertebral angle tenderness; acute hematuria; or pelvic discomfort. In patients with spinal cord injury, UTI can present as increased spasticity, autonomic dysreflexia, or a sense of unease. As with all patients with complicated UTIs, it is difficult to make specific antibiotic recommendations, but the IDSA recommends a 7-day course in patients with prompt clinical response (> 48 hours) to antibiotics, and they recommend extending the regimen to 10 to 14 days for a delayed response. Patients with CA-UTI are more often hospitalized and exposed to antibiotics and will have a higher rate of multidrug-resistant species (such as vancomycin-resistant Enterococcus) or extended-spectrum beta-lactamase producers. Selection of empiric antibiotics should be individualized and should take into account prior urine culture results, recent hospitalization, prior antimicrobial exposure, or suspected institutional susceptibilities. Because resistant microorganisms may be acquired by transfer from other patients, urine catheter systems should be carefully disposed of, and hands must be properly washed and decontaminated before and after insertion and management.

Patients With Nephrolithiasis
Patients who have kidney stones associated with UTIs will have a broader range of pathogens as a possible etiology. In contrast to simple UTIs, this subset of patients will more often have infection from Proteus and Pseudomonas species. Diagnosing a UTI in these patients can be difficult due to a wide spectrum of clinical presentations and a variable degree of pyuria. In a single-center prospective observational study with 360 patients, the probability of infection increased as the degree of pyuria increased. Additionally, in a prospective study including 73 patients with a ureteral obstruction, the midstream urine culture was not reliable when the infection was proximal to the stone. Treatment strategies will depend on the severity of illness. Given the potential for significant complications (such as severe sepsis and abscess formation), a more liberal antibiotic strategy seems reasonable. Empiric antibiotics should address the broader range of pathogens. In patients with pyelonephritis who are obstructed, emergent consultation for proximal decompression is necessary. In the sickest subset of patients, one should be attempting to rule out an obstruction because, without a source control strategy, these patients will not get better. On the other hand, nonobstructive stones with concurrent UTI may be treated with outpatient antibiotics and outpatient urologic follow-up, depending on the clinical scenario.

Patients With Diabetes Mellitus/Renal Transplant/Immunosuppression
Patients with complex comorbidities have UTIs with a broad spectrum of pathogens, and they lack host defense mechanisms, making them more susceptible to treatment failure. These patients are also prone to a number of complications. Diabetic patients are more susceptible to acute cystitis and pyelonephritis when compared to their nondiabetic counterparts. This is thought to be secondary to bladder dysfunction from neuropathy. More concerning in diabetic patients is the development of emphysematous pyelonephritis, a fulminant necrotizing infection of the renal parenchyma. This infection will require parenteral antibiotics and surgical intervention for possible nephrectomy.

Renal transplant patients are at risk for graft failure and, like other immunosuppressed patients, they are more susceptible to viral and fungal infections. Treatment in these patients is more complicated for a number of reasons. The potential danger of antibiotics in renal impairment must be considered. Nitrofurantoin is contraindicated in renal insufficiency, and there is a substantial risk of nephrotoxicity with aminoglycosides. There are also important interactions to consider between immunosuppressive agents and antibiotics. Because of these factors
and the broad range of pathogens, there are no published consensus guidelines for these patients. In these complicated cases, it is especially important to send a urine culture in all suspected UTIs, and consider specialist consultation before beginning empiric treatment.

**Controversies And Cutting Edge**

Familial disposition to UTI and pyelonephritis has been documented. This relationship is thought to be secondary to a predisposition to persistent vaginal colonization with *E. coli*. Pedigree studies suggest that more than 1 gene may be involved in the inheritance of UTI susceptibility, and that both maternal and paternal sides of the family can pass this gene. This same study found that although the disease penetrance was higher in females, males also had a higher frequency of pyelonephritis. Based on data from animal models and family pedigrees, low expression of the host defense gene, CXCR1, is thought to be a predisposing factor in the development of acute pyelonephritis. This can become important in the context of pediatric patients, especially those with mechanical defects (such as urinary reflux), as identification may make it possible to decrease the risk of recurrent pyelonephritis and subsequent renal scarring through more intense follow-up and therapy. CXCR1 expression may be quantified after a child’s first episode of febrile UTI (using approaches similar to those used with suspected cystic fibrosis patients) to detect polymorphisms in gene expression. The clinical use of such information needs further research and development and may be purely academic at this point, but as we delve further into personalized medicine, it has the potential to add to the disposition decision-making process for patients who are suspected of having subclinical or early UTI or pyelonephritis in whom you are considering empiric treatment.

**Antibiotic Stewardship Programs**

Antibiotic stewardship programs, far from presenting a barrier to the clinician, have been demonstrated to be a positive tool. They are associated with decreased inappropriate antibiotic use, decreased resistance, decreased complications, improved outcomes, and lower cost of care. Antibiotic stewardship programs take into account local antibiograms and the site of infection to give recommendations for optimal therapy. They can enforce best practices by developing hard-to-override electronic order sets and by referral for peer review. In our view, antibiotic stewardship program recommendations constitute the local standard of care for antibiotic prescribing. Emergency clinicians who practice in a setting with no antibiotic stewardship program are encouraged to institute and/or adopt this tool.

Antibiotic stewardship programs are established to optimize treatment options for overtreated conditions. These programs include recommending types of therapy, dosing regimens, and duration of treatment in an effort to minimize healthcare costs, maximize patient outcome, and limit antibiotic-resistant bacteria strains. Antibiotic stewardship programs exist for asymptomatic bacteriuria, catheter-associated infections, multidrug-resistant gram-negative urinary infections, simple cystitis, and pyelonephritis. These programs focus on the frequency of overtreatment, proper diagnostic modalities, who to screen and who not to screen, and recommendations for management.

Antibiograms demonstrate local resistance patterns and help to guide the practitioner on which antibiotics may be ineffective on their local patient population. However, antibiograms encompass data from both the outpatient and inpatient setting and they may actually overestimate antibiotic resistance. A recent study conducted in New Zealand showed 19% trimethoprim resistance in hospital isolates of *E. coli* but only 11% in the community. Similarly, in Singapore, 46% of hospital isolates of *E. coli* were resistant to TEM-SMX but only 21% from community clinics. This suggests that, although hospital antibiograms are helpful in assessing inpatient antibiotic resistance, they may also overestimate community resistance patterns.

**Additional Resources And Applications**

There are a variety of resources to help the emergency clinician.

1. Android and iPhone applications: CD Antibiotics Pocket, EMRA Antibiotic Guide, and Infectious Disease Compendium. They are available in trial form on Google Play and iTunes app stores. They are easy to access and quick to use, but they lack local data for the emergency clinician’s particular setting.

2. Local antibiograms: This will give the emergency clinician the most up-to-date information on local susceptibility patterns. The most common organisms to consider in UTI are *E. coli*, *Klebsiella*, *Proteus*, and *E. faecalis*.

3. Local antibiotic stewardship programs: A well-designed antibiotic stewardship program gives best-practice recommendations for the local setting and constitutes the local standard of care.

**Timing Of First Dose Of Antibiotic**

There are no studies on the optimal timing of the first dose of antibiotic for UTI. Drawing from the improvements in outcomes associated with protocols for early antibiotics in community-acquired pneumonia and sepsis, it is reasonable to extrapolate that early treatment of UTIs with antibiotics in the ED should also be associated with improved outcomes.
prospective study of 278 infants with UTI demonstrated decreased renal inflammation when antibiotic therapy was instituted within 24 hours of onset of symptoms.\textsuperscript{121} Administering the first dose of antibiotic in the ED prior to discharge has not been compared with administration at home once the patient has picked up the prescription at the pharmacy; however, given the basic principle of bacterial doubling time and the available literature, administration of the first dose in the ED prior to discharge is likely a beneficial and low-risk intervention.

**Obtaining Cultures**

It bears repeating that indications for cultures in an uncomplicated UTI vary in the literature. The general consensus is to obtain cultures if symptoms do not resolve following treatment.\textsuperscript{24,41,42} If the pretest probability is high and a urine dipstick is negative, it is advisable to obtain a urine culture.\textsuperscript{24} It is generally agreed upon in the literature that if a patient is male or considered to have immunosuppression, comorbid conditions, a complicated UTI or pyelonephritis, cultures should be obtained.\textsuperscript{24,41,42} It can be argued that liberally culturing UTIs is best for determining local resistance patterns.

**Disposition**

**When To Admit**

The main indications for hospitalization are intractable nausea or vomiting (ie, inability to tolerate fluids), hemodynamic instability (including severe sepsis/septic shock), and the presence of complications (eg, obstruction, emphysematous pyelonephritis). Other reasons for hospitalization may include the existence of concomitant immunocompromised states (eg, diabetes mellitus, cancer), the presence of indwelling catheters, failure of outpatient therapy, and poor social support (eg, inability to purchase medications or follow up as recommended, or homelessness).\textsuperscript{41} Patients who present with nausea and vomiting who improve with treatment in the ED may be safe to discharge without an inpatient stay.\textsuperscript{122,123} The patient should be immunocompetent and have adequate follow-up.\textsuperscript{124} There is also literature to support a single-dose treatment with intravenous antibiotics prior to discharge.\textsuperscript{125,126} The patient should give a reliable way to be contacted for culture results, if obtained.

Pregnant women with pyelonephritis are generally admitted to the hospital (or observation unit) for intravenous antibiotics, due to the complications that could ensue for the mother and fetus. They can be discharged from the ED selectively when well hydrated, well appearing, tolerating oral intake, and with good follow-up. Oral outpatient therapy has been shown to be safe and effective for the treatment of selected pregnant patients with pyelonephritis.

These studies included initial observation and treatment with parenteral antibiotics; however, no outpatient trials have been done in pregnant patients in whom oral therapy was used alone.

**Criteria For Safe Discharge**

A patient may be safely discharged from the ED provided the patient has/is:

1. Stable vital signs
2. Tolerating oral fluids
3. First time visit for this infection
4. No obstruction to voiding
5. No complication (such as perinephric abscess or sepsis or SIRS)
6. Not pregnant
7. Reliable means for obtaining prescription
8. Reliable follow-up provider or can return to the ED in case of complications

**PredischARGE Checklist**

1. All necessary samples have been obtained
2. Patient is hemodynamically stable
3. Pain is well controlled
4. Patient is tolerating oral fluids
5. Patient has access to obtain medications
6. Patient has given a reliable follow-up contact number
7. Patient has a place to follow up for complications
8. The patient has met the criteria for an uncomplicated UTI or pyelonephritis

**Follow-Up**

The patient should have adequate follow-up to ensure resolution of disease and address any complications. Their primary care physician may also obtain culture results for the patient.

**Summary**

The diagnosis of UTI is relatively simple, but the management of UTI is relatively complex. The cornerstone of therapy is determining whether the patient has a lower UTI or an upper UTI and whether the patient has a complicated or uncomplicated UTI. These 2 factors will determine whether antibiotic therapy is necessary, for how long, and whether cultures are indicated.

Choosing antibiotic therapy is best done using up-to-date and local antibiograms or, when available, the recommendations of the local antibiotic stewardship program. Antibiotic stewardship programs have been shown to be beneficial, and they constitute the best-practice/standard of care for the practice environment. The drug of choice for lower UTI at this time is, generally, nitrofurantoin. Fosfomycin is a very good and well-studied alternative, but it is not widely available in the USA. If
the UTI is uncomplicated and a lower, no cultures are necessary. If the UTI is complicated and lower, then cultures are indicated. Most pyelonephritis cases should have cultures obtained. The oral drugs of choice for pyelonephritis vary from community to community. Gentamicin, in the once-daily dosing, remains highly effective for pyelonephritis in the admitted patient with normal renal function. Second- and third-generation cephalosporins are generally favored over fluoroquinolones. In the case of TMP-SMX allergy and severe penicillin allergy, fluoroquinolones at about a 50% increased dosing may be the only option.

The emergency clinician should be aware that a percentage of patients with pyelonephritis have early sepsis and should be aware of the diagnostic criteria for sepsis from the Surviving Sepsis Campaign. Patients with UTI meeting criteria for sepsis should be considered for admission to rule out progression to sepsis. Sepsis guidelines have become much more inclusive. Under the Surviving Sepsis Campaign, most patients with pyelonephritis meet criteria for early sepsis, at least upon arrival, if they have an elevated heart rate and an elevated temperature. A full discussion of the sepsis guidelines is beyond the scope of this article, and the reader is encouraged the review the 2014 article, "The Surviving Sepsis Campaign Guidelines 2012: Update for Emergency Physicians," in the Annals of Emergency Medicine, by Jones et al. Additional helpful resources for understanding the latest guidelines and for screening include the “Bellevue Severe Sepsis Protocol” and “Sepsis Clinical Guide” mobile device applications to screen for sepsis.

Case Conclusions

The first patient was having vaginal discharge and, given your understanding of the substantial overlap of UTI symptoms and urethritis, you performed a pelvic examination and sent cultures for STIs. You decided to give her an IM dose of ceftriaxone and a subsequent levofloxacin prescription to cover for cystitis and Chlamydia trachomatis.

For your second patient, you were not deterred by her lack of fever or symptoms. She admitted to taking ibuprofen prior to arrival and you recognized her risk for pyelonephritis with concurrent antibiotics. Surprisingly, your bedside ultrasound revealed an acute obstruction in her right kidney. The urologist was impressed by your clinical acumen and she said she would see her for an acute obstruction and pyelonephritis.

For your nursing home patient, your investigation uncovered that he had not had his catheter changed in months. After a thorough physical examination and careful evaluation to rule out other sources for fever, you had the nurse replace the Foley catheter before sending a urinalysis and urine culture. Your workup was consistent with a complicated UTI. You began appropriate broad-spectrum antibiotics and admitted him to the hospital.

In your final patient, you informed her that she was pregnant prior to initiating treatment. She was surprised, even though you weren’t. You told her that you perform a urine pregnancy check in every childbearing-aged women because it changes your treatment plan. You chose an appropriate antibiotic for her, and then you discussed the need for admission with the obstetrician.

References

Evidence-based medicine requires a critical appraisal of the literature based upon study methodology and number of subjects. Not all references are equally robust. The findings of a large, prospective, randomized, and blinded trial should carry more weight than a case report.

To help the reader judge the strength of each reference, pertinent information about the study will be included in bold type following the reference, where available. In addition, the most informative references cited in this paper, as determined by the authors, will be noted by an asterisk (*) next to the number of the reference.

8. Andrade SS, Sader HS, Jones RN, et al. Increased resistance to first-line agents among bacterial pathogens isolated from urinary tract infections in Latin America: time for local guidelines? Mem Inst Oswaldo Cruz. 2006;101(7):741-748. (Laboratory research; 611 samples)
1. “Fever and tachycardia are routine with pyelonephritis, and I only need to screen for sepsis if the patient looks septic.”
   The definition of sepsis has recently been defined much more broadly by the Surviving Sepsis Campaign guidelines. A patient needs only to have a source of infection and 2 of 24 criteria positive to meet the current definition for the diagnosis of sepsis. Fever and tachycardia, which are frequently present in pyelonephritis, qualify the patient as having sepsis by the Surviving Sepsis Campaign guidelines. Nonetheless, in our view, the criteria for sepsis cannot be interpreted to mean that every patient who presents febrile and tachycardic must be admitted. Rather, the presence of fever and tachycardia should serve as a trigger to treat the fever and tachycardia and to consider further workup for the presence of sepsis as a definite process. IV fluids are indicated as well as treatment of the fever. Further laboratory tests (such as a complete blood count, a basic metabolic profile, and a lactate level) can be considered to see if more criteria for sepsis are present. Select patients can be safely sent home on a case-by-case basis; the first dose of parenteral antibiotics prior to discharge and mandatory follow-up in 24 hours is warranted.

2. “I don’t think about also prescribing pain and nausea medications for home.”
   Patients return to the ED for preventable and unpreventable reasons. Unpreventable reasons include new resistance patterns and poor response to appropriate therapy. Preventable reasons include use of an antibiotic with known high resistance in the community, poor patient compliance, and inadequate treatment of pain and nausea. The emergency clinician can reduce the preventable returns by reinforcing the need to take the full course of antibiotics, by prescribing according to local antibiotic stewardship programs and antibiograms, and by prescribing medications for pain and nausea control in addition to antibiotics at discharge.

3. “Her heart rate is still 120 beats/min, but that is just part of having a UTI. She will be fine.”
   A certain percentage of patients will return, even with sepsis, after being appropriately diagnosed and treated. To decrease the risk of bounceback or occult sepsis, emergency clinicians are encouraged to resolve abnormal vital signs before discharge. Pyrexia should be treated. If the tachycardia is associated with dehydration, intravenous fluids should be administered. It should be clear to anyone reviewing the chart that the practitioner searched for and reasonably ruled out the presence of clinical sepsis.

4. “He has a positive urine dipstick, so my work here is complete.”
   When performing a fever workup, it can be tempting to assume a diagnosis of UTI or pelvic inflammatory disease in a patient with a fever and trace or 1+ leukocytes. Particularly in the case of a patient with high fever, abnormal vital signs, or immunosuppression, it is important to consider other possibilities. The emergency clinician should also bear in mind that fever is relatively uncommon in isolated cystitis. Strategies to reduce risk include gathering history and physical examination information to rule out other causes of infection, catheterization of the urinary bladder to obtain a more reliable sample, and running a microscopic urinalysis to confirm the presence of leukocytes and rule out the presence of contamination.

5. “I didn’t know that counted as a complicated UTI”
   UTIs will behave differently in different patients. It is important to consider the host patient as well. Has the patient been recently hospitalized or is the patient immunosuppressed? Does the patient have diabetes mellitus? Conditions that weaken the host should be considered.
6. “I didn’t know appendicitis could cause pyuria.”
   In the case of lower abdominal pain, the presence of trace or 1+ leukocytes can lead to premature closure in the evaluation of abdominal pain. Cystitis characteristically causes pain mostly with urination. Pyelonephritis characteristically presents with fever and flank pain (except in transplant patients where the tenderness will be over the graft site) and not with abdominal pain. When the inflamed appendix is close to the ureter, it can cause sterile pyuria. In patients with lower abdominal pain and trace or 1+ leukocytes on a urine dipstick, the diagnosis of appendicitis should be at least considered, and it should be clearly documented that the right lower quadrant is not tender if no more workup is to be done.

7. “She had lower abdominal pain and pyuria, so I didn't think a pelvic examination was indicated.”
   With pelvic inflammatory disease or tubo-ovarian abscess, irritation of the bladder can also cause sterile pyuria. In women, the diagnosis of pelvic inflammatory disease or tubo-ovarian abscess should always be at least considered when lower abdominal pain and mild or minimal pyuria are present. It is recommended to establish and document that there are no concurrent pelvic symptoms in women with UTI. Pelvic examination may be warranted.

8. “History and physical examination are of diminished value in the modern age.”
   Appendicitis, tubo-ovarian abscess, diverticulitis, nephrolithiasis, spinal epidural abscess, and pelvic inflammatory disease can mimic UTI. The key to picking these mimic cases is not so much in testing as it is in careful questioning and physical examination.

9. “I will not let antibiotic stewardship programs interfere with my practice.”
   Antibiotic stewardship programs and local antibiograms, when present, are a valuable resource and represent the community standard of care. Treating according to a national application or booklet (which lack local antibiogram data or antibiotic stewardship program recommendation) is a second-line choice. In our community, adherence to antibiotic stewardship program recommendations and local antibiogram data have resulted in fewer treatment failures, fewer complications (such as C difficile infection), and, somewhat surprisingly, overall diminished resistance pattern across the board. In our institutions, practitioners who do not prescribe according to antibiotic stewardship program recommendations and do not document a reason for exception are subject to peer review.

10. “I just use the most broad-spectrum antibiotic, so my treatment never fails.”
    It may be tempting to use the “biggest gun,” but it is not always best for the patient. Antibiotics with relatively high anaerobic bactericidal activity (such as amoxicillin clavulanate or levofloxacin) are seldom the first-line choice. By killing commensal organisms, they may increase the risk of C difficile infection. Additionally, antibiotics with extreme range but not a lot of strength in any single area (such as ciprofloxacin) are also considered second-line choices, not just because of resistance patterns, but because their weak activity against such a broad spectrum tends not to be bactericidal but to simply promote increased resistance across the board. Practice environments can be unique, and it is possible for fluoroquinolones to be first-line agents in some communities; it depends on the local antibiogram and the local antibiotic stewardship program recommendations.
Time- and Cost-Effective Strategies

1. The sensitivity and specificity of a urine dipstick for the presence of leukocytes are very close to that of a urinalysis with microanalysis, and it is cheaper and faster. In low-risk scenarios (eg, uncomplicated lower UTI), a positive or negative dipstick can safely be used without recourse to a full urinalysis and microanalysis. In potentially more complicated scenarios, if the dip is equivocal, then it may be best to add a full urinalysis with microanalysis. Local protocols can be a good guide when you are uncertain.

2. Blood cultures have been repeatedly demonstrated to be of little value, except in cases of uncertain focus and in sepsis. In UTI, the emergency clinician has easy access to the body fluid (urine) containing the causative organism in large amounts. The authors could not find any evidence to support routine use of blood cultures in most cases of upper or lower UTI.

3. Except in the case of emphysematous or necrotic type pyelonephritis, UTIs are not associated with renal failure. Chemistry testing (such as basic or complete metabolic panels) is unnecessary for UTI unless the emergency clinician has other reasons to suspect that there is renal dysfunction of electrolyte abnormalities or if screening for sepsis is warranted. Blood counts are not necessary to confirm or rule out the presence of UTI. They are seldom necessary, though they are useful in screening for sepsis, and high and low WBC counts and bandemia are criteria for sepsis.

4. Urine cultures are very useful for the individual patient and for community surveillance of resistance patterns. We encourage their use in all males, in complicated UTI, and in upper UTI. If the local susceptibility patterns are known and in uncomplicated lower UTI in females, they are not necessary unless the treatment fails.

5. Imaging is rarely indicated in adult women with UTI. The course of the female urethra is straight and short, and it is seldom anatomically abnormal. In males, imaging (such as bladder scanning or scrotal ultrasound) may occasionally be necessary in complex or difficult cases. For the most part, urinary retention and UTI are treated with bladder decompression and outpatient imaging. A few scenarios warrant imaging, including patients with signs and symptoms of emphysematous pyelonephritis. Patients with typical signs and symptoms of pyelonephritis but with a paucity of leukocytes will probably also benefit from imaging to rule out the presence of a perinephric abscess or psoas abscess mimicking pyelonephritis.


of Clostridium difficile infection. J Antimicrob Chemother. 2011;66(9):2168-2174. (Retrospective case-control; 349 cases)


CME Questions

1. What is the most common causative organism for uncomplicated UTI?
   a. Klebsiella marcesens
   b. Enterobacter faecalis
   c. Proteus mirabilis
   d. Escherichia coli

2. An 18-year-old male presents with anorexia, lower abdominal pain, and trace leukocytes on urine dipstick. What is your next step?
   a. Nothing further needs to be done. Treat and street for cystitis.
   b. Order a WBC count to establish whether appendicitis is present.
   c. Consider appendicitis, and more history and physical examination is indicated.
   d. Proceed straight to CT abdomen and pelvis.

3. A diabetic female patient who is chronically noncompliant with her medications is diagnosed with a lower UTI. Which of the following is the next best step?
   a. Discharge home on the broadest spectrum antibiotic available.
   b. Discharge home with antibiotic and no further consideration.
   c. Consider that the diabetes may be severe or poorly controlled and, therefore, this may be a complicated UTI and cultures may be indicated.
   d. Prescribe a fluoroquinolone, as they are best class in all communities.

4. Change the sex of the patient in question 1 to male. Which of the following now applies?
   a. Cultures are indicated only because of diabetes.
   b. Cultures are not indicated, because men recover quickly from UTI
   c. Prescribe a fluoroquinolone, as they are best class in all communities.
   d. Cultures are indicated because of the patient’s sex.

5. A patient with flank pain and an obstructing stone has 1+ leukocytes on dip. Which of the following is TRUE?
   a. No further diagnostic maneuvers are indicated.
   b. Further consideration is warranted. This may represent a UTI concurrent with an obstructing stone and possibility of failure, and development of sepsis is increased.
   c. Blood has leukocytes, and when there is hematuria there is also pyuria. Even 3+ leukocytes is not worrisome.
   d. Antibiotics and cultures are indicated; otherwise no further considerations or management is necessary.
6. Nitrofurantoin is:
   a. A tertiary amine
   b. Indicated for pyelonephritis
   c. A good choice in lower UTI
   d. An old, out-of-date drug with no indications

7. You diagnose a patient with a UTI. You pull out your pink antibiotic pocketbook from residency, and it gives you a recommendation. Which of the following is most true?
   a. The recommendations in this book accurately reflect local resistance patterns and the best antibiotics to use.
   b. This is best practice only when no local antibiograms or antibiotic stewardship programs for the local community exist.
   c. A nationally famous person wrote it. It must be true and accurate.
   d. It doesn’t matter if it is 5 years old.
Susceptibility patterns don’t change that fast.

8. Your local antibiotic stewardship program recommends nitrofurantoin as a first-line agent for cystitis. What is the best way to view this recommendation?
   a. Antibiotic stewardship programs have been shown to be of little value.
   b. It is always better to use a pocketbook with national guidelines.
   c. Antibiotic stewardship programs are useful, and their recommendations bear careful consideration.
   d. Only when antibiotic stewardship programs are composed by national experts do their recommendations carry weight.