Urinary Tract Infection In Children: Emergency Department Diagnostics And Interventions

Abstract

Pediatric patients represent a significant portion of patients in the emergency department, and they often present with nonspecific complaints (such as fussiness, decreased oral intake, crying, or fever), which can pose a diagnostic dilemma. One serious cause for these complaints that should be considered is a urinary tract infection. Approximately 7% of fevers in pediatric patients presenting to the ED are caused by a bacterial infection of the normally sterile urinary system, and there is a litany of ways in which a young patient can manifest a urinary tract infection. This review will discuss the epidemiology, natural history, and pathophysiology of urinary tract infections in children. Pertinent history and physical examination findings as well as the diagnostic and treatment modalities will be examined, with the goal of providing updated evidence on the varied options in managing a patient once diagnosed. Controversies in the exact diagnosis of a urinary tract infection as well as a review of novel concepts in the management of this condition will also be presented.

CME Objectives

1. Identify an evidence-based course of investigation in a pediatric patient with likely UTI.
2. Discuss the physical examination and laboratory findings that should guide disposition and mode of therapy.
3. Describe the pertinent signs and symptoms for different pediatric patients with an initial UTI.
4. Apply basic management guidelines in a pediatric patient with an initial UTI.

Prior to beginning this activity, see “Physician CME Information” on the back page.

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Authors

Michael Reinberg, MD
Department of Emergency Medicine, Allegheny General Hospital, Pittsburgh, PA

Brian Rempe, MD
Department of Emergency Medicine, Allegheny General Hospital, Pittsburgh, PA

Steven Bin, MD
Associate Clinical Professor, Division of Pediatric Emergency Medicine, University of California, San Francisco, UCSF Benioff Children’s Hospital, San Francisco, CA

Marie Waterhouse, MD
Assistant Professor of Clin. Pediatrics, USC, Keck School of Medicine, Attending Physician, Children’s Hospital of Los Angeles, Emergency Department, Los Angeles, CA

Peer Reviewers

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Assistant Professor, Director, Undergraduate and Emergency Simulation, Mount Sinai School of Medicine, New York, NY

Mark A. Hostetler, MD
Chief of Pediatric Emergency Medicine, St. Joseph’s Children’s Hospital, Orland Park, IL

Michael Reinberg, MD
Department of Emergency Medicine, Allegheny General Hospital, Pittsburgh, PA

Brian Rempe, MD
Department of Emergency Medicine, Allegheny General Hospital, Pittsburgh, PA

Steven Bin, MD
Associate Clinical Professor, Division of Pediatric Emergency Medicine, University of California, San Francisco, UCSF Benioff Children’s Hospital, San Francisco, CA

Marie Waterhouse, MD
Assistant Professor of Clin. Pediatrics, USC, Keck School of Medicine, Attending Physician, Children’s Hospital of Los Angeles, Emergency Department, Los Angeles, CA

CME Objectives

Upon completion of this article, you should be able to:
1. Describe the pertinent signs and symptoms of different age groups that should increase suspicion of UTI.
2. Identify an evidence-based course of investigation in a pediatric patient with likely UTI.
3. Discuss the physical examination and laboratory findings that should guide disposition and mode of therapy.
4. Apply basic management guidelines in a pediatric patient with an initial UTI.

Prior to beginning this activity, see “Physician CME Information” on the back page.
Case Presentations

Two anxious parents arrive at the ED with an 8-month-old male who has a chief complaint of tactile fever lasting 2 days. They state that he has been drinking less than normal and that his urine has a distinct odor. His parents deny any cough, coryza, vomiting, diarrhea, or rash. He stools daily, and he last moved his bowels a small amount the previous day. The triage vital signs are: temperature, 39.7°C; heart rate, 160 beats/min; respiration, 25 breaths/min; and oxygen saturation, 98%. Physical examination reveals a well-appearing male with moist mucous membranes, no respiratory distress, a mildly distended abdomen, and an uncircumcised penis. Examination of the head, ears, eyes, nose, and throat is normal. A straight-catheterized urine sample is positive for nitrates. You wonder if there are any other tests that should be ordered, and if the child should be admitted. You further question if there are any predisposing factors to UTI that also need to be addressed.

An 18-year-old female presents to the ED complaining of 3 days of lower abdominal discomfort with mild dysuria. Her mother tells the triage nurse she just wants an antibiotic for her daughter’s bladder infection and indicates that they need to get in and out quickly. The teenager is afebrile and has normal vital signs. She takes no medicines except birth control pills and is otherwise healthy. While the mother is asking about the antibiotics, you wonder if history alone is sufficient to diagnose and treat UTI. Should you talk to the patient outside the presence of her mother? Can you just dip her urine and rapidly discharge her?

A 9-week-old child with fever to 40°C presents to the ED with her parents. She is slightly lethargic initially and has dry mucous membranes, but she improves with IV fluids and acetaminophen. She has a cough with scattered rales and wheezing on lung examination. Chest x-rays show mild hyperinflation with some peribronchial cuffing. She is breathing comfortably, but is still not tolerating liquids orally. Rapid RSV test is positive. At this point, you question whether any further testing is required and if the patient can be sent home with close follow-up.

Introduction

A urinary tract infection (UTI) results from bacterial colonization of any part of the genitourinary tract, which is a normally sterile system. UTI is one of the most common infections in children, with a cumulative incidence of 3% to 7% in females and 1% to 2% in males.1,2 UTIs result in > 1.1 million physician visits and 500,000 emergency department (ED) visits per year in the United States, accounting for 0.7% of all physician visits and approximately 7% of febrile presentations in the ED.1,3,4 Before the advent of antimicrobials in the 1930s, febrile UTI carried a 20% mortality rate in children.5 This has greatly decreased with antibiotics, but UTI is still considered a significant source of serious bacterial infections, causing bacteremia in 2% to 4% of cases, and carrying the risk of sepsis.6,7 Historically, there has been concern for significant long-term risks of having a UTI (such as renal scarring and the subsequent development of hypertension, chronic kidney disease, and preeclampsia);8,9,10 however, a more recent systematic review highlighted that, while there is a significant risk of renal scarring (affecting 1 in 7 children), there is a great disparity in evidence demonstrating how often subsequent pathology from the scarring occurs.11 The emergency clinician plays an important role in the diagnosis and management of UTI in children. In this issue, we will discuss key points regarding the diagnosis, treatment, and disposition of pediatric UTIs, issues that may arise under special circumstance, and several new developments in the management of UTIs.

Etiology And Pathophysiology

Urinary tract infection is a very common diagnosis in the pediatric population. Studies have found that 5% to 9% of febrile infants are diagnosed with UTI.4,12,13 More than 500,000 ED visits per year result in the diagnosis of UTI, with approximately 50,000 admissions per year.1,14 The Healthcare Utilization Project found that UTI was implicated in approximately 1.8% of all pediatric admissions, with hospital costs at nearly $4000 per stay.12 A 2007 cohort study of approximately 75,000 patients indicated a cumulative incidence of 4.2% for all children, 3% to 7% for females, and 1% to 2% for males.1 Extrapulating these data to the population of the United States suggests an incidence of

Critical Appraisal Of The Literature

A literature search was performed using the PubMed, OVID, and Cochrane databases. Searches were limited to those studies published in English involving human subjects dating back to 1990. Search terms included: pediatric, urinary tract infection, UTI, pyelonephritis, vesicoureteral reflux, fever, circumcision, and urinalysis. Articles deemed relevant were read, and references within were reviewed. The Cochrane Database of Systematic Reviews was searched for any pertinent systematic reviews or meta-analyses. The American Academy of Pediatrics (AAP) practice parameters and previously published guidelines were also utilized. The Infectious Diseases Society of America has no guidelines regarding pediatric urinary tract infections. The total body of literature included systematic reviews, meta-analyses, randomized controlled trials, prospective trials, retrospective analyses, and case reports. A total of 1286 studies were scrutinized, using abstracts, when available, and then were determined applicable based on their relevance to the scope of this article.
approximately 300,000 to 400,000 new UTIs every year in the pediatric population.\textsuperscript{15}

Factors that have been shown to increase risk for contracting a UTI are female gender, white race, vesicoureteral reflux (grades IV-V), bladder dysfunction, constipation, malnourishment, renal transplant, and history of prior UTI.\textsuperscript{16-19} Caucasian and Hispanic populations have been shown to have a much higher prevalence of UTI, almost double that of African Americans (Ethnicity was reported by parents).\textsuperscript{4,20} An important and increasingly recognized risk factor is an uncircumcised phallus. A meta-analysis of 12 different studies found a combined positive likelihood ratio (LR) of 2.8 for uncircumcised status.\textsuperscript{21} Other less-validated risk factors are the use of super-absorbent diapers, vitamin D supplementation, history of maternal UTI, and idiopathic hypercalciuria.\textsuperscript{22-25}

The pathophysiology of UTIs is a fairly well understood phenomenon in which the normally sterile urinary epithelium is colonized by bacteria. There are 3 pathways through which infection can occur, with the most common being retrograde ascent of gastrointestinal bacteria via the perineum.\textsuperscript{26} The majority of UTIs (81\%-88\%) are caused by Escherichia coli through this route.\textsuperscript{27-29} A second, less common, pathway is via instrumentation, resulting in nosocomial or other flora entering the urinary tract. This is an important consideration in intensive care units, where Candida is the major etiologic agent.\textsuperscript{30,31} Finally, infection of the urinary tract can develop through bacteremia from some other source.

### Differential Diagnosis

The differential diagnoses for a UTI are organized based on the age group of the patient. In any febrile or jaundiced neonate (aged < 28 days), it is important to consider any potential cause of serious bacterial infection, specifically pneumonia, bacteremia, and meningitis. A recent retrospective review of 1 center’s experience with 668 infants with fever without any localizing signs found that 10.8\% did have a serious bacterial infection,\textsuperscript{32} so having a high index of suspicion is necessary for the emergency clinician.

Unfortunately, the presence of an alternate fever-causing illness does not exclude UTI. A prospective multicenter study found that, while febrile infants who tested positive for influenza had a much lower risk of serious bacterial infection, UTI was still found to be a co-pathology 2.4\% of the time.\textsuperscript{33} A diagnosis of influenza only reduced the probability of UTI by half. A similar study by the same designers found that, in 269 febrile infants with respiratory syncytial virus (RSV), UTI was diagnosed 5.2\% of the time (as opposed to 10.1\% of the time in the RSV-negative group of 979 febrile infants).\textsuperscript{34} Other studies have found concomitant UTIs in patients with respiratory infections (eg, bronchiolitis), gastroenteritis, and malnutrition.\textsuperscript{35,36}

In children aged > 2 years (barring uncircumcised status or genitourinary tract abnormalities), the majority of patients with urinary complaints tend to be females. The most important differential diagnosis in females presenting with urinary complaints or abdominal, pelvic, and/or flank pain is a sexually transmitted infection (such as chlamydia or gonorrhea).\textsuperscript{37} In adolescent females, studies have shown that urinary or vaginal symptoms do not differentiate well between UTI and sexually transmitted infection and that concurrent infections are common.\textsuperscript{38} Additionally, the first UTI in an adolescent female can be a sign of the beginning of sexual activity, so extra attention should be given to the possibility of a sexually transmitted infection.\textsuperscript{39} Additional possible diagnoses for a child presenting with lower urinary tract symptoms (such as dysuria, urinary frequency, and change in color or odor of the urine) include chemical cystitis, meatitis, cystitis (eg, bathtub cystitis in females or irritation from clothing in males), vulvitis from a candidal infection, and balanitis.

### Prehospital Care

Prehospital care for UTI is limited, given that the diagnosis would not be made in the prehospital setting. While the diagnosis might be presumed based on history and/or symptomatology, emergency medical services may be called for transport of a febrile infant. However, exclusive of obtaining history and checking vital signs, there is no diagnostic role for emergency medical services personnel in management of a UTI. Children who are hypotensive or appear to be in shock should be resuscitated according to standard procedures. Further discussion of sepsis management is beyond the scope of this article.

### Emergency Department Evaluation

#### Preverbal Infants

**History Of Present Illness**

The history of illness will need to be obtained from the parents or caregiver of the infant. The most likely element in the history of an infant that will be indicative of UTI is fever.\textsuperscript{40,42} Other possible symptoms of UTI include irritability or fussiness, decreased oral intake, vomiting, decreased urine production, urinary incontinence or frequency, diarrhea, and failure to thrive. A 2007 meta-analysis from JAMA used data from 12 studies to create LRs for signs and symptoms of UTI in patients aged 0 to 24 months. The authors found statistically significant positive prognostic indicators in this population to be a temperature > 40°C and suprapubic
tenderness. They found a positive LR of 4 for an infant with a fever lasting > 48 hours with no other potential cause of the fever (eg, otitis media, upper respiratory tract infection, or acute gastroenteritis). Ill appearance had a statistically significant positive LR in infants aged 3 to 24 months, but not in patients aged < 3 months. A multicenter prospective study of 1025 patients aged > 60 days showed an odds ratio of 2.4 per degree Centigrade for maximum temperature above normal for the presence of infection.

Of note, one study found that, in 399 neonates with a chief complaint of fever, 8.4% of those whose fevers were identified by history alone were found to have a bacterial infection, as opposed to 18% of those with documented fevers. Therefore, objective fever is considered a much more significant prognosticator than subjective fever, though a report of fever at home should not be entirely discounted. One commonly overlooked symptom is the presence of crying without an identifiable cause. A retrospective review of 237 crying, afebrile patients aged < 12 months found UTI to be the most common serious bacterial infection (12 patients had a serious bacterial infection; 3 due to UTI), and the authors of the study recommended urine testing in all patients aged < 1 month who present with crying even without fever.

Other important elements of the history include the birth history (prematurity status, complications, and stay in the neonatal intensive care unit), congenital abnormalities, recent illnesses and antibiotic use, and jaundice (in neonates), as all of these influence the likelihood of UTI. A study in Iran evaluated 100 breast-fed infants with jaundice lasting > 2 weeks and no other complaints. After all other causes of jaundice were ruled out and laboratory values were noted to be otherwise normal, 6 patients were found to have UTIs. Other studies have identified UTI as the only diagnosis in 5.5% to 12.5% of otherwise asymptomatic jaundiced infants. Interestingly, a retrospective review found that infants with prolonged (> 1 week) jaundice with UTI are less likely to have a fever and pyuria than nonjaundiced patients, indicating that it is prudent for the emergency clinician to consider UTI in all jaundiced infants.

Of note, a recent prospective cohort study of 331 children aged 1 to 36 months found that malodorous urine (as reported by parents) had an odds ratio of 2.83 for the presence of UTI, and, thus, does increase the probability of UTI in suspected cases but does not definitively diagnose or exclude an infection. Additionally, a large cross-sectional survey found that malodorous urine or gross hematuria, both as reported by the parents, did signify a higher pre-test probability of UTI, as the prevalence in that population was 8.6%, compared to a total prevalence of 3.3%.

### Physical Examination

The physical examination should be thorough, as all causes of fever or irritability must be excluded, if these are the only presenting symptoms, and as infants cannot provide a firsthand report of symptomatology. Vital signs, including pulse oximetry, should be acquired in any febrile child, with attention given to high fever, tachycardia, hypotension, or low oxygen saturation. Conduct a thorough head, ears, eyes, nose, and throat examination to assess the patient for acute otitis media, pharyngitis, or the presence of oral ulcers. Fully expose the chest and abdomen to inspect for any rash, auscultate the chest to detect any adventitious breath sounds, and palpate the abdomen carefully. Because this can be difficult to do in older infants, a supine abdominal examination is best. Care should be taken to elicit suprapubic tenderness, which has a positive LR of 4.4 for UTI. The clinician should assess for costovertebral angle tenderness. This can be difficult to produce in infants; however, this is important, as it may signal an increased likelihood of pyelonephritis. Next, conduct the genital examination, focusing on any rash or excoriation, labial adhesions, and circumcision status. Uncircumcised status, in particular, greatly increases the likelihood of UTI. The prevalence rate for febrile UTI in circumcised and uncircumcised males aged < 3 months is 2.4% and 20.1%, respectively. Additionally, a prospective study that followed 190 infants for 1 year after they had experienced a first febrile UTI found that males with persistent nonretractile prepuces had double the risk of recurrence (34% compared to 17.6%). Of note, recent circumcision, especially ritualistic circumcision, does place the infant at a higher risk for UTI, specifically with non-EC coli bacteria.

### Verbal Patients

#### History Of Present Illness

Older, verbal patients will more often present with specific urinary symptoms (dysuria, frequency, urgency, hematuria, or new-onset incontinence). However, the lack of urinary complaints does not rule out UTI, as symptoms may be vague in many cases (abdominal or back pain, vomiting, or fever). Important elements to glean in the history include duration of symptoms, any vaginal or penile discharge, and gastrointestinal symptoms. Inquire whether the child has any prior history of UTI and, if so, whether he or she is currently taking prophylactic antibiotics. Ask about any recent antibiotic use, history of hospitalization, genitourinary defects or surgeries (including renal transplant), and history of voiding dysfunction or constipation. The probability of a UTI in a circumcised male aged > 2 years is < 1%, so careful attention should be given to other possible diagnoses.
**Physical Examination**

As in the preverbal age group, the physical examination should be thorough and concentrate on other potential causes of fever (such as otitis media, pharyngitis, and upper or lower respiratory tract infection) prior to diagnosing UTI. A complete head, ears, eyes, nose, and throat examination as well as a pulmonary examination should be completed. In older, more cooperative patients, assess for costovertebral angle tenderness, which may be suggestive of renal involvement. Perform a supine examination of the abdomen to assess for suprapubic tenderness as well as to detect constipation or other possible causes of lower abdominal pain (such as appendicitis or hernia). Younger children with fever, full skin exposure to check for rashes is prudent. A genital examination is indicated in younger children who complain of pelvic and/or genital pain and in adolescent or older females for whom a sexually transmitted infection is considered. Signs and symptoms of UTI are noted in Table 1.

**Diagnostic Studies**

**Urinalysis And Urine Culture**

The diagnosis of a UTI is usually accomplished in a stepwise fashion, guided by clinical suspicion. The heretofore gold standard for diagnosis is growth of any organism from a suprapubic aspiration (SPA) or growth of > 50,000 colony-forming units (CFUs)/mL from a sterile-catheterized sample.\(^5\) However, the exact number of CFUs/mL necessary for diagnosis is a topic of debate. A 2005 retrospective review of 952 patients who were symptomatic or had higher pretest probability of UTI (eg, febrile females) found that even < 10,000 CFUs were still highly associated with UTI.\(^5\)

The utility of urine collecting bags is also a topic of debate. One prospective review found that bagged specimens in children who were not toilet-trained (aged < 3 years old) had higher sensitivity, yet lower specificity, than catheterized specimens.\(^5\) In a prospective study of 86 children aged < 4 years who required bladder catheterization, 2 samples per catheterization were collected. The study showed that early urine is more likely to have contaminants and false positives. It is important to collect mid- or late-stream samples even if catheterizing the child.\(^5\) In older, toilet-trained children, obtaining clean mid-stream urine is desirable, and a recent randomized study of 350 toilet-trained children found a significantly higher contamination rate in samples collected without perineal cleansing prior to collection versus samples collected with prior perineal cleansing.\(^5\) In children who are not toilet-trained, a straight-catheterized urine sample should be obtained.

The 2011 AAP guidelines for the management of febrile UTI in infants aged 2 to 24 months recommend a catheter specimen or SPA in the septic patient or when emergent antibiotics are being administered, as a bagged specimen cannot reliably diagnose a UTI.\(^5\) False positive rates are too high to be useful. In less emergent situations, however, a bagged specimen can be used to exclude the presence of UTI. If the bagged specimen were positive for leukocyte esterase (LE) and/or nitrite, or if microscopic analysis of that specimen were positive for leukocytes or bacteria, then a catheter or SPA specimen should be obtained and sent for urinalysis. Only negative bag results are considered reliable, according to the AAP guideline. This test may be useful if the parents are uncomfortable with catheterization or the SPA technique. SPA, while frequently successful (especially with ultrasound guidance), is less often practiced by emergency clinicians, and it is more frequently used when anatomical variations (such as phimosis or labial adhesions) make the catheter difficult or impossible to utilize.

The 2011 AAP guideline also recommends urine testing in stable patients, based on the patient’s risk for developing UTI. For females, white race, age < 12 months, temperature ≥ 39°C, fever for ≥ 2 days, and the absence of an alternate source of infection are all discussed as risk factors. For males, the major risk factor cited is the absence of circumcision. In the uncircumcised febrile infant, the risk of UTI is > 1% even in the absence of any other risk factor. In addi-
tion to noncircumcision, other risk factors for males include nonblack race, fever ≥ 39°C, fever for > 24 hours, and the absence of any other source of infection. Table 2 summaries these risk factors and the probability of UTI based on the number of factors that are present.

A very large British systematic review and economic model from 2006 found that the optimum strategy begins with a urine dipstick.38 The 2 values on the urine test strip useful for diagnosing UTI are nitrites and LE. Many of the Gram-negative pathogens responsible for UTIs have an enzyme that converts nitrate (normally found in the urine) into nitrite. LE is an enzyme found in white blood cells and is, therefore, used as a surrogate marker for urine leukocytosis. According to the study, when using the urine dipstick, if the results of nitrite and LE are concordant, then a UTI is effectively ruled in or out (pooled positive LR is 28.2 and pooled negative LR was 0.2), resulting in a positive predictive value of 84% when both nitrite and LE are positive and a negative predictive value of 95% when both nitrite and LE are negative. In this sense, limiting the testing will limit costs, and further testing is not needed to diagnose the infection. If either nitrite or LE is positive, then microscopy is necessary.59 If the microscopy result is positive for both elevated white blood cell (WBC) count (for most studies in the systematic review, the cut-off point of > 10 WBCs/mm³ was used) and bacteria, the emergency clinician should continue with the assumption that a UTI exists. If both are negative, UTI is excluded. If only one is positive, a diagnostic culture is required to make the diagnosis.58 A large cross-sectional study at the Children’s Hospital of Philadelphia ED found that, from a cost-benefit perspective, the most efficient approach was to begin treatment on all infants aged < 2 years with moderate LE or positive nitrites and to send cultures for laboratory analysis.59 The cost of this method was $3.70 per child (1998 dollars). This is in comparison to the cost of $6.66 per child for an enhanced urinalysis with treatment and only culturing if gram stain was positive or WBCs were > 10/ mm³ (again, in 1998 dollars).60

Another systematic review of 70 articles by Whiting et al supports this conclusion, with a positive LR of 28.2 for UTI when both dipstick tests were positive, 6.1 when just one was positive, and 37 when microscopy yielded a positive result for pyuria (> 10 WBCs/mm³) and bacteriuria (negative LR of 0.11).60 A very large, ED-based, retrospective Chilean study found similar LRs.61 Therefore, we recommend that emergency clinicians should consider starting investigation with dipstick and only obtain urinalysis if there is discordance of the nitrite and LE. However, some clinicians will begin treatment of UTI based solely on a positive nitrite test because of the high specificity of the test. Urine cultures should be sent on any patient who is treated, as the microbiology data will be useful in case of resistance and to guide future antibiotic choices should the patient develop recurrent infections. Table 3 (page 7) shows the sensitivities and specificities as found by the AAP guidelines.

**Hematuria Testing**

Isolated hematuria is a less-studied diagnostic parameter for UTIs, and the aforementioned systematic review by Whiting et al did not recommend utilizing it in a diagnostic algorithm, citing insufficient evidence, low sensitivity, and moderate specificity. In a 2010 cross-sectional study of children aged 1 month to 11 years, 28 of 66 children with UTI had transient microscopic hematuria, compared to 0 of the 52 control patients.62 While this study is quite small, hematuria was found to be specific and, if positive, may heighten a clinician’s suspicion for UTI.

**Complete Blood Count And C-Reactive Protein**

Some ancillary tests may be useful in the management of UTI. A complete blood count provides data on WBC levels. Historically, the WBC count was utilized to assess severity of infection (eg, bacteremia or pyelonephritis); however, the sensitivities for this are somewhat low compared to other biomarkers.63,64 If there is concern for a more serious infection, clinicians may elect to test for serum C-reactive protein.

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**Table 2. Risk Stratification Prior To Testing For Urinary Tract Infection In Febrile Infants**

<table>
<thead>
<tr>
<th>Individual risk factors</th>
<th>Females</th>
<th>Males</th>
</tr>
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<tbody>
<tr>
<td>White race</td>
<td>Age &lt; 12 months</td>
<td>Nonblack race</td>
</tr>
<tr>
<td>Temperature of ≥ 39°C</td>
<td>Fever ≥ 48 hours</td>
<td>Temperature of ≥ 39°C</td>
</tr>
<tr>
<td>Fever ≥ 48 hours</td>
<td>Absence of another source of infection</td>
<td>Fever ≥ 24 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Absence of another source of infection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uncircumcised status*</td>
</tr>
<tr>
<td>UTI probability ≤ 1%</td>
<td>≤ 1 risk factor</td>
<td>≤ 2 risk factors</td>
</tr>
<tr>
<td>UTI probability ≤ 2%</td>
<td>≤ 2 risk factors</td>
<td>≤ 3 risk factors</td>
</tr>
</tbody>
</table>

*Note: Uncircumcised status makes risk > 1% regardless of other factors.
Abbreviation: UTI, urinary tract infection.
(CRP). A retrospective review of 590 Taiwanese children showed that CRP levels of ≥ 66.4 mg/L in patients with > 2 days of fever prior to admission had 71.6% sensitivity and 72.5% specificity for acute pyelonephritis. A Finnish retrospective review analyzing differences in the presentation of patients with UTI with and without bacteremia found that, while there were almost no clinical differences, there was a statistically significant greater CRP level on presentation of bacteremic patients than those who were nonbacteremic (116 mg/L vs 76 mg/L). This testing may be ordered if there is high suspicion of sepsis and/or renal involvement.

**Procalcitonin**

Another biomarker that should be considered when ascertaining severity of UTI is procalcitonin (PCT), which is the prohormone of calcitonin. PCT was first discussed in 1993 as a unique marker for bacterial infection in children. It has since been found useful both in distinguishing viral from bacterial infections and as a marker of severity, specifically indicating renal involvement in UTIs. A 2009 meta-analysis involving 627 children from 10 studies found that elevated PCT (≥ 0.5 ng/mL) is a useful determinant of renal involvement in UTI, with a pooled odds ratio of 14.25 (95% confidence interval [CI], 4.7 to 43.23). Several ED-based studies have found that elevated PCT is a more useful indicator than elevated CRP, WBC, or erythrocyte sedimentation rate in determining renal parenchymal involvement that is confirmed via dimercaptosuccinic acid (DMSA) scintigraphy. It is important to note, however, that the AAP guidelines do not specifically endorse any hematologic investigation in an infant with a suspected or diagnosed UTI, and these tests should be utilized by the clinician’s judgment, especially considering that, at the time of this writing, procalcitonin level is not available in a timely enough fashion in most hospitals to influence clinical decision making.

**Table 3. Sensitivity And Specificity Of Different Urinary Tests For Diagnosis Of Urinary Tract Infections**

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leukocyte esterase</td>
<td>83 (67-94)</td>
<td>78 (64-92)</td>
</tr>
<tr>
<td>Nitrite</td>
<td>53 (15-82)</td>
<td>98 (90-100)</td>
</tr>
<tr>
<td>Leukocyte esterase or nitrite</td>
<td>93 (90-100)</td>
<td>72 (58-91)</td>
</tr>
<tr>
<td>Microscopy, white blood cell</td>
<td>73 (32-100)</td>
<td>81 (45-98)</td>
</tr>
<tr>
<td>Microscopy, bacteria</td>
<td>81 (16-99)</td>
<td>83 (11-100)</td>
</tr>
<tr>
<td>Leukocyte esterase, nitrite,</td>
<td>99.8 (99-100)</td>
<td>70 (60-92)</td>
</tr>
</tbody>
</table>

Additional Testing Based On Clinical Suspicion

There is no definitive diagnostic imaging test that can or should be done in the ED for suspected UTI. While DMSA scintigraphy is the gold standard for determining renal parenchyma inflammation, there is no role in the ED for its use. An abdominal x-ray is a reasonable test if there is clinical suspicion that constipation may be predisposing the patient to a UTI. Importantly, in adolescent females, careful attention must be given to the possibility of a sexually transmitted infection. In these patients, it is necessary to obtain either a cervical swab or a first-catch urine, as opposed to the mid-stream urine collected for UTI diagnosis, as it will contain urethral epithelial cells infected with intracellular chlamydia.

**Treatment**

Emergency department treatment for UTI is centered on preventing complications. Sepsis is one potential complication, though it is quite rare, as patients with UTI represent only 4.1% of pediatric sepsis cases. Current treatment focuses on the prevention of renal scarring and subsequent renal failure, though this is a topic of controversy. Prompt treatment has been considered helpful in the prevention of renal scarring in patients with febrile UTI, as about 60% have pyelonephritis.

Most sources recommend that the choice of antibiotic be based on local susceptibilities. Frequently used medications include cephalosporins, trimethoprim/sulfamethoxazole (Bactrim®, Septra®, Sulfatrim Pediatric®), and amoxicillin/clavulanic acid (Augmentin®). Amoxicillin (Amoxicillin®) has become less effective as resistance to E. coli has risen. Because of poor drug concentrations in the blood and at the kidney level, nitrofurantoin is not effective against bacteria or pyelonephritis. Therefore, its use should be limited to afebrile patients in whom these conditions are less likely.

A 2010 study demonstrated the potential usefulness of urinary nitrite testing in determining antibiotic choice. This retrospective chart review, which involved 173 pediatric patients with UTI, found a 14.4% resistance rate to third-generation cephalosporins with a negative nitrite versus a 1.4% resistance rate when nitrite was present. There were similar results for first-generation cephalosporins, with 8.4% resistance if nitrite was positive versus 22.2% resistance if nitrite was negative. Enterococcus does not convert nitrate to nitrite, making nitrite-negative urine more likely to be infected with this organism. In this study, 79% of cefixime (Suprax®)-resistant organisms were Enterococcus. However, as amoxicillin resistance is rising, it would not necessarily be a viable alternative for Enterococcus. This highlights
the need for knowledge of local resistance patterns.

Previous antibiotic exposure should also be considered when choosing the course of treatment. In 2010, Pascke et al reported on a retrospective cohort study of 533 children with UTI who had been exposed to ampicillin, amoxicillin/clavulanate, trimethoprim/sulfamethoxazole, or a first- or third-generation cephalosporin within the previous 60 days. In 2012, Bocquet et al also supported these findings with a prospective, multicenter study that included 3407 children, the authors found no difference in outcomes between the treatment groups. A 2010 study by Brady et al investigated the necessary length of antibiotic intravenous therapy in patients aged <6 months and admitted with UTI. In this retrospective cohort study, which involved 12,333 infants, the authors determined that whether intravenous antibiotics were administered for greater or less than 3 days had no bearing on the likelihood of treatment failure or of readmission.

Infections in the lower urinary tract may be treated with much shorter courses of antibiotics. The 2007 Cochrane review determined that 2 to 4 days of therapy may be as effective as 7 to 14 days in the setting of a simple UTI. Michael et al evaluated 10 studies involving 652 children with UTI. At 1 to 10 days, as well as at 1 to 15 months after treatment, there was no difference in the incidence of positive urine cultures between those with 2 to 4 days of treatment and those with 7 to 10 days of treatment. Studies included in this review showed no difference in the development of resistant organisms or in the incidence of recurrent UTI.

**Intravenous Versus Oral Therapy**

The AAP guideline recommendation is that the choice of oral or intravenous therapy be based on the child’s appearance as well as practical considerations. Patients who appear well can be treated with oral antibiotics as outpatients, whereas patients who appear ill or who may not be able to tolerate oral medications should be admitted.

The use of oral treatment has been supported by research. In 1999, Hoberman et al reported on a randomized controlled trial involving 306 children aged 1 to 24 months with febrile UTI. The study compared the use of 14 days of oral cefixime to 3 days of intravenous cefotaxime (Claforan) followed by 11 days of oral cefixime. The authors found no difference in outcomes between the treatment groups. A 2007 Cochrane review reported similar results. In 23 studies involving 3407 children, the authors found no difference in the length of fever or in evidence of renal scarring at 6 to 12 months regardless of whether oral or combined intravenous/oral therapy was utilized. The authors reported no difference in outcomes whether treatment began with 3 days of intravenous therapy or consisted only of oral antibiotics. They also compared 7 to 14 days of intravenous therapy to intravenous therapy followed by outpatient oral therapy and found no difference in renal damage.

In 2012, Bocquet et al also supported these findings with a prospective, multicenter study that included 171 children. All patients were aged 1 to 36 months and were being treated for their first episode of pyelonephritis. They all had PCT levels of ≥ 0.5 ng/mL and normal ultrasounds. All patients included in follow-up had a positive scintigraphy within 10 days of the onset of symptoms. Two treatment groups were formed, one receiving 10 days of oral cefixime and the other receiving 4 days of intravenous ceftriaxone followed by 6 days of oral antibiotics. Follow-up scintigraphy showed scarring in 30.8% of the oral treatment group and 27.3% of the intravenous/oral treatment group. The authors also noted no difference in time to apyrexia between the groups. Of note, children were excluded from this study if they were aged <1 month, had any evidence of uropathy on ultrasound, or appeared too ill for discharge or if there was concern that parents might have failed to adhere to the study instructions. All patients had *E. coli* infections. Notably, this study lacked statistical power sufficient to prove noninferiority of oral treatment.

**Length Of Treatment Required**

Febrile UTI should be treated with 7 to 14 days of antibiotics. Shorter courses of antibiotics have been proven to be inferior. However, prolonged (>3 days) courses of intravenous therapy are not usually necessary. A 2010 study by Brady et al investigated the necessary length of antibiotic intravenous therapy in patients aged <6 months and admitted with UTI. In this retrospective cohort study, which involved 12,333 infants, the authors determined that whether intravenous antibiotics were administered for greater or less than 3 days had no bearing on the likelihood of treatment failure or of readmission.

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**Special Populations**

Infants aged <1 month require more aggressive therapy in the setting of febrile UTI. These patients require admission and further sepsis workup. There is a gray area between 1 and 2 months of age regarding whether these patients should be treated similarly to the neonate group or to the infants aged ≥3 months. A 2010 study by Schnadower et al derived a prediction model that could be used to identify infants aged 29 to 60 days with febrile UTI who are at a low risk for adverse outcomes.
Clinical Pathway For Management Of Pediatric Urinary Tract Infection

Abbreviations: CFU, colony-forming unit; UTI, urinary tract infection.


Class Of Evidence Definitions

Each action in the clinical pathway section of Pediatric Emergency Medicine Practice receives a score based on the following definitions.

Class I
- Always acceptable, safe
- Definitely useful
- Proven in both efficacy and effectiveness

Level of Evidence:
- One or more large prospective studies are present (with rare exceptions)
- High-quality meta-analyses
- Study results consistently positive and compelling

Class II
- Safe, acceptable
- Probably useful

Level of Evidence:
- Generally higher levels of evidence
- Non-randomized or retrospective studies: historic, cohort, or case control studies
- Less robust randomized controlled trials
- Results consistently positive

Class III
- May be acceptable
- Possibly useful
- Considered optional or alternative treatments

Level of Evidence:
- Generally lower or intermediate levels of evidence
- Case series, animal studies, consensus panels
- Occasionally positive results

Indeterminate
- Continuing area of research
- No recommendations until further research

Level of Evidence:
- Evidence not available
- Higher studies in progress
- Results inconsistent, contradictory
- Results not compelling

This clinical pathway is intended to supplement, rather than substitute for, professional judgment and may be changed depending upon a patient’s individual needs. Failure to comply with this pathway does not represent a breach of the standard of care.

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patients were studied in a 20-center retrospective review. Children were considered high risk if they were clinically ill or had a “high-risk” medical history (including prior UTI or genitourinary disease or history of prematurity), bandemia of ≥ 1250 cells/ mcL, or an absolute neutrophil count of < 1500 cells/ mcL. Among those who met none of these criteria, adverse events occurred in 51 of 1842 patients. The authors concluded that outpatient treatment may be feasible in these cases. However, we recommend admission in these cases as no formal guideline exists recommending outpatient management at this time.

Renal transplant recipients have a 15% to 33% risk of contracting a UTI. Graft function has been shown to decline at a significantly higher rate in children with recurrent UTIs. Prompt diagnosis and consultation with the transplant service should be sought for these patients.

Controversy And Cutting Edge

Use Of Procalcitonin Testing

In the future, PCT could conceivably be used to determine which patients with febrile UTI have pyelonephritis and, therefore, require testing for vesicoureteral reflux. Mantadakis et al performed a meta-analysis to determine whether or not PCT could be used to predict renal parenchymal involvement in UTI. PCT levels rose in response to serum bacterial endotoxins, more so in more significant infectious processes. Of 10 included studies using a PCT cutoff of 0.5 to 0.6 ng/ mL, 8 showed that these PCT values were associated with renal parenchymal involvement. Use of this marker could allow patients with negative PCT to avoid unnecessary testing for vesicoureteral reflux and potentially undergo shorter courses of antibiotics. Interestingly, in the Bocquet study, 85% of children sent for initial scintigraphy had a positive test, compared to 60.5% to 63.3% of children included in previous studies. The authors of the study attributed this to the use of PCT testing.

Risk Of Significant Renal Damage

D. Newman et al recently called into question the aggressive approach to pediatric UTI that is laid out in the 2011 AAP guidelines. In their 2013 review, the authors questioned the evidence behind a connection between UTI and clinically significant renal damage (such as that causing hypertension or the need for dialysis). In their review of the literature, the authors noted that, while UTI frequently progresses to pyelonephritis, there is little evidence that antibiotic treatment has any effect on renal scarring. They also pointed out that there is little evidence to suggest that pyelonephritis in the pediatric population has any significant effect on the development of clinical renal disease. They noted that studies have not linked a decrease in renal blood flow or a slight decrease in glomerular filtration rate to clinically significant renal disease or hypertension. Thus, D. Newman et al suggested that an observational approach may be more reasonable than aggressive testing.

The effect that antibiotic therapy would have on the progression to renal scarring is also questioned by T. Newman in a commentary on the 2011 AAP guideline. However, he states that the risk of progression to sepsis in the pediatric population in UTI that is left untreated is unknown at this time. In a 2008 study, Hewitt et al reported on 287 children with confirmed pyelonephritis via DMSA scintigraphy. There was no difference noted in scarring in these patients despite whether fever had been present for 1 day or for up to 5 days at the time antibiotics were initiated. This suggests that a delay in antibiotics did not lead to an increased risk of scarring.

The risk of progression to bacteremia and sepsis in untreated UTI is unclear and not likely to be studied prospectively. The connection between UTI and renal dysfunction is still a topic of debate. Antibiotic therapy is utilized to improve the symptoms and shorten the course of the UTI and pyelonephritis. For these reasons, we recommend that emergency clinicians continue to maintain a high degree of suspicion for UTI in the febrile infant. Shaw et al stated that current data is inconclusive with regard to the relationship between childhood UTIs and the risk of renal failure. They recommend utilizing consensus expert opinion at this time to guide management of patients.

This underscores that early diagnosis and treatment of UTI in febrile infants is paramount.

Day Treatment Centers

A relatively new and useful development is ambulatory intravenous treatment at day treatment centers. A 2004 study found that, with a protocol for referral to day treatment centers, 72.9% of 291 patients aged 1 month to 5 years were able to be treated in an outpatient setting with daily intravenous gentamicin, with a success rate of 96.1% (defined as adherence for 96 hours, return to normothermia, and no rehospitalization within 14 days). A 2008 study used a similar protocol in patients aged 30 to 90 days, sending 67 patients to a day treatment center and 51 to be hospitalized. Eight treatment failures were noted in the day treatment center group, most of which were attributed to positive blood cultures with no clinical deterioration. Additionally, day treatment centers have been shown to be useful in ensuring patient and family concordance with antibiotic treatment and reducing costs as compared to inpatient management.
1. “The patient never made urine, so I just empirically treated for UTI.”
It is vital to obtain an appropriate urine specimen, both for diagnosis and for later antibiotic-sensitivity assessment. If the patient has no urine, even on bladder catheterization, then significant dehydration and possibly a more serious infection should be considered.

2. “I prescribed an antibiotic, so I’m not sure why the patient returned with sepsis.”
Not only is it vital to make sure that the patient’s bacterial agent is sensitive to your antibiotic, you must make sure that he or she can actually tolerate oral intake before discharge and has not had difficulty with oral medications in the past.

3. “The patient’s mom didn’t want her child to have an intravenous line, so I thought oral antibiotics were the right choice.”
While it is prudent to minimize trauma and harm to the child, there are certain indications that warrant intravenous antibiotics, including sepsis, inability to tolerate oral intake, evidence of pyelonephritis, and significant dehydration.

4. “I treated the patient with locally-susceptible antibiotics. I don’t know why her condition did not improve.”
While verifying local susceptibilities is important, assessing the patient for risk factors (such as pediatric intensive care unit stay, immunosuppression, renal transplant, recurrent UTIs, or genitourinary deformities) is also necessary in determining the proper pharmacologic agent.

5. “The adolescent girl complained of dysuria and was certain it was a UTI because her mom had recurrent cystitis. I treated it, even though the urinalysis was unremarkable.”
In adolescent females, sexually transmitted diseases must be on the differential for complaints of dysuria, and, in the presence of any uncertainty, a pelvic examination is necessary. Asking the parent to leave the room in order to obtain a more detailed history is always warranted, especially in this age population. It is also not uncommon for urine WBCs or LE to be elevated in a patient with sexually transmitted urethritis or cervicitis.

6. “The patient was afebrile in the ED, so I didn’t consider UTI.”
It is important in pediatric populations to note in the history the patient’s objective or even subjective febrile temperatures before presentation to the ED, especially as the child may have received anti-inflammatory medications prior to arrival. Additionally, it is important to remember that not all UTIs present with fever.

7. “I didn’t check for a UTI because the patient is a boy.”
In male patients aged < 2 years and, especially male patients aged < 6 months, UTI is not uncommon and approaches the prevalence of this condition in females. For male patients aged > 2 years, circumcision status should be sought, as uncircumcised males still have a higher prevalence of UTIs.

8. “The patient’s father didn’t want us to catheterize his newborn baby, so we placed an adhesive bag. When the UA showed bacteria, I treated it.”
In all infants and toddlers who are not toilet-trained, an adhesive bag, regardless of perineal cleansing, is not as specific as a straight catheterization. Contaminated specimens from a bag may result in unnecessary treatment or a missed diagnosis.

9. “The 3-month-old looked great. I can’t believe his dad is threatening to sue because I didn’t admit him.”
New guidelines suggest that infants aged > 2 months who appear well can be sent home on oral antibiotics. Additionally, new studies have shown that patients “on the cusp” can obtain effective treatment in facilities that provide daily ambulatory intravenous antibiotics.

10. “I treated the otherwise healthy girl who had positive nitrites and LE on dipstick with an antibiotic. How would I have known that it was not a sensitive antibiotic?”
While it is acceptable to treat a patient with a strongly positive urine dipstick, sending the urine for a formal culture is recommended to ensure a correct diagnosis and to confirm that the antibiotic choice was appropriate.
Disposition

An important consideration after the diagnosis of a UTI is the disposition of the child. Any neonate (aged < 28 days) with fever and suspicion of a UTI must be admitted for intravenous antibiotics and follow-up on culture results. The AAP Practice Parameter advises admission and parenteral antibiotics for patients aged 2 months to 2 years, if they appear toxic, dehydrated, or unable to tolerate oral intake. 88

A recent, large, multicenter retrospective review found that infants aged 29 to 60 days who did not appear dehydrated, in respiratory distress, or otherwise ill in the ED, and who were without certain risk factors (including prior UTI or genitourinary disease, concomitant illness, congenital disease, or history of prematurity), had a very low rate of adverse effects and bacteremia and could potentially be treated as outpatients. 88 Further research is needed in this area. However, the 2011 AAP guidelines confirm that well-appearing children aged > 60 days can be treated with oral medications as outpatients. 53

Patients managed in an outpatient setting should be advised to seek care within 48 hours if febrile symptoms persist. Though it will likely fall to the pediatrician, the most recent guidelines from the AAP recommend that all patients aged < 2 years with a first febrile UTI be referred for renal/bladder ultrasound, preferably within the first 48 hours. The results should guide further imaging or urologic referral. In children who are not improving or are particularly ill, ultrasound is recommended early to rule out renal abscess or obstructive uropathy. According to the AAP guidelines, ultrasound can be delayed beyond 48 hours as long as the child continues to improve clinically. 53 Renal/bladder ultrasound is also indicated in patients with recurrent febrile UTIs, those who fail to respond to therapy as expected, and those with a family history of renal or bladder disease. 53

Routine voiding cystourethrogram is discouraged by the 2011 AAP guideline. Evidence has shown that patients experiencing vesicoureteral reflux with UTI in the absence of structural abnormalities (such as those detected by ultrasound) do not typically go on to develop chronic kidney disease. Evidence for this is presented in a 2011 study by Salo et al in which they evaluated 366 local patients and reviewed articles involving 1576 patients with chronic kidney disease. According to the authors, all of the patients with recurrent UTIs as a possible cause of kidney failure had structural abnormalities detected by their initial imaging that could have been detected by a previous ultrasound. 89

Summary

UTI is a diagnosis encountered frequently by emergency clinicians, and it carries serious clinical consequences if missed. Clinicians should have a heightened suspicion for UTI in any febrile infant, especially those with high fever, male infants aged < 6 months, uncircumcised males, all female children, or those with recurrent UTI or congenital genitourinary malformations. Obtaining a catheterized urine sample in non-toilet-trained children or midstream urine in toilet-trained children is a vital part of the process, with preliminary analysis by dipstick and then urinalysis and culture as indicated. Other tests that may be helpful in predicting severity are PCT, CRP, and WBC count. Treatment of the patient should be guided by local susceptibilities. The decision to treat as an inpatient or outpatient is guided by how toxic or dehydrated the child appears, the age of the child, and his or her ability to tolerate oral

Time- And Cost-Effective Strategies

1. Obtain a urine dipstick in well-appearing children in whom there is low suspicion of a UTI. If both nitrite and LE are negative, UTI can essentially be ruled out, though a culture should still be sent, as a negative nitrite and LE are not 100% sensitive.

   Risk management caveat: Ensure that you have a well-collected urinary sample and that the child has a low likelihood of genitourinary infection. If the child is toxic, a formal urinalysis should be obtained.

2. If both the nitrite and LE are positive on dipstick testing, a formal urinalysis is not necessary. If the child is nontoxic and tolerates oral intake, treat based on local susceptibilities, and send a formal culture to be followed up in the outpatient setting.

3. Choose intravenous antibiotics only when necessary. There are sufficient data to suggest that, in nontoxic children who can tolerate oral intake, there is no benefit of intravenous over oral antibiotics. Resist pressure from parents to pursue parenteral antibiosis, and explain the utility of oral therapy.

   Risk management caveat: Infants aged < 28 days must receive intravenous treatment, as should those who cannot tolerate oral treatment, appear quite ill, or have other risk factors for serious infection.

4. Ordering appropriate antibiotics according to local guidelines is essential in avoiding undertreatment while also limiting the increase in antibiotic resistance.

5. Appropriate identification of children at risk for UTI can also diminish additional costs incurred when treating the complications of missed UTI.
antibiotics. Prompt follow-up or referral is prudent in diagnosing and preventing recurrent infections or any genitourinary abnormalities. A comparison of the updates to the AAP’s clinical practice guidelines is presented in Table 4 (page 14).

Case Conclusions

You informed the infant’s parents that the likely diagnosis is UTI, based on the presentation and the nitrates in his urine. The infant’s WBC count was 7.2 x 10^6 with 78% neutrophils, and his CRP level was 60 mg/L. Since you had noted abdominal distention on physical examination, you ordered an abdominal x-ray, which revealed moderate fecal loading. The parents were concerned about the risk to their son’s kidneys and asked whether he should be admitted. You related to them that evidence suggests oral antibiotics and home treatment are just as safe and effective as inpatient therapy in the boy’s age group. You administered his first dose of oral antibiotics in the ED and wrote a prescription for ongoing oral antibiotics. You discussed with his parents that constipation can be a predisposing factor to UTI, and they agreed to start treatment with a stool softener after discussion with their pediatrician. The 48-hour follow-up revealed that the urine had grown E coli. The quality assurance nurse called to update the family, and they reported that their son is back to normal, afebrile, and is tolerating the oral antibiotics well. They are appreciative that they did not have to spend the night in the hospital. A few weeks later, renal ultrasound showed no congenital deformities or renal scarring.

When you went back to the room where the teenager was waiting, you asked to speak to her alone, and her mother waited outside. She admitted to being sexually active for the previous 2 weeks with a new boyfriend. A pelvic examination revealed purulent cervical drainage as well as cervical motion tenderness. Her urine dipstick was negative for nitrite and leukocyte esterase. Her HCG was negative. You counseled her on safe sex practices, and you treated her with an appropriate course of doxycycline as well as cervical motion tenderness. Her urine dipstick was negative for nitrite and leukocyte esterase. Her HCG was negative. You counseled her on safe sex practices, and you treated her with an appropriate course of doxycycline. You informed the infant’s parents that the likely diagnosis is UTI, based on the presentation and the nitrates in his urine. The infant’s WBC count was 7.2 x 10^6 with 78% neutrophils, and his CRP level was 60 mg/L. Since you had noted abdominal distention on physical examination, you ordered an abdominal x-ray, which revealed moderate fecal loading. The parents were concerned about the risk to their son’s kidneys and asked whether he should be admitted. You related to them that evidence suggests oral antibiotics and home treatment are just as safe and effective as inpatient therapy in the boy’s age group. You administered his first dose of oral antibiotics in the ED and wrote a prescription for ongoing oral antibiotics. You discussed with his parents that constipation can be a predisposing factor to UTI, and they agreed to start treatment with a stool softener after discussion with their pediatrician. The 48-hour follow-up revealed that the urine had grown E coli. The quality assurance nurse called to update the family, and they reported that their son is back to normal, afebrile, and is tolerating the oral antibiotics well. They are appreciative that they did not have to spend the night in the hospital. A few weeks later, renal ultrasound showed no congenital deformities or renal scarring.

On further evaluation of the other infant, you recalled that the presence of RSV does not exclude UTI. A catheterized specimen was obtained, and the urine dipstick was positive for leukocytes and nitrite. After blood cultures were obtained, you administered intravenous ceftriaxone, as the patient was not tolerating oral intake. The cultures were obtained, you administered intravenous ceftriaxone, as the patient was not tolerating oral intake. The cultures were obtained, you administered intravenous ceftriaxone, as the patient was not tolerating oral intake. The cultures were obtained, you administered intravenous ceftriaxone, as the patient was not tolerating oral intake. The cultures were obtained, you administered intravenous ceftriaxone, as the patient was not tolerating oral intake. The cultures were obtained, you administered intravenous ceftriaxone, as the patient was not tolerating oral intake.

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.


Table 4. Comparison Of Previous And Updated Practice Guidelines From The American Academy Of Pediatrics\textsuperscript{53,88}

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1999 AAP Practice Parameters</th>
<th>2011 AAP Clinical Practice Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approaching the febrile patient</td>
<td>Unexplained fever in patients aged 2 to 24 months:</td>
<td>Unexplained fever in a toxic-appearing infant in whom antibiotic therapy will be administered:</td>
</tr>
<tr>
<td></td>
<td>• Consider UTI.</td>
<td>• Catheterized or SPA urine specimen for urinalysis and culture.</td>
</tr>
<tr>
<td></td>
<td>• Check toxic appearance, clinical dehydration, and toleration of oral intake.</td>
<td>Febrile infant who does not appear to require immediate antibiotic treatment:</td>
</tr>
<tr>
<td>When and how to obtain the sample</td>
<td>Unexplained fever in patients aged 2 to 24 months:</td>
<td>• Assess likelihood of UTI.</td>
</tr>
<tr>
<td></td>
<td>• Catheterization or SPA to obtain a urine sample, if significantly ill as to require antibiotic therapy. A bag specimen cannot be used to diagnose a UTI.</td>
<td>a. Low likelihood: no testing for UTI; only clinical follow-up.</td>
</tr>
<tr>
<td></td>
<td>• 2 options if not significantly ill as to require antibiotic therapy:</td>
<td>b. Not low-risk:</td>
</tr>
<tr>
<td></td>
<td>a. Urine culture using a sample obtained via catheterization or SPA.</td>
<td>1. Urine culture and urinalysis via catheterization or SPA.</td>
</tr>
<tr>
<td></td>
<td>b. UA on a sample obtained by the most convenient way.</td>
<td>2. UA on sample obtained via the most convenient means.</td>
</tr>
<tr>
<td>Diagnosis of UTI</td>
<td>Urine culture is necessary to diagnose a UTI.</td>
<td>To diagnose a UTI, a urine sample acquired from catheterization or SPA should have both the presence of &gt; 50,000 CFUs/mL of a bacteria and pyuria and/or bacteriuria on the UA.</td>
</tr>
<tr>
<td></td>
<td>• If the UA does not suggest a UTI, then the patient can be followed without starting antibiotics, with the knowledge that a negative UA does not definitively exclude a UTI.</td>
<td>• If UTI is unlikely for UTI (negative LE and nitrite), monitor patient without starting antibiotics.</td>
</tr>
<tr>
<td></td>
<td>• If the UA does suggest a UTI, then SPA or catheterization must be done and the sample sent for culture.</td>
<td>• If UA shows likely UTI (positive LE or nitrite test or microscopy positive for leukocytes or bacteria), then SPA or catheterization must be done and the sample sent for culture.</td>
</tr>
<tr>
<td>Treatment of UTI</td>
<td>In patients aged 2 to 24 months with diagnosed or potential UTI, appearing toxic, clinically dehydrated, or intolerant of oral intake:</td>
<td>Oral and parenteral antibiotics have the same efficacy, and the route should be chosen based on clinical and practical concerns.</td>
</tr>
<tr>
<td></td>
<td>• Administer parenteral antibiotics and consider inpatient management.</td>
<td>Antibiotic choice should be based on local sensitivities (if the information is available) and altered based on sensitivity of the cultured pathogen.</td>
</tr>
<tr>
<td></td>
<td>In patients aged 2 to 24 months with UTI diagnosed by culture but who otherwise appear well:</td>
<td>The course of treatment should last between 1 and 2 weeks.</td>
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<td>• Administer parenteral or oral antibiotics.</td>
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<td>Treatment for patients aged 2 to 24 months diagnosed with UTI should entail 1 to 2 weeks of oral antibiotics, even if initial treatment was parenteral.</td>
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<td>Follow-up</td>
<td>In patients aged 2 to 24 months diagnosed with UTI who have had 2 days of antibiotics but have not improved:</td>
<td>Parents and/or guardians of an infant diagnosed with a UTI should be informed to follow up with a practitioner who can evaluate and treat recurrent infections or other future febrile illnesses.</td>
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<td>• Culture repeat urine sample.</td>
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<td>• Reevaluate patient.</td>
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<td>After completing 1 to 2 weeks of antibiotics and showing sterile urine:</td>
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<td>• Patients aged 2 to 24 months should receive either prophylactic or curative doses of antibiotics until follow-up imaging can be completed.</td>
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<td>Follow-up imaging</td>
<td>In patients aged 2 to 24 months diagnosed with UTI who have had 2 days of antibiotics but have not improved:</td>
<td>RBUS should be performed on febrile infants with UTIs.</td>
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<td>• Perform further imaging (including an ultrasound urgently and VCUG or RNC) as soon as conveniently possible.</td>
<td>RBUS should precede VCUG in all cases. VCUG is indicated only if RBUS demonstrates renal scarring, hydronephrosis (or other indications of high-grade reflux), or obstructive uropathy, unless atypical or other complex clinical circumstances dictate so.</td>
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<td>If the patient has improved as expected:</td>
<td>If there is a recurrence of febrile UTI, further evaluation is warranted.</td>
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<td>• Perform an ultrasound and VCUG or RNC as soon as conveniently possible.</td>
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Abbreviations: AAP, American Academy of Pediatrics; CFU, colony-forming unit; LE, leukocyte esterase; NA, not applicable; RBUS, renal and bladder ultrasonography; RNC, radionuclide cystography; SPA, suprapubic aspirate; UA, urinalysis; UTI, urinary tract infection; VCUG, voiding cystourethrography.


Weisz D, Seabrook JA, Lim RK. The presence of urinary nitrates is a significant predictor of pediatric urinary tract infection susceptibility to first- and third-generation cephalosporins. *J Emerg Med.* 2010;39(1):6-12. (Retrospective study; 173 patients)


3. The most sensitive symptom for pediatric urinary tract infection is:
   a. Malodourous urine  b. Back pain
c. Dysuria  d. Fever > 40°C

4. Which of the following is the ideal first option in collecting urine in a 1-year-old male?
   a. Suprapubic aspiration  b. Perineal adhesive bag
c. Collection from a diaper  d. Urethral catheterization

5. Which laboratory value can help confirm clinical suspicion of pyelonephritis?
   a. High leucocyte esterase level on urinalysis  b. Procalcitonin of 0.73 ng/mL
c. CRP of 22 mg/L  d. Increased alanine aminotransferase/aspartate aminotransferase ratio

6. A well-appearing 14-year-old girl presents with complaints of dysuria and mild abdominal pain. In addition to a urinalysis, which other diagnostic modality must be employed?
   a. First-catch urine or cervical swab for gonococcus/chlamydia  b. Kidney, ureter, bladder x-ray
c. Fecal ova/parasite  d. Amylase/lipase

7. Which of the following is not helpful in deciding on antibiotic choice?
   a. Presence or absence of urinary nitrites  b. Previous antibiotic exposure
c. Concomitant upper respiratory tract infection  d. Local antibiotic susceptibilities

8. Which of the following would be an appropriate antibiotic for a febrile 2-year-old patient who otherwise appears well?
   a. Cefdinir  b. Nitrofurantoin
c. Ceftriaxone  d. Amoxicillin

9. A previously healthy 3-year-old girl presents with 3 days of fever and no other complaints. Physical examination confirms a temperature of 39°C. The patient has a nontoxic appearance, and the examination is otherwise nonfocal. Urine dipstick is positive for leukocyte esterase and nitrites. What is the next appropriate step?
   a. Send the urine for formal urinalysis and culture and await results.
b. Check CBC, CRP, and procalcitonin.
c. Discharge the patient home on oral antibiotics based on local susceptibilities.
d. Give 1 dose of intravenous antibiotics and obtain renal ultrasound.
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Pediatric Water Submersion Injuries And Nonfatal Drownings

Water submersion injuries and drowning events are a highly preventable, yet significant, cause of childhood morbidity and mortality in North America and worldwide. Defining the drowning event and identifying at-risk pediatric populations and the pathophysiology of drowning will be discussed in this review. Prehospital and emergency department management, as well as the predictors of outcomes in nonfatal drowning victims, will also be outlined. Special circumstances in pediatric drowning cases, such as hypothermia and cold water drowning and drowning as a result of nonaccidental trauma, will be noted. Finally, a discussion of prevention research in pediatric drowning and a brief look at the global endemic of drowning in low and middle income countries will be presented in an effort to focus on how the tragedy of childhood drowning may be prevented in the future.

Upon completion of this article, you should be able to:
1. Identify specific populations of children at risk for drowning.
2. Describe the pathophysiology of the drowning process.
3. Initiate emergency management of the drowning victim and manage the hypothermic drowning patient.
4. Discuss the predictors of outcomes, and their limitations, when resuscitating the pediatric drowning patient.

Pediatric Inflammatory Bowel Disease: ED Implications And Management

Inflammatory bowel disease (IBD) includes both Crohn disease and ulcerative colitis. Twenty to thirty percent of IBD is diagnosed in childhood. Pediatric-onset IBD differs from adult IBD in disease type, location, progression, and gender preponderance. Extraintestinal manifestations, particularly growth delay, are the predominating presenting feature in childhood IBD.

IBD flares typically require intravenous steroids and inpatient admission. Acute emergencies include toxic megacolon, intestinal obstruction, and intestinal perforation. The use of steroids may also obscure diagnosis of an underlying abdominal emergency by masking signs and symptoms. The emergency clinician must be cognizant of such complications and diagnostic challenges.

Upon completion of this article, you should be able to:
1. Describe the differences between pediatric- and adult-onset inflammatory bowel disease as well as the differences between Crohn disease and ulcerative colitis.
2. Describe emergency department assessment and management of inflammatory bowel disease.
3. Identify and manage complications of inflammatory bowel disease.

Erratum

In the “Pediatric Herpes Simplex Virus Infections: An Evidence-Based Approach To Treatment” article in Pediatric Emergency Medicine Practice, Vol. 11, No. 1, an incorrect cause of chancroid ulcers was listed in the “Differential Diagnosis: Genital Lesions” section. This should have been “Hae-mophilus ducreyi” and not “Haemophilus influenzae.” The correct version of this article appears on our website at www.ebmedicine.net/PEMP. We regret any confusion this may have caused.
Physician CME Information

Date of Original Release: May 1, 2014. Date of most recent review: April 15, 2014. Termination date: May 1, 2017.

Accreditation: EB Medicine is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians. This activity has been planned and implemented in accordance with the Essential Areas and Policies of the ACCME.

Credit Designation: EB Medicine designates this enduring material for a maximum of 48 AMA PRA Category 1 Credits™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

ACEP Accreditation: Pediatric Emergency Medicine Practice is also approved by the American College of Emergency Physicians for 48 hours of ACEP Category 1 credit per annual subscription.

AAP Accreditation: This continuing medical education activity has been reviewed by the American Academy of Pediatrics and is acceptable for a maximum of 48 AAP credits per year. These credits can be applied toward the AAP CME/CPD Award available to Fellows and Candidate Fellows of the American Academy of Pediatrics.

AOA Accreditation: Pediatric Emergency Medicine Practice is eligible for up to 48 American Osteopathic Association Category 2A or 2B credit hours per year.

Needs Assessment: The need for this educational activity was determined by a survey of medical staff, including the editorial board of this publication; review of morbidity and mortality data from the CDC, AHA, NCHS, and ACEP; and evaluation of prior activities for emergency physicians.

Target Audience: This enduring material is designed for emergency medicine physicians, physical assistants, nurse practitioners, and residents.

Goals: Upon completion of this activity, you should be able to: (1) demonstrate medical decision-making based on the strongest clinical evidence; (2) cost-effectively diagnose and treat the most critical ED presentations; and (3) describe the most common medicolegal pitfalls for each topic covered.

Discussion of Investigational Information: As part of the newsletter, faculty may be presenting investigational information about pharmaceutical products that is outside Food and Drug Administration approved labeling. Information presented as part of this activity is intended solely as continuing medical education and is not intended to promote off-label use of any pharmaceutical product.

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