



Urinary Tract Infection Diagnosis and Management



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Urinary Tract Infections in Children

Urinary tract infections (UTIs) are common infections of childhood that may affect any part of the urinary tract, from the urethra to the kidneys. Pediatric UTI can range from simple cystitis to severe febrile infections that, if left untreated, can lead to kidney damage and the many sequelae of chronic kidney disease (CKD). UTIs affect approximately 3 percent of all U.S. children each year and result in up to 1 million office visits annually. During the first year of life, boys are more likely to experience UTI, with uncircumcised boys at 10 times the risk of circumcised boys. After infancy, gender prominence reverses, with 8 percent of all girls and 2 percent of all boys experiencing a UTI during childhood.

General Management Principles

The following guidance will focus on uncomplicated UTIs in otherwise healthy children. Infections in children with underlying renal diseases, anatomic or functional anomalies of the urinary tract, urinary catheters, or immunocompromising conditions/therapies constitute complicated UTIs and must be approached on an individual basis.

The management of suspected UTI in children involves six key steps:

1. Determine whether the pre-test probability of UTI is high enough to warrant testing.
2. Obtain an appropriate urine sample for urinalysis and urine culture (if urinalysis positive or clinical suspicion despite a negative urinalysis).
3. Decide whether empiric antibiotic therapy for presumed UTI is warranted.
4. When empiric therapy is given, prescribe the most appropriate antibiotic for the optimal duration.
5. Follow-up results of the urine culture and susceptibility testing and adjust therapy if needed (i.e. stop or change the antibiotic).
6. Assess and manage risk factors for recurrent UTI and UTI-related morbidity.

Steps 1 and 2 are beyond the scope of these guidelines, except to emphasize that it is essential to obtain an appropriate urine sample for culture given the impact on both the acute and subsequent management of a child with presumed UTI. Catheterization is recommended for urine cultures in pre-toilet trained children. The American Academy of Pediatrics' recommendations allow bagged urine samples for initial urinalysis but NOT for culture due to potential for contamination.¹ Thus, bagged urine samples with either A) positive leukocyte esterase or nitrite test results, or B) presence of white blood cells or bacteria on microscopy require collection of a second urine sample by catheterization or suprapubic aspiration for culture. References 1 and 2 at the end of this document provide additional information regarding UTI diagnosis.

Treatment of UTI in Children

Once the clinician determines that the clinical presentation and urinalysis results are suggestive of an uncomplicated UTI, the decision whether to treat empirically, and if so, with which antibiotic depends on several factors:

1. Does the child have presumed cystitis or pyelonephritis?

The presence of vomiting, flank pain or costovertebral angle tenderness suggests a diagnosis of pyelonephritis and warrants prompt empiric antibiotic therapy. Although the presence of fever is not an absolute indicator of pyelonephritis, approximately 60 percent of children with a febrile UTI have evidence



of pyelonephritis on a DMSA scan.³ Because no routine clinical test adequately distinguishes cystitis from pyelonephritis, we consider all febrile UTIs the equivalent of pyelonephritis for management. A recent study confirmed prior data that delay in initiation of antibiotics for febrile UTIs is associated with increased risk for renal scarring.⁴ In contrast, treatment of children without signs or symptoms of pyelonephritis is less urgent, and the clinician should consider waiting for results of the urine culture to make a definitive diagnosis and provide optimal management.

2. Has the child had prior culture-confirmed UTIs to guide empiric therapy?

Previous urine culture results and susceptibilities may help guide the choice of empiric antibiotic therapy.

3. What are the local susceptibility patterns of typical uropathogens?

The most common UTI pathogen is *E. coli*. Resistance of *E. coli* to commonly prescribed UTI antibiotics is growing. Nearly half are resistant to amoxicillin, and trimethoprim-sulfamethoxazole (TMP-SMX) and ciprofloxacin resistance are on the rise.⁵ Check your local susceptibility patterns.

4. Which antibiotics achieve adequate concentration at the site of infection?

Nitrofurantoin is an excellent antibiotic for cystitis, but it does not achieve adequate concentrations in the bloodstream or in tissues and is not appropriate when pyelonephritis is a concern. The other antibiotics discussed below may be used for both cystitis and pyelonephritis.

5. Which effective antibiotic option has the narrowest spectrum of activity?

Given the rising threat of antimicrobial resistance in the U.S. and across the globe, the importance of antimicrobial stewardship cannot be emphasized enough. Nitrofurantoin, amoxicillin, cephalexin, and TMP-SMX are generally considered narrow-spectrum UTI antibiotics, while amoxicillin-clavulanate, cefdinir, and ciprofloxacin are broad-spectrum antibiotics.

After answering the above questions and reviewing any antibiotic allergies, consider cost, dosing schedule, and tolerability. These factors present competing priorities, and which factor is most important depends on the patient in some cases.

In 2015, Nationwide Children's off-campus urgent care providers initiated a quality improvement project aimed to optimize treatment of uncomplicated cystitis. In a review of urine *E. coli* isolates from Nationwide Children's urgent care patients, resistance to TMP-SMX was 20 percent, while resistance to cefazolin (a surrogate marker in the lab that predicts susceptibility to all oral cephalosporins) and nitrofurantoin were <5 percent. For this reason and considering additional factors discussed above, the following approach to antibiotic choice was developed:

AGE RANGE	SUSPECTED DIAGNOSIS	PREFERRED ANTIBIOTIC	ALTERNATE ANTIBIOTIC
<12 years	Cystitis or pyelonephritis	cephalexin 25 mg/kg/dose TID	cefdinir 14 mg/kg/dose daily
≥12 years	Cystitis	nitrofurantoin macrocrystal/monohydrate 100 mg BID	cephalexin 500 mg BID
≥12 years	Pyelonephritis	cephalexin 500 mg TID	cefdinir 600 mg daily

The preferred antibiotics may be different for populations with different rates of bacterial resistance.

The optimal duration of therapy for UTI is controversial and based on limited data. Single-dose or single-day therapy is inferior to more prolonged (7-14 day) courses.⁶ However, for treatment of cystitis, two meta-analyses showed no statistical differences in treatment failure or reinfection when short courses (3 days in most studies) were compared to long courses (7-14 days).^{6,7} Although controversy persists, 3-5 days for cystitis is often recommended.⁸⁻¹⁰ For pyelonephritis, 7-10 days is likely sufficient.^{1,9-12} An ongoing clinical trial is comparing 5 days to 10 days for UTI in children aged 2 months to 10 years with and without fever; however, the results of this trial are currently unknown.

For follow-up management, adjust the antibiotic therapy as indicated depending on the results of the urine culture and susceptibilities. If the urine culture does not suggest a UTI, stop the antibiotic and consider other diagnoses. Be aware that low colony counts may occur in unusual circumstances.¹³ For children who improve with treatment, test-of-cure urine cultures are NOT routinely recommended after treatment. For children who do not demonstrate improvement in pyelonephritis symptoms after 48-72 hours of appropriate antibiotic therapy, consider obtaining a renal/bladder ultrasound to evaluate for complications such as renal or perirenal abscess.

Risk Factors for Recurrence and Renal Scarring

Finally, clinicians should consider risk factors for UTI recurrence and renal scarring. Recent studies have highlighted bowel/bladder dysfunction (BBD) as a major risk factor for recurrent UTIs.^{4, 14, 15} Primary care physicians can assess for BBD and initiate strategies to manage constipation and voiding dysfunction when present.¹⁶

Recommended imaging studies to identify vesicoureteral reflux or other abnormalities are described in the following consensus statements of the Nationwide Children's Sections of Urology and Nephrology:

1. Children less than 2 months of age with their first febrile UTI should undergo a renal/bladder ultrasound and VCUG.
2. Children between 2 and 24 months of age with their first febrile UTI should undergo a screening renal/bladder ultrasound only.^{1,15} A VCUG may be obtained if there are abnormalities on the ultrasound or on a patient-specific basis.
3. Children >2 years of age with recurrent UTI should undergo a renal/bladder ultrasound.
4. Children with recurrent UTI despite preventive care and a normal renal/bladder ultrasound may benefit from a VCUG.

When to Refer

Consider referral to Pediatric Urology for further evaluation of children with recurrent UTIs, abnormal renal/bladder ultrasound results, or symptoms of voiding dysfunction when not infected (urgency, frequency, enuresis).

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Referrals and Consultations

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