**Definition:** The presence of a pure growth of more than 100,000 colony-forming units (cfu) of bacteria per milliliter of urine in a patient with clinical signs and laboratory values suggestive of UTI (positive urinalysis required). Lower counts of bacteria may be clinically important, especially in boys and specimens obtained by catheterization or suprapubic aspiration. (1,2)

**Pathophysiology:** The disease is usually caused by a bacterial infection. *Escherichia coli* is the most common bacterial species identified. Other common gram negative species include *Klebsiella*, *Proteus*, *Enterobacter*, and *Citrobacter*. Gram positive species include *Staphylococcus saprophyticus* and *Enterococcus*. Pyelonephritis results from bacterial infection of the kidney.

**Inclusion Criteria** (1-3)
- 1 month - 12 years
- Prepubertal children
- First episode of UTI
- Febrile

**Exclusion Criteria** (1-3)
- Afebrile
- Conditions in which immunity may be compromised (e.g., transplant recipient [solid organ or hematopoetic], chronic renal insufficiency/kidney disease)
- Known major genitourinary anomalies
- Toxic-appearing
- Sepsis with shock or meningitis
- PICU or NICU 3/4 admission
- Extended-spectrum beta-lactamase (ESBL) producing bacteria
- Other severe comorbid conditions

**Differential Diagnosis**
- Renal abscess
- Discitis
- Kidney stones
- Trauma
- Sacroiliitis
- Fever
- Vertebral osteomyelitis
- Gastroenteritis
- Appendicitis
- Vaginitis/Urethritis

**Diagnostic Evaluation:** Clinical history, physical examination, and labs are used to diagnose UTI.

**History:** Assess for
- Urinary symptoms (incontinence, lack of proper stream, withholding maneuvers, frequency, urgency, dysuria)
- Previous UTIs
- Vescouretreal reflux (VUR)
- Previous undiagnosed febrile illnesses
- Family history of frequent UTIs, VUR, and other genitourinary abnormalities
- Constipation
- Sexual history

**Physical Examination**
Complete routine vital signs including blood pressure

**Assess for**
- Toxic appearance, irritable
- Fever
- Disinterested in feeding
- Lethargic
- Poor tone (floppy)
- Poor perfusion
- Sluggish capillary refill
- Tachycardia or bradycardia
- Tachypnea or apnea
- Sunken fontanelle
- Dry mucous membranes
- Jaundice
- Vomiting
- Suprapubic tenderness
- Abdominal/Flank tenderness
- Abdominal mass
- Failure to thrive

**Laboratory Tests** (4)
Urinalysis is positive if the sample is positive for leukocyte esterase (LE) or nitrates or microscopy is positive for WBC (≥5 WBCs per high-power field) or bacteria. UTI is unlikely (<0.3%) if the urinalysis is negative.

**Sensitivity and Specificity of Urinalysis Components** (1,5-7)
Consider empiric treatment until culture results are available.

<table>
<thead>
<tr>
<th>Method</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>LR +</th>
<th>LR -</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dipstick</td>
<td>70%</td>
<td>98%</td>
<td>35</td>
<td>0.3</td>
</tr>
<tr>
<td>Dipstick &amp; Micro</td>
<td>80%</td>
<td>64%</td>
<td>2.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Dipstick &amp; Micro</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-1 mos</td>
<td>82%</td>
<td>92%</td>
<td>10</td>
<td>0.2</td>
</tr>
<tr>
<td>&gt;1-3 mos</td>
<td>82%</td>
<td>94%</td>
<td>13</td>
<td>0.07</td>
</tr>
<tr>
<td>Bag LE</td>
<td>76%</td>
<td>84%</td>
<td>4.75</td>
<td>0.29</td>
</tr>
</tbody>
</table>

If nitrates are positive, diagnosis of UTI is very likely.

*LR+: a positive test increases the odds of disease by this factor
*LR-: a negative test decreases the odds of disease by this factor
It is the odds that change, not the probability.

**Positive Urine Culture** (1,3)

<table>
<thead>
<tr>
<th>Method</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catheterization/Suprapubic Aspiration</td>
<td>≥50,000 cfu/mL</td>
</tr>
<tr>
<td>Midstream Clean Catch</td>
<td>≥100,000 cfu/mL</td>
</tr>
</tbody>
</table>

Urine specimens should be processed as expediently as possible. If the specimen is not processed promptly, then it should be refrigerated to prevent the growth of organisms. Urine specimens with ≥3 different colony types above the threshold will not be evaluated.
Critical Points of Evidence

Evidence Supports

- Obtain a urine specimen via transurethral catheterization in non-toilet trained children and via midstream clean catch for toilet trained children. (10-15) – Strong recommendation, moderate quality evidence
- For rapid diagnosis of UTI, utilize LE and nitrite testing. (14,16-23) – Strong recommendation, moderate quality evidence
- Obtain a renal ultrasound (RUS) in children 1-24 months with their first febrile UTI. If RUS is normal, a voiding cystourethrogram (VCUG) is not needed. Consider a RUS based on clinical findings in children >24 months. (24-45) – Strong recommendation, moderate quality evidence
- Administer oral antibiotics (7-14 days total of effective antimicrobial therapy) to toilet trained children and/or children >60 days who are tolerating PO. (46-50) – Strong recommendation, moderate quality evidence
- Administer oral antibiotics (10-14 days total of effective antimicrobial therapy) and consider outpatient management for non-toilet trained children and/or children 31-60 days who meet the following criteria: no elevated inflammatory markers, tolerating PO, well-hydrated, not tachycardic, adequate transportation, ability to follow up with PCP within 24-48 hours. (46-52) – Weak recommendation, low quality evidence
- Utilize short-course IV antibiotics (3-4 days) followed by oral antibiotics (once afebrile and feeding adequately) in children who require admission. Total duration of effective antimicrobial therapy should be 10-14 days for non-toilet trained children and/or children 31-60 days and 7-14 days for toilet trained children or children >60 days. (46-50) – Strong recommendation, low quality evidence
- The health benefits of newborn male circumcision outweigh the risks and that the procedure’s benefits justify access to this procedure for families who choose it (per the AAP’s Circumcision Policy Statement). (53-56) – Strong recommendation, moderate quality evidence

Evidence Against

- Do not routinely administer prophylactic antibiotics to infants/children with their first febrile UTI with a normal renal ultrasound. (57-63) – Strong recommendation, moderate quality evidence
- Do not administer prophylactic antibiotics to infants/children with Grades I-III vesicoureteral reflux. (57-63) – Weak recommendation, moderate quality evidence

Evidence Lacking/Inconclusive

- A positive culture is indicated by >50,000 cfu/mL of a single urinary pathogen from a urine specimen obtained by catheterization or SPA. The cutoff for a clean-catch specimen from a child beyond toilet-training is >100,000 cfu/mL. The diagnosis of UTI requires both a positive culture and a urinalysis suggesting infection. (6-9) – Weak recommendation, very low quality evidence
- No evidence addressing whether the diagnostic accuracy of RUS is affected if taken within two days after UTI diagnosis versus several days after diagnosis.

Condition-Specific Elements of Clinical Management

Urine Specimen for Urinalysis and Culture* (10-15)
- Non-toilet trained children: transurethral catheterization
- Toilet trained children: midstream clean catch

Hydration
- IV fluids if not taking oral fluids adequately.

Imaging Studies (1,24-45)

<table>
<thead>
<tr>
<th>Age</th>
<th>Imaging Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-24 months</td>
<td>Renal ultrasound (RUS) If RUS is normal, a VCUG is not needed.</td>
</tr>
<tr>
<td>&gt;24 months</td>
<td>RUS at discretion of physician based on clinical findings</td>
</tr>
</tbody>
</table>

*VCUG may be performed as soon as fever is decreasing and culture-specific antibiotics are in use. There is no need to perform an additional urinalysis if the patient is on appropriate antibiotics.

Admission Criteria

- Unable to tolerate oral fluids (requires IV fluids for hydration)
- Failed outpatient therapy (requires IV antibiotics)

Inpatient Discharge Criteria

- A decreasing trend in daily maximal temperatures combined with physician discretion
- On culture-specific antibiotics
- Tolerating oral intake

- Patient/Caregiver discharge teaching completed on:
  - Discharge care
  - Signs and symptoms of concern
  - Risk of recurrence
  - Proper perineal care
  - Documentation of scheduled PCP follow-up

Parent Teaching

- Teach parents to recognize symptoms of UTI
- Clearly explain the course of necessary testing and treatment
- Explain strategies to prevent future recurrence (e.g., adequate hydration, frequent voiding, perineal hygiene, completion of antibiotic course)
- Pediatrician follow-up

Consults/Referrals

- Refer to urology if surgical intervention is being considered and/or if child has VUR.
- Refer to nephrology if child has VUR and associated renal insufficiency, hypertension, abnormal serum chemistries, or renal scarring.

Measures
Structure
- Location of radiologic studies (inpatient or outpatient setting)

Process
- Utilization of the order set(s)
- Frequency of completed radiologic studies
- Time frame to complete radiologic studies

**Outcome**
- Use of prophylactic antibiotics with documented reflux
- EC visit within 14 days and reason for visit
- Documented use of prophylactic antibiotics
- Length of stay
- Organisms and their resistance patterns
- Rate of positive/negative RUS, radionuclide cystogram, and VCUG
**Antibiotic Therapy** *(64)*

Consider insurance/Medicaid formulary restrictions

### Empirical Oral Therapy - Outpatient

<table>
<thead>
<tr>
<th>Age &amp; Weight Parameters</th>
<th>Dose and Frequency</th>
<th>TCH Formulary</th>
<th>Cost</th>
</tr>
</thead>
</table>
| **Cefixime** | Infants and children ≤45 kg | 8 mg/kg/dose PO every 24 h *(MAX: 400 mg/DAY)* | No | $$
| | Children >45 kg and adolescents | 400 mg PO every 24 h | | $$
| **Cefdinir** | Children ≥6 months to 12 years | 14 mg/kg/dose PO every 24 h *(MAX: 600 mg/DAY)* | Yes | $$
| | Adolescents | 600 mg PO every 24 h | | $$

### Empirical Parenteral Therapy (IV/IM) - Emergency Center or Inpatient

<table>
<thead>
<tr>
<th>Age &amp; Weight Parameters</th>
<th>Dose and Frequency</th>
<th>TCH Formulary</th>
<th>Cost</th>
</tr>
</thead>
</table>
| **CefTRIAXone** | Infants and children 2-24 months | 50-75 mg/kg/dose IV every 24 h *(MAX: 2 grams/DAY)* | Yes | N/A
| | Children >24 months and adolescents | 50 mg/kg/dose IV every 24 h *(MAX: 2 grams/DAY)* | Yes | N/A
| **CefOTAXime** | Children ≥2 months to 12 years (<50 kg) | 33-75 mg/kg/dose IV every 8 h *(MAX: 2 grams/dose)* | Yes | N/A
| | Adolescents (≥50 kg) | 1-2 grams/dose IV every 8 h *(MAX: 2 grams/dose)* | Yes | N/A
| **Gentamicin*** | Infants, children and adolescents | 2.5 mg/kg/dose IV every 8 h *(MAX: 3 mg/kg/dose not to exceed 120 mg/dose)* | Yes | N/A

*Not typically first-line monotherapy

### Directed Oral Therapy (Based on Lab Results)

<table>
<thead>
<tr>
<th>Age &amp; Weight Parameters</th>
<th>Dose and Frequency</th>
<th>TCH Formulary</th>
<th>Cost</th>
</tr>
</thead>
</table>
| **Cefixime** | Infants and children ≤45 kg | 8 mg/kg/dose PO every 24 h *(MAX: 400 mg/DAY)* | No | $$
| | Children >45 kg and adolescents | 400 mg PO every 24 h | | $$
| **Cefdinir** | Children ≥6 months to 12 years | 14 mg/kg/dose PO every 24 h *(MAX: 600 mg/DAY)* | Yes | $$
| | Adolescents | 600 mg PO every 24 h | | $$
| **Amoxicillin** | Infants and children <40 kg | 13 mg/kg/dose PO every 8 h *(MAX: 500 mg/dose)* | Yes | $\$
| | Children and adolescents ≥40 kg | 500 mg PO every 8 h | | $\$
| **Trimethoprim and Sulfamethoxazole (TMP/SMX)** | Children 2-24 months | 3-6 mg TMP/kg/dose PO every 12 h *(MAX: 160 mg TMP/dose)* | Yes | $
| | Children >24 months and adolescents | 4 mg TMP/kg/dose PO every 12 h *(MAX: 160 mg TMP/dose)* | Yes | $

### Directed Parenteral Therapy (IV) - Inpatient (Based on Micro Results)

<table>
<thead>
<tr>
<th>Age &amp; Weight Parameters</th>
<th>Dose and Frequency</th>
<th>TCH Formulary</th>
<th>Cost</th>
</tr>
</thead>
</table>
| **CefTRIAXone** | Infants and children 2-24 months | 50-75 mg/kg/dose IV every 24 h *(MAX: 2 grams/DAY)* | Yes | N/A
| | Children >24 months and adolescents | 50 mg/kg/dose IV every 24 h *(MAX: 2 grams/DAY)* | Yes | N/A

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Quality and Outcomes Management, Texas Children's Hospital
## CefOTAXime

**NOTE:** Restricted usage to:
- Neonatal patients (defined as ≤44 weeks postmenstrual age OR neonates <1 month of age)
- Patients receiving calcium-containing IV fluids with a single lumen or single IV site
*Use cefTRIAXone as an alternative

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children ≥2 months to 12 years (&lt;50 kg)</td>
<td>33-75 mg/kg/dose IV every 8 h (MAX: 2 grams/dose)</td>
</tr>
<tr>
<td>Adolescents (≥50 kg)</td>
<td>1-2 grams/dose IV every 8 h (MAX: 2 grams/dose)</td>
</tr>
</tbody>
</table>

## Ampicillin

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants and children</td>
<td>25-50 mg/kg/dose IV every 6 h (MAX: 100 mg/kg/dose not to exceed 2 grams/dose or 12 grams/DAY)</td>
</tr>
</tbody>
</table>

## Gentamicin

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants and children</td>
<td>2.5 mg/kg/dose IV every 8 h (MAX: 3 mg/kg/dose not to exceed 120 mg/dose)</td>
</tr>
</tbody>
</table>
References


3. Cincinnati Children's Hospital Medical Center, Health Policy and Clinical Effectiveness Program. (2006). Evidence-based care guideline for children 12 years of age or less with first urinary tract infection.


Clinical Standards Preparation
This clinical standard was prepared by the Evidence-Based Outcomes Center (EBOC) team in collaboration with content experts at Texas Children’s Hospital. Development of this clinical standard supports the TCH Quality and Patient Safety Program initiative to promote clinical standards and outcomes that build a culture of quality and safety within the organization.

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Development Process
This clinical standard was developed using the process outlined in the EBOC Manual. The literature appraisal documents the following steps:

1. Review Preparation
   - PICO questions established
   - Evidence search confirmed with content experts

2. Review of Existing Internal and External Guidelines
   - Cincinnati Children’s First Urinary Tract Infection in Children ≤12 Years; American Academy of Pediatrics’ Urinary Tract Infection: The Diagnosis and Management of Initial UTI in Febrile Infants and Children 2 to 24 Months; National Institute of Health and Clinical Excellence Urinary Tract Infection in Children

3. Literature Review of Relevant Evidence
   - Searched: PubMed, Cochrane Collaboration, CINAHL, Google

4. Critically Analyze the Evidence
   - 13 systematic reviews/meta-analyses, 3 randomized controlled trials, 39 nonrandomized studies

5. Summarize the Evidence
   - Materials used in the development of the guideline, evidence summary, and order sets are maintained in a UTI evidence-based review manual within EBOC.

Evaluating the Quality of the Evidence
Published clinical guidelines were evaluated for this review using the AGREE II criteria. The summary of these guidelines are included in the literature appraisal. AGREE II criteria evaluate Guideline Scope and Purpose, Stakeholder Involvement, Rigor of Development, Clarity and Presentation, Applicability, and Editorial Independence using a 4-point Likert scale. The higher the score, the more comprehensive the guideline.

Recommendations
Practice recommendations were directed by the existing evidence and consensus amongst the content experts. Patient and family preferences were included when possible. The Content Expert Team and EBOC team remain aware of the controversies in the diagnosis/management of first febrile UTI in children. When evidence is lacking, options in care are provided in the clinical standard and the accompanying order sets (if applicable).

Approval Process
Clinical standards are reviewed and approved by hospital committees as deemed appropriate for its intended use. Clinical standards are reviewed as necessary within EBOC at Texas Children’s Hospital. Content Expert Teams are involved with every review and update.

Disclaimer
Practice recommendations are based upon the evidence available at the time the guideline was developed. Clinical standards (guidelines, summaries, or pathways) do not set out the standard of care, and are not intended to be used to dictate a course of care. Each physician/practitioner must use his or her independent judgment in the management of any specific patient and is responsible, in consultation with the patient and/or the patient family, to make the ultimate judgment regarding care.