Clinical pathway for evaluation & treatment of healthy children with possible urinary tract infection (UTI)

Duke Children's

Duke Pediatrics Quality Program
Clinical Pathway Development

Child ≥ 60 days without exclusion criteria presenting with suspected UTI

Assessment of history, physical exam findings, & risk factors

UTI suspected

Collect urine studies

- Order Urine analysis (UA) chemical with reflex to microscopic review **and** Culture, Urine, Restricted Patient Population
- Obtain urine culture and UA via catherization if possible. If not, bag specimen is reasonable for UA.
- If outpatient, order POC UA and consider ordering urine culture based on results

Child ≥ 2 years of age

- Order Culture, Urine Routine with Pyuria Screen (reflexed from UA)
- Separate UA order is *not* required
- Obtain urine via mid-stream clean catch
- If outpatient, order POC UA and consider ordering urine culture based on results

Evaluate UA results

Consider empiric treatment based on UA results

Child 2-23 months of age

- Use UTICalc to help with treatment decision considering risk factors and UA results
- Treat as pyelonephritis

Child ≥ 2 years of age

- Symptomatic **and**
- Leukocyte esterase positive **or**
- Nitrite positive **or**
- >5 WBC/hpf

Exclusion Criteria

- Age < 60 days old
- Known or suspected GU abnormalities
- Pregnancy
- Immunocompromised host
- Septic or toxic appearance (follow sepsis pathway)

Follow Up Recommendations

- Adjust antibiotics to urine culture speciation and susceptibilities, if needed
- Antibiotic dosage may be different for patients with CKD, see CustomID
- For adolescents, consider GC/CT testing
- If first UTI and < 2 years, obtain renal ultrasound during admission, or 3-4 weeks after diagnosis if not done during admission or if admission ultrasound is abnormal
- Referral to urology if second febrile UTI or abnormal renal ultrasound
- Patients should be re-evaluated if not improved after 48h of antibiotics

Signs, symptoms, and risk factors

History & physical exam findings:

- Fever (often only sign in < 24 months)
- Dysuria, frequency, urgency, hematuria
- Abdominal pain, nausea, vomiting
- New incontinence
- Flank or back pain

Risk factors in children 2-23 months:

Use UTICalc to estimate probability of UTI

- History of UTI
- No alternative source of fever
- Temperature > 39°C
- Female or uncircumcised male
- Fever > 2 days
- Age < 12 months

Order sets

- PED Pediatric Urinary Tract Infection/Pyelonephritis Admission

Review admission considerations

- Ill appearing
- Moderate/severe dehydration
- Inability tolerate oral fluids or antibiotics
- Concern for lack of follow up
- Lower threshold for admitting infants < 3 months

DUH outpatient Gram negative, urine source antibiogram

DUH inpatient Gram negative, urine source antibiogram

Inpatient treatment

- Treat based on recommendations below
- Tailor antibiotics to susceptibilities
- Discontinue antibiotics if urine culture is without substantial growth (< 50,000 colonies) or shows growth of mixed flora or common contaminant
- If well appearing and urine culture pending, can discharge & follow-up susceptibilities outpatient
- Transition to oral antibiotics, if applicable, when tolerating PO
- See follow up recommendations

Outpatient treatment

- Treat based on recommendations below
- Review susceptibilities, change antibiotics if indicated
- If urine culture is without substantial growth (< 50,000 colonies), or shows growth of mixed flora or common contaminant: inform family that child did not have a UTI and discontinue antibiotics
- See follow up recommendations

Indication		First-line therapy	Severe allergy to first-line therapy	Duration/Comments
Cystitis *Dysuria, urgency, frequency, or suprapubic pain & UA/culture consistent with UTI*	**Empiric treatment**	**Cephalexin** 50 mg/kg/day PO q12h (max: 500 mg/dose) or **Cefazolin** 50 mg/kg/day IV q8h (max: 6g/day)	**Trimethoprim-sulfamethoxazole** 8 mg TMP/kg/day PO/IV q12h (max: 160 mg TMP/dose = 1 DS tablet)	• 5 days for cephalosporins • 3 days for TMP/SMX
	Alternative for adolescents > 12 years	**Nitrofurantoin** 100 mg/dose PO q12h		• 5 days
	History of UTI due to *Pseudomonas or* multi-drug resistant organism in past 1 year	**Ciprofloxacin** 10 mg/kg/dose PO q12h (max: 750 mg/dose) or **Cefepime** 50 mg/kg/dose IV q8h (max: 2 g/dose)		• 3 days for ciprofloxacin • 5 days for other antibiotics • Consider ID consult
Pyelonephritis *CVA tenderness and fever ≥ 39C with UA/culture consistent with UTI; children < 24 months should be treated as pyelonephritis*	**Empiric treatment**	**Cephalexin** 50 mg/kg/day PO **q8h** (max: 500 mg/dose) or **Cefazolin** 50 mg/kg/day IV q8h (max: 6g/day)	**Trimethoprim-sulfamethoxazole** 8 mg TMP/kg/day PO/IV q12hr (max: 160 mg TMP/dose = 1 DS tablet)	• 7 days total (IV+PO) • Consider longer (up to 14 days) if atypical course or abnormal ultrasound • If ill-appearing & inpatient, can consider ceftriaxone 50 mg/kg/dose
	History of UTI due to *Pseudomonas or* multi-drug resistant organism in past 1 year	**Ciprofloxacin** 10 mg/kg/dose PO q12h (max: 750 mg/dose) or **Cefepime** 50 mg/kg/dose IV q8h (max: 2 g/dose)		• 7 days total (IV+PO) • Consider longer (up to 14 days) if atypical course or abnormal ultrasound • Consider ID consult

Pathway approved by the Duke Pediatrics Quality Program's Standardization and Translation of Evidence in Pediatrics (STEP) Committee, Pediatric Antimicrobial Stewardship and Evaluation Team (ASET), and Children's P&T.
 Last revised: 12-01-2025

Duke Pediatrics Urinary Tract Infection (UTI) Clinical Pathway

Definition: Urinary tract infection (UTI) is a bacterial infection affecting the urinary tract.

Epidemiology: UTIs account for nearly 1% of office visits and 5-14% of pediatric Emergency Department (ED) visits (Shaikh et al., 2008). In the first year of life, UTI is more common in boys (3.7%) compared to 2% in girls (Mattoo et al., 2021). A child's age, toilet training status, sex, bowel or bladder function (i.e. spina bifida, congenital anomalies of the genitourinary tract, constipation) are all risk factors for UTI. In older children, diabetes and sexual activity are additional risk factors.

Etiology: UTI is caused when colonic bacteria creates infection that ascends from from the urethra to the urinary tract. Pyelonephritis occurs when the infection and inflammation ascend to the kidneys rather than being contained in the bladder (cystitis). In otherwise healthy children, the most common etiological pathogen is *Escherichia coli* (85-95% of cases) (Mattoo et al., 2021; Chakupurakal et al., 2010; Bell et al., 2009). Infections caused by *Klebsiella*, *Proteus* (more common with stone formation), *Enterococcus spp.*, and *Enterobacter spp*. are less common (Mattoo et al., 2021). Atypical organisms include *Pseudomonas spp*., group B *Streptococcus*, and *Staphylococcus aureus* and these organisms are often associated with congenital anomalies, recent genitourinary (GU) surgery, or indwelling catheters (Mattoo et al., 2021).

Inclusion Criteria: Otherwise healthy children ≥60 days to 18 years old with suspected/proven UTI managed in the outpatient, emergency department, inpatient, or intensive care settings.

Exclusion Criteria

- Children < 60 days old
- Known or suspected GU abnormalities
- Pregnancy
- Immunocompromised host
- Septic shock or toxic appearance (follow sepsis pathway)

Differential Diagnosis: Sexually transmitted disease, pelvic inflammatory disease, kidney stone, interstitial cystitis, vaginitis, candidiasis, medication side effects, and other uncommon infections of the urinary tract

Diagnostic Evaluation

History and Physical Examination: The clinical diagnosis of urinary tract infection requires historical and/or physical evidence of acute infection that can vary based on age and specific site of infection. Younger children also have notable risk factors that should be taken into consideration. The UTICalc tool should be used to help determine risk of UTI in children 2-23 months of age.

Symptoms can include:

- Fever (often only sign in < 24 months)
- Dysuria, increased frequency, urgency, hematuria
- Abdominal pain, nausea, vomiting
- New incontinence
- Flank or back pain

Pathway approved by the Duke Pediatrics Quality Program's Standardization and Translation of Evidence in Pediatrics (STEP) Committee.
This guideline is not intended as a substitute for independent professional medical assessment, diagnosis, and treatment. November 12, 2025

Laboratory Tests and Imaging:

- Recommended orders for urine testing at Duke varies based on age:
  - For children 2-23 months of age: order Urine analysis (UA) chemical with reflex to microscopic review **AND** Culture, Urine, Restricted Patient Population. These patients will receive a UA and a urine culture.
  - For children ≥24 months of age: order Culture, Urine Routine with Pyuria Screen (reflexed from UA). A separate UA is not required for these patients. If the UA shows >5 WBC/hpf, a urine culture will automatically be added.
  - If outpatient: reasonable to order Point of Care (POC) UA and obtain urine culture based on results of POC UA
- Urine specimens should be obtained via straight catheterization in children 2-23 months of age when possible. If this is not possible, a bag specimen is reasonable for UA.
- Urine specimens should be obtained via mid-stream clean cath for children ≥24 months of age.
- First febrile UTI <2 years old requires a renal ultrasound to be performed during admission or 3-4 weeks after diagnosis

Critical Points of Evidence

Evidence Supports

- Urine collection methods affect diagnostic accuracy. Straight catheterization is preferred for urine culture in diapered children (AAP, 2011; Shaikh et al., 2010).
- Prompt diagnosis and treatment of febrile UTI to reduce risk of renal scarring (AAP, 2011; Craig et al., 2015).
- Renal and bladder ultrasound (RBUS) is recommended after first febrile UTI (AAP, 2011).[6]
- Voiding cystourethrogram (VCUG) is reserved for abnormal RBUS or recurrent febrile UTI (AAP, 2011).
- Antibiotic prophylaxis reduces recurrent UTI risk in children with high-grade vesicoureteral reflux (VUR) (RIVUR Trial Investigators, 2014).
- Absence of leukocyte esterase and pyuria has a high negative predictive value (NPV) for significant bacteriuria. Combined UA parameters did not perform better than pyuria alone with regard to NPV. The high NPV ≥0.90 of pyuria was maintained among most patient subgroups including in younger patients (Advani et al., 2023).
- A positive test for nitrite can indicate presence of gram-negative bacteriuria, but it does not diagnose UTI in the absence of symptoms. Similarly, a negative test for nitrite does not rule out UTI, as some urinary pathogens like Enterococcus do not produce nitrite (Advani et al., 2021). Four studies (Alghounaim et al., 2021; Kim et al., 2018; Liang et al., 2021; 3129-Prah et al., 2019) measured the PPV of nitrites to identify a UTI (n = 2610). The overall PPV for nitrites to diagnose a UTI was 84% with a NPV of 89%.
- It is reasonable to treat for UTI if urine analysis shows positive leukocyte esterase (LE), nitrites, or pyuria. Three studies (Alghounaim et al., 2021; Chaudhari et al., 2017; Nadeem et al., 2021) measured the PPV of LE and nitrites to identify a UTI (n = 39,316). The overall PPV for LE and nitrites to diagnose a UTI was 93% with a NPV of 94%.
- Evidence suggests the use of an antibiotic with a narrower spectrum, such as first-generation cephalosporin, is as effective (Daley et al., 2020; Poole et al., 2020).
- While treatment duration of 7 to 14 days for UTI was previously recommended (Roberts, 2011), shorter durations are often appropriate. Shorter duration of narrower agents may decrease the risk of adverse medication effects and antimicrobial resistance while also decreasing healthcare costs (Fox et al., 2020).

Evidence Lacking/Inconclusive

- Effectiveness of antibiotic prophylaxis for preventing UTI in children without VUR or with low-grade VUR (Craig et al., 2009).
- Long-term outcomes of low-grade VUR without prophylaxis (Peters et al., 2008).
- Best urine collection method for non-toilet-trained children to balance invasiveness and contamination risk (Westwood et al. 2015).

Evidence Against

- Routine use of VCUG after first febrile UTI regardless of ultrasound findings (AAP, 2011).
- Routine antibiotic prophylaxis in all children after first UTI (AAP, 2011).
- Use of bag urine specimens for urine culture diagnosis (Shaikh et al., 2010).
- Treating asymptomatic bacteriuria (Advani, 2021; Nicolle, 2003).

Condition-Specific Elements of Clinical Management

Treatment Recommendations

Indication		First-line therapy	Severe allergy to first-line therapy	Duration/Comments
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	Alternative for adolescents > 12 years	**Nitrofurantoin** 100 mg/dose PO q12h		• 5 days
	History of UTI due to *Pseudomonas or* multi-drug resistant organism in past 1 year	**Ciprofloxacin** 10 mg/kg/dose PO q12h (max: 750 mg/dose) or **Cefepime** 50 mg/kg/dose IV q8h (max: 2 g/dose)		• 3 days for ciprofloxacin • 5 days for other antibiotics • Consider ID consult
Pyelonephritis *CVA tenderness and fever ≥ 39C with UA/culture consistent with UTI; children < 24 months should be treated as pyelonephritis*	**Empiric treatment**	**Cephalexin** 50 mg/kg/day PO q8h (max: 500 mg/dose) or **Cefazolin** 50 mg/kg/day IV q8h (max: 6g/day)	**Trimethoprim-sulfamethoxazole** 8 mg TMP/kg/day PO/IV q12hr (max: 160 mg TMP/dose = 1 DS tablet)	• 7 days total (IV+PO) • Consider longer (up to 14 days) if atypical course or abnormal ultrasound • If ill-appearing & inpatient, can consider ceftriaxone 50 mg/kg/dose
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Admission Criteria

- Ill-appearing
- Moderate/severe dehydration
- Inability to tolerate oral fluids or antibiotics
- Concern for lack of follow up
- Lower threshold for admitting infants < 3 months of age

Consults and Referrals

- Pediatric Urology: Second febrile UTI or abnormal renal ultrasound
- Pediatric Nephrology: UTI/pyelonephritis with concern for chronic kidney disease
- Pediatric infectious diseases: UTI/pyelonephritis without improvement on antibiotics, concern for abscess, or resistant organism on culture

Infection Control: Transmission based precautions are recommended. Please see policy. Contact isolation is required for patients with infection caused by an multi-drug resistant organism.

Discharge Criteria:

- Tolerating oral antibiotic
- If urine culture is positive, the patient is on an appropriate antibiotic.
- If urine culture is negative, antibiotics are discontinued.
- If urine culture is pending and patient is well appearing, patient can be discharged with empiric antibiotic while urine culture susceptibilities result.

Follow up Care:

- Consider follow up with PCP at end of antibiotic therapy
- If indicated, follow up with appropriate specialties as seen during admission.
- If indicated, renal ultrasound 3-4 weeks after diagnosis (for those with first febrile UTI <2 years old) if renal ultrasound was not obtained during admission or if admission renal ultrasound is abnormal.

Measures:

- Utilization of the UTI clinical pathway
- Antibiotic utilization including narrow-spectrum antibiotic use concordant with the clinical pathway
- Antibiotic duration concordant with the clinical pathway
- Length of stay for UTI/pyelonephritis – emergency department and inpatient
- Appropriateness of urine studies ordered

Maestro Care Tools: PED Pediatric Urinary Tract Infection/Pyelonephritis Admission

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Pathway Preparation

This pathway was prepared by the Duke Pediatrics STEP Committee in collaboration with content experts at Duke Children's Hospital and faculty members in the Duke University School of Medicine. Development of these evidence-based care clinical pathways promote the mission of providing high quality care within the organization

Development Process

This pathway was developed using the process outlined in the Duke Pediatrics STEP Committee 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/Pathways
3. Literature Review of Relevant Evidence
4. Critically Analyze the Evidence
5. Summarize the Evidence
- Materials used in the development of the guideline/pathway, evidence summary, and order sets are maintained by the Duke Pediatrics STEP Committee

Evaluating the Quality of Evidence

This pathway specifically summarizes the evidence *in support of or against* specific interventions and identifies where evidence is *lacking/inconclusive*. The following categories describe how research findings provide support for treatment interventions. *"Evidence Supports"* the pathway provides clear evidence from well-designed randomized controlled trial(s) (RCT[s]) that the benefits of the intervention exceed harm.

"Evidence Against" provides clear evidence from more than one well done RCT that the intervention is likely to be ineffective or that it is harmful.

"Evidence Lacking/Inconclusive" indicates there is currently insufficient data or inadequate data to support or refute a specific intervention.

Recommendations

Practice recommendations were directed by the existing evidence and consensus amongst the content experts. Patient and family preferences were included when possible. The STEP Committee remains aware of the controversies in the clinical management of patients. 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 STEP Committee as deemed appropriate for its intended use. Content experts are involved with every review and update.

Disclaimer

Practice recommendations are based upon the evidence available at the time the clinical standard was developed. Clinical standards 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's family, to make the ultimate judgment regarding care.

Clinical Pathway Authors and Role

Contact the lead for questions or feedback related to this pathway. Ganga Moorthy, MD (co-lead, Pediatric Infectious Diseases), Brandi Holthaus, MD (co-lead, Pediatric Infectious Diseases), Rachel O'Brian, MD (co-lead, Pediatric Emergency Medicine), Dana Clifton, MD (Pediatric Hospital Medicine), Katherine Stein, PharmD (Pediatric Pharmacy), Leeann Williamson, PharmD (Pediatric Pharmacy), Ibukun Kalu, MD (Pediatric Infectious Diseases & Infection Prevention), May Slowik, MD (Pediatric Primary Care), Melissa Wells, RN (Pediatric Nursing), Annabelle Chua, MD (Pediatric Nephrology), Samantha Eaker, NP (Pediatric Urology)

Version History

Date	Comments
May 2020	Original pathway developed
October 2025	Formatted using STEP template and updated with current data