Antimicrobial Stewardship Guidelines

Guidelines for the Evaluation and Management of Urinary Tract Infections

This guideline was developed by the following multidisciplinary group:

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I. Diagnosis

Basic Principles

- Urinalysis (UA) and urine culture should be obtained prior to administration of antibiotics in children with signs and symptoms of urinary tract infection (UTI), including:
  - Dysuria
  - Urinary urgency or frequency
  - Suprapubic pain
  - Costovertebral angle tenderness
  - Fever and emesis
  - Fever without a source, especially in children under 2 years of age
- Foul-smelling or cloudy urine has poor correlation with UTI and is not an indication to obtain UA or urine culture in the absence of other symptoms of UTI
- Urine cultures should not be routinely sent from asymptomatic patients with indwelling urinary catheters. Over time, urinary catheters become colonized with microbes. Positive urine cultures obtained from indwelling urinary catheters should be interpreted with caution. In patients who practice daily clean intermittent catheterization, new pain during catheterization should raise suspicion for UTI.

Urine Sample

- ≤24 months or not toilet trained: catheterized specimen or suprapubic (SP) tap
  - A bagged urine sample or bladder massage sample may be used for a screening UA, but if the UA is abnormal, a catheterized or SP sample should be sent for repeat culture. A bagged urine sample or bladder massage sample should not be sent for culture or used to diagnose a UTI.
- >24 months **and** toilet-trained: clean voided specimen

*****Please accurately denote in the order how the sample is obtained (i.e. catheterized, SP, bladder massage, bagged sample)**

Testing Approach

The preferred test for patients >2 months old with suspected UTI is **urinalysis reflex to microscopic and culture.**

- Designated urine collection kits (Figure 1) should be used. Kits include a collection container and two tubes:
  - Urinalysis tube—vacutainer with yellow top
  - Urine culture tube—gray-top tube with boric acid preservative
- If UA result meets criteria outlined in algorithm in Figure 1, urine culture is automatically performed (reflex)
  - The culture tube is held by the lab for 48 hours. A clinician can request that culture be performed if indicated despite a negative UA by 1) placing a separate order for urine culture with frequency “add-on” in Epic AND 2) calling the laboratory at 314-454-4268 to notify them of the request.

For infants ≤2 months old, order **urinalysis reflex to microscopic** and a separate **urine culture.**

- This recommendation is based on the unclear sensitivity of UA to detect UTI in neonates as well as possibility of inadequate volume of urine to fill both tubes for the reflex order.

For neutropenic patients, order **urinalysis reflex to microscopic and culture**.

- The lab automatically screens patients for neutropenia using recent CBC results. In patients with ANC < 0.5 K/cumm, the reflex to culture is not reliant on the presence of pyuria (see Figure 1 and Table 1).

Figure 1. Urinalysis reflex to culture test kit (left) and algorithm for urinalysis reflex orders (right)

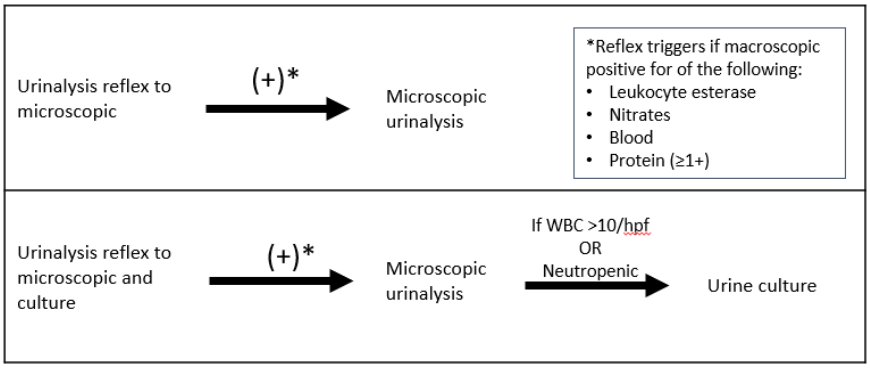

Table 1. Recommended Testing Approach for Suspected Urinary Tract Infections in Children

Population	Recommended Test
All patients ≤2 months old	Separate orders: 1) urinalysis reflex to microscopic AND 2) urine culture
EU patients to be discharged home	Urinalysis reflex to microscopic and culture +/- POCT/dipstick urinalysis
EU patients to be admitted and inpatients	Urinalysis reflex to microscopic and culture
Neutropenic patients	Urinalysis reflex to microscopic and culture (with reflex if ANC<0.5 K/cumm if pyuria is not present)

Definition

- The diagnosis of UTI is based on clinical symptoms of UTI **and** urinalysis results suggestive of infection (pyuria) **and** the presence of ≥100,000 CFU/mL (or ≥50,000 CFU/mL in children ≤24 months) of a uropathogen in an appropriately collected urine culture
  - Nitrites and leukocyte esterase alone are inadequately sensitive and specific to diagnose UTI
  - Absence of pyuria is rare in UTI; combination of positive culture and no pyuria most often indicates asymptomatic bacteriuria
  - Urine culture methods are insufficiently precise to distinguish colony counts between 50,000 CFU/mL and 100,000 CFU/mL. For children 2-24 months of age with reported colony counts of 10,000-100,000 CFU/mL, providers should base treatment decisions on clinical suspicion and urinalysis results.
- In the EU, treatment decisions may be based on results of macroscopic urinalysis or POCT UA to facilitate timely discharge. Consider treatment if ≥ small/1+ leukocyte esterase or positive nitrite on UA. If subsequent microscopic urinalysis or culture results are not consistent with UTI, prescribed antibiotics should be discontinued.
- For patients who are not critically ill, clinicians should wait for results of microscopic UA before treating for UTI
  - If antibiotics were started for suspected UTI and microscopic urinalysis does not show pyuria (>10 WBCs/hpf) or culture is not consistent with UTI, antibiotics should be discontinued
  - Consider alternative etiologies for positive macroscopic UA

- The following are uncommon uropathogens:
  - *Staphylococcus aureus*: Unlikely to cause isolated UTI. Obtain blood cultures to evaluate for bacteremia.
  - *Candida* spp: *Candida* recovered in urine culture (candiduria) usually represents colonization and does not require treatment. Urinary catheter removal can resolve candiduria. Treatment may be warranted in symptomatic patients, especially those who are neutropenic or undergoing a urologic procedure.

II. Management

General Principles

- For patients with prior UTIs, previous culture results should be reviewed to assist with selection of empiric therapy
- In patients who can tolerate enteral therapy, intravenous (IV) antibiotics are not required for empiric treatment
- If treatment is initiated with IV therapy, the regimen should be converted to oral (PO) therapy as soon as patients show clinical improvement and can tolerate and absorb enteral antibiotics
  - A short duration of bacteremia associated with UTI does not preclude conversion to PO therapy once there is clinical improvement
- Empiric treatment recommendations (Table 2) and dosing (Table 3) are below. Once culture and susceptibility results are available, antibiotics should be tailored (or stopped if urine culture results are not consistent with infection).

Special Populations and Clinical Considerations

- Neonates: The sensitivity of abnormal UA for diagnosis of UTI in infants under 2 months of age is less clear. Clinicians may consider treating positive urine cultures in the absence of pyuria if clinical suspicion for UTI is high.
- Immunocompromised
  - Renal transplant recipients: Screening for and treatment of asymptomatic bacteriuria is not recommended.
  - Neutropenic patients: May not exhibit pyuria on UA. Urine culture is necessary to diagnose UTI. Order **Urinalysis reflex to microscopic and culture** as you would for other patients. The lab automatically screens patients for neutropenia using recent CBC results. In patients with ANC < 0.5 K/cumm, the reflex to culture is not reliant on the presence of pyuria (see Figure 1 and Table 1).
- Spinal cord injury: Routine screening for and treatment of asymptomatic bacteriuria is not recommended.
  - Increased spasticity or autonomic dysreflexia, without alternative etiology, could suggest UTI.
- Pregnancy: Asymptomatic bacteriuria during pregnancy should be treated as cystitis.
  - Preferred therapies during pregnancy are cephalexin, amoxicillin, and amoxicillin-clavulanic acid. Fluoroquinolones and tetracyclines are not recommended in pregnancy. Discuss other options with clinical pharmacist.

Imaging

- All patients <24 months with first febrile UTI should undergo renal ultrasound. Follow-up VCUG should be performed for any patient with abnormal renal ultrasound, and for other patients at the provider's discretion.
- Renal ultrasound should be strongly considered in any patient with UTI who fails to respond to antibiotics, to evaluate for renal abscess.

Table 2. Empiric Antibiotic Recommendations for Urinary Tract Infections in Children

Diagnosis	Definition	Empiric Therapy	Duration
Asymptomatic Bacteriuria	Presence of a positive urine culture, regardless of urinalysis results, without signs or symptoms of a UTI Urine cultures should generally not be obtained in asymptomatic patients	**None** In patients who are pregnant or about to undergo a urologic procedure, treat as cystitis (see Special Populations section for antibiotic selection in pregnant patients) For patients with indwelling catheter, consider discontinuing or changing catheter	N/A
Cystitis	Dysuria, urgency, frequency, and/or suprapubic pain in the absence of fever or other systemic symptoms AND Pyuria (>10 WBC/hpf) AND Positive urine culture ≥100,000 cfu/mL (≥50,000 cfu/mL in children ≤24 mo)[1]	• **Cephalexin PO** • Nitrofurantoin PO • Trimethoprim/sulfamethoxazole (TMP/SMX) PO • History of *Pseudomonas*: ciprofloxacin PO	5 days 3 days for TMP/SMX or ciprofloxacin

Pyelonephritis	Fever, flank pain, or ill appearing
	AND
	Pyuria (>10 WBC/hpf)
	AND
	Positive urine culture ≥100,000 cfu/mL (≥50,000 cfu/mL in children ≤24 mo)[1]
		• Previously healthy children:
		  ○ **Cefazolin IV or cephalexin PO**
		• Children with history of prior UTI or other concern for cefazolin resistance:
		  ○ Ceftriaxone IV
		• Immunocompromised, catheter-dependent, or history of *Pseudomonas*:
		  ○ Cefepime IV
		  ○ Consider ciprofloxacin PO if able to tolerate enteral therapy
		• History of ESBL-producing Enterobacterales (not *Pseudomonas*):
		  ○ Ertapenem IV
		• Cephalosporin allergy:
		  ○ Aztreonam IV
		  ○ TMP/SMX PO if able to tolerate enteral therapy
			7 days
			
			14 days max for patients with complex GU anatomy or other risk factors for treatment failure

[1]Urine culture methods are insufficiently precise to distinguish colony counts between 50,000 CFU/mL and 100,000 CFU/mL. For children 2-24 months of age with reported colony counts of 10,000-100,000 CFU/mL, providers should base treatment decisions on clinical suspicion and urinalysis results.

Table 3. Dosing of Antimicrobials in the Treatment of Urinary Tract Infections (in alphabetical order)

Antimicrobial	Recommended Dose/Route[1]
Aztreonam	30 mg/kg/dose IV q8h (max: 1000 mg/dose)
Cefazolin	25 mg/kg/dose IV q8h (max: 1000 mg/dose)
Cefdinir	7 mg/kg/dose PO q12h (max: 300 mg/dose) OR 14 mg/kg/dose PO q24h (max: 600 mg/dose)
Cefepime	50 mg/kg/dose IV q8h (max: 2000 mg/dose)
Ceftriaxone	50 mg/kg/dose IV q24h (max: 2000 mg/dose)
Cephalexin	Pyelonephritis: 25 mg/kg/dose PO q8h (max: 500 mg/dose) Cystitis: 25 mg/kg/dose PO q12h (max: 500 mg/dose)
Ciprofloxacin	Usual dosing: 10 mg/kg/dose PO/IV q12h (max: 400 mg/dose IV; max: 500 mg/dose PO) UTI due to *Pseudomonas:* 15 mg/kg/dose PO q12h (max: 750 mg/dose); 10 mg/kg/dose IV q8h (max: 400 mg/dose)
Ertapenem	Patients ≤12 years old: 15 mg/kg/dose IV q12h (max: 500 mg/dose) Patients ≥13 years old: 1000 mg IV q24h
Levofloxacin	Patients <5 years old: 10 mg/kg/dose IV/PO q12h (max: 375 mg/dose) Patients ≥5 years old: 10 mg/kg/dose IV/PO q24h (max: 750 mg/dose)
Nitrofurantoin[2]	Macrodantin 1.5-2 mg/kg/dose PO q6h (max: 100 mg/dose) **Macrocrystal/monohydrate (Macrobid) 100 mg PO q12h can be used in patients ≥ 12 years old for outpatients or at discharge. It is non-formulary at SLCH and not routinely available for inpatients.
TMP/SMX	5 mg/kg/dose trimethoprim component PO/IV q12h (max: 800/160 mg/dose)

[1]Adjust based on renal function as appropriate.
[2]Nitrofurantoin should be used for cystitis only; it should not be used for pyelonephritis due to inadequate kidney penetration. Avoid in patients with CrCl <30 ml/min due to concern for ineffectiveness and further renal dysfunction.

Relevant SLCH guidelines and resources:

- St. Louis Children's Hospital Antibiogram

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