



Pediatric Urinary Tract Infections (>60 days) Inpatient and Outpatient

Treatment guidelines are not intended to replace clinical judgment. Recommendations are intended to be optimal for the majority of patients with these disease states but cannot account for all clinical situations or atypical presentations. This guideline is to be used for infants and children >60 days of age. **Exclusions** include those with known urinary tract abnormalities, neurogenic bladder, recent genitourinary surgery, and immunocompromised patients. Consider an Infectious Diseases consultation for complex cases not meeting typical treatment approaches.

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Symptom Assessment (Most to Least Common)

Preverbal	Verbal
• Fever • Abdominal pain • Poor feeding • Vomiting • Loin tenderness • Hematuria • Malodorous urine • Lethargy • Irritability	• Frequency • Dysuria • Urgency • Hesitancy • Fever • Malaise • Vomiting • Hematuria • Malodorous urine

Common Organisms

Gram-Negative	Gram-Positive	Common Contaminants
<i>Escherichia coli</i> * <i>Klebsiella</i> spp. <i>Proteus</i> spp. <i>Pseudomonas</i> spp. <i>Enterobacter</i> spp.	<i>Enterococcus</i> spp. Group B Streptococci <i>Staphylococcus saprophyticus</i>	<i>Lactobacillus</i> spp. <i>Corynebacterium</i> spp. Coagulase-negative Staphylococci Alpha-hemolytic Streptococci <i>Candida</i> spp.

*Warrants empiric coverage – *unless history of other organism(s)*

Risk Factors (RF) and Recommendations to Obtain a Urinalysis

	Males		Females
Risk	- Non-black race - Temperature $\geq 39^{\circ}\text{C}$ - Fever ≥ 2 days - No source of infection		- Temperature $\geq 39^{\circ}\text{C}$ - Fever ≥ 2 days - No source of infection
When to obtain UA	<u>Circumcised</u> - Consider if ≥ 3 RF - Recommend if ≥ 4 RF	<u>Uncircumcised</u> - Consider if ≥ 2 RF - Recommend if ≥ 3 RF	- Consider if ≥ 2 RF - Recommend if ≥ 3 RF

Definitions

PYURIA	BACTERIURIA
>10 WBC count in urine - Positive leukocyte esterase	$>10^5$ CFU/mL organisms in urine culture
YES: Treat (if symptoms correlate)	NO: Do not treat

Specimens

Specimen	Definite (CFU/mL)	Possible (CFU/mL)
Catheterization	$>50,000$ CFU/mL	$>10,000$ CFU/mL
Clean-catch	$>100,000$ CFU/mL	$>50,000$ CFU/mL
Suprapubic aspiration	Any growth	Any growth

2019 Carilion Outpatient Antibigram

		<i>Escherichia coli</i> *	<i>Klebsiella pneumoniae</i>	<i>Enterococcus faecalis</i>	<i>Proteus mirabilis</i>	<i>Pseudomonas aeruginosa</i>
PREVALENCE		59%	12%	7%	6%	3%
PO	Cephalexin	97	94	0	93	0
	Ciprofloxacin	88	87	82	68	80
	Levofloxacin	88	87	82	70	78
	Nitrofurantoin	97	71	100	0	0
	TMP/SMX	76	90	0	79	0
IV	Cefepime	97	95	0	95	98
	Ceftriaxone	97	95	0	95	0

*Data for *E. coli* derived from 2019 pediatric antibiogram (all other data derived from 2019 adult antibiogram)

Inpatient Management		
Drug (NORMAL RENAL FUNCTION)		Duration
Inpatient Cystitis & Pyelonephritis (2-36 months)		
Patients ≤ 2 years should undergo renal and bladder ultrasonography (RBUS) during their first episode		
A single dose of ceftriaxone or gentamicin is recommended empirically for <u>pyelonephritis</u> (all ages)		
IV	Ceftriaxone 50 mg/kg/dose IV every 24 h (max = 2000 mg/dose)	Step-down to PO
Preferred	Step-down PO therapy: Cephalexin 12.5-25 mg/kg/dose PO four times daily (max = 500 mg/dose)	10 days
Alternative	Second-line: Cefdinir 14 mg/kg PO every 24 h (div 1-2 times/day, max = 600 mg/day)	10 days
	Third-line (or β-lactam allergy): TMP/SMX 5-6 mg TMP/kg/dose PO BID (max = 160 mg TMP/dose)	10 days
Inpatient Cystitis & Pyelonephritis (36 months – 11 years)		
IV	Ceftriaxone 50 mg/kg/dose IV every 24 h (max = 2000 mg/dose)	Step-down to PO
Preferred	Step-down PO therapy: Cephalexin 12.5-25 mg/kg/dose PO four times daily (max = 500 mg/dose)	Cystitis: 3 days Pyelonephritis: 10 days
	Cystitis only: Nitrofurantoin (Furadantin, Macrochantin) 1.25-1.75 mg/kg/dose PO four times daily (max = 100 mg/dose)	Cystitis: 5 days
Alternative	Second line: Cefdinir 14 mg/kg PO every 24 h (div 1-2 times/day, max = 600 mg/day)	Cystitis: 3 days Pyelonephritis: 10 days
	Third-line (or β-lactam allergy): TMP/SMX 4 mg TMP/kg/dose PO BID (max = 160 mg TMP/dose)	Cystitis: 3 days Pyelonephritis: 10 days
Inpatient Cystitis & Pyelonephritis (≥ 12 years)		
IV	Ceftriaxone 50 mg/kg IV x 1 (max = 2000 mg/dose)	Step-down to PO
Preferred	Step-down PO therapy: Cephalexin 12.5-25 mg/kg/dose PO four times daily (max = 500 mg/dose)	Cystitis: 3 days Pyelonephritis: 10 days
	Cystitis only: Nitrofurantoin (Furadantin, Macrochantin) 1.25-1.75 mg/kg/dose PO four times daily (max = 100 mg/dose) Nitrofurantoin (Macrobid) 100 mg PO BID	Cystitis: 5 days Pyelonephritis: 10 days
Alternative	Second line: Cefdinir 14 mg/kg PO every 24 h (div 1-2 times/day, max = 600 mg/day)	Cystitis: 3 days Pyelonephritis: 10 days
	Third-line (or β-lactam allergy): TMP/SMX 4 mg TMP/kg/dose PO BID (max = 160 mg TMP/dose)	Cystitis: 3 days Pyelonephritis: 10 days
	Last-line (reserve for when no other antibiotic would be appropriate) Ciprofloxacin 10 mg/kg/dose PO BID (max = 750 mg/dose)	Cystitis: 7 days Pyelonephritis: 10 days

Outpatient Management		
Drug (NORMAL RENAL FUNCTION)		Duration
Outpatient Cystitis & Pyelonephritis (2-36 months)		
Patients ≤ 2 years should undergo renal and bladder ultrasonography (RBUS) during their first episode		
A single dose of ceftriaxone or gentamicin is recommended empirically for <u>pyelonephritis</u> (all ages)		
IV/ IM	Ceftriaxone 50 mg/kg/dose IV or IM x 1 (max = 2000 mg/dose)	Step-down to PO
	Gentamicin 7.5 mg/kg IM x 1	Step-down to PO
Preferred	Step-down PO therapy: Cephalexin 12.5-25 mg/kg/dose PO four times daily (max = 500 mg/dose)	10 days
Alternative	Second-line: Cefdinir 14 mg/kg every 24 h (divided 1-2 times/day, max = 600 mg/day)	10 days
	Third-line (or β-lactam allergy): TMP/SMX 5-6 mg TMP/kg/dose PO BID (max = 160 mg TMP/dose)	10 days
Outpatient Cystitis & Pyelonephritis (36 months – 11 years)		
IV/IM	Ceftriaxone 50 mg/kg/dose IV or IM x 1 (max = 2000 mg/dose)	Step-down to PO
	Gentamicin IM x 1 < 5 years: 7.5 mg/kg 5-10 years: 6 mg/kg 11-12 years: 4.5 mg/kg	Step-down to PO
Preferred	Cystitis only: Nitrofurantoin (Furadantin, Macrochantin) 1.25-1.75 mg/kg/dose PO every 6 h (max = 100 mg/dose)	Cystitis: 5 days
	Cephalexin 12.5-25 mg/kg/dose PO four times daily (max = 500 mg/dose)	Cystitis: 3 days Pyelonephritis: 10 days
Alternative	Second-line: Cefdinir 14 mg/kg every 24 h (divided 1-2 times/day, max = 600 mg/day)	Cystitis: 3 days Pyelonephritis: 10 days
	Third-line (or β-lactam allergy): TMP/SMX 4 mg TMP/kg/dose BID (max = 160 mg TMP/dose)	Cystitis: 3 days Pyelonephritis: 10 days
Outpatient Cystitis & Pyelonephritis (≥ 12 years)		
IV/ IM	Ceftriaxone 50 mg/kg/dose IV or IM x 1 (max = 2000 mg/dose)	Step-down to PO
	Gentamicin 4.5 mg IM x 1	Step-down to PO
Preferred	Cystitis only: Nitrofurantoin (Macrobid) 100 mg/dose BID Nitrofurantoin (Furadantin, Macrochantin) 1.25-1.75 mg/kg/dose four times daily (max = 100 mg/dose)	Cystitis: 5 days
	Cephalexin 12.5-25 mg/kg/dose four times daily (max = 500 mg/dose)	Cystitis: 3 days Pyelonephritis: 10 days
Alternative	Second-line: Cefdinir 14 mg/kg every 24 h (divided 1-2 times/day, max = 600 mg/day)	Cystitis: 3 days Pyelonephritis: 10 days
	Third-line (or β-lactam allergy): TMP/SMX 4 mg TMP/kg/dose BID (max = 160 mg TMP/dose)	Cystitis: 3 days Pyelonephritis: 10 days
	Last-line (reserve for when no other antibiotic would be appropriate) Ciprofloxacin 10 mg/kg/dose BID (max = 750 mg/dose)	Cystitis: 3 days Pyelonephritis: 7 days

Other Pathogens

	Empiric Agent(s)	Targeted (Confirm Susceptibility)
<i>Enterococcus faecalis</i> <i>Enterococcus faecium</i>	Ampicillin 50-200 mg/kg/day IV divided every 6 hours (max = 8 g/day) Amoxicillin 45 mg/kg PO in two divided doses (max = 500 mg/dose)	Aminopenicillins can be used for all Enterococcus UTIs regardless of ampicillin sensitivities. <u>Exception: Amp-resistant pyelonephritis</u> Linezolid - Children <12 years: 10 mg/kg IV or PO every 8 hours (max = 600 mg/dose) - Children ≥ 12 years: 600 mg IV or PO every 12 hours
Extended-spectrum beta-lactamase (ESBL)	Ertapenem - Infants ≥3 months and children: 15 mg/kg IV BID (max = 500 mg/dose) - Adolescents: 1000 mg once daily	Fosfomycin (cystitis only) - Children < 12 years: 2000 mg x 1 - Children ≥12 years: 3000 mg x 1 TMP/SMX Ciprofloxacin/levofloxacin (reserve for when no other antibiotic would be appropriate)
AmpC (e.g., <i>Enterobacter</i> , <i>Citrobacter</i> , <i>Morganella</i> , <i>Serratia</i>)	Cefepime 50 mg/kg IV BID (max = 1000 mg/dose)	Fosfomycin (cystitis only) - Children < 12 years: 2000 mg x 1 - Children ≥12 years: 3000 mg x 1 TMP/SMX Ciprofloxacin/levofloxacin (reserve for when no other antibiotic would be appropriate)
Carbapenem resistance	Infectious Diseases Consultation	

References:

1. Finnell SM, Carroll AE, Downs SM. Technical report – Diagnosis and management of an initial UTI in febrile infants and young children. *Pediatrics* 2011; 128: e749-70.
2. Gorelick MH, Hoberman A, Kearney D, Wald E, Shaw KN. Validation of a decision rule identifying febrile young girls at high risk for urinary tract infection. *Pediatr Emerg Care* 2003; 19(3): 162-4.
3. Saadeh SA, Mattoo TK. Managing urinary tract infections. *Pediatr Nephrol* 2011;26(11):1967-76.
4. Roberts KB. Urinary tract infection: clinical practice guideline for the diagnosis and management of the initial UTI in febrile infants and children 2 to 24 months. *Pediatrics* 2011; 128(3): 595-610.
5. Reaffirmation of AAP Clinical Practice Guideline: The diagnosis and management of the initial urinary tract infection in febrile infants and young children 2-24 months of age. *Pediatrics* 138(6): 1-5.
6. Michael M, Hodson EM, Craig JC, Martin S, Moyer VA. Short versus standard duration oral antibiotic therapy for acute urinary tract infection in children. *Cochrane Database Syst Rev* 2003; (1): CD003966.
7. Strohmeier Y, Hodson EM, Willis NS, Webster AC, Craig JC. Antibiotics for acute pyelonephritis in children. *Cochrane Database Syst Rev* 2014;(7):CD003772.