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Urinary Tract Infection (UTI) Clinical Pathway

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Rationale

This clinical pathway was developed by a consensus group of JHACH physicians, advanced practice providers, nurses and pharmacists to standardize the management of children hospitalized for Urinary Tract Infection (UTI). It addresses the following clinical questions or problems: It addresses the following clinical questions or problems:

1. Diagnosis
2. General Treatment Principles
3. Empiric Treatment of Children with Suspected UTIs
4. Dosing and Activity of Selected Antibiotics for the Treatment of UTIs

Background

Urinary tract infections (UTI) are a common and important clinical problem in childhood. Upper urinary tract infections may lead to renal scarring, hypertension, and end-stage renal dysfunction. Although children with pyelonephritis tend to present with fever, it can be difficult on clinical grounds to distinguish cystitis from pyelonephritis, particularly in young children (those younger than two years). Thus, we have defined UTI broadly without attempting to distinguish cystitis from pyelonephritis.

Diagnosis

- Obtain urinalysis (UA) and urine culture before antibiotic initiation only if child has signs and symptoms suggestive of a UTI (e.g. dysuria, urgency, frequency, suprapubic pain, fevers with no known source, fevers and emesis, costovertebral angle tenderness, irritability without an alternate explanation) *(evidence quality: A; strong recommendation).*
- Routine UA and urine culture should **NOT** be obtained in asymptomatic children with indwelling urinary catheters
- For patients with spinal cord injuries who are catheter-dependent, signs and symptoms of UTIs may include new onset fevers or rigors with no alternate source, costovertebral angle tenderness, or acute hematuria
- “Foul smelling” or “cloudy” urine has poor correlation with a UTI and should **NOT** be used as the sole criterion for obtaining a UA and urine culture
- Although catheterized specimens are preferred in younger children, bagged specimens can be considered as the first step to evaluate for pyuria. If a bagged urine specimen from a younger child indicates pyuria, send a catheterized specimen for urine culture and repeat UA **PRIOR** to antibiotics being initiated

- **Urinalysis:**
    - UA indicating pyuria requires **>10 WBC/hpf**
    - Presence of nitrites indicate Gram-negative bacteria in the urine
    - Presence of leukocyte esterase indicates WBCs in the urine

Table 1. Sensitivity and Specificity of Components of Urinalysis, Alone and in Combination (AAP Guidelines)

Test	Sensitivity, (range), %	Specificity (range), %
Leukocyte esterase test	83 (67-94)	78 (64-92)
Nitrite Test	53 (15-82)	98(90-100)
Leukocyte esterase or nitrite test positive	93 (90-100)	72 (58-91)
Microscopy, WBCs	73 (32-100)	81 (45-98)
Microscopy, bacteria	81 (16-99)	83 (11-100)
Leukocyte esterase test, Nitrite test, or Microscopy positive	99.8 (99-100)	70 (60-92)

Table 2. (Ref: *The Harriet Lane Handbook)*

Method of Collection	CFUs necessary to diagnose a UTI
Suprapubic aspiration	>50,000 CFUs Some resources consider <50,000 CFUs, recommend clinical correlation
Transurethral catheterization	>50,000 CFUs
Clean catch	>100,000 CFUs
Bagged specimen	Positive culture cannot be used to document UTI
Catheter Associated (indwelling or suprapubic)	No specific data for pediatric patients. Adults IDSA guidelines define as presence of signs and symptoms compatible with UTI and >1000 CFU/mL of 1 or more bacterial species in a single catheter urine specimen or in a midstream voided urine specimen from a patient whose catheter has been removed within previous 48 hours.

- **Urine culture:**
    - Interpretation of urine culture (in correlation with UA):
    - Urine cultures with more than one organism (in non-catheterized patients) are unlikely to be clinically significant
    - Patients already on antibiotics at the time urine cultures were obtained may have lower colony counts
    - Urine culture from a patient with an indwelling urinary catheter with ≥1000 cfu/mL can be clinically significant
- **Ultrasonography**
    - Febrile infants with UTIs should undergo a screening renal and bladder ultrasonography (RBUS) (up to 36 months and/or where clinically indicated) within 7-10 days of UTI diagnosis either inpatient or outpatient. *(evidence quality: C; recommendation)*
- **Voiding cystourethrography (VCUG)**
    - VCUG should not be performed routinely after the first febrile UTI; VCUG is indicated if RBUS reveals hydronephrosis, scarring, or other findings that would suggest either high-grade VUR or obstructive uropathy, as well as in other atypical or complex clinical circumstances *(evidence quality B; recommendation)*.
        - Per local Pediatric Urology consensus, a VCUG should be obtained once the patient is on appropriate antibiotics (based on culture sensitivities) and has been afebrile for 24 hours at the earliest. The VCUG can be done inpatient or outpatient depending on the overall clinical scenario within 7-10 days of abnormal RUS.

Emergency Center Management

Urinary tract infections are a common discharge diagnosis in the emergency department, and are generally treated empirically while a culture matures. Appropriate evaluation should be performed, with consideration for pyelonephritis, hydration status, co-existing diagnosis, sepsis, social concerns and availability of follow up. Patients with complicating factors are frequently evaluated in the emergency department including patients with indwelling catheters or who require regular catheterization, those with urinary tract abnormalities and infants less than 60 days. These patients may require consultation or admission, or may have chronic colonization, and will not be generally included in this algorithm.

Further evaluation:

Febrile infants with UTIs: Consider ultrasound, especially if less than 6 months.
VCUG is not routinely recommended, but may be considered if there is an abnormal renal US and/or recurrent febrile UTIs.
Constipation may contribute to UTIs. Obtain appropriate history and consider treatment of concurrent constipation.

Admission criteria:

Dehydration/Not tolerating intake
Vomiting
Significant comorbidities (Pelvic inflammatory disease, nephrolithiasis, abnormal ultrasound)
Uncontrolled pain
Failure of outpatient management
Poor follow up/Social concerns

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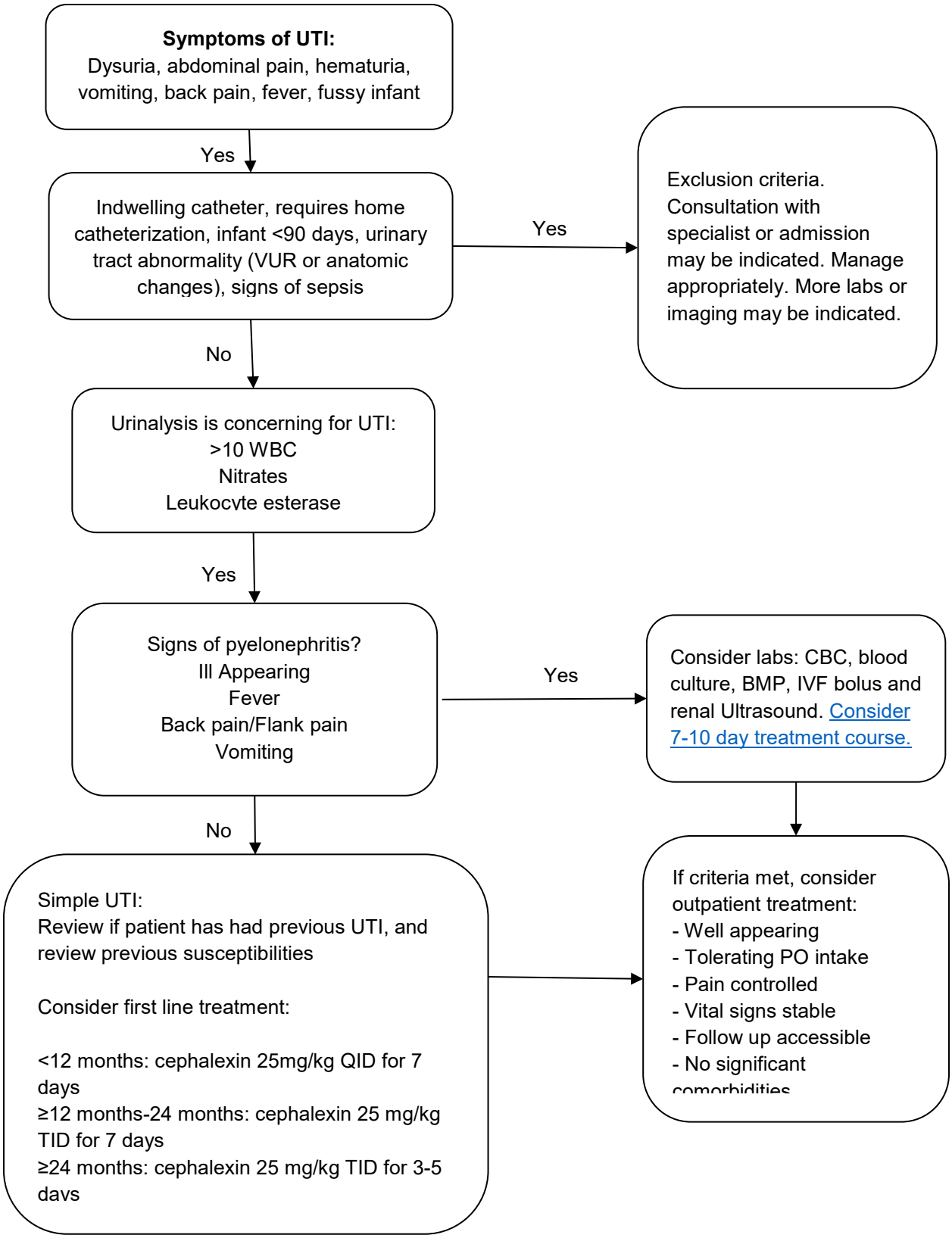

Additional Considerations

Documentation Recommendations

- If the patient meets criteria for cystitis (per clinical indicators outlined in Table 3), please document accordingly.
- Please document if hematuria was present or not.
- If the patient meets criteria for pyelonephritis (per clinical indicators outlined in Table 3), please document accordingly.
- Please be sure to include if the infection is acute or chronic.
- Please document the organism, or suspected organism, you are treating

Inpatient Management

General Treatment Principles

- Always review previous urine culture results to assist with selection of empiric therapy
- Always narrow antibiotics (if possible) or stop therapy (if urine cultures reveal no organisms) once culture results are finalized
- In the case of catheter-associated UTIs, treatment does not need to continue for the duration of the indwelling catheter
- Do not send repeat urine cultures to evaluate for “test of cure”
- If started on intravenous therapy, consider change antibiotics to enteral therapy once able to tolerate enteral therapy and demonstrating clinical improvement as long as repeat blood culture in patients with bacteremia is negative and patient does not have a complication such as renal abscess.[7,8,9]
- A short duration of bacteremia from a urinary source should not preclude conversion to enteral therapy when patient is showing clinical improvement
- Extended spectrum beta-lactamase (ESBL)-producing organisms (most commonly *E.coli*, *Klebsiella* spp., and *Proteus*) hydrolyze most penicillins, cephalosporins, and aztreonam, but not carbapenems. First line empiric therapy is ertapenem and oral options are dependent on final susceptibility report with ciprofloxacin, sulfamethoxazole-trimethoprim or nitrofurantoin sometimes being options.
- Administration of intravenous fluids should be considered in any child admitted with suspected pyelonephritis[13]
- Patients with simple cystitis can typically be treated as an outpatient with oral therapy. Consider hospitalization for patients unable to tolerate sufficient oral intake to maintain hydration, intractable vomiting, failed outpatient therapy, or high risk patients (such as those that are immunocompromised, less than 28 days of age, or have history of multi-drug resistant UTIs that are not amenable to oral empiric therapy).
    - Observation status should be considered for most patients being hospitalized, if discharge is anticipated within 24 to 48 hours.

Empiric Treatment of Children with Suspected UTIs

Table 3.

Category	Definition	Empiric Therapy
Asymptomatic bacteriuria	No symptoms of a UTI even with pyuria and positive urine culture Obtaining routine cultures in asymptomatic patients (regardless of presence of a catheter) is NOT recommended	**None** If patient is about to undergo a urologic procedure, has a renal transplant, or is pregnant, treat like cystitis If patient has an indwelling catheter, discontinue or change catheter if possible
Simple UTI	Dysuria, urgency, frequency, or suprapubic pain in the absence of fever or other systemic symptoms **AND** pyuria (>10 WBC/hpf) **AND** positive urine culture as defined in Table 2. **AND** a blood culture (if obtained) negative for the organism isolated from urine	• **Cephalexin PO** (preferred) • **Nitrofurantoin PO** History of Pseudomonas • **Ciprofloxacin PO** **Duration:** **<12 months: cephalexin 25mg/kg QID for 7 days** **≥12 months-24 months: cephalexin 25 mg/kg TID for 7 days** **≥24 months: cephalexin 25 mg/kg TID for 3-5 days**

Pyelonephritis	Fever, flank pain, or ill appearance
	AND
	pyuria (>10 WBC/hpf)
	AND
	positive urine culture as defined in Table 2.
		<1 month:
		• **Ampicillin PLUS Gentamicin**
		
		≥1 month:
		• **Cefazolin IV** (preferred)
		  o **Cephalexin PO** (if able to tolerate PO)
		• **Ceftriaxone IM** (if no IV access)
		• **Cefepime IV** (if history of Pseudomonas or catheter-dependent)
		  o **Ciprofloxacin PO** (if able to tolerate enteral therapy)
		• **Ertapenem IV** (if history of ESBL-producing *Enterobacteriaceae*)
		
		Duration: 7 days (if clinical improvement by day 3), otherwise 10 days

Dosing and Activity of Selected Antibiotics for the Treatment of UTIs (Table 4)

Antimicrobial	Dosing for beyond the neonatal period, assuming normal renal function (Refer to Neofax for neonatal dosing)	% Susceptibility of urine isolates at JHACH 2017 and 2018 (# of isolates)		
		E.coli, non ESBL (n=860)	E.faecalis (n=108)	Pseudomonas (n=42)
Amoxicillin	40 mg/kg/day PO divided q8h (max 500 mg/dose)	52	100[3]	0
Amoxicillin-clavulanate	40 mg/kg/day PO divided q8h (max 500 mg/dose)	57	100[3]	0
Ampicillin	25 mg/kg/dose IV q6h (max 1000mg/dose)	52	100	0
Cefazolin	25 mg/kg/dose IV q8h (max 1000 mg/dose)	97[1]	0	0
Cefepime	50 mg/kg/dose IV q8h (max 2000 mg/dose)	100	0	93
Ceftriaxone	50 mg/kg/dose IV/IM q24h (max 2000 mg/dose)	98	0	0
Cephalexin	25 mg/kg/dose PO q6h (max 500 mg/dose) (q8h dosing can be considered for UTI if relatively well-appearing **and** patient is >2 years old) ≥15yo AND uncomplicated cystitis: 500mg PO BID	97[1]	0	0
Cefprozil	15mg/kg/dose PO q12h (max 500mg/dose) *non-formulary at JHACH, outpatient use only*	97[1]	0	0
Ciprofloxacin	10 mg/kg/dose IV q8h (max 400 mg/dose IV) **OR** 20 mg/kg/dose PO q12h (max 750 mg/dose PO)	90	81	90
Ertapenem	1 month to <12 years: 15 mg/kg/dose IV q12h (max 500 mg/dose) ≥12 years: 1000 mg IV q24h	99	0	0
Gentamicin	<44 weeks post-menstrual age (PMA=Gestational Age + Postnatal Age): *refer to Neofax* Extended interval dosing is only recommended if patient has normal renal function, is not critically ill and does not have altered volume of distribution (i.e. ECMO, ascites, burns >20% TBSA, trauma, shock, obese): <5 years: IV: 7.5 mg/kg/dose every 24 hours 5 to 10 years: IV: 6 mg/kg/dose every 24 hours >10 years and Adolescents: IV: 4.5 mg/kg/dose every 24 hours	92	0	91
Nitrofurantoin (NOT for pyelonephritis)	>1 month: Macrodantin 1.75 mg/kg/dose PO q6h (max 100 mg/dose) ≥12 years: Macrocrystal/monohydrate (Macrobid) 100 mg PO q12h	99	N/R[2]	0
Trimethoprim/ Sulfamethoxazole	5 mg/kg/dose of TMP IV/PO q12h (max 160 mg of TMP/dose)	74	0	0

[1] Activity against *E. coli* based on urinary breakpoints established in 2014 (MIC ≤16 mcg/mL is considered susceptible). Cefazolin susceptibility is a surrogate to predict the efficacy of all oral cephalosporins (e.g., cephalexin, cefprozil, etc.) for the treatment of UTIs due to *E. coli*, *K. pneumoniae*, and *P. mirabilis*.

[2] N/R = not reported at JHACH, but expected to be active in vitro and have clinical efficacy

[3] Susceptibility inferred from Ampicillin

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Urinary Tract Infection (UTI) Clinical Practice Guideline
Johns Hopkins All Children's Hospital

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Disclaimer

Clinical Pathways are intended to assist physicians, physician assistants, nurse practitioners and other health care providers in clinical decision-making by describing a range of generally acceptable approaches for the diagnosis, management, or prevention of specific diseases or conditions. The ultimate judgment regarding care of a particular patient must be made by the physician in light of the individual circumstances presented by the patient.

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