



Health Policy & Clinical  
Effectiveness Program

Evidence-Based Care Guideline

## For medical management of First Urinary Tract Infection in children 12 years of age or less<sup>a</sup>

Changes to the guideline made in November, 2006

based on a literature review conducted in 2006;  
see Development Process section for method,  
results and discussion of changes

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### Target Population

**Inclusion:** Intended primarily for use in:

- children with a first presumed or definite episode of UTI

**Exclusion:** Children:

- with known immunodeficiencies
- with known major genitourinary anomalies
- with sepsis with shock or meningitis
- needing ventilator or other intensive care
- with other severe comorbid conditions

### Target Users

Includes but is not limited to (in alphabetical order):

- Attending physicians
- Community physicians and practitioners
- Nephrologists
- Patient / family
- Patient care staff
- Radiologists
- Residents
- Urologists

<sup>a</sup> Please cite as: **UTI Guideline Team, Cincinnati Children's Hospital Medical Center:** Evidence-based care guideline for medical management of first urinary tract infection in children 12 years of age or less, <http://www.cincinnatichildrens.org/svc/dept-div/health-policy/ev-based/uti.htm>, Guideline 7, pages 1-23, November, 2006.

## Introduction

References in parentheses ( ) Evidence strengths in [ ] (See last page for definitions)

Urinary tract infections (UTI) are a frequent source of fever in young children (Gorelick 2000 [C], Hansson 1999 [C]) and the most common serious bacterial infection in infants and young children. Because UTI is associated with pyelonephritis which has potential sequelae, including renal scarring (Lin 2003 [C]), chronic renal failure (Hansson 1999 [C]), hypertension (Wennerstrom 2000a [C]) and increased risk for pregnancy-related complications (Martinell 1990 [D]), it is important that these infections are diagnosed promptly and accurately. Therefore, there have been a number of guidelines developed (White 2001 [S], AAP 1999 [S], Jodal 1999 [S,E], Ahmed 1998 [S,E]) in the past few years focusing on this issue. See Appendix 1 for a glossary of terms related to the diagnosis and management of urinary tract infections.

Overall prevalence of positive culture in children 0 to 21 yrs of age with UTI symptoms ranges from 8.8% to 14.8% (Lohr 1993 [C], Boreland 1986 [C], Marsik 1986 [C]). See Appendix 2 for study details. The details of three specific prevalence studies on children under age two are presented in Appendix 3 (Shaw 1998 [C], Hoberman 1993 [C], Bachur 2001a [D]). One systematic review calculated crude estimates of the effect of age and gender on the prevalence of UTI: males younger than one year (3%); males older than one year (2%); females younger than one year (7%); and females older than one year (8%) (Downs 1999 [M]). See Appendix 4 for organisms associated with UTI in children.

In the target populations, the objectives of this guideline are to:

- improve the use of appropriate diagnostic criteria,
- improve the use of appropriate antibiotic therapy,
- improve the use of appropriate imaging studies,
- avoid long-term medical problems,
- improve parental involvement in decision making around the management of UTI,
- identify the infants and children at most risk for long-term renal damage.

The areas of uncertainty offering challenges in the management of UTI include accurate and prompt diagnosis, decisions regarding prophylactic therapy, and decisions regarding imaging procedures.

**Table 1 Likelihood Ratios (LR) that a Screening Test for UTI will Result in a Positive Urine Culture**

Positive Test Result--to Rule in UTI	Positive LR*
Nitrite	25
Microscopy, bacteria	5
Microscopy, leukocytes	4
Leukocyte esterase (LE)	5 (approx. range 2 to 18)
Gram stain	19

(Gorelick 1999 [M], Armengol 2001 [C])

\*LR scale: rules of thumb

- LR >10 greatly increases diagnostic certainty
- LR =1 test result is not helpful in diagnosis
- LR <0.2 greatly helps rule out condition

Likelihood ratios quantify the change in probability of definite UTI when a given test result is present in a specific clinical case and depend upon a starting estimate of probability. For more information, see Appendix 6 for definition and use of LR.

## Guideline Recommendations

### Assessment and Diagnosis

#### History and Physical Examination

1. It is recommended that prompt evaluation for a diagnosis of UTI be conducted. See Appendix 5 for clinical findings consistent with the diagnosis of a UTI.

**Note:** Risk factors for UTI include:

- male:
  - uncircumcised < 1 year
  - all < 6 months
- female, in general
  - particularly < 1 year
- non-African-American race
- fever ≥ 39° C

(Shaw 1998 [C], Craig 1996 [C], Hoberman 1993 [C], Bachur 2001a [D], Bachur 2001b [D]).

Absence of high fever or other specific risk factors does not preclude the presence of UTI. See Appendix 2 and Appendix 3.

#### Laboratory Studies

2. It is recommended that urine samples be collected by catheter or suprapubic aspiration (if age-appropriate), if a high quality clean catch midstream urine sample cannot be obtained (Hoberman 1996 [C], Weinberg 1991 [D]).

**Note 1:** In a child with a low clinical suspicion of UTI, and in whom a catheterization would be both required for a culture and considered invasive by the clinician or the family, the option to perform a dipstick or routine urinalysis on a specimen collected by more convenient

means may be considered, followed by catheterization if the urinalysis suggests a UTI (AAP 1999 [S]). See Table 1.

**Note 2:** See CCHMC Nursing Policies, Procedures and Standards: [III-701 Urinary Catheterization/Bladder Irrigation](#)<sup>b</sup>.

3. It is recommended, in screening for UTI, to perform:
  - dipstick (nitrite and leukocyte esterase [LE]) **or**
  - routine urinalysis (nitrite, LE and microscopy) **and**
  - urine culture and susceptibilities
 (Gorelick 1999 [M]). See Table 1.

**Note:** Gram stain is not commonly conducted in the Cincinnati pediatric community (Hoberman 1996 [C]).

### Diagnosis

#### General

Presumed UTI is diagnosed while urine culture results are pending in a child with abnormal laboratory studies and clinical findings consistent with the diagnosis of a UTI.

Definite UTI is diagnosed after obtaining a positive result for a urine culture in a child presenting with a clinical profile consistent with a UTI.

#### Presumed UTI

4. It is recommended that while pending results of culture, any positive result from a dipstick or routine urinalysis, in the presence of clinical findings consistent with the diagnosis of a UTI, be considered consistent with a presumptive diagnosis of UTI (Gorelick 1999 [M]). Any one of the following study results defines a positive urinalysis (Gorelick 1999 [M]). See Table 1 and Table 2.

- positive nitrite screen
- positive leukocyte esterase
- positive microscopic exam:
  - the definition of abnormal microscopic exam is dependent on patient or provider-specific determinants

**Table 2**

WBC/hpf (spun)	LR
≥ 5	3.7 - 13.5
≥ 10	6.2 - 32.0

(Hoberman 1993 [C], Weinberg 1991 [D])

<sup>b</sup> Urinary Catheterization / Bladder Irrigation policy III-701: <http://www.cincinnatichildrens.org/ed/cme/ed-services/policies.htm>

**Definite UTI**

5. It is recommended that a definite UTI be defined as a single organism cultured from a suprapubic aspirate (SPA), catheter specimen (cath), or clean catch midstream specimen (CCM) at the following concentrations. The higher the concentration of organisms, the more reliable the results; however, colony counts must be interpreted within the clinical context and lower colony counts may be significant, especially in a dilute urine
- SPA: > 1,000 cfu/mL
  - cath: > 10,000 cfu/mL
  - CCM:  $\geq$  100,000 cfu/mL
- (Hansson 1998 [C], Rushton 1997 [S,E]).

**Management****Admission Criteria**

6. It is recommended that admission be primarily restricted to infants and children:
- who require IV for fluids
  - who require IV antibiotics due to severe illness or due to lack of response to PO antibiotics
- Note:** A high quality, randomized controlled trial demonstrated that oral cefixime is a safe and effective treatment for children age 1 to 24 months with definite UTI (Hoberman 1999 [A]).
- who are 0 to 30 days of age,
  - who are 31 to 60 days of age and identified as high-risk clinically or by laboratory data, or
  - with whom the clinician or family is uncomfortable managing in an outpatient setting
- (Local Expert Consensus, [E]).

**Medications**

7. It is recommended that a child with presumed UTI be empirically treated with antibiotics after obtaining an appropriate sample for culture. Prompt treatment with antibiotics reduces the severity of renal scarring (Benador 1997 [C], Winberg 1982 [S,E]). See Appendix 7 and Appendix 8 for summary of recommended doses for parenteral and oral antibiotics, respectively.
- Note:** Well-appearing children who are not febrile, and in whom dipstick or urinalysis results are equivocal, can be considered for outpatient observation without starting antibiotic therapy until the subsequent clinical course and culture results are known. As long as uncertainty persists, this course of management assumes:

- available reliable follow up as needed and
  - healthcare provider(s) confident that caregiver will use appropriate observational and follow-up skills
- (Local Expert Consensus, [E]).

8. It is recommended, if the child is diagnosed with a definite UTI, that antibiotic therapy be continued for a minimum of 7 to 14 days (Keren 2002 [M]). Culture and susceptibility results may indicate that a change of antibiotic is necessary. See Appendix 7 and Appendix 8 for summary of recommended doses for parenteral and oral antibiotics, respectively.
9. It is recommended, if the urine culture is negative, that antibiotics be discontinued (Local Expert Consensus [E]).

**Discharge criteria**

10. It is recommended that the hospitalized child be discharged as soon as:
- afebrile for at least 12 hours
  - taking adequate oral fluids
  - pain controlled with oral medications
  - home antibiotics tolerated (PICC line or oral)
  - parent confident in caring for child at home
  - imaging studies are complete or arrangements have been made
  - primary care provider(s) identified, notified, and agree(s) with discharge decision, and arrangements for appropriate follow up have been made
- (Local Expert Consensus [E]).

**Imaging**

Imaging procedures available for children with UTI are described in Appendix 9: ultrasound (US), cystogram and renal cortical scan. See also imaging algorithm, page 8 and Appendix 10 (reflux grading system).

A primary goal of imaging is to identify structural abnormalities of the urinary tract or bladder that may benefit from surgical or medical intervention. Decisions to perform imaging presume that the findings will sufficiently influence management to justify the burden of testing; for example, the discomfort of catheterization.

**Note 1:** The diagnostic validity of a cystogram for detection of VUR<sup>c</sup> does not appear to be affected if the procedure is performed during an inpatient stay for treatment of UTI (Mahant 2001 [D]).

**Note 2:** Routine cystogram and US following a first childhood UTI identifies a small proportion of children with associated treatable conditions. The

<sup>c</sup> VUR = vesicoureteral reflux, often just called “reflux”

approximate prevalences of VUR among girls age 0 to 18yrs referred for VCUG after documented UTI (first or subsequent) are: Grade I 7%; Grade II 22%; Grade III 6%; Grade IV 1%; and Grade V <1% (Bisset 1987 [D]). The prevalence of US-identified anatomic abnormalities amenable to surgical correction following first UTI is approximately 1% (Zamir 2004 [C], Bisset 1987 [D]).

11. It is recommended, because careful long-term outcomes research has not been performed, that children in the following categories, with a first UTI, have a cystogram and US. See Appendix 9.

- all boys
- girls age < 36 months (see Note 1 below)
- girls age 3 to 7 years (84 months) **with fever**  $\geq 38.5^{\circ}\text{C}$  ( $101.3^{\circ}\text{F}$ )

(Gordon 2003 [M], Hoberman 2003 [A], Wennerstrom 2000b [C], Jodal 2000 [S], AAP 1999 [S]).

**Note 1:** Although an age break at three years is used, the appropriate age cutoff may depend, in part, on the girl's ability to verbalize dysuria symptoms and/or her status of toilet training (Local Expert Consensus [E]).

**Note 2:** A relatively small number of significant anatomic abnormalities will be missed if routine imaging after first UTI is not done (Zamir 2004 [C], Bisset 1987 [D]).

**Note 3:** Schedule the US and cystogram for the same date, with the cystogram to follow the US. If an RNC has been ordered, and if there are significant US abnormalities, the Radiology staff physician will ask to substitute a VCUG for the RNC at that appointment (Local Expert Consensus, [E]).

**Note 4:** An optional imaging evaluation for children with febrile UTI, especially those over age three years is to first perform US and renal cortical scan (see Appendix 9). This avoids bladder catheterization (part of the cystogram procedure) if the results of the scan are normal. However, if pyelonephritis or cortical scarring is found on the renal cortical scan, a cystogram is indicated (Local Expert Consensus, [E]).

12. It is recommended, for children in the following categories, that observation without imaging be considered and that the family share in the decision of whether or not imaging be performed after the first UTI or delayed until after the second UTI, if one occurs:

- girls  $\geq 3$  years of age yrs without fever (temperature <  $38.5^{\circ}\text{C}$ )
- all girls > 7 years of age

(Local Expert Consensus, [E]).

Observation without imaging is defined as follow up with dipstick or routine urinalysis when age-appropriate symptoms of UTI are observed.

**Note 1:** For imaging after first or second UTI, one option is to perform a cystogram and US. An alternative, for febrile UTI, is to perform a renal cortical scan and US (see Note 4 in the previous recommendation, and see Appendix 9).

**Note 2:** Factors influencing choice of imaging option:

- clinical symptoms and rate of resolution (see Appendix 5)
- age (continuously decreasing risk of reflux over age five years)
- abnormal relevant history (e.g. voiding dysfunction) or physical exam (e.g. sacral dimple)
- family input: family understands the imaging procedures, that there is a small chance that an anatomic abnormality exists and that close follow up is needed for subsequent UTIs after which imaging may be performed
- compliance: confidence that caregiver will use appropriate observational skills and follow up
- African-Americans have lower risk of vesicoureteral reflux and renal damage (West 1993 [C], Chand 2003 [D], Melhem 1997 [D], Askari 1982 [D])
- availability of prenatal US images for review by radiologist (Ismaili 2004 [C], Chitty 1991 [D]).

13. It is recommended that a renal cortical scan be considered if identification of acute pyelonephritis or renal scarring will affect management decisions in febrile UTI (Wennerstrom 2000a [C], Wennerstrom 2000b [C], Majd 1992 [S,E], Rushton 1988 [F]). See Appendix 9.

**Note:** The long-term significance of scarring identified by a renal cortical scan remains unclear. Factors to be considered are illness severity, grade of vesicoureteral reflux, radiation exposure and avoidance of bladder catheterization.

### Follow up

14. It is **not** recommended that routine follow-up urine cultures be conducted during the initial course of inpatient or outpatient therapy.

**Note:** In a retrospective study, there were no positive results among follow-up urine cultures in 291 children while hospitalized with UTI. Thirty-two percent of these patients had fever longer than 48 hours (Currie 2003 [D]).

15. It is recommended that follow-up assessment for expected clinical response occur after 48 to 72 hours of antimicrobial therapy. Culture and susceptibility results may indicate that a change of antibiotic is necessary. If expected clinical improvement is lacking, consider further evaluation which may include: laboratory studies, imaging, and/or consultation with specialists (*Local Expert Consensus, [E]*).

16. It is recommended that families and clinicians maintain a high index of suspicion for recurrent UTI, and to obtain a dipstick, urinalysis and/or culture for age-appropriate symptoms of UTI, including unexplained fever (*Wennerstrom 2000a [C], Local Expert Consensus [E]*). See Appendix 5. Screening urine cultures are not necessary (*Wettergren 1990 [C]*).

**Note:** Low rates of scarring, hypertension and loss of renal function have been attributed to aggressive assessment of febrile illnesses and treatment of recurrent UTI (*Wennerstrom 2000a [C], Wennerstrom 2000b [C], Wennerstrom 2000c [C]*).

17. It is recommended, for children who will have imaging, to consider the use of post-treatment antibiotic prophylaxis until radiologic evaluation results are known (*Local Expert Consensus [E]*). See Appendix 11 for a summary of recommended doses of prophylactic antibiotics.

**Note:** Uncertainty exists regarding the effectiveness of prophylaxis in improving outcomes (*Garin 2006 [A], Beetz 2006 [S]*). See Appendix 12.

### **Consults and Referrals**

18. It is recommended that consultation with a specialist in childhood renal disorders be considered:

- when uncertain about the management of a child with documented or suspected vesicoureteral reflux, renal scarring, or structural abnormalities of the urinary tract; or
- if a renal or bladder stone is identified (*Local Expert Consensus, [E]*).

19. It is recommended that a consultation with Infectious Diseases be considered when there are questions about antibiotic selection or unusual organisms (*Local Expert Consensus, [E]*).

### **Education**

Health Topics on CCHMC's website <sup>d</sup>:

- [Urinary System Anatomy and Function](#)
- [Urinary Tract Infection \(UTI\) Prevention](#)
- [Temperature Taking](#)
- [Urine Culture: Adult Assisting a Female Child](#)
- [Urine Culture: Adult Assisting a Male Child](#)

Imaging Procedures:

- [Kidney Ultrasound \(US\)](#)
- [Voiding Cystourethrogram \(VCUG\)](#)
- [Nuclear Cystogram \(RNC\)](#)

A parent information brochure, [Urinary Tract Infections in Young Children](#) is available for bulk purchase from the AAP <sup>e</sup>.

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### **Future Research Agenda**

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Clinical questions related to guideline recommendations and of potential interest to CCHMC investigators:

- What are the appropriate cost-benefit age breaks for imaging evaluation in children with their first UTI?
- From the family perspective, is urethral catheterization or suprapubic aspiration the appropriate method for obtaining a urine specimen in young children?
- Does imaging after the first episode compared to the second or later episodes of UTI result in fewer complications?
- What are the appropriate criteria for hospitalization of infants with first UTI?
- What are the likelihood ratios for the various imaging studies performed in children with first UTI?
- In children with a presumptive diagnosis of first UTI, under what circumstances is initiation of antibiotic therapy appropriate?
- What are the relationships between renal scarring associated with first UTI and long-term renal function?
- What proportion of parents desire to participate in decisions regarding management of UTI? What decisions do they make? Is there a relationship

<sup>d</sup> CCHMC Health Topic website:

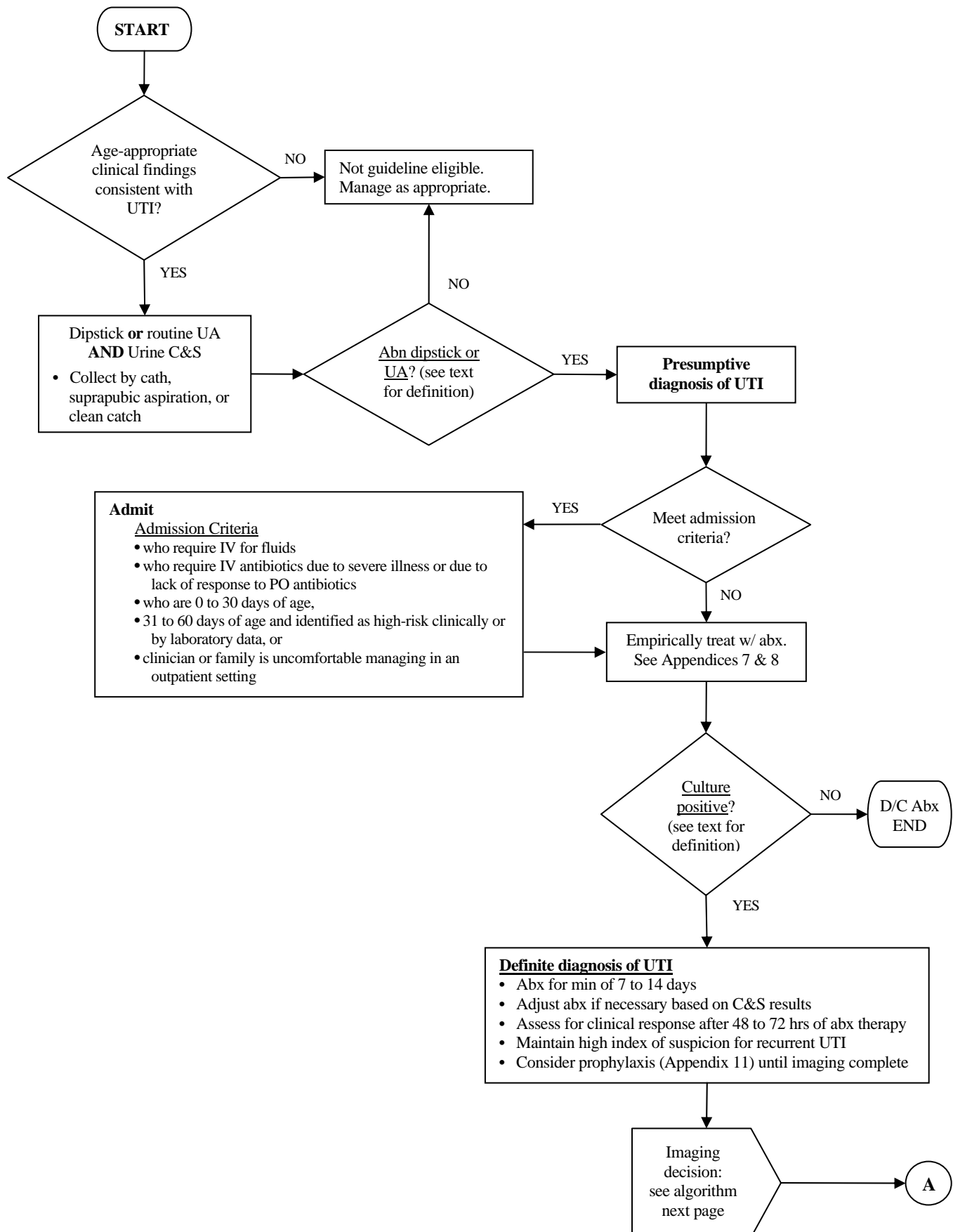
[www.cincinnatichildrens.org/health/info](http://www.cincinnatichildrens.org/health/info)

<sup>e</sup> AAP = American Academy of Pediatrics [www.aap.org](http://www.aap.org)

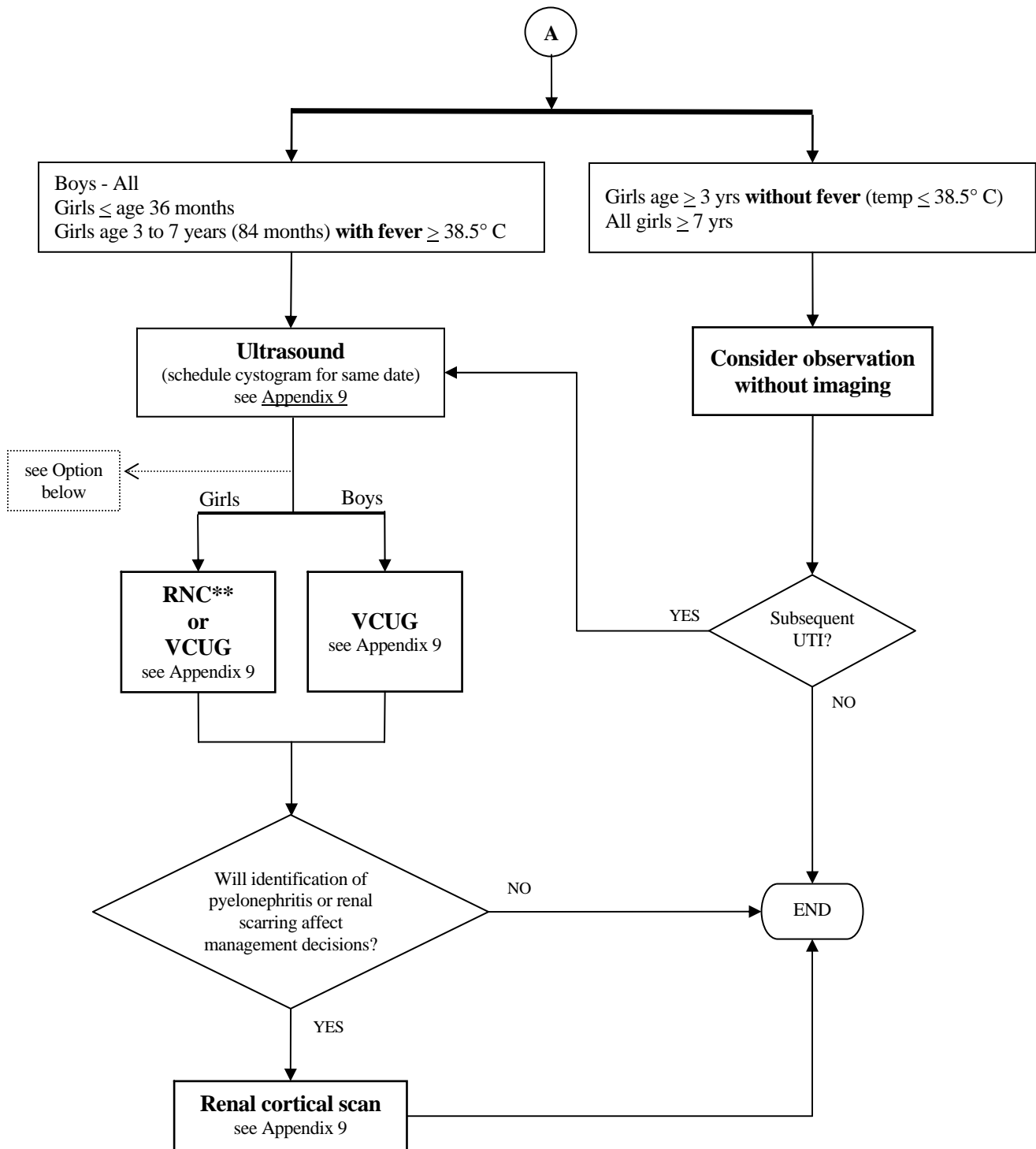
between participation in shared decision making and use of services or patient outcome?

- Are prenatal ultrasound images and reports useful in the workup of children with first UTI?
- Are antibiotics for prophylaxis of recurrent UTI safe and effective? If so, under what circumstances?
- In children who have had one UTI, will dipstick for all/some subsequent febrile illnesses improve outcomes? Is home dipstick screening effective and safe?

## Algorithm for medical management of First Urinary Tract Infection



## Recommended Imaging\* Algorithm for First Urinary Tract Infection



\*Obtain a [Radiology Scheduling Request](#) form: call 513-636-3200, Option #1. FAX completed order request as directed. Physician office or parent to call 513-636-3200 to schedule appointment at a [CCHMC Radiology facility](#).

\*\*If an RNC has been ordered, and if there are significant US abnormalities, the Radiology staff physician will ask to substitute a VCUG for the RNC at that appointment.

**Option:** An optional imaging evaluation for children with febrile UTI, especially those over age three years, is to first perform US and renal cortical scan (see Appendix 9). This avoids bladder catheterization (part of the cystogram procedure) if the results of the scan are normal. However, if pyelonephritis or cortical scarring is found on the renal cortical scan, a cystogram is indicated.

## Appendix 1 Glossary of Terms Related to the Diagnosis and Management of Urinary Tract Infections

**bacteriuria** – bacteria in the urine, may or may not cause symptoms

**bladder** – the sac that holds urine

**calyx** (plural: calyces) – the collection areas in the kidney for urine

**catheter** – a tube placed in the bladder to collect a urine specimen

**catheterization** – the procedure to collect a urine specimen by placing a tube in the bladder

**cortex** (cortical) – the outer part of the kidney

**cyst-, cysto-** – relating to the bladder

**cystitis** – bacterial infection of the bladder

**cystogram** – see Appendix 9 for description of commonly used radiologic evaluation for UTI

**DMSA** (renal cortical scan) – see Appendix 9 for description of commonly used radiologic evaluation for UTI

**dilation, dilatation** – abnormal enlargement of the urine collection system, which may include the ureters, the renal pelvis and the calyces

**dysuria** – painful urination

**febrile** – to have a fever

**flank pain** – pain in the side of the trunk between the right or left upper abdomen and back

**fluoroscopic VCUG** – also called X-ray voiding VCUG, see Appendix 9 for description of commonly used radiologic evaluation for UTI

**hydronephrosis** – a dilation of the renal pelvis and calyces

**imaging** – obtaining medical pictures of the inside of the body

**kidney** (renal) – the bean-shaped organ which moves waste from the blood to the urine for removal from the body

**medulla** (medullary) – the inner part of the kidney

**neph-, nephro-** – relating to the kidney

**nephrologist, nephrology** – a physician and the medical field specializing in the medical care of the kidney

**nuclear cystogram** (RNC) – see Appendix 9 for description of commonly used radiologic evaluation for UTI

**obstruction of the urinary tract** – may be caused by dilation of the collecting system; must be treated if it does not resolve quickly

**parenchyma** (parenchymal) – the part of the kidney that makes urine

**parenteral** – medication administered by any route other than mouth

**pelvis** (pelvic) – the part of the kidney where the calyces join before becoming a ureter

**prophylactic antibiotics** (prophylaxis) – antibiotics given to prevent infection

**pyelonephritis, acute** (APN) – bacterial infection of the kidney

most severe form of UTI

often associated with reflux

occasionally associated with scarring

**RNC** (radionuclide cystogram) – see Appendix 9 for description of commonly used radiologic evaluation for UTI

**radiologic evaluation** – one or more medical imaging procedures conducted and interpreted

**radiologist, radiology** – a physician and the medical field specializing in the medical use of X-rays and other medical images

**radionuclide cystogram** (RNC) – see Appendix 9 for description of commonly used radiologic evaluation for UTI

**reflux** – a condition in which urine backs up from the bladder into the kidney;

also known as VUR or vesicoureteral reflux

severity is graded I – V, see Appendix 10

**renal** – relating to the kidney

**renal cortical scan** (scintigraphy DMSA) – see Appendix 9 for description of commonly used radiologic evaluation for UTI

**scarring** – irreversible damage to the kidney;

may be associated with hypertension and/or chronic renal failure as a long-term adverse outcome

**suprapubic aspiration** – a method of collecting a urine specimen with a needle placed through the abdominal wall (most commonly used on infants)

**susceptibility** – a laboratory test to determine how effective different antibiotics are against this patient's specific bacterial infection

**ultrasound** (US) – see Appendix 9 for description of commonly used radiologic evaluation for UTI

**ureters** (ureteral) – the tubes which carry newly formed urine from the kidneys to temporary storage in the bladder

**urethra** (urethral) – the tube which carries urine from the bladder to the outside of the body

**urologist, urology** – a surgeon and the surgical field specializing in the medical care of the urinary tract

**VCUG** (voiding cystourethrogram) – see Appendix 9 for description of commonly used radiologic evaluation for UTI

**vesicoureteral reflux** (VUR) – see reflux, above

**X-ray voiding cystourography** (VCUG) – see Appendix 9 for description of commonly used radiologic evaluation for UTI

**Appendix 2 Positive Culture Prevalence in Patients with UTI Symptoms, age 0 to 21 Years**

	<b>Boreland, 1986</b>	<b>Lohr, 1993</b>	<b>Marsik, 1986</b>
<b>Type of study</b>	Prospective	Prospective	Prospective
<b>N</b>	N = 700	N = 689	N = 601
<b>Prevalence of Positive Culture</b>	11.7%	14.8%	8.8%
<b>Age</b>	0 – 14 years	1 mo – 16 years	0 – 21 years
<b>Collection Method(s)</b>	<ul style="list-style-type: none"> <li>•not standardized</li> </ul>	<ul style="list-style-type: none"> <li>•midstream void technique, urethral catheterization or suprapubic aspiration</li> <li>•bag specimens not used</li> </ul>	<ul style="list-style-type: none"> <li>•clean-catch methods, catheterization or suprapubic tap</li> </ul>
<b>Criteria for inclusion</b>	<ul style="list-style-type: none"> <li>•urine specimens submitted to hospital lab from inpatient and outpatient sources</li> </ul>	<ul style="list-style-type: none"> <li>•physicians in pediatric clinic requested the urine studies to assist in ruling out or documenting a UTI, including follow up of previous infection</li> <li>•verified by chart review that clinical presentations were consistent with having a UTI</li> <li>•excluded specimens from children with neurogenic bladders or from other children with anatomic abnormalities who were known to have persistent bacteriuria</li> </ul>	<ul style="list-style-type: none"> <li>•not described, laboratory setting</li> <li>•retrospective chart review of all patients with positive cultures showed positive results on at least one of the following: LE, nitrite or microscopy, in 49 of 53 patients; records of the remaining 4 patients did not reveal the presence of UTIs</li> </ul>
<b>Criteria for positive culture</b>	<ul style="list-style-type: none"> <li>• <math>\geq 100,000</math> cfu/mL pure culture or mixed culture of not more than 2 different species</li> <li>•“contaminated” cultures were considered negative</li> </ul>	<ul style="list-style-type: none"> <li>•suprapubic aspiration: <math>&gt; 1,000</math> cfu/mL</li> <li>•catheterization: <math>&gt; 10,000</math> cfu/mL</li> <li>•midstream clean catch: <math>&gt;100,000</math> cfu/mL</li> </ul>	<ul style="list-style-type: none"> <li>•suprapubic aspiration: any number cfu/mL</li> <li>•catheterization: <math>&gt; 10,000</math> cfu/mL</li> <li>•midstream clean catch: <math>&gt; 100,000</math> cfu/mL for gram-negative or <math>&gt; 10,000</math> cfu/mL for gram-positive organisms</li> </ul>

(Lohr 1993 [C], Boreland 1986 [C], Marsik 1986 [C])

**Appendix 3 UTI Prevalence and Risk Factors in Children with Fever**

	<b>Hoberman, 1993</b>	<b>Shaw, 1998</b>	<b>Bachur, 2001</b>
<b>Type of study</b>	Prospective	Prospective	Retrospective
<b>N</b>	N = 945	N = 2411	N = 37,450
<b>% UTI (all figures below)</b>			
<b>Overall Prevalence</b>	5.3	3.3	2.1
<b>Gender</b>			
male	2.5	1.8	1.5
female	8.8	4.3	2.9
<b>Age</b>			
study population	0 to 12mos	< 24 mos	<24 mos
male <6 mos	*	2.7	2.5 – 5.3
male ≥6 mos	*	1.3	0.3 – 0.8
female <12 mos	*	6.0	2.3 – 5.9
female ≥12 mos	*	2.1	1.4
<b>Circumcision</b>			
	98% circumcised	*	*
yes	*	1.2	*
no	*	8.0	*
<b>Race</b>			
white	6.6	10.7	female 5.0 male 1.4
black	3.6	2.1	female 1.0 male 0.8
other	5.0	5.7	female 2.1 male 2.2
<b>Fever</b>			
Study population	T ≥ 38.3° C	T ≥ 38.5° C	T ≥ 38° C
<39° C	4.2	2.2	female 2.2 male 1.3
≥39° C	6.4	3.9	female 3.8 male 1.6
<b>Limitations</b>	<ul style="list-style-type: none"> <li>sample obtained on 47% of potential patients</li> </ul>	<ul style="list-style-type: none"> <li>possible selection bias <ul style="list-style-type: none"> <li>83% of eligible sample</li> <li>excluded patients with definite source of fever</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>30% of possible patients had urine culture</li> <li>concurrent antibiotic use in 14%</li> </ul>
<b>Inclusion Criteria</b>	<ul style="list-style-type: none"> <li>ED setting</li> <li>age ≤ 1 year</li> <li>rectal temp. ≥38.3° C or history within past 24 hours of: <ul style="list-style-type: none"> <li>rectal temp ≥38.3° C or axillary temp ≥37.4° C</li> </ul> </li> <li>no antibiotics within 24 hrs</li> <li>no catheterization within 24 hrs</li> </ul>	<ul style="list-style-type: none"> <li>ED setting</li> <li>boys age &lt; 1 year</li> <li>girls age &lt; 2 years</li> <li>rectal temp. ≥38.5° C</li> <li>not taking antibiotics</li> <li>not immunosuppressed</li> <li>no definite source (minor potential source included)</li> <li>caretaker absent or unable to communicate</li> </ul>	<ul style="list-style-type: none"> <li>ED setting</li> <li>age &lt; 2 years</li> <li>temperature ≥38° C</li> <li>documented urinalysis and culture</li> </ul>

\* data for this cell not available from this study  
(Shaw 1998 [C], Hoberman 1993 [C], Bachur 2001a [D])

### Appendix 4 Organisms Associated With UTI In Children

<b>Gram-negative organisms</b>	<b>Features</b>
<i>Escherichia coli</i>	Most common organism. Causative agent in >80% of first UTIs.
<i>Klebsiella</i> species	Second most common organism. Seen more in young infants.
<i>Proteus</i> species	May be more common in males.
<i>Enterobacter</i> species	Cause <2% of UTIs.
<i>Pseudomonas</i> species	Cause <2% of UTIs.
<b>Gram-positive organisms</b>	<b>Features</b>
<i>Enterococci</i> species	Uncommon >30 days of age.
<i>Coagulase-negative staphylococcus</i>	Uncommon in childhood. If suspicion is high for UTI, adjust antibiotic therapy to cover; otherwise, a repeat culture is prudent.
<i>Staphylococcus aureus</i>	Uncommon >30 days of age.
<i>Group B streptococci</i>	Uncommon in childhood.

(Honkinen 1999 [D])

### Appendix 5 Clinical Signs and Symptoms of UTI

<b>Newborns</b>	<b>Infants and Preschoolers</b>	<b>School Age Children</b>
Jaundice		
Sepsis	Diarrhea	
Failure to thrive	Failure to thrive	
Vomiting	Vomiting	Vomiting
Fever	Fever	Fever
	Strong-smelling urine	Strong-smelling urine
	Abdominal or flank pain	Abdominal or flank pain
	New onset urinary incontinence	New onset urinary incontinence
	Dysuria (preschoolers)	Dysuria
	Urgency (preschoolers)	Urgency
		Frequency

adapted from: (Todd 1995 [S])

**Appendix 6 Definition of LIKELIHOOD RATIOS (LR) in the context of evaluating laboratory and other tests used in the diagnosis of First Urinary Tract Infection**

[Call Clinical Effectiveness Department’s Evidence-Based Care Team for help: 513-636-0180]

A **likelihood ratio (LR)** is:

the likelihood of the presence of a positive test result in the child **WITH** UTI, divided by the likelihood of the presence of a positive test result in the child **WITHOUT** UTI.

An **LR value**:

- greater than 10 is very helpful in increasing diagnostic certainty:  
the test result is 10 times more likely to be present in a child with UTI than in a child without UTI
- of 1 is not helpful:  
the test result is just as likely to be present in child with UTI as in a child without UTI
- less than 0.2 is very helpful in ruling out the condition:  
the test result is one-fifth as likely to be present in a child with UTI as in a child without UTI

The **pre-test probability** is the clinician’s best judgment, BEFORE seeing the test results in question (e.g. nitrite, LE, microscopy), of the percent chance this patient has a UTI. For UTI this may range from 1 to 20% depending on factors such as gender, known symptoms, presence of fever, exposure history to other possible pathogens, etc.

The **post-test probability** is the percent chance this same patient has UTI, AFTER obtaining the test results.

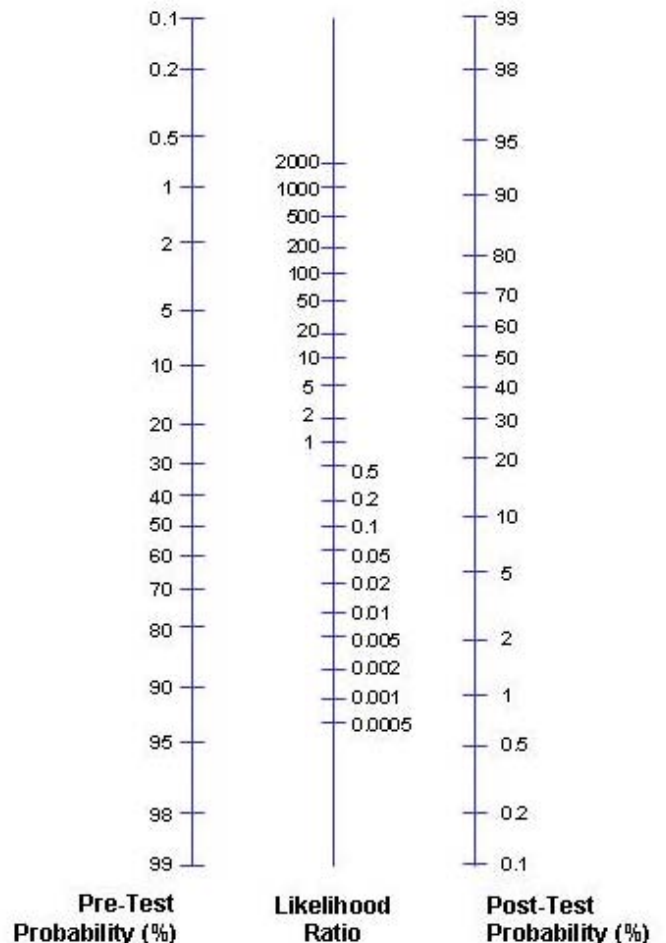
For more information on LRs see: [http://www.cebm.net/likelihood\\_ratios.asp](http://www.cebm.net/likelihood_ratios.asp)

**Probability Worksheet for your own use**

1. Based on \_\_\_\_\_ (Prior Factors Considered), my estimate of the **pre-test probability** is \_\_\_\_\_% that this child has UTI.
2. The diagnostic test that I used, \_\_\_\_\_, has a **LR** of \_\_\_\_\_.
3. Using the nomogram, I calculate that the **post-test probability** is \_\_\_\_\_% that this child has UTI.
4. Repeat steps 1 to 3, as desired, for each additional sign or symptom observed (shortcut: multiply LRs before starting).
5. The final **post-test probability** is \_\_\_\_\_% that this child has UTI.

**Probability Worksheet EXAMPLE**

1. Based on this child’s age, degree of fever, race, gender and the chief complaint for this visit, my uncalculated, but professional estimate of the **pre-test probability is 15%** that this child has UTI, before I have had a chance to do a urinalysis.
2. The diagnostic test result, a positive nitrite, has an **LR of 25**.
3. Using the nomogram, I calculate that the **post-test probability is about 80%** that this child has UTI.
4. Repeating steps 1 to 3, for each additional diagnostic test result, (shortcut: multiply LRs before starting), there is a positive LE which has an **LR of 3** (25 X 3 = 75 = LR for both signs together).
5. With no other significant findings, the final **post-test probability is 92%** that this child has UTI.



**Appendix 7 Parenteral Antibiotics for Treatment of UTI (usually inpatient)**

Antibiotic	Dose, Frequency & Max Daily Dose	Relative Cost	Comments
<b>Cefotaxime</b> (Claforan®)	150 mg / kg / day Max daily dose: 12 gm given as: 50 mg / kg every 8 hours if age < 7 days, given as: 50 mg / kg every 12 hours	Mod	If 0 to 30 days of age, combine with ampicillin. If 31 to 60 days of age consider adding ampicillin to assure coverage for <i>Listeria monocytogenes</i> , gram-positive cocci or enterococcus (Brown 2002 [M], Byington 2003 [D], Sadow 1999 [D]).
<b>Ampicillin</b>	100 mg / kg / day Max daily dose: 12 gm given as: 25 mg / kg every 6 hours if age < 7 days, given as: 50 mg / kg every 12 hours	Low	In combination with a 3 <sup>rd</sup> generation cephalosporin or gentamicin for infants ≤ 30 days of age to cover for <i>L. monocytogenes</i> or enterococcal infection. Consider adding for infants 31 to 60 days of age (Brown 2002 [M]).
<b>Gentamicin</b>	Determine dosing based on age, gestational age, and individual renal function if age < 1 month, given as: 3 mg / kg every 24 hours if age 1 – 2 months, given as: 2.5 mg / kg every 12 hours if age ≥ 3 months, given as: 1.5 – 2.5 mg / kg every 8 hours	Low	Not first line drug as monotherapy. If 0 to 30 days of age, combine with ampicillin. If 31 to 60 days of age consider adding ampicillin to assure coverage for <i>Listeria monocytogenes</i> or enterococcus (Brown 2002 [M], Byington 2003 [D], Sadow 1999 [D]).
<b>Ceftriaxone</b> (Rocephin®)	50 – 100 mg / kg / day Max daily dose: 1 gm, but may be as high as 2 to 4 gm for adult weight older child with severe disease given: 25 – 50 mg / kg every 12 hours, or 50 – 100 mg / kg every 24 hours	Mod	Reserve IM administration for child unable to tolerate oral route or when compliance is a concern (Local Expert Consensus, [E]). Use with caution in jaundiced infant (Wagner 2000 [C], Martin 1993 [C]).

Source for dosages: CCHMC Formulary

**Appendix 8 Antibiotics for Outpatient Treatment of UTI**

Recommend minimum of 7 to 14 days treatment. See Appendix 11 for subsequent prophylactic doses.

Antibiotic & Dose Form	Dose, Frequency & Max Daily Dose (oral unless otherwise specified)	<i>(Steele 1997 [O])</i>		Comments
		Taste	Relative Costs	
<b>First-Line Antibiotics Recommended for First Urinary Tract Infection</b>				
<b>Cefixime</b> (Suprax®) 100mg / 5mL suspension or 400 mg tablet	Day 1: 16 mg / kg / day taken as: 8 mg / kg BID Day 2 – 14: 8 mg / kg / day taken once daily Max daily dose: 400 mg	OK	High	<i>(Hoberman 1999 [A])</i>
<b>Cephalexin</b> (Biocef®, Keflex®) 125 or 250 mg / 5mL suspension or 250 or 500 mg capsule	25 – 100 mg / kg / day Max daily dose: 4 gm taken in 4 divided doses	OK	Low	
<b>Sulfamethoxazole / Trimethoprim</b> (Bactrim®, Septra®, Generic) 200/40 mg S/T per 5mL suspension or 400/80 or 800/160 mg S/T tablet	Dosing based on trimethoprim 6 – 10 mg / kg / day Max daily dose: 320 mg trimethoprim 1600 mg sulfamethoxazole taken as: 3 – 5 mg / kg / dose twice a day	Un- pleasant	Mod	Use with caution in jaundiced infant ( <i>Notarianni 1990 [S], Shankaran 1977 [F]</i> ). May be an appropriate choice in an older child.
<b>Alternative Antibiotics for Patients with Special Circumstances</b>				
<b>Nitrofurantoin</b> (Macrochantin®, Furadantin®) 25 mg / 5mL suspension or 25, 50 or 100 mg capsule	5 – 7 mg / kg / day Max daily dose: 400 mg taken in 4 divided doses	Un- pleasant	Low	Not considered adequate for treatment for pyelonephritis because of poor tissue penetration. May be useful in older children with cystitis.
<b>Ciprofloxacin</b> (Cipro®) 250 or 500 mg / 5mL suspension or 100, 250, 500 or 750 mg tablet	20 – 30 mg / kg / day Max daily dose: 1.5 gm taken in 2 divided doses	Un- pleasant	High	Approved as a second line agent for complicated UTI in children over one year of age.
<b>Ceftriaxone</b> (Rocephin®)	50 – 100 mg / kg / day Max daily dose: 1 gm, but may be as high as 2 - 4 gm for adult weight older child with severe disease given: 25 – 50 mg / kg every 12 hours, or 50 – 100 mg / kg every 24 hours	NA	High	Reserve IM administration for child unable to tolerate oral route or when compliance is a concern ( <i>Local Expert Consensus, [E]</i> ). Use with caution in jaundiced infant ( <i>Wagner 2000 [C], Martin 1993 [C]</i> ).
<b>Note:</b> Amoxicillin is not listed in this table due to the increasing incidence of resistance to <i>E. Coli</i> .				

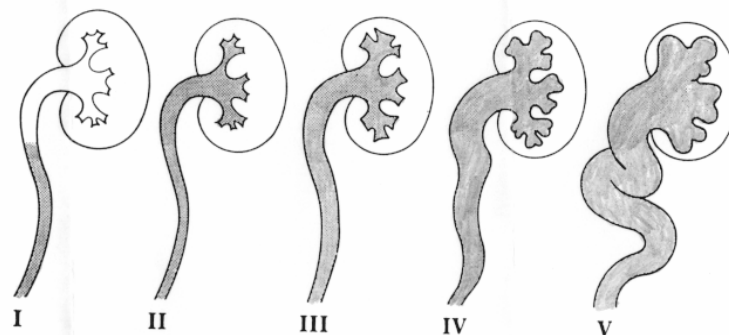
CCHMC Formulary

**Appendix 9 Three major categories for radiologic evaluation of a child following a first definite UTI**

Category	Procedure	Purpose	Notes
<b>I. ULTRASOUND</b>	<b>Renal and bladder ultrasound (US)</b>	Demonstration of the anatomy of the kidneys, ureters, and bladder	Not reliable to evaluate reflux Limited accuracy in evaluation of renal scarring or pyelonephritis
<b>II. CYSTOGRAM</b>	<b>Radionuclide Cystogram (RNC)</b> also called nuclear cystogram	Screening and grading vesicoureteral reflux (VUR)	Suggested for girls only, if available Reproducibly low radiation dose The grading is similar to VCUg when performed by experienced radiologist Little anatomic detail
	<b>X-ray voiding cystourethrogram (VCUG)</b> also called fluoroscopic VCUG	Screening and grading vesicoureteral reflux (VUR) Demonstration of anatomic detail of the male urethra, ureters (when reflux is present), and bladder	Suggested for girls and all boys Involves ionizing radiation
<b>III. RENAL CORTICAL SCAN</b>	<b>Renal Cortical Scan</b> uses <sup>99m</sup> Tc DMSA or <sup>99m</sup> Tc glucoheptonate also called scintigraphy or DMSA	Accurate for differentiating pyelonephritis from cystitis and assessing for renal scarring.	Requires IV injection of radioisotope, with imaging about 2 hours later for about 45 minutes Sedation usually required in those < 3 years of age
<b>General Comments:</b>			
<ul style="list-style-type: none"> <li>Both ultrasound and cystogram may be scheduled for the same visit. If the RNC is not available at the preferred location, a VCUG is acceptable.</li> <li>The diagnostic validity of VCUG for detection of VUR does not appear to be affected by performing the procedure during inpatient stay for treatment of UTI (<i>Mahant 2001 [DJ]</i>).</li> <li>When performing a cystogram on a child at risk for bacterial endocarditis due to a congenital heart defect, the American Heart Association recommends <a href="#">prophylactic antibiotic therapy</a>.</li> </ul>			

**Appendix 10 International Reflux Grading System of Vesicoureteral Reflux (VUR)**

Grade	Degree of reflux
I	Into distal ureter
II	Up ureter into pelvis and calyces. No dilatation, normal calyceal fornices
III	Same as II, but with mild dilatation of pelvis and calyces
IV	Same as III, but the ureter and pelvis are moderately dilated, and the calyces are moderately blunted
V	Gross dilatation and tortuosity of ureter, pelvis and calyces with significant blunting of the majority of the calyces.



(Lebowitz 1985 [X])

**Appendix 11 Prophylactic Antibiotics**

Recommend until radiologic evaluation results are known and duration individualized thereafter

<b>Drug</b>	<b>Dose , Frequency &amp; Max Daily Dose</b>	<b>Taste</b> <i>(Steele 1997 [O])</i>	<b>Relative Costs</b>	<b>Comments</b>
<b>Sulfamethoxazole / Trimethoprim</b> (Bactrim®, Septra®, Generic) 200/40 mg S/T per 5mL suspension or 400/80 or 800/160 mg S/T tablet	dosing based on trimethoprim 2 mg / kg / day Max daily dose: 320 mg trimethoprim 1600 mg sulfamethoxazole taken: daily at bedtime	Unpleasant	Mod	<i>(Smellie 1988 [C], Smith 1994 [D])</i> Use with caution in jaundiced infant <i>(Notarianni 1990 [S], Shankaran 1977 [F])</i> .
<b>Nitrofurantoin</b> (Macrochantin®, Furadantin®) 25 mg / 5mL suspension or 25, 50 or 100 mg capsule	1 – 2 mg / kg / day Max daily dose: 100 mg taken daily at bedtime	Unpleasant	Low	
<b>Amoxicillin</b> 125, 200, 250 or 400 mg / 5mL suspension or 250 or 500 mg capsule or 500 or 875 mg tablet or 125, 200, 250, 400 mg chewable tablet	10 mg / kg / day Max daily dose: 2 gm taken: daily at bedtime	OK	Low	Use may be limited due to increasing resistance <i>(Byington 2003 [D], Sadow 1999 [D])</i> .
<b>Cephalexin</b> (Biocef®, Keflex®) 125 or 250 mg / 5mL suspension or 250 or 500 mg capsule	10 mg / kg / day Max daily dose: 4 gm taken: daily at bedtime	OK	Mod	This choice is not preferred but is used occasionally for patients with intolerance or allergies to nitrofurantoin and sulfamethoxazole.

CCHMC Formulary

## Appendix 12 Prophylaxis

Recurrent UTIs are associated with renal scarring in girls (*Wennerstrom 2000c [C]*, *Greenfield 1997 [D]*) and renal scarring may be associated with changes in renal function of uncertain clinical significance (*Wennerstrom 2000b [C]*).

In recent decades, based on biological plausibility and results of evidence from early studies which are now considered low quality due to study design flaws (*Le Saux 2000 [M]*, *Smellie 1978 [B]*, *Lohr 1977 [B]*, *Holland 1963 [C]*), antibiotic prophylaxis has been used extensively in children with reflux, in children who have had pyelonephritis in the absence of reflux, in children with recurrent UTI of undetermined cause, and in children with both minor and major urinary tract anomalies. VUR has been considered an important risk factor for scarring (*Jodal 1999 [S,E]*).

More recently, the relationship of VUR to scarring has been questioned (*Wheeler 2004 [M]*, *Wennerstrom 2000c [C]*). In addition, systematic reviews do not confirm the effectiveness of antibiotic prophylaxis in preventing UTIs (*Williams 2001 [M]*, *Le Saux 2000 [M]*). Not included in those reviews is one good quality recently published randomized controlled trial (RCT) described below. Several high quality studies are currently being conducted.

A recent randomized controlled trial (RCT) of 218 children with acute pyelonephritis (age 3 months to 18 years) demonstrated no benefit of antibiotic prophylaxis for preventing recurrent UTI, pyelonephritis, or scarring in children with or without reflux (grades I – III only) after one year of follow up. The overall incidence of UTI recurrence after pyelonephritis was 20.1% with no statistically significant differences between those with or without VUR or those with or without prophylaxis. Most cases of recurrence were cystitis. Twelve patients had recurrence of pyelonephritis. Thirteen of the 218 patients developed renal scars, including 7 with VUR and 6 without. Most of the patients with scarring and VUR had grade III reflux (*Garin 2006 [A]*).

Scientific uncertainty remains regarding many aspects of preventing adverse outcomes of UTIs. Unanswered questions include the effectiveness of long-term antibiotic use in preventing UTI recurrence or renal scarring, the ability to identify which at-risk patients would most benefit from this intervention, and whether it is safe to wait for a second UTI before intervening with antibacterial prophylaxis (*Beetz 2006 [S]*).

Therefore, the role of prophylaxis is evolving and may vary with the age of the child, the severity of the initial illness, and the results of any imaging studies (*Beetz 2006 [S]*).

The following relate to the decision to use prophylactic antibiotics after a first UTI:

- individual risk of recurrence of UTI, especially of pyelonephritis
- individual risk of scarring or other renal damage
- presence of voiding dysfunction
- adverse effects of long-term use of antibiotics
- individual patient/family adherence/compliance behavior
- individual patient/family preferences and values

(*Le Saux 2000 [M]*, *Garin 2006 [A]*, *Wennerstrom 2000a [C]*, *Wennerstrom 2000b [C]*, *Wennerstrom 2000c [C]*, *Beetz 2006 [S]*, *Wald 2006 [E]*, *Local Expert Consensus [E]*).

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## Development Process

The process by which this guideline was developed is documented in the [Guideline Development Process Manual](#); a Team Binder maintains minutes and other relevant development materials. The recommendations contained in this guideline were formulated by an interdisciplinary working group which performed systematic and critical literature reviews, using the grading scale that follows, and examined current local clinical practices.

CCHMC Grading Scale			
M	Meta-analysis or Systematic Review	S	Review article
A	Randomized controlled trial: large sample	E	Expert opinion or consensus
B	Randomized controlled trial: small sample	F	Basic Laboratory Research
C	Prospective trial or large case series	L	Legal requirement
D	Retrospective analysis	Q	Decision analysis
O	Other evidence	X	No evidence

To select evidence for critical appraisal by the group, the Medline, EmBase and the Cochrane databases were searched for dates of January, 1999 through October, 2004 to generate an unrefined, "combined evidence" database using a search strategy focused on answering clinical questions relevant to UTI and employing a combination of Boolean searching on human-indexed thesaurus terms (MeSH headings using an OVID Medline interface) and "natural language" searching on searching on human-indexed thesaurus terms (MeSH headings using an OVID Medline interface) and "natural language" searching on words in the title, abstract, and indexing terms. The citations were reduced by: eliminating duplicates, review articles, non-English articles, and adult articles. The resulting abstracts were reviewed by a methodologist to eliminate low quality and irrelevant citations. During the course of the guideline development, additional clinical questions were generated and subjected to the search process, and some relevant review articles were identified. December 1998 was the last date for which literature was reviewed for the previous version of this guideline. The details of that review strategy are not documented. However, all previous citations were reviewed for appropriateness to this revision.

A search using the above criteria was conducted for dates of October, 2004 through July, 2006. One relevant article was selected as potentially requiring changes to the 2005 version of the recommendations. The article was appraised and the Team approved the following changes to the guideline:

- emphasize early identification of recurrent UTI (recommendation 16 and new note) with respective change to the algorithm
- clarify language, not intent, in prophylaxis recommendation (recommendation 17) and refer reader to new Appendix 12 for discussion of prophylaxis
- clarify the title of the guideline
- consecutively number all recommendations

Tools to assist in the effective dissemination and implementation of the guideline may be available online at <http://www.cincinnatichildrens.org/svc/alpha/h/health-policy/ev-based/default.htm>. Experience with the implementation of earlier publications of this guideline has provided learnings which have been incorporated into this revision.

Once the guideline has been in place for three years, the development team reconvenes to explore the continued validity of the guideline. This phase can be initiated at any point that evidence indicates a critical change is needed.

Recommendations have been formulated by a consensus process directed by best evidence, patient and family preference and clinical expertise. During formulation of these recommendations, the team members have remained cognizant of controversies and disagreements over the management of these patients. They have

tried to resolve controversial issues by consensus where possible and, when not possible, to offer optional approaches to care in the form of information that includes best supporting evidence of efficacy for alternative choices.

The guideline has been reviewed and approved by clinical experts not involved in the development process, distributed to senior management, and other parties as appropriate to their intended purposes.

The guideline was developed without external funding. All Team Members and Clinical Effectiveness support staff listed have declared whether they have any conflict of interest and none were identified.

Copies of this Evidence-based Care Guideline (EBCG) are available online and may be distributed by any organization for the global purpose of improving child health outcomes. Website address: <http://www.cincinnatichildrens.org/svc/alpha/h/health-policy/ev-based/default.htm> Examples of approved uses of the EBCG include the following:

- copies may be provided to anyone involved in the organization's process for developing and implementing evidence-based care guidelines;
- hyperlinks to the CCHMC website may be placed on the organization's website;
- the EBCG may be adopted or adapted for use within the organization, provided that CCHMC receives appropriate attribution on all written or electronic documents; and
- copies may be provided to patients and the clinicians who manage their care.

Notification of CCHMC at [HPCEInfo@cchmc.org](mailto:HPCEInfo@cchmc.org) for any EBCG adopted, adapted, implemented or hyperlinked by the organization is appreciated.

**NOTE: These recommendations result from review of literature and practices current at the time of their formulations. This guideline does not preclude using care modalities proven efficacious in studies published subsequent to the current revision of this document. This document is not intended to impose standards of care preventing selective variances from the recommendations to meet the specific and unique requirements of individual patients. Adherence to this guideline is voluntary. The physician in light of the individual circumstances presented by the patient must make the ultimate judgment regarding the priority of any specific procedure.**

*For more information about this guideline, its supporting evidences and the guideline development process, contact the Health Policy & Clinical Effectiveness office at: 513-636-2501 or [HPCEInfo@cchmc.org](mailto:HPCEInfo@cchmc.org).*

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