Urinary Tract Infection (UTI) v11.0: Criteria and Definition

Approval & Citation | Summary of Version Changes | Explanation of Evidence Ratings

Inclusion Criteria

- Birth to 18 years with a postmenstrual age of at least 40 weeks
- Presumed or definite first-time or recurrent UTI in an otherwise healthy child

Exclusion Criteria

- Chronic kidney disease as defined by estimated glomerular filtration rate (GFR) by the original Schwartz formula < 80 mL/min/ 1.73m^2
- Known OR suspected genitourinary abnormalities, including: previous genitourinary surgery (other than circumcision), neurogenic bladder conditions, obstructive uropathy, vesicoureteral reflux
- Septic shock
- Presumed or definite meningitis
- Conditions requiring Intensive Care Unit care
- Immunocompromised host
- Pregnancy
- Recent history of sexual abuse

Diagnosis
Outpatient Management
Inpatient Management
Imaging
Culture Results Decision Tree

Definition of a UTI

- Clinical signs and symptoms
- UA with pyuria and/or bacteriuria
- Growth of a urinary pathogen

Specimen	Possible	Definite
Catheterization	≥ 10,000 cfu/mL	≥ 50,000 cfu/mL
Clean-catch	≥ 50,000 cfu/mL	≥ 100,000 cfu/mL

For questions concerning this pathway, contact: UTI@seattlechildrens.org

Last Updated: October 2020
Next Expected Review: February 2025

Urinary Tract Infection (UTI) v11.0: Diagnosis

Approval & Citation | Summary of Version Changes | Explanation of Evidence Ratings

Not Toilet Trained
Infants 0-56 Days of Age
- See Neonatal Fever pathway

Not Toilet Trained
Female > 56 Days of Age*

Risk Factors
- Temperature ≥ 39°C
- Fever ≥ 2 days
- No source
- < 12 months of age

If 2 factors present
- Consider screening

If 3 or more factors present
- Recommend screening

Not Toilet Trained
Male > 56 Days of Age*

Risk Factors
- Temperature ≥ 39°C
- Fever ≥ 2 days
- No source
- < 6 months of age

If 1 factor present
- If uncircumcised, consider screening

If 2 factors present
- If circumcised, consider screening
- If uncircumcised, recommend screening

If 3 or more factors present
- If circumcised, recommend screening

Patients 2 to 23 Months of Age
- Can also use UTICalc tool to help with decision to test https://uticalc.pitt.edu/

Fully Toilet Trained
All Patients

Risk Factors
- Symptoms referable to urinary tract
- Prior history of UTI and fever ≥ 2 days
- Prolonged fever ≥ 5 days

If any factors present
- Recommend screening

***If prior history of UTI, consider screening if**
- Fever ≥ 2 days
- No alternative source

Decision-to-test criteria met?

Obtain Urinalysis and Urine Culture by the Following Method(s)

- **Infants and Non-Toilet Trained Children:** Catheterization or if unable to catheterize, consider suprapubic aspiration (SPA)
- **Toilet Trained Children:** Midstream clean catch
- **Adolescents:** Midstream clean catch + 'dirty' urine for Gonococcus (GC) / Chlamydia (Chl)

Additional Studies

For infants 0-56 days of age
- See Neonatal Fever pathway

For adolescents
- HSV testing: culture visible lesions, or cervical culture as indicated
- If GC/Chl positive: consider Syphilis Screen
- Annual HIV testing
- Consider pregnancy testing in girls

If ill appearing
- See Septic Shock pathway

*Risk factors and screening recommendations are adapted from CHOP's UTI pathway (www.chop.edu/clinical-pathway/urinary-tract-infection-uti-febrile-clinical-pathway). This screening algorithm is intentionally not consistent with the American Academy of Pediatrics UTI guideline for risk assessment that includes race as a factor. The pathway team believes that there is little biological basis for including race as a UTI risk factor (NEJM 2020; 383:874-882). If using UTICalc to calculate pre/post-test probabilities, we recommend selecting 'non-black' for all patients.

Last Updated: October 2020
Next Expected Review: February 2025

Urinary Tract Infection (UTI) v11.0: Outpatient Management

Approval & Citation | Summary of Version Changes | Explanation of Evidence Ratings

Patients 2 to 23 Months of Age
- Can also use UTICalc tool to help with decision to start antibiotics https://uticalc.pitt.edu/

UA with pyuria
- ≥ trace LE or
- ≥ 5 WBC/hpf

and/or bacteriuria?

Yes

Admit Criteria

All Age Categories
- Dehydration requiring IV fluids
- Adherence risk as defined by: unable to take previously prescribed regimen, no reliable caregivers at home, inability to follow recommended care plan, or at risk for loss to follow-up
- Failed outpatient therapy as defined by: persistent clinical symptoms beyond 48 hours on appropriate therapy, or inability to maintain hydration status

Infants
- Admit all febrile patients up to 56 days of age with presumed or definite UTI

Adolescents
- Adherence risk is not an admission criteria for adolescents with cystitis

Patient meets admit criteria?

No, begin outpatient management for presumed UTI

Yes, begin inpatient management for presumed UTI

Go to Inpatient

Outpatient Management: Nonfebrile Infants 29-56 days
- Give cephalexin PO
- Consider ceftriaxone IM if concern for PO tolerance
- Follow up with primary care provider within 24 hours

Outpatient Management: Non-Toilet Trained Children, Toilet Trained Children & Adolescents
- Give cephalexin PO OR trimethoprim/sulfamethoxazole PO (if cephalexin allergy concern, see Beta-Lactam Antibiotic Allergy Reference)
- Consider ceftriaxone IM if concern for PO tolerance
- Follow up with primary care provider within 24 hours

!

Criteria for Urology Referral

!

Consider further imaging if no improvement in 48 hrs

Culture results follow-up
- Call family to review culture results
- Narrow coverage when sensitivities return

Urinary Tract Infection (UTI) v11.0: Inpatient Management

Approval & Citation | Summary of Version Changes | Explanation of Evidence Ratings

Inpatient Management: Infants 0-28 days

- Give IV ampicillin + gentamicin

If *E. coli*
- Minimum 3 days IV antibiotics
- Consider switch to PO after 3 days if afebrile and back to baseline ≥24 hours, identification and sensitivities returned

If Non-*E. coli*
- *S. aureus* or *Pseudomonas*: consult ID
- Other non-*E. coli* pathogens: consider ID consult to discuss IV duration

- Total IV+PO duration: 14 days

Inpatient Management: Infants 29-56 days

- Give IV cefazolin **OR** ampicillin + gentamicin if cocci/ enterococcus is suspected
- Minimum 36 hours IV antibiotics
- Switch to PO after 36 hours if afebrile and back to baseline ≥24 hours, identification and sensitivities returned
- Total IV+PO duration: 14 days

Inpatient Management: Older Infants, Children & Adolescents

- Give IV cefazolin **OR** ampicillin + gentamicin if cocci/ enterococcus is suspected
- No minimum IV duration
- Switch to PO if responding after identification and sensitivities return
- Total antibiotic duration: 7 days
  - Consider longer total duration up to 14 days if atypical clinical course, non-*E. coli* UTI, or abnormal renal-bladder ultrasound
- Adolescents with cystitis: 3 days total

Positive Blood Culture

If *E. coli*
- Repeat blood culture if not clinically improved within 48 hours of starting antibiotics
- Consider switch to PO after 3 days if meets criteria above, plus repeat blood culture negative x36 hours (if applicable)

If Non-*E. coli*
- *S. aureus* or *Pseudomonas*: repeat blood culture and consult ID
- Other non-*E. coli* pathogens: repeat blood culture and consider ID consult to discuss IV duration

Positive Blood Culture

If *E. coli*
- Repeat blood culture if not clinically improved within 48 hours of starting antibiotics
- Minimum 2 days IV antibiotics
- Consider switch to PO after 2 days if meets criteria above, plus repeat blood culture negative x36 hours (if applicable)

If *Non-E. coli*
- *S. aureus* or *Pseudomonas*: repeat blood culture and consult ID
- Other non-*E. coli* pathogens: repeat blood culture and consider ID consult to discuss IV duration

! Consider further imaging if no improvement in 48 hrs

! Criteria for Urology Referral

Discharge Criteria

General discharge criteria for all patients
- Clinical response to therapy
- Social risk factors assessed and addressed
- Family education provided/completed
- Urine culture is negative on final report OR urine culture is positive and patient is on targeted antibiotics
- Other studies for bacteremia and meningitis are negative (if applicable), or if bacteremic have completed appropriate course of IV antibiotic therapy
- If indicated, renal ultrasound completed or scheduled
- If indicated, VCUG scheduled
- Consultation (e.g., urology, nephrology, ID) completed if desired

Last Updated: October 2020
Next Expected Review: February 2025

Urinary Tract Infection (UTI) v11.0: Imaging

Approval & Citation | Summary of Version Changes | Explanation of Evidence Ratings

Patients ≤ 24 Months of Age

- RBUS if
  - First-time febrile UTI or
  - Recurrent febrile UTI
- If stones are present, refer to Nephrolithiasis pathway

Patients > 24 Months of Age

- RBUS if
  - Non-*E. coli* UTI,
  - Recurrent febrile UTI, or
  - Atypical clinical course
- If stones are present, refer to Nephrolithiasis pathway

Obtain Renal Bladder Ultrasound (RBUS)

- Within 1 month or
- During acute infection if severe illness or not improving by 48 hours

RBUS results

Urinary Tract Dilation (UTD) Normal

- No further imaging

UTD P1

- Repeat RBUS in 1-6 months
- If abnormalities persist on repeat RBUS, consult Urology

UTD P2

- Repeat RBUS in 1-3 months AND consider VCUG
- Consult Urology as needed for imaging recommendations or imaging abnormalities

UTD P3 or Kidney Size Discrepancy

- Schedule VCUG and Urology evaluation
- Start prophylactic antibiotics after acute treatment until VCUG performed or Urology evaluation

Recurrent Febrile UTI

Patients ≤ 12 months of age

- Schedule VCUG (regardless of RBUS results)
- Consider Urology consult

Patients > 12 months of age

- Consult Urology for imaging recommendation

Voiding Cystourethrogram (VCUG)

- When patient is stable
- >24 hours afebrile
- Preferably after 4+ days of antibiotics

VCUG results

Gr I-III vesicoureteral reflux

- Antibiotic prophylaxis not routinely recommended

Gr IV-V vesicoureteral reflux

- Management per Urology

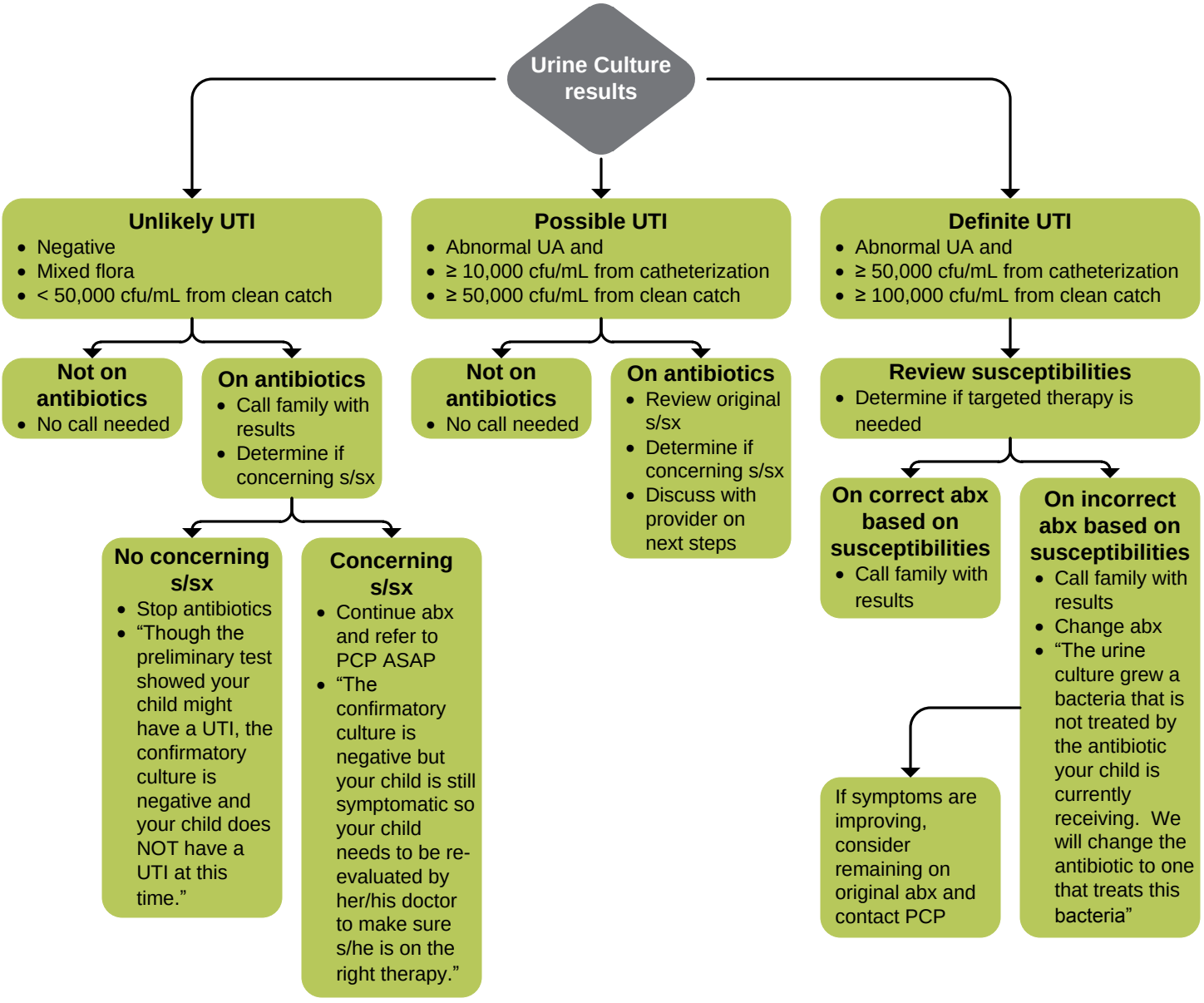
Last Updated: October 2020
Next Expected Review: February 2025

Urinary Tract Infection (UTI) v11.0: Emergency / Urgent Care
UTI Culture Results Decision Tree

Approval & Citation | Summary of Version Changes | Explanation of Evidence Ratings

Concerning signs/symptoms
- Persistent fever
- Persistent vomiting and/or abdominal pain
- Persistent dysuria
- In patients with GU abnormalities or recurrent UTIs – persistence of presenting complaints typical of prior UTIs

Inclusion Criteria
- Child discharged with presumed UTI
- UCx pending



UTI Pathway: Additional Information

Urinalysis (UA) Post-Test Probability, Part 1

Urinalysis Results (# Studies, n) Gold Standard: Urine Culture	(+) LE Trace or greater	(+) Nitrite	(+) gram stain	WBC > or = 5 per HPF	WBC > or = 10 per HPF	> 1 bacteria per HPF	(-) LR Point estimate (95% CI)	(-) LR GRADE	(-) Post –test probability (%) low prevalence estimate of 5%	(-) Post –test probability (%) high prevalence estimate of 25%	(+) LR Point estimate (95% CI)	(+) LR GRADE	(+) Post –test probability (%) low prevalence estimate of 5%	(+) Post –test probability (%) high prevalence estimate of 25%
Recommended for both thresholds														
WBC > or = 10 per HPF or (+) Gram Stain (1 study, n = 3741)					WBC > or = 10 per HPF		0.0 (0.0-0.1)	+4 High certainty	0 (0-1)	0 (0-3)	12.9 (11.5-14.4)	+4 High certainty	40 (38-43)	81 (79-83)
			(+) gram stain											
Recommended based on NPV > 98% threshold:														
(+) LE (trace or >), (+) nitrite and WBC > or = 10 per HPF (1 study, n = 4935)	(+) LE Trace or greater	(+) Nitrite			WBC > or = 10 per HPF		0.06 (0.04-0.08)	+4 High certainty	0 (0-0)	0 (0-0)	7.6 (7.1-8.2)	+4 High certainty	29 (27-30)	72 (70-73)
Nitrite or LE (trace or >) or WBC > 5 per HPF (1 study, n = 3470)	(+) LE Trace or greater						0.07 (0.04-0.10)	+4 High certainty	0 (0-1)	2 (1-3)	10.5 (9.4-11.6)	+3 Moderate certainty	36 (33-38)	78 (76-79)
		(+) Nitrite												
				WBC > or = 5 per HPF										
(+) Nitrite or LE (trace or >) (2 studies, n = 3814)	(+) LE Trace or greater						0.09 (0.0-0.15)	+4 High certainty	0 (0-1)	3 (0-5)	14.8 (8.7-25.2)	+2 Low certainty	44 (31-57)	83 (74-89)
		(+) Nitrite												

Return to Diagnosis Page

Continue to Part 2

Return to Home

UTI Pathway: Additional Information

Urinalysis (UA) Post-Test Probability, Part 2

Urinalysis Results (# Studies, n) Gold Standard: Urine Culture	(+) LE Trace or greater	(+) Nitrite	(+) gram stain	WBC > or = 5 per HPF	WBC > or = 10 per HPF	> 1 bacteria per HPF	(-) LR Point estimate (95% CI)	(-) LR GRADE	(-) Post –test probability (%) low prevalence estimate of 5%	(-) Post –test probability (%) high prevalence estimate of 25%	(+) LR Point estimate (95% CI)	(+) LR GRADE	(+) Post –test probability (%) low prevalence estimate of 5%	(+) Post –test probability (%) high prevalence estimate of 25%
Recommended based on PPV > 50% threshold														
WBC > or = 10 per HPF and (+) Gram Stain (1 study, n= 4007)			(+) gram stain		WBC > or = 10 per HPF		0.12 (0.09-0.18)	+4 High certainty	1 (0-1)	4 (3-6)	104.3 (74.3-146.3)	+4 High certainty	85 (80-89)	97 (96-98)
WBC > or = 5 per HPF (4 studies, n = 7003)				WBC > or = 5 per HPF			0.29 (0.18-0.46)	+2 Low certainty	2 (1-2)	9 (6-13)	13.9 (11.7-16.4)	+4 High certainty	42 (38-46)	82 (80-85)
WBC > or = 10 per HPF (4 studies, n=10068)					WBC > or = 10 per HPF		0.26 (0.07-1.02)	+1 Very low certainty	1 (0-5)	8 (2-25)	16.3 (10.4, 25.6)	+3 Moderate certainty	46 (35-57)	84 (78-90)
(+) LE (trace or >) (2 studies, n = 3899)	(+) LE Trace or greater						0.13 (0.05-0.34)	+2 Low certainty	1 (0-2)	4 (2-10)	19.3 (12.0, 31.2)	+4 High certainty	50 (39-62)	87 (80-91)
WBC > or = 5 per HPF and > 1 bacteria per HPF in unspun sample (1 study, n = 388)				WBC > or = 5 per HPF		> 1 bacteria per HPF	0.51 (0.36-0.72)	+3 Moderate certainty	3 (2-4)	15 (11-19)	22.1 (10.6, 45.9)	+3 Moderate certainty	54 (36-71)	88 (78-94)

Return to Diagnosis Page

Return to Part 1

Return to Home

UTI Pathway: Additional Information

Suprapubic Aspiration (SPA)

- SPA is an available option if there is difficulty obtaining a catheterized specimen
- Additionally, UAs may be falsely (+) in uncircumcised infant boys
- SPA may be offered to parents and performed in the following circumstances:
  - Uncircumcised infant boy with positive cath screening tests (urinalysis, microscopy)
  - Operationally difficult to obtain a catheterized specimen
- The following criteria must be met prior to performing SPA:
  - Provider with demonstrated competency available (consult Urology, Nephrology, or Neonatology for teaching or help performing SPA)
  - Ultrasound guidance available
  - With agreement of family after discussion of risks/benefits

Return to Diagnosis Page

UTI: Typical vs. Atypical Clinical Course

- Approximately 80-90% of first-time UTI is due to *E. coli*
- Patients on appropriate treatment typically improve clinically by 48 hours
- Atypical clinical course may have one or more of the following features:
  - Seriously ill
  - Poor urine flow (oliguria not due to dehydration)
  - Elevated creatinine
  - Failure to respond to treatment with suitable antibiotics within 48 hours
- In patients who have not improved by 48 hours or have an atypical clinical course, recommend renal bladder ultrasound (RBUS) during the acute infection to assess for abscess or other condition that may require acute surgical intervention
  - If RBUS negative and continued clinical concern for abscess, consider CT scan (the gold standard)
  - Consult Radiology as needed to discuss imaging options
- In the United Kingdom's NICE UTI Guidelines, non-*E. coli* UTI and bacteremic UTI are considered “atypical UTI” because of concerns that there is a higher prevalence of urinary tract abnormalities in these patients, especially younger infants. The AAP's UTI Guideline does not make this distinction.

Return to Outpatient Page Return to Inpatient Page Return to Imaging Page

UTI Pathway: Additional Information

Empiric Antibiotic Choice

- Overuse of broad spectrum antibiotics has led to emergence of resistant *E. coli* and other Gram-negatives
- ~80% of first-time UTIs are due to *E. coli*
- 3rd generation cephalosporins, such as oral cefixime, are NOT recommended as first-line empiric therapy
- Narrow spectrum (1st generation) cephalosporin, such as cephalexin, is recommended
  - Cephalosporins should not be used where enterococci are suspected, due to intrinsic resistance
  - If cephalexin allergy concern, see Beta-Lactam Antibiotic Allergy Reference
  - Also recommended for adolescent patients with pyelonephritis, per ID and ASP based on peer institution and local clinical experience
- Antibiotic therapy should always be targeted to the sensitivities of the organism when those sensitivities are known

Rationale for Cephalexin

- Cephalexin is highly concentrated in the urine (~100 fold)
- Cephalexin is approximately 10 times less expensive than 2nd and 3rd generation cephalosporins
- Most *E. coli* are susceptible to cephalexin (=cefazolin) in the urine, even when susceptibility testing based on treatment for bloodstream infections report intermediate or resistant susceptibility
- Some children would be expected to respond to treatment with cephalexin even when their urinary isolate was reported intermediate or resistant to cefazolin
- Questions can be directed to the ID service if questions about antibiotic choice for resistant organisms

MIC Breakpoints for Cefazolin

- In January 2011, the Clinical and Laboratory Standards Institute (CLSI) published new minimum inhibitory concentration (MIC) breakpoints for cefazolin against Enterobacteriaceae
- These new breakpoints were largely based on data from bloodstream infections in adults
- Following adoption of this new standard in March 2011, Seattle Children's antibiograms gave the false impression that intrinsic resistance of *E. coli* to cefazolin was increasing
- Because of this, the Microbiology lab now includes a comment for *E. coli* isolates from the urine discussing this issue

Return to Outpatient Page

UTI Pathway: Additional Information

Criteria for Urology Referral

- Children with recurrent febrile UTIs
- Abnormal imaging: anatomic abnormality detected on ultrasound or VCUG, including complex congenital urologic problems such as:
  - Renal parenchymal loss or kidney size discrepancies
  - Ureterocele
  - Bladder or cloacal exstrophy
  - Any grade vesicoureteral reflux with febrile UTI
  - Posterior urethral valves
  - Other structural abnormalities of genitourinary development, such as persistent genitourinary sinus or cloacal abnormalities
- If uncertain if patient's medical condition requires Urology management, please consult Urology to discuss further
- DMSA Scan is an imaging study used to assess renal scarring approximately 12 months post-UTI and if needed, should be ordered via consultation with Urology

Return to Outpatient Page Return to Inpatient Page

UTI Pathway: Additional Information

Urinary Tract Dilation (UTD) Classification

- The UTD grading system classifies findings seen on renal bladder ultrasounds
  - See https://www.jpurol.com/article/S1477-5131(14)00310-6/fulltext, Figure 6
- Voiding cystourethrogram is needed for definitive evaluation and grading of vesicoureteral reflux (VUR)

Return to Imaging Page

UTI Pathway: Additional Information

Antibiotic Prophylaxis Prior to VCUG

- For patients with UTD P3 results or kidney size discrepancy on RBUS, clinicians should prescribe antibiotic prophylaxis for patients until VCUG is performed or Urology evaluation has occurred
- Patients < 2 months of age
  - Amoxicillin
- Patients 2 months to 18 years of age
  - Trimethoprim-sulfamethoxazole or
  - Nitrofurantoin

Return to Imaging Page

Voiding Cystourethrogram (VCUG)

- VCUG is the definitive test for vesicoureteral reflux (VUR)
- Although VCUG is felt to be the best imaging study for detection of VUR, it is no longer necessary for most patients *(Guideline, AAP 2016)*
  - *Approximate prevalences of VUR among girls 0-18 years of age*
    - *Grade I: 7%*
    - *Grade II: 22%*
    - *Grade III: 6%*
    - *Grade IV: 1%*
    - *Grade V: < 1%*
  - *Antibiotic prophylaxis is not felt to be helpful for patients with no reflux or grade I-III reflux (AAP 2016, Chand 2003)*
  - This suggests that over 30 VCUGs would need to be performed to find a patient with high grade (IV-V) reflux
- VCUG is not a good study for detection of acute pyelonephritis or to delineate renal parenchymal anatomy
- VCUG is an invasive test that involves fluoroscopy; children may need sedation to tolerate the procedure

Return to Imaging Page

UTI Pathway: Additional Information

Antibiotic Prophylaxis if Vesicoureteral Reflux (VUR) is Found

- Ongoing antibiotic prophylaxis IS NOT routinely recommended for patients with first-time febrile UTI or with low grade (I-III) VUR
- *Multiple randomized trials examined the relationship between the effectiveness of antibiotic prophylaxis in different patient populations; this recommendation was reaffirmed by the 2014 RIVUR study (level of evidence: +4 high certainty)*
- Children with high grade VUR should be referred to Urology

Return to Imaging Page

Summaries of Literature Evidence for VUR Antibiotic Prophylaxis

- *A trial of 338 randomized children with first febrile UTI showed no benefit of prophylaxis (Montini et al. 2008)*
- *A trial of 100 randomized patients showed no benefit in children under 30 months of age with grade II-IV reflux (Pennesi et al. 2008)*
- *A study of 225 randomized patients 1 month to 3 years of age with grade I-III reflux show no benefit of prophylaxis (Roussey-Kesler et al. 2008)*
- *A retrospective review suggested that recurrent UTIs were associated with high grade (IV-V) reflux, Caucasian race, and 3-5 years of age and that antibiotic prophylaxis was associated with increasing resistance of organisms (Conway et al. 2007)*
- *A prospective randomized study of 218 children 3 months to 18 years of age suggests that grade I-III reflux does not increase the incidence of UTI / pyelonephritis and that antibiotic prophylaxis does not appear to prevent the recurrence of UTI nor the development of renal scarring (Garin et al. 2006)*
- *The RIVUR study was a randomized control study that assigned children 2 to 71 months of age with grade I-IV reflux to receive placebo vs. antibiotic prophylaxis*
  - *The study found fewer symptomatic recurrences in the placebo group (RR: 0.55; 95% CI: 0.38-0.78) but no significant difference in renal scarring at 2 years of follow-up*
  - *Antimicrobial resistance rates were higher in the prophylaxis group compared to placebo (63% vs. 19%) (Hoberman et al. 2014)*

CSW Urinary Tract Infection Pathway Approval & Citation

Approved by the UTI Pathway team for February 20, 2020, go-live

CSW Urinary Tract Infection (UTI) Pathway Team:

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Retrieval Website: http://www.seattlechildrens.org/pdf/UTI-pathway.pdf

Please cite as:
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Evidence Ratings

This pathway was developed through local consensus based on published evidence and expert opinion as part of Clinical Standard Work at Seattle Children's. Pathway teams include representatives from Medical, Subspecialty, and/or Surgical Services, Nursing, Pharmacy, Clinical Effectiveness, and other services as appropriate.

When possible, we used the GRADE method of rating evidence quality. Evidence is first assessed as to whether it is from randomized trial or cohort studies. The rating is then adjusted in the following manner (from: Guyatt G et al. J Clin Epidemiol. 2011;4:383-94, Hultcrantz M et al. J Clin Epidemiol. 2017;87:4-13.):

Quality ratings are *downgraded* if studies:

- Have serious limitations
- Have inconsistent results
- If evidence does not directly address clinical questions
- If estimates are imprecise OR
- If it is felt that there is substantial publication bias

Quality ratings are *upgraded* if it is felt that:

- The effect size is large
- If studies are designed in a way that confounding would likely underreport the magnitude of the effect OR
- If a dose-response gradient is evident

Certainty of Evidence:

✪✪✪✪ High: The authors have a lot of confidence that the true effect is similar to the estimated effect
✪✪✪○ Moderate: The authors believe that the true effect is probably close to the estimated effect
✪✪○○ Low: The true effect might be markedly different from the estimated effect
✪○○○ Very low: The true effect is probably markedly different from the estimated effect
Guideline: Recommendation is from a published guideline that used methodology deemed acceptable by the team
Expert Opinion: Based on available evidence that does not meet GRADE criteria (for example, case-control studies).

To Bibliography

Summary of Version Changes

- **Version 1.0 (12/2011)**: Go live.
- **Version 2.0 (12/3/2011)**: Expanded recommendation for empiric outpatient antibiotics to include oral cephalexin or oral cefuroxime.
- **Version 2.3 (4/3/2013)**: Removed race from the decision to treat parameter. Included information on timing of obtaining a VCUG. Expanded discussion about cephalexin still being first-line treatment for *E. coli* in UTI.
- **Version 3.0 (6/3/2014)**: Added additional content/information regarding the VCUG and SFU grade with a link to the SFU grade training slide.
- **Version 4.0 (4/8/2015)**: Periodic review go live. Completed full literature search. Made multiple changes to this document and PowerPlan.
- **Version 4.1 (7/6/2015)**: Updated bibliography formatting.
- **Version 5.0 (9/29/2015)**: Updated inclusion/exclusion criteria to coincide with Nephrolithiasis pathway go live. Added to imaging page, specifically renal ultrasound to consider Nephrolithiasis pathway if stones are present.
- **Version 6.0 (1/20/2016)**: Performed CSW value analysis, including review of positive blood culture recommendation.
- **Version 7.0 (2/26/2016)**: Updated thresholds for positive urine cultures to better align with most recent AAP Guidelines.
- **Version 7.1 (11/22/2016)**: Updated approval page to include Laboratory.
- **Version 8.0 (10/31/2018)**: Updated UTI diagnosis criteria to include UA results and added UA's false negative rate and LR from literature review.
- **Version 9.0 (4/4/2019)**: Changed cephalexin approximate daily dosing to Q8H instead of QID. This change is supported by recognition of actual practice in antibiotic frequency ordering and evidence that reducing frequency of antibiotic dosing is effective per pharmacy consultation.
- **Version 10.0 (2/20/2020)**: Periodic review go live. Overhauled entire document: modified inclusion criteria to include recurrent UTI; added CFU criteria to include possible UTI; and extensively revised the screening and management algorithms to align with 2011 and 2016 AAP Guideline and current literature, including age group classification, risk factors for screening, IV antibiotic duration in neonates, and when to obtain imaging.
- **Version 10.1 (4/14/2020)**: Clarified admit criteria for infants.
- **Version 11.0 (10/30/2020)**: Added indication for cephalexin. Added explanation for not including race as a UTI risk factor.

Medical Disclaimer

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required.

The authors have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication.

However, in view of the possibility of human error or changes in medical sciences, neither the authors nor Seattle Children's Healthcare System nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they are not responsible for any errors or omissions or for the results obtained from the use of such information.

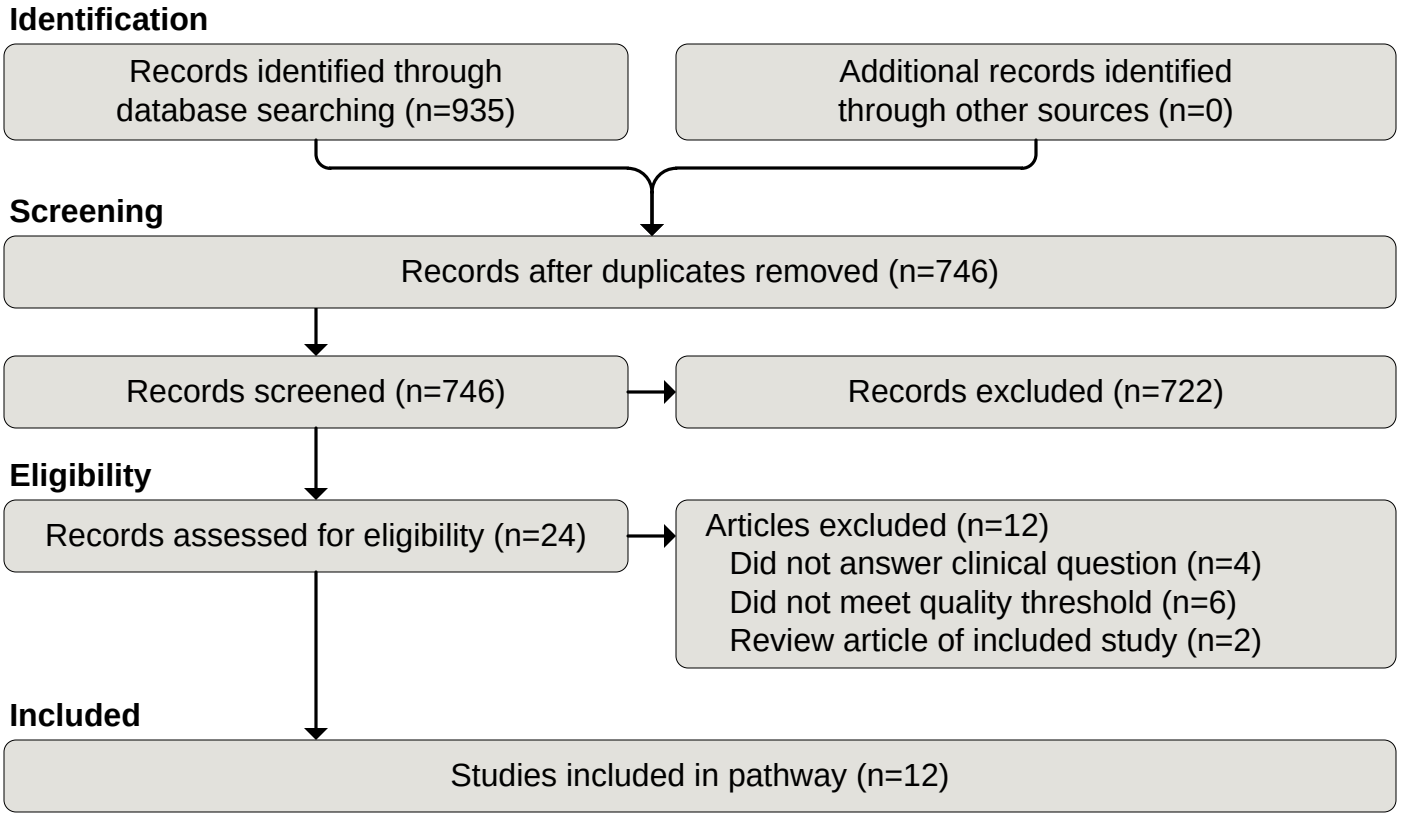
Readers should confirm the information contained herein with other sources and are encouraged to consult with their health care provider before making any health care decision.

Bibliography

Literature Search Methods:
For this update, we revised the search strategies in line with current Library practices. Literature searches were conducted in July 2019. The search targeted synthesized literature on urinary tract infections from 2014 to current, and was executed in Ovid Medline, Embase, Cochrane Database of Systematic Review (CDSR), and Turning Research into Practice database (TRIP).

Screening and data extraction were completed using DistillerSR (Evidence Partners, Ottawa, Canada). Two reviewers independently screened abstracts and included guidelines and systematic reviews that addressed optimal diagnosis, treatment, and prognosis of patients who meet pathway inclusion/exclusion criteria. One reviewer screened full text and extracted data and a second reviewer quality checked the results. Differences were resolved by consensus.

Literature Search Results:
The search retrieved 935 records. No additional records were included from other sources. Once duplicates had been removed, we had a total of 746 records. We excluded 722 records based on titles and abstracts. We obtained the full text of the remaining 24 records and excluded 12; twelve articles were used for this review. The flow diagram summarizes the study selection process.



Flow diagram adapted from Moher D et al. BMJ 2009;339:bmj.b2535

Return to Evidence Ratings

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Return to Home

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