Urinary Tract Infection (UTI) v7.1: Criteria and Definitions

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

Inclusion Criteria

- Birth to 18 years, with a postmenstrual age of at least 40 weeks, with presumed or definite UTI (not a recurrent UTI)

Exclusion Criteria

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

Atypical Versus Typical UTI

Atypical UTI is defined as a UTI with one of the following properties:

- Seriously ill
- Poor urine flow: oliguria not due to dehydration, or urinary retention; urine output less than 1 ml/kg/hour
- Abdominal or bladder mass
- Elevated creatinine (eGFR < 80 ml/min/1.73 m^2)
- Septicemia
- Failure to respond to treatment with appropriate antibiotics within 48 hours
- Infection caused by organism other than Escherichia coli

Typical UTI is defined as a UTI without any of these conditions.

Urinary Tract Infection v7.1: Diagnosis

Decision to Test: Infants

- Febrile or prolonged jaundice
- > 8 days of age: irritable, emesis, failure to thrive

Decision to Test: Non-Toilet Trained Children

- **Girl or uncircumcised boy:** need ≥ 1 of the following.
- **Circumcised boy:** need ≥ 2 of the following **OR** suprapubic tenderness alone.

Ill appearing, suprapubic tenderness, fever > 24 hrs, fever > 39ºC, fever without source

Decision to Test: Toilet Trained Children & Adolescents

- **Girl or uncircumcised boy:** need ≥ 1 of the following.
- **Circumcised boy:** need ≥ 2 of the following.

Abdominal pain, back pain, dysuria, frequency, new-onset incontinence, fever > 40ºC (particularly if no source)

Decision to test criteria met

! **Test of cure urine cultures not recommended**

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

- **Infants:** Catheterization or suprapubic aspiration (SPA)
- **Non-Toilet Trained Children:** 2-6 months: consider SPA; otherwise catheterized
- **Toilet Trained Children:** Midstream clean catch
- **Adolescents:** Midstream clean catch + 'dirty' urine for Gonococcus (GC)/Chlamydia(Chl)

! **Potential poor sensitivity of U/As in infants**

If an infant, also obtain

If an adolescent, also obtain

If non-toilet trained, also obtain

If toilet trained, also obtain

Additional Studies: Infants

- **0-60 days of age:** refer to Neonatal Fever Pathway

Additional Studies: 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

Additional Studies: Non-Toilet Trained

- If ill appearing, consider blood culture and CSF studies

Additional Studies: Toilet Trained

- If ill appearing, consider blood culture

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Next Expected Review: April 2020

Urinary Tract Infection v8.0: Outpatient Management

Admit Criteria

All Age Categories
- Toxic appearance
- 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 patients up to 30 days of age with presumed or definite UTI
- Admit all febrile patients 31-60 days of age with presumed or definite UTI

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

! **Consider further imaging if no improvement in 48 hrs**

Patient meets admit criteria?

No, begin outpatient management for presumed UTI

Yes, begin inpatient management for presumed UTI

Outpatient Management: Nonfebrile Infants (31-60 days)
- Give ceftriaxone IM **OR** cephalexin PO
- 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 cephalosporin allergy) **OR** ceftriaxone IM

! **Criteria for Urology Referral**

Phase Change

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

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Urinary Tract Infection v8.0: Inpatient Management

Inpatient Management: Infants (0-30 days)

- Give IV ampicillin + gentamicin **OR** ampicillin + cefotaxime
- Give IV antibiotics 7 days minimum, then 7 days PO; 14 days total
- Switch to PO at 7 days if responding and after identification and sensitivities return; narrow coverage if possible

Positive blood culture?

Positive Blood Culture

- If Bacteremic, continue management as above (v)

Evaluate for discharge

Inpatient Management: Infants (31-60 days)

- Give IV ceftriaxone **OR** ampicillin + gentamicin if cocci/enterococcus is suspected
- Give IV antibiotics until afebrile X 24 hrs (minimum 36 hours IV with negative initial blood cultures)
- Switch to PO if responding after identification and sensitivities return; narrow coverage if possible
- Total duration of antibiotics: 14 days

Positive blood culture?

Positive Blood Culture (v)

- If Bacteremic, give 7 days IV + 7 days PO
- May consider early transition if:
  - clinically back to baseline
  - afebrile x 24hrs
  - repeat blood culture negative x 48hrs
  - good oral option available
- Consider ID consult in cases of atypical UTI, early transition to orals in children 1-6 months old, or any other ID related questions

Evaluate for discharge

Inpatient Management: Non-Toilet Trained Children, Toilet Trained Children & Adolescents

- Give IV ceftriaxone **OR** ampicillin + gentamicin if cocci/enterococcus is suspected
- Switch to PO if responding after identification and sensitivities return; narrow coverage if possible
- Total duration of antibiotics: adolescents (7 days), toilet trained (7-14 days), non-toilet trained (10-14 days), adolescent with cystitis (3 days)

Evaluate for discharge

! **Consider imaging if no improvement in 48 hrs**

! **Criteria for Urology Referral**

Discharge Criteria

General discharge criteria for all patients

- Clinical response to therapy
- Able to maintain hydration status
- 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 pre-natal ultrasound reviewed
- If indicated, VCUG completed or scheduled
- Consultation (e.g., urology, nephrology, ID) completed if desired

Infants: General criteria and

- Afebrile (T < 38C) for 24 hours
- Tolerating planned home therapy

Non-toilet trained and toilet trained children

- Afebrile (T < 38C) for 12 hours

Adolescents

- Completion of or plan for additional sexually transmitted infection (STI) testing as indicated

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Urinary Tract Infection v7.0: Imaging Recommendations

Age Category?

Infant or non-toilet trained

Toilet-trained or adolescent

Imaging Recommendations: Infants and Non-toilet Trained Children

Renal Ultrasound (RUS)

- Can skip RUS if high quality third trimester U/S is normal and < 1 month of age
- If stones are present, refer to Nephrolithiasis Pathway

VCUG if

- Atypical UTI (seriously ill, poor urine flow (< 1 ml/kg/hr), mass, increased creatinine (eGFR < 80), treatment failure, non-E. coli) **OR**
- RUS shows: hydronephrosis (pelvocaliectasis), renal parenchymal loss, kidney size discrepancies independent of **SFU grade**

VCUG recommended when patient is stable, >24 hours afebrile, and prior to the end of antibiotic therapy if possible

Imaging Recommendations: Toilet-trained Children and Adolescents

Renal Ultrasound (RUS)

- For boys with first UTI, or girls with atypical UTI
- If stones are present, refer to Nephrolithiasis Pathway

VCUG if

- Atypical UTI (seriously ill, poor urine flow (< 1 ml/kg/hr), mass, increased creatinine (eGFR < 80), treatment failure, non-E. coli) **OR**
- RUS shows: hydronephrosis (pelvocaliectasis), renal parenchymal loss, kidney size discrepancies independent of **SFU grade**

VCUG recommended when patient is stable, >24 hours afebrile, and prior to the end of antibiotic therapy if possible

! **Antibiotic prophylaxis not routinely recommended for Gr I-III vesicoureteral reflux**

! **Give antibiotic prophylaxis prior to VCUG**

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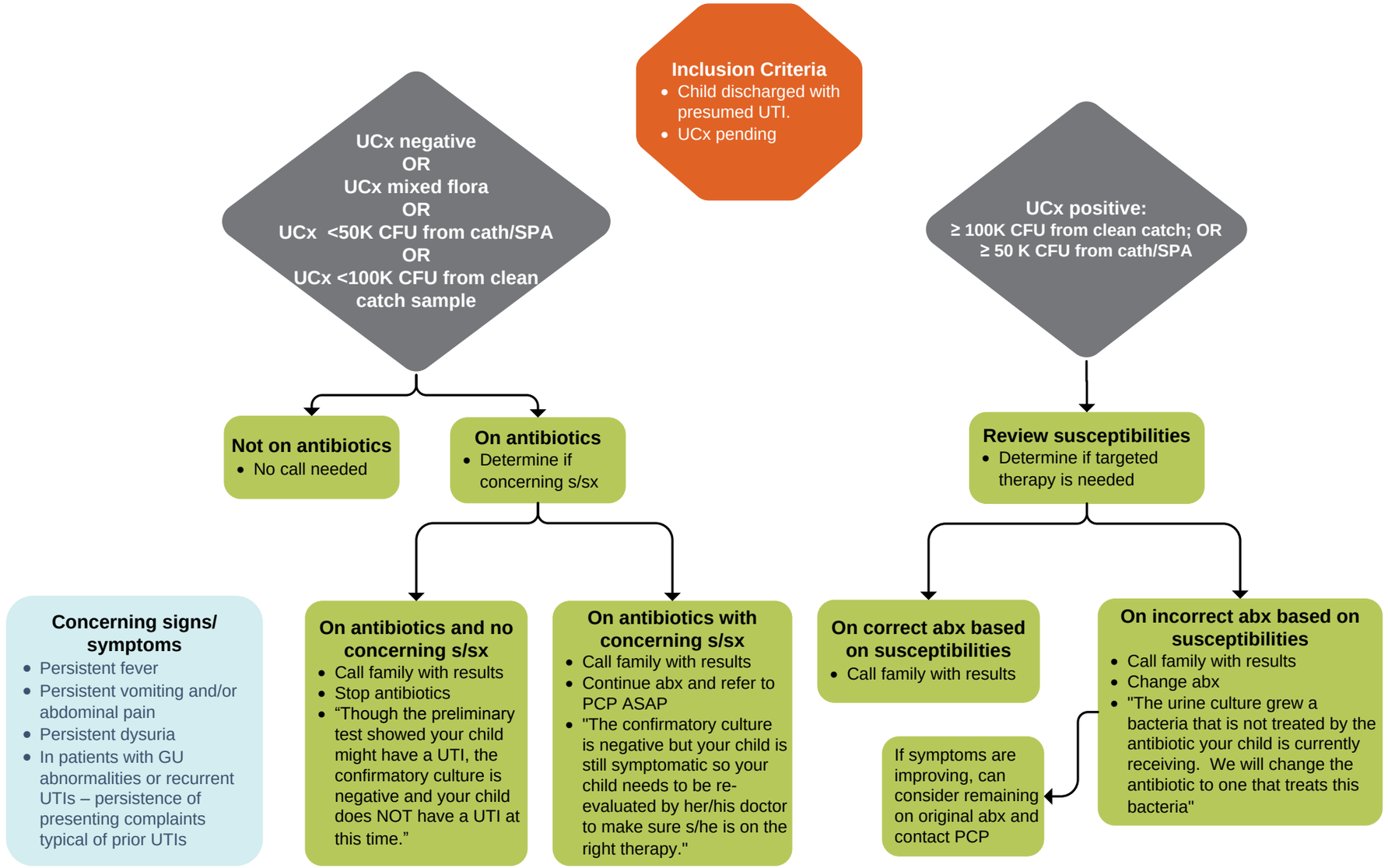
Emergency / Urgent Care UTI culture results decision tree



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Age Categories: Overview

There are 4 age categories; the management of each varies.	
Infants:	birth to 60 days of age
Non-toilet trained children:	greater than 60 days of age
Toilet trained children:	up to 12 years
Adolescents:	13 years and older or sexually active

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Return to Diagnosis

Urinary Tract Infection (UTI) v4.0: Atypical vs Typical UTI Definitions

ATYPICAL Urinary Tract Infection	• UTI with one of the following properties:
	  ◦ Seriously ill
	  ◦ Poor urine flow: oliguria not due to dehydration, or urinary retention; urine output less than 1 ml/kg/hour
	  ◦ Abdominal or bladder mass
	  ◦ Elevated creatinine (eGFR < 80 ml / min / 1.73 m^2)
	  ◦ Septicemia
	  ◦ Failure to respond to treatment with suitable antibiotics within 48 hours
	  ◦ Infection caused by organism other than Escherichia coli

TYPICAL Urinary Tract Infection	• UTI without any of the above conditions

- *This categorization of typical vs. atypical UTI is based on a descriptive study of 180 infants aged 1 to 24 months with acute pyelonephritis (Jantunen, 2001). This study found that risk factors for significant urinary tract abnormalities included: younger infants (1 to 6 months of age), urine infected with organisms other than Escherichia coli, infants with a positive blood culture, or a lack of papG adhesin genes in patients infected with Escherichia coli. The other findings appear to have been generated by NICE committee consensus as representing risk factors where further imaging would be warranted.*

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Presumed Versus Definite UTI Definitions

PRESUMED Urinary Tract Infection	• Infants and non-toilet trained children: defined by a combination of clinical features where urinary tract infection is deemed likely, regardless of urinalysis result. • Toilet trained children and adolescents: defined by a combination of clinical features and a positive urine screening test (urinalysis shows nitrite or leukocyte esterase; microscopy shows bacteria or >10 WBC / hpf).
DEFINITE Urinary Tract Infection	• All age categories: defined by a combination of clinical features and a positive urine culture.

(Guideline, AAP 2011)

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Sensitivity of U/As in Infants

- *The distinction for infant and non-toilet trained children is based upon the observation that urine screening studies (urinalysis, urine dip and microscopy) in these age groups are felt to be insufficient to rule in or rule out urinary tract infection. (Wong, Lee & Han 2008) (Nys et al. 2006) (Antwi et al. 2008) (McIsaac, Moineddin & Ross 2007) (Little et al. 2006)*
- As a result, the committee felt that these tests were insufficient to rule out urinary tract infection in this age group where clinical suspicion was otherwise high.
- *The strongest clinical predictors of UTI in infants and non-toilet trained children are: Fever (>38 infants and >39 in non-toilet trained children), Fever > 24 hrs, Fever without apparent source, ill-appearance, abdominal pain and suprapubic tenderness. (Cincinnati 2006, Texas 2008, NICE 2007, Todd 1995, Shaikh 2006)*

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Diagnosis: Definite UTI

Culture results defining a definite UTI are:

- Single predominant organism (one organism meets criteria below, all other organisms do not meet criteria below) (✪✪○○, Seattle Children's UTI Pathway 2011)
  - ≥ 100,000 colony forming units (CFU)/ml for clean catch
  - ≥ 50,000 CFU/ml for in- and out- catheterization and suprapubic aspiration

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Diagnosis: Adolescent and Sexually Active Patients

In adolescents and sexually active pre-adolescents:	• Clinicians must document a sexual history and an external genitourinary examination. • Clinicians should perform a bimanual examination in females if clinically indicated (e.g., in cases of pelvic pain). (✪✪○○, Seattle Children's UTI Pathway 2011)
Additional lab testing to consider in this population:	• "Dirty" urine for Gonococcus (GC) and Chlamydia • If GC/Chlamydia positive, consider Syphilis Screen • HSV: Culture Visible lesions or cervical culture if indicated • Annual HIV Screen • Pregnancy Testing in females

One ED study of adolescents 12 to 25 years of age presenting with urinary complaints found that 49% of sexually active patients were not tested (Musacchio, Gehani & Garofalo 2009). Of those tested, 12/43 had chlamydia or gonorrhea, and 13/43 had a positive urine culture. Another study of sexually active females aged 14-22 ascertained through teen health centers and emergency rooms ((Huppert et al. 2007) found the prevalence of UTI and sexually transmitted infection (STI) to be 17 and 33%, respectively.

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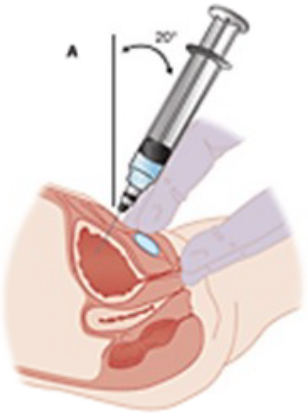
Diagnosis: Suprapubic Aspiration

- Suprapubic aspiration (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



Suprapubic Aspiration Technique
Source: http://www.baus.org.uk

- 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

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Return to Diagnosis

Treatment: Empiric Antibiotic Choice

- **Overuse of broad spectrum antibiotics has lead 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.
    - Note: cephalosporins should not be used where **enterococci** are suspected, due to intrinsic resistance.
    - In case of cephalosporin allergy, trimethoprim/sulfamethoxazole is an alternative.
  - Antibiotic therapy should always be targeted to the sensitivities of the organism when those sensitivities are known.

- Further rationale for recommending empiric cephalexin therapy included factors such as cost and percent of antibiotic excreted unchanged in the urine.

	Cephalexin (Keflex)	Cefuroxime (Ceftin)	Cefixime (Suprax)
Approximate Daily Dosing	50 mg/kg/day (divided QID)	30 mg/kg/day (divided BID)	Day 1: 16 mg/kg/day Subsequent days: 8 mg/kg/day
Cost (suspension)	250 mg/5ml (200 ml) = $29.55 or $0.148/ml	250 mg/5ml (100ml) = $166.64 or $1.67/ml	100 mg/5ml (50ml) = $168.37 or $3.37/ml
Cost/ day for a 10 kg patient	10 ml x $0.148 = $1.48	6 ml x $1.67/ml = $10.02	8 ml x $3.37/ml = $26.96 (day 1) 4 ml x $3.37/ml = $13.48 (subsequent)
% excreted unchanged in urine	90%	50%	50%

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To Antibiotic Stewardship Pg 2

Return to Outpatient Management

Treatment: Rationale for Cephalexin

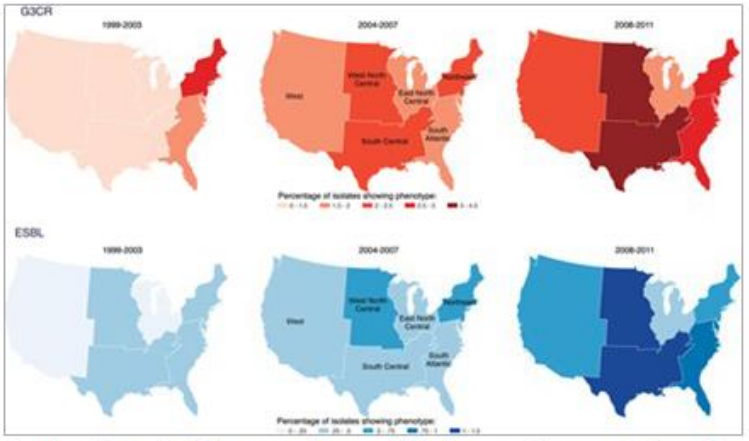
- Cephalexin is highly concentrated in the urine (~100 fold)
- Most *E. coli* are susceptible to cephalexin (=cefazolin) in the urine, even when susceptibility testing based on treatment for ***bloodstream*** infections report intermediate or resistant susceptibility
- Some children would be expected 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.

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 Management

Treatment: Antibiotic Stewardship

- Current epidemiology differs dramatically from that during the Hoberman study (1992-1997) which recommended empiric cefixime. (Hoberman, 1999)
- Resistance to 3rd generation cephalosporins is rising around the world.
- The UTI Pathway recommends a susceptible narrow-spectrum agent. Avoiding routine use of broad-spectrum antibiotics for empiric treatment of infections helps prevent further resistant and promotes antibiotic stewardship.



Regional trends in the prevalence of third-generation cephalosporin resistant (G3CR) and extended-spectrum β-lactamase (ESBL) phenotypes among pediatric *Enterobacteriaceae isolates in The Surveillance Network-USA database, 1999-2011. Logan et al. JPIDS 2014.*

Seattle Children's Hospital produces a yearly antibiogram of our urinary isolates that can be found here: Antibiograms

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To Antibiotic Stewardship Pg 3

Return to Outpatient Management

Treatment: "Switch Therapy" (IV to Oral Antibiotics)

- Strong evidence supports the equivalence of long-course IV therapy, "switch" therapy of 2-4 days of IV therapy followed by PO therapy, and PO therapy alone. (Guideline, NICE 2013)
- Limited data available for early “switch” therapy in infants 0-30 days of age.
- Because of small numbers of infants and children with bacteremia in these studies, results are also not easily generalizable to this specific patient population.

Treatment: “Switch Therapy” (infants <30 days of age)

- Given the high incidence of bacteremia (12.4%) and potential for suboptimal blood culture volumes in infants, the committee recommended 7 days of IV therapy followed by 7 days of oral therapy for this age group regardless of blood culture results.
- The assumed pathogenesis of UTI in infants 0-30 days of age is an initial bloodstream infection independent of blood culture result. (Expert Opinion)
- Given this relatively short course of IV antibiotics, Peripherally Inserted Central Catheters (PICCs) are ***not*** necessary. (Expert Opinion)

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Return to Inpatient Management

Treatment: UTI With Positive Blood Cultures Children >30 days of age

- Given limited evidence to guide duration of therapy in patients with UTI with associated bacteremia, local expert consensus was reached after literature review and discussion by Infectious Disease Division
- Increasing evidence suggests that early transition to orals antibiotics in patients with bacteremia may be equally effective as prolonged IV therapy

Current pathway recommendation for patients >30 days of age with bacteremia:

- 7d IV + 7d PO therapy = total duration 14 days
- May consider early transition to oral antibiotics if clinically back to ***baseline, afebrile x 24hrs, repeat blood culture negative x48hrs, and good oral option available***
- Only 1 repeat blood culture is necessary following initial positive as this is negative in the majority of cases
- Consider ID Consult in case of atypical UTI, early transition to orals in children 1-6 months old, any other ID related questions

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Return to Inpatient Management

Treatment: Adolescents

- Adolescent females with presumed cystitis can be treated with 3-day course of narrow-spectrum antibiotic (e.g. cephalexin or trimethoprim-sulfamethoxazole). (Guideline, NICE 2013)
- Remember to follow up STI testing and treat when indicated.

A systematic review conducted to examine the appropriate treatment of cystitis concluded that in children 3 months to 18 years of age, a 2-4 day course of systemic antibiotics appeared as effective as a 7-14 day course of systemic antibiotics in eradicating lower tract UTI in children (Michael, 2009), however, it was noted that this analysis pooled many small studies with wide age ranges. The committee felt that given the difficulty in definitively distinguishing between lower and upper tract UTI in the younger age groups, this recommendation was most appropriate.

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Return to Inpatient Management

Treatment: Overview

Treatment guidelines are summarized in the following table: (✪OOO)

Age Group	Empiric therapy for presumed UTI	Treatment strategy	Treatment duration
Infants (0-30 days)	IV ampicillin + gentamicin or IV ampicillin + cefotaxime	7 days IV antibiotics, then 7 days PO	14 days **
Infants (31-60 days)	If admitted (e.g. febrile): IV ceftriaxone OR IV ampicillin + gentamicin if cocci / Enterococcus suspected If outpatient: IM ceftriaxone OR po cephalexin	IV antibiotics until afebrile x 24 hours (minimum 36 hours IV with negative blood cultures), then switch to PO to complete course if responding	14 days **
Non-toilet trained children	If admitted: IV ceftriaxone OR IV ampicillin + gentamicin if cocci / Enterococcus suspected If outpatient: PO cephalexin OR PO cefuroxime OR if cephalosporin allergy, PO trimethoprim-sulfamethoxazole OR IM ceftriaxone	For inpatients: IV antibiotics until identification and sensitivities return, then switch to targeted PO to complete course if responding For outpatients: target antibiotics when identification and sensitivities return	10-14 days* **
Toilet trained children			7-14 days* **
Adolescents			7 days ** 3 days if cystitis

* When there is a treatment range, use longer courses if slower to respond to therapy
** Refer to UTI + bacteremia slides for treatment duration and switch to oral recommendations

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Return to Outpatient Management

Treatment: No Clinical Improvement in 48 Hours

Expect clinical improvement within 48 hours	Fever should resolve by 72 hours. In patients that have not clinically improved in 48 hours despite appropriate antibiotic therapy, ensure renal ultrasound has occurred and consider specialty consult. (Guideline, AAP 2011)
Patient persistently febrile	CT is considered gold standard, as RUS does not always detect perinephric abscess. However, depending on patient characteristics, RUS may be more appropriate first line imaging study. (Expert Opinion)
Further imaging	If considering further imaging, consult radiology to discuss ultrasound vs. CT scan and need for contrast in CT scan. (Expert Opinion)

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Return to Outpatient Management

Return to Inpatient Management

Treatment: Test of Cure Cultures

Follow-up urine cultures for test of cure are ***not*** routinely indicated. (✪✪✪○, Seattle Children's UTI Pathway 2011)

- *Two retrospective reviews support the lack of usefulness of follow-up urine cultures at 48 hours. One study of 364 children < 18 years of age showed that of 291 follow-up urine cultures, none were positive (Currie, 2003). Another study of 599 children hospitalized and treated with UTI with 328 having a urine culture at 48 hours found only one positive culture (Oreskovic, 2007).*

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Return to Diagnosis

Diagnostic Imaging: Renal Ultrasound (RUS)

- It is felt that a RUS is a radiation free, high yield initial screen for identifying anatomical abnormalities in children up to 36 months of age (Guideline, AAP 2011)
- Studies suggest that third-trimester prenatal ultrasounds were highly likely to identify the anatomical abnormalities on postnatal ultrasound (Guideline, AAP 2011)
- If third-trimester prenatal ultrasound images could be obtained and reviewed by radiology, may be sufficient to preclude obtaining a repeat ultrasound at the time of infection if patient under 30 days of age (Expert Opinion)

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To VCUG

Return to Imaging

Diagnostic Imaging: SFU Grade

- The Society for Fetal Urology (SFU) developed an ultrasonography grading system for hydronephrosis in 1993 based on renal sinus splitting patterns and dilation of the renal pelvis and calyces.
- Though SFU grading is currently being applied to RUS interpretation at Seattle Children's, local expert consensus recommends using all RUS findings to guide clinicians in VCUG decision making rather than SFU grade alone.
- Per the 2011 AAP Recommendation on imaging following first urinary tract infection, "VCUG is indicated if renal and bladder ultrasonography reveals hydronephrosis, scarring, or other findings that would suggest either high-grade VUR or obstructive uropathy and in other atypical or complex clinical circumstances."

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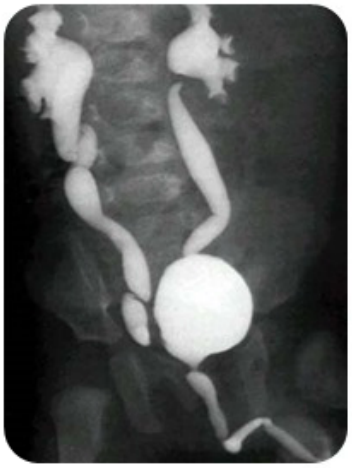
Back to RUS | Return to Imaging | Procalcitonin

Diagnostic Imaging: 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 2011).
- 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.



Diagnostic Imaging: VCUG

Diagnostic Imaging: Radionucleotide VCUG

OPTION:

- Radionucleotide VCUG may be used in place of fluoroscopic VCUG for initial detection of VUR in females. This study offers a lower radiation dose, although with lesser anatomic detail and limited spatial resolution.
- If considering a Radionucleotide Study, consult Radiology to discuss appropriateness of this test

Although VCUG is felt to be the best imaging study for detection of VUR, it is **no longer necessary** for most patients.

- *Approximate prevalences of VUR among girls age 0 to 18 yrs are: (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 2011, Cincinnati 2006, Chand 2003)*
- This suggests that over 30 VCUGs would need to be performed to find a patient with high grade (IV-V) reflux.

Back to RUS

Return to Imaging

Imaging: Procalcitonin

- Leroy 2013 and 2011 studies address the issues of utility of Procalcitonin in guiding decision making for imaging following first febrile UTI, specifically VCUG vs DMSA
- Procalcitonin may help predict upper vs lower tract disease and may help identify which patients are at risk for scarring
- However, procalcitonin may not be useful if drawn after start of therapy. Additionally, it is a send-out test with a lengthy turnaround time

Local consensus: Procalcitonin is not recommended at this time. Will re-evaluate in setting of further evidence.

Variable	VUR <3	VUR ≥3	Sensitivity	Specificity	PPV	NPV
PCT						
≥0.5	272 (58)	44 (83)	83%	42%	14%	96%
<0.5	201 (42)	9 (17)				
PCT						
≥1	201 (43)	39 (74)	74%	57%	16%	95%
<1	265 (57)	14 (26)				
PCT						
≥2	134 (28)	31 (58)	58%	72%	18.8%	94%
<2	339 (72)	22 (42)				
Dilation on RUS						
Yes	60 (13)	19 (38)	38%	87%	24%	93%
No	402 (87)	31 (62)				

(Leroy, 2011)

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Return to Imaging

Criteria for Referral to Urology

- Children under 6 years of age with recurrent UTIs
- Abnormal imaging: Anatomic abnormality detected on Ultrasound or VCUG including complex congenital urologic problems such as:
  - Renal parenchymal loss or kidney size discrepancies
  - duplex systems
  - ureterocele
  - bladder or cloacal exstrophy
  - grade III-V vesicoureteral reflux
  - 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 should be ordered via consultation with Urology

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Return to Outpatient Management

Return to Inpatient Management

Diagnostic Imaging: Antibiotic Prophylaxis Prior to VCUG

When a VCUG is indicated, clinicians should prescribe antibiotic prophylaxis for patients until VCUG is performed.

Infants <2 months:

- amoxicillin 20 mg/kg, up to 500 mg once daily

Infants >2 months to children <18 years:

- trimethoprim-sulfamethoxazole 2 mg/kg of trimethoprim up to 80 mg once daily, OR
- nitrofurantoin 1 mg/kg up to 100 mg once daily

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Return to Imaging

Antibiotic Prophylaxis if VUR is Found

- Ongoing antibiotic prophylaxis ***IS NOT*** routinely recommended for patients with first febrile urinary tract infection, or with low grade (I-III) vesicoureteral reflux (VUR). In setting of Grade III VUR, please discuss need for antibiotic prophylaxis with Urology.

- 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 (✪✪✪✪).
- Children with high grade VUR should be referred to Urology.

Summaries of literature evidence

- *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 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 showed no benefit of prophylaxis. (Roussey-Kesler et al. 2008).*
- *An retrospective review suggested that recurrent UTIs were associated with high-grade (IV, V) reflux, Caucasian race, and ages 3-5; and that antibiotic prophylaxis was associated with increasing resistance of organisms. (Conway et al. 2007).*
- *Another prospective randomized study of 218 children aged 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 ages 2 to 71 months of age with grade I-IV VUR 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).*

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Return to Imaging

Value Analysis: Positive Blood Cultures

DIMENSION	CARE OPTION A	CARE OPTION B	PREFERRED OPTION	ASSUMPTIONS MADE
DESCRIPTION OF CARE TREATMENT OPTION	All children with bacteremia receive minimum 7 days IV antibiotics	Children with bacteremia can transition early from IV to PO based on clinical criteria		
OPERATIONAL FACTORS				
Percent adherence to care (goal 80%)	90%	100.00%	OPTION B	
Care delivery team effects	maintaining IV access for 7 days is problematic; may		OPTION B	
BENEFITS / HARMS (QUALITY/OUTCOME)				
Degree of recovery at discharge			NEUTRAL	assumes that IV and oral a
Effects on natural history of the disease over equivalent time			NEUTRAL	
Potential to cause harm	prolonged hospitalization	risk of less adherence if se	UNKNOWN	
Palatability to patient/family			OPTION B	
Population-related benefits			N/A	
Threshold for population-related benefits reached				
COST (Arising from Options A or B) - express as cost per day				
"ROOM RATE" ($ or time to recovery)	$6,000 (additional 3 days)	No additional cost	OPTION B LESS EXPENSIVE	
"Dx/Rx" costs ($)	$38/day x 3 additional day	$29/day for 3 additional da	OPTION B LESS EXPENSIVE	
COST (Complications/adverse effects arising from Options A or B)- express as cost per day				
"ROOM RATE" ($ or time to recovery)			NEUTRAL	
"Dx/Rx" costs ($)	IV infiltratings and IV lost		OPTION B LESS EXPENSIVE	

STEP 3: APPLY VALUE ANALYSIS GRID

	BENEFIT (QUALITY & OUTCOMES)			
COST	**A > B**	**A = B**	**A < B**	**Unclear**
A costs more than B	Make value judgement	B	B	Do B and PDSA in 1 year
A and B costs are the same	A	A or B, operational factors may influence choice	B	A or B, operational factors may influence choice, PDSA in 1 year
B costs more than A	A	A	Make value judgement	Do A and PDSA in 1 year

STEP 4: MAKE CSW VALUE JUDGEMENT

FINAL CSW VALUE STATEMENT	*Due to the uncertainty surrounding the difference between Option A and B to produce harm, the committee did not feel that it could provide a strong recommendation to change current practice in favor of Option B. Consensus was reached between the committee, Hospital Medicine and Infectious Diseases to maintain current state but to provide guidance on when it would be appropriate to consider early tranistion to PO therapy (afebrile for 24hrs, repeat blood culture negative for 48hrs and good oral option available). The committee will review local outcomes data in 1 year to determine if there is enough data to inform the potential to cause harm variable.*

Return to Inpatient Phase

Urinary Tract Infection (UTI) Approval & Citation

Approved by the CSW Urinary Tract Infection (UTI) for April 8, 2015

CSW UTI Team:

Hospital Medicine, Owner	**Rebecca Taxier, MD**
Emergency Medicine, Owner	**Derya Caglar, MD**
Emergency Medicine, CNS	**Sara Fenstermacher, RN**
Hospital Medicine, CNS	**Kristi Klee, MSN, RN-BC**
Laboratory	**Xuan Qin, PhD**
Radiology	**Randy Otto, MD**
Urology	**Richard Grady, MD**

Clinical Effectiveness Team:

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Project Leader	**Elizabeth Austin, MPH**
KM Analyst:	**Susan Stanford, MPH, MSW**
CIS Informatician:	**Michael Leu, MD, MS, MHS**
CIS Analyst:	**Heather Marshall**
Librarian:	**Susan Klawansky, MLS**
Program Coordinator:	**Ashlea Tade**

Executive Approval:

Sr. VP, Chief Medical Officer	Mark Del Beccaro, MD
Sr. VP, Chief Nursing Officer	Madlyn Murrey, RN, MN
Surgeon-in-Chief	Bob Sawin, MD

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

Example:
Seattle Children's Hospital, Taxier R, Austin E, Caglar D, Crowell C, Fenstermacher S, Grady R, Klee K, Leu MG, Otto R, Rooholamini S. 2015 April. Urinary Tract Infections (UTI) Pathway. Available from: http://www.seattlechildrens.org/pdf/UTI-pathway.pdf

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.):

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

Quality of Evidence:
✪✪✪✪ High quality
✪✪✪○ Moderate quality
✪✪○○ Low quality
✪○○○ Very low quality
Guideline
Expert Opinion

Guideline – Recommendation is from a published guideline that used methodology deemed acceptable by the team.

Expert Opinion – Our expert opinion is based on available evidence that does not meet GRADE criteria (for example, case-control studies).

Note about periodic reviews: The CSW team conducts a full literature search for pathways every 3-5 years, reviewing literature since the previous pathway version and updating all recommendations with new evidence as applicable. The evidence ratings shown on pathway pages represent literature graded across pathway iterations:

- If the newer evidence is higher than the previous, the grade reflects the new evidence.
- If the evidence level is the same as the previous pathway iteration, the grade remains the same (representing a combination of old and new literature).
- If the evidence level is lower in the new literature, both the new literature and the old pathway may be cited (graded separately).
- If there is no new evidence, the previous pathway evidence and grade are cited.

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Summary of Version Changes

Version 1.0 (12/2016): 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, full literature search completed, multiple changes made to algorithm and power plan
Version 4.1 (7/6/2015): Formatting updates to bibliography
Version 5.0 (9/29/15): Updated inclusion/exclusion criteria to coincide with Nephrolithiasis pathway go live. Addition to imaging section specifically renal ultrasound to consider Nephrolithiasis pathway if stones are present.
Version 6.0 (1/20/16): CSW value analysis performed 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 (11/22/16): Updated approval page to include Laboratory

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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.

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Bibliography

Literature Search

Literature Search Strategy

Search Methods, *Urinary Tract Infection (UTI),* Clinical Standard Work

Studies were identified by searching electronic databases using search strategies developed and executed by a medical librarian, Susan Klawansky.. Searches were performed in May and October, 2014. The May 2014 search was performed in the following databases: on the Ovid platform – Medline (July 2010 to date), Cochrane Database of Systematic Reviews (2010 to date); elsewhere – Embase (July 2010 to date), Clinical Evidence, National Guideline Clearinghouse and TRIP (all 2010 to date). Retrieval was limited to English language and ages 0-18, except for the question relating to VCUG, which was limited to infants ages 0-2. In Medline and Embase, appropriate Medical Subject Headings (MeSH) and Emtree headings were used respectively, along with text words, and the search strategy was adapted for other databases using textwords alone. Concepts searched were urinary tract infection, pyelonephritis, cystitis, bacteriuria, pyuria and vesico-ureteral reflux/VCUG. All retrieval was further limited to certain evidence categories such as relevant publication types, Clinical Queries, index terms for study types and other similar limits.

An additional search was conducted in October 2014 in the following databases: on the Ovid platform – Medline and Central Register of Controlled Clinical Trials; elsewhere – Embase. All were searched from 2010 to current, results limited to English and ages 0-18. Search strategies were constructed as above, using index terminology and textwords as appropriate. Concepts searched were anti-bacterial agents, drug administration routes, intravenous injections or infusions, oral administration, drug administration schedule, bacteremia and blood culture – searched independently of urinary tract infections. All retrieval was further limited to certain evidence categories such as relevant publication types, Clinical Queries, index terms for study types and other similar limits.

Additional articles were identified by team members and added to results.

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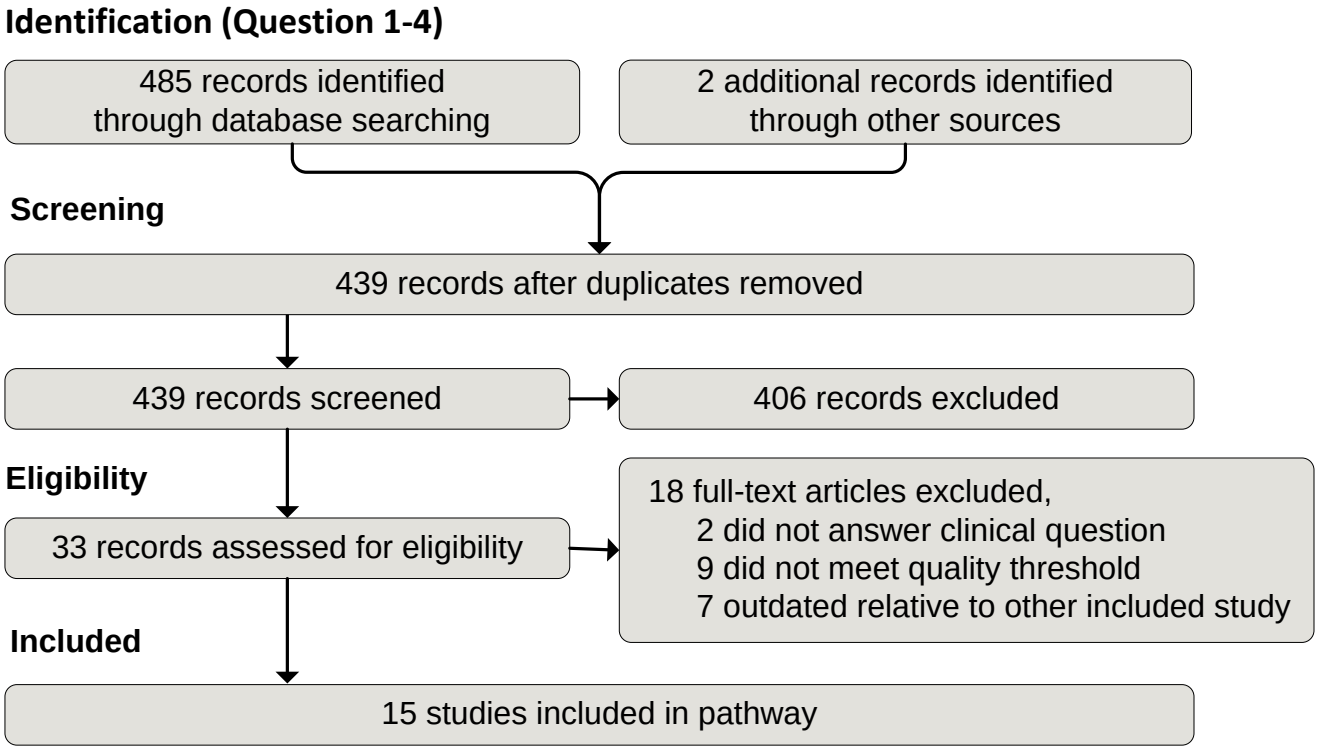
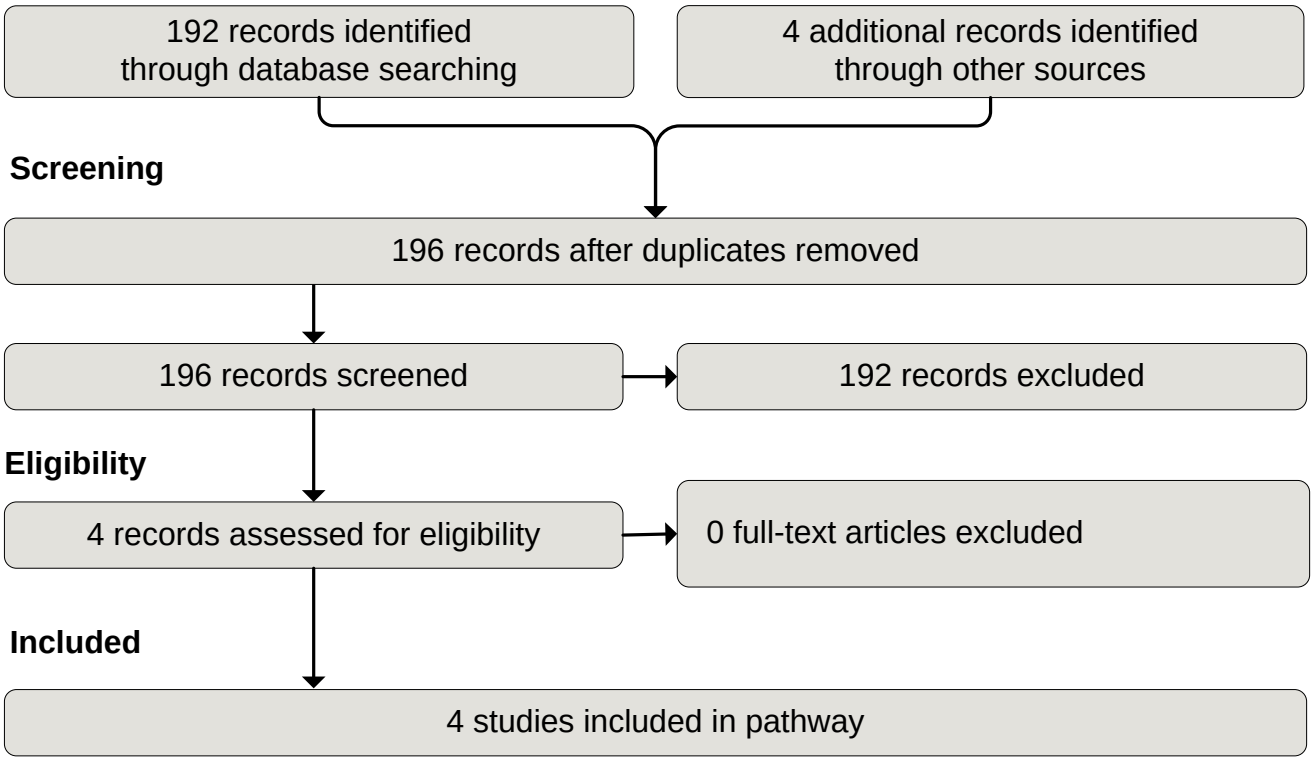


Flow diagram adapted from Moher D et al. BMJ 2009;339:bmj.b2535



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

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Link to Appendix for original Bibliography

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