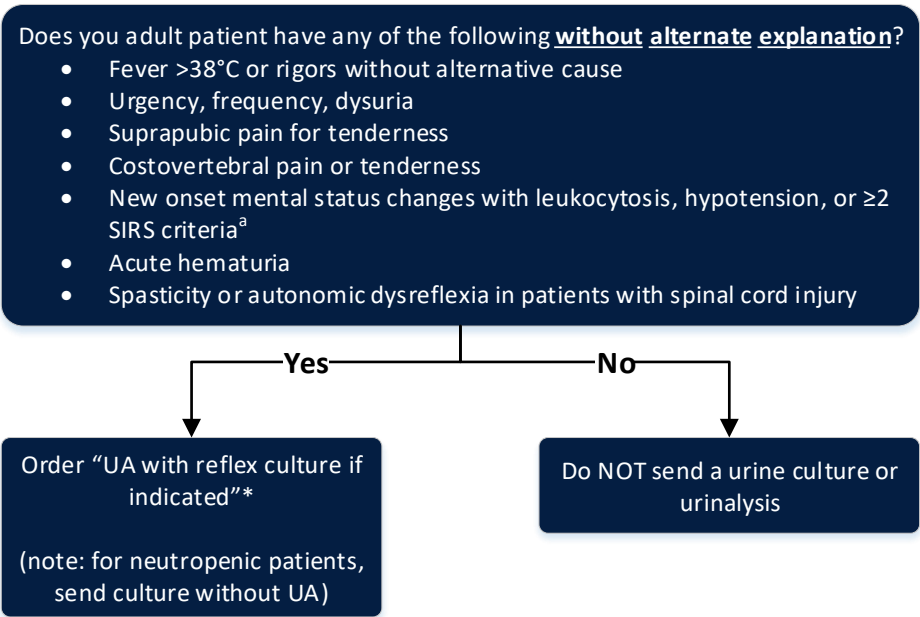




## URINARY TRACT INFECTIONS IN ADULTS

**When to Order a Urine Culture:** Asymptomatic bacteriuria is often treated unnecessarily, and accounts for a substantial burden of unnecessary antimicrobial use. National guidelines recommend against testing for asymptomatic bacteriuria, except in select circumstances. Therefore urine cultures should only be obtained on adult inpatients for appropriate reasons. In the absence of signs or symptoms (see below) attributable to a urinary tract infection, patients with a positive urine culture and/or pyuria should not be treated with antibiotics irrespective of high bacterial colony count, or a multi-drug resistant organism. The following is an effective strategy for how and when to order a urinalysis and/or urine culture. NOTE: this does not apply to patients being screened for asymptomatic bacteriuria (see subsequent page for recommendations in such patients).



\*: With this order, a urine culture will only be performed if a urinalysis result demonstrates pyuria or bacteriuria. In the absence of clinical suspicion for urinary tract infection based on the criteria listed above, pyuria and/or bacteriuria should not be treated. The presence of pyuria or bacteriuria is **expected** in patients with catheterization or suprapubic catheters and should not alter clinical decision making on whether a urinary tract infection is present. This is a strategy to decrease unnecessary antibiotic treatment in samples indicative of colonization and not infection <sup>6</sup>

<sup>a</sup> SIRS Criteria: Heart rate greater than 90 bpm, respiratory rate greater than 20 breaths per minute, temperature less than 36°C, white blood count less than 4,000 cells/mm<sup>3</sup>, temperature greater than 38°C, white blood count greater than 12,000 cells/mm<sup>3</sup>.

<a href="#">Asymptomatic Bacteriuria</a>	<a href="#">Uncomplicated Cystitis</a>	<a href="#">Complicated Lower Cystitis w/o sepsis/bacteremia</a>	<a href="#">Uncomplicated Pyelonephritis</a>
<a href="#">Complicated UTI w/ sepsis/bacteremia</a>	<a href="#">Complicated Pyelonephritis</a>	<a href="#">Pyelonephritis in Pregnancy</a>	<a href="#">Perinephric Abscess</a>
<a href="#">Prostatitis</a>		<a href="#">Epididymitis</a>	<a href="#">References</a>

Clinical Setting	Therapy	Duration	Comments
<p><b>Asymptomatic Bacteriuria<sup>1</sup></b></p> <p>No symptoms of UTI (listed below)</p> <p>Possible UTI symptoms include (without alternative explanation):</p> <ul style="list-style-type: none"> <li>- Urgency, frequency, dysuria</li> <li>- Suprapubic pain or tenderness</li> <li>- Costovertebral pain or tenderness</li> <li>- New onset mental status changes with leukocytosis, hypotension, or ≥ 2 SIRS criteria<sup>a</sup></li> <li>- Acute hematuria</li> <li>- Spasticity or autonomic dysreflexia in patients with spinal cord injury</li> </ul>	<p>In most circumstances, asymptomatic bacteriuria <u>should not be treated</u>, regardless of pyuria, bacterial density, or isolation of resistant organisms.</p> <p>Treatment is recommended in the following circumstances: pregnancy and prior to urologic procedures.</p> <p>Preferred:</p> <p><u>1<sup>st</sup> line:</u> <b>Nitrofurantoin</b> 100 mg PO BID (contraindicated if CrCl &lt; 30 mL/min)</p> <p>Alternative:</p> <p><b>Cephalexin</b>* 500 mg PO BID OR <b>Fosfomycin</b> 3 g PO once</p> <p><u>*Adjust dose based on renal function</u></p>	<p><b>Cephalexin:</b> 7 days (pregnancy only)</p> <p><b>Nitrofurantoin:</b> 5 days (pregnancy only)</p>	<ul style="list-style-type: none"> <li>● Surgical prophylaxis guidelines provide recommendations on antimicrobial prophylaxis prior to genitourinary operation</li> <li>● Screening for and treatment of asymptomatic bacteriuria prior to implantation of prosthetic orthopedic<sup>2</sup> or cardiac devices or neurosurgical procedures should <b>not</b> be treated.</li> <li>● <u>Pregnancy:</u> <ul style="list-style-type: none"> <li>○ Urine culture should be sent and treatment adjusted based on susceptibilities. Follow-up urine cultures should be obtained for test of cure.</li> <li>○ <u>Relatively contraindicated throughout pregnancy:</u> Fluoroquinolones and</li> <li>○ <u>Avoid in first 8 weeks of pregnancy:</u> TMP-SMX</li> </ul> </li> </ul>

Clinical Setting	Therapy (Should take into account recent previous cultures)	Duration	Comments
<p><b>Uncomplicated Cystitis<sup>3</sup></b></p> <p>(Non-pregnant female without obstruction catheters, flank pain, or co-morbid conditions except well-controlled diabetes mellitus)</p>	<p><u>Preferred</u>  <b>Nitrofurantoin</b> 100 mg PO BID (contraindicated if CrCl &lt; 30 mL/min).</p> <p><u>1<sup>st</sup> Alternative</u>  <b>TMP-SMX*</b> 1 DS tab PO BID</p> <p><u>2<sup>nd</sup> Alternative</u>  <b>Cephalexin*</b> 500 mg PO BID (avoid if anaphylaxis to penicillin)</p> <p><u>3<sup>rd</sup> Alternative</u>  <b>Fosfomycin</b> 3 g PO once  OR  <b>Ciprofloxacin</b> 500 mg PO BID  OR  <b>Levofloxacin</b> 750 mg PO daily</p> <p><u>4<sup>th</sup> Alternative:</u>  <b>Gentamicin*</b> 5 mg/kg IV x1  OR  <b>Tobramycin*</b> 5 mg/kg IV x1  OR  <b>Amikacin*</b> 15 mg/kg IV x1</p>	<p><b>Nitrofurantoin:</b> 5 days</p> <p><b>Ciprofloxacin / levofloxacin:</b> 3 days</p> <p><b>Fosfomycin:</b> 1 dose</p> <p><b>Cephalexin:</b> 7 days</p> <p><b>TMP-SMX:</b> 3 days</p>	<ul style="list-style-type: none"> <li>• Fosfomycin should only be used to treat <i>E. coli</i>. Fosfomycin is less effective than nitrofurantoin and should only be used if a contraindication to nitrofurantoin exists.</li> <li>• Fluoroquinolones are no longer recommended as 1<sup>st</sup>-line agents due to high rates of <i>E. coli</i> resistance and propensity for collateral damage (resistance, <i>C. difficile</i> infection). Use should be reserved when 1<sup>st</sup> and 2<sup>nd</sup> line options are not feasible</li> </ul>

Clinical Setting	Therapy (Should take into account recent previous cultures)	Duration	Comments
<p><b>Complicated Lower Urinary Tract Infection (Cystitis) Without Sepsis or Bacteremia</b> <sup>4</sup></p> <p>(Male, urinary catheter present or removal within the last 48 hours, recent GU instrumentation, anatomic abnormality or obstruction, pregnancy or other significant co-morbid conditions such as uncontrolled diabetes or immunosuppression)</p>	<p><u>Preferred</u> <b>Nitrofurantoin</b> 100 mg PO BID (contraindicated if CrCl &lt; 30 mL/min).</p> <p><u>1<sup>st</sup> Alternative</u> <b>TMP-SMX*</b> 1 DS tab PO BID</p> <p><u>2<sup>nd</sup> Alternative</u> <b>Cephalexin</b> 1000 mg PO TID (avoid if anaphylaxis to penicillin)</p> <p><u>3<sup>rd</sup> Alternative</u> <b>Fosfomycin</b> 3 g PO once OR <b>Ciprofloxacin</b> 500mg PO q12h OR <b>Levofloxacin</b> 500mg PO q24h</p> <p><u>Preferred IV option if patient cannot take PO medications:</u> <b>Cefazolin</b> 1 g IV q8h</p> <p><u>Alternative IV option if patient has a history of ESBL-producing organisms:</u> <b>Meropenem</b> 1 g IV q8h followed by oral therapy if possible</p> <p><u>Alternative IV option if patient has a history of penicillin allergy:</u> <b>Cefazolin</b> 1 g IV q8h followed by oral therapy if possible (safe even with penicillin anaphylaxis)</p> <p><u>PREGNANCY:</u> Follow recommendations as above but note agents to avoid/use with caution in comments.</p>	<p>Based on clinical response, 7 days usually appropriate</p> <p><u>Delayed response to therapy:</u> 10-14 days</p>	<ul style="list-style-type: none"> <li>● Empiric therapy should take prior antimicrobial susceptibility into account</li> <li>● Nitrofurantoin and fosfomycin should be avoided if any upper-tract or parenchymal involvement is suspected or confirmed. No data are available to support repeat dosing of fosfomycin for complicated lower urinary tract infection.</li> <li>● Asymptomatic bacteriuria with or without pyuria in catheterized patients are NOT an indication for treatment</li> <li>● Remove urinary catheter whenever possible</li> <li>● If catheter removed and instigating symptoms have resolved, likely no infection was present and no treatment is needed</li> <li>● Antimicrobial choice should be adjusted based on urine culture and susceptibility testing</li> <li>● <u>Pregnancy:</u> <ul style="list-style-type: none"> <li>○ Follow-up urine cultures should be obtained for test of cure.</li> <li>○ <u>Relatively contraindicated throughout pregnancy:</u> <ul style="list-style-type: none"> <li>○ Fluoroquinolones</li> </ul> </li> <li>○ <u>Avoid in first 8 weeks:</u> <ul style="list-style-type: none"> <li>○ TMP-SMX</li> </ul> </li> </ul> </li> </ul>

Clinical Setting	Therapy (should take into account recent previous cultures)	Duration	Comments
<p><b>Uncomplicated Pyelonephritis<sup>3</sup></b></p> <p>(healthy, non-pregnant female with no indwelling devices)</p>	<p><u>Preferred:</u> <b>Ceftriaxone</b> 2 g IV daily followed by oral therapy if possible (safe in patients with anaphylaxis to penicillin)*</p> <p><u>Alternative in patients with ceftriaxone allergy:</u> <b>Meropenem</b> 1g IV q8h followed by oral therapy if possible*</p> <p><u>Alternative in patients with history of ESBL-producing organisms:</u> <b>Meropenem</b> 1 – 2g IV q8h followed by oral therapy if possible*</p> <p>*See appendix</p>	<p><u>TMP-SMX:</u> 7 days</p> <p><u>Ciprofloxacin or levofloxacin:</u> 5 days</p> <p><u>Oral Beta-lactams:</u> 10-14 days</p> <p><u>IV Beta-lactams:</u> 7 days</p>	<ul style="list-style-type: none"> <li>• Urine culture and susceptibility testing should be obtained</li> <li>• Use of oral therapy is dependent on the susceptibility of the organism</li> <li>• Oral therapy appropriate for patients with bacteremia</li> </ul>

Clinical Setting	Empiric Therapy (should take into account recent previous cultures)	Duration	Comments
<p><b>Complicated Urinary Tract Infection with Sepsis or Bacteremia, Complicated Pyelonephritis, Pyelonephritis in Pregnancy, or Perinephric Abscess</b></p>	<p><u>Community-acquired:</u> <b>Ceftriaxone</b> 2 g IV daily (safe even with penicillin anaphylaxis)</p> <p><u>Critically ill, septic shock, healthcare- or hospital-acquired:</u> <b>Cefepime*</b> 2g IV q8h + Vancomycin IV (see nomogram) followed by oral therapy if possible (safe even with penicillin anaphylaxis)*</p> <p><u>Alternative in patients with history of ESBL-producing organisms:</u> <b>Meropenem</b> 1 – 2 g IV q8h with or without vancomycin as above followed by oral therapy if possible*</p> <p><u>PREGNANCY:</u> Follow recommendations as above, but note agents to avoid in comments</p> <p>*See appendix</p>	<p><u>Complicated pyelonephritis with or without bacteremia:</u> 7-14 days from first negative blood culture 7-day duration recommended<sup>7</sup> for patients <u>without urinary diversion, recent urologic surgery, anatomic abnormalities, relapsed infection, or other complicating factors</u> and:</p> <ul style="list-style-type: none"> <li>• Transient bacteremia (single day) with rapid clinical improvement within 72 hours</li> <li>• Not polymicrobial or bacteremic with <i>Pseudomonas</i></li> <li>• Not neutropenic, HCST/SOT, HIV with CD4 &lt;200</li> <li>• Remains hemodynamically stable at day 7</li> <li>• Been afebrile ≥48 hours (at day 7)</li> <li>• Quinolone or TMP-SMX used as definitive therapy</li> </ul> <p>If does not meet above criteria or wish to treat with agents other than IV beta-lactam, quinolone or TMP-SMX: 14 days</p> <p><u>Perinephric Abscess:</u> Prolonged duration (see comments)</p>	<ul style="list-style-type: none"> <li>• Perinephric abscess: recommend ID and urology consult</li> <li>• <b>Pregnancy:</b> <ul style="list-style-type: none"> <li>○ Urine culture should be sent and treatment adjusted based on susceptibilities. Follow-up urine cultures should be obtained for test of cure.</li> <li>○ <u>Relatively contraindicated throughout pregnancy:</u> <ul style="list-style-type: none"> <li>○ Fluoroquinolones</li> </ul> </li> <li>○ <u>Avoid in first 8 weeks of pregnancy:</u> <ul style="list-style-type: none"> <li>○ TMP-SMX</li> </ul> </li> </ul> </li> </ul>

Clinical Setting	Therapy (should take into account recent previous cultures)	Duration	Comments
<p><b>Prostatitis</b></p> <p>Patients typically present with frequency, urgency, urinary incontinence, poor stream, hesitancy, fever <b>and</b> a tender, edematous prostate on exam.</p>	<p><u>Preferred:</u>  <b>Ciprofloxacin</b> 750 mg PO BID  OR  <b>Levofloxacin</b> 750 mg PO daily  OR  <b>TMP-SMX</b> 2 DS tab PO BID</p> <p><u>Alternative for patients with <i>E. coli</i> or <i>E. faecalis</i>, in consultation with ID:</u>  <b>Fosfomycin</b> 3g PO daily x 1 week followed by 3g PO q48h x6-12 weeks</p>	<p>4-6 weeks</p>	<ul style="list-style-type: none"> <li>• Antimicrobial choice should be adjusted based on urine culture and susceptibility testing</li> <li>• Insurance coverage and access should be verified for fosfomycin prior to initiation of therapy</li> </ul>
<p><b>Epididymitis</b></p> <p>Primary pathogens <i>C. trachomatis</i> or <i>N. gonorrhoeae</i></p> <p>Enteric organisms are more likely in men who practice insertive anal intercourse</p> <p>Enteric organisms in select patients only, such as after prostate biopsy, vasectomy, and other urinary tract instrumentation.</p>	<p><b>Ceftriaxone</b> 500 mg** IM once (safe even with penicillin anaphylaxis)  + <b>Doxycycline</b> 100 mg PO BID</p> <p><i>Men who practice insertive anal intercourse</i></p> <p><b>Ceftriaxone</b> 500 mg** IM once (ceftriaxone could be omitted in select cases if there is a low suspicion for gonorrhea or there is a negative NAAT for <i>N. gonorrhoeae</i>; (safe even with penicillin anaphylaxis))</p> <p>+ <b>Levofloxacin*</b> 750 mg PO daily (coverage of enteric organisms)</p> <p><a href="#">*Adjust dose based on renal function</a>  <b>** If weight ≥150 kg, ceftriaxone dose should be 1000 mg</b></p>	<p><b>Doxycycline:</b> 10 days</p> <p><b>Levofloxacin:</b> 10 days</p>	<ul style="list-style-type: none"> <li>• Recommended tests: U/A, Urine culture, and NAATs from urine or urethral specimen for <i>N. gonorrhoeae</i> and <i>C. trachomatis</i></li> <li>• <b>All men should be empirically treated with antibiotics that cover <i>C. trachomatis</i> and <i>N. gonorrhoeae</i>. Antimicrobial regimens should be re-evaluated based on NAAT and urine culture results.</b></li> </ul>

**[\\*Renal Dosing Recommendations](#)**

<sup>a</sup>SIRS Criteria: Heart rate greater than 90 bpm, respiratory rate greater than 20 breaths per minute, temperature less than 36°C, white blood count less than 4,000 cells/mm<sup>3</sup>, temperature greater than 38°C, white blood count greater than 12,000 cells/mm<sup>3</sup>.

Appendix 1. Preferred oral antibiotic dosing for bacteremia, pyelonephritis, and other non-cystitis urinary tract infections

Antibiotic	Bioavailability	Dosing (normal renal function)
Amoxicillin <sup>‡</sup>	70 – 80%	1000mg PO q6h
Ciprofloxacin*, €	70%	750mg PO q12h
Levofloxacin*, €	99%	750mg PO q24h
Trimethoprim-sulfamethoxazole, €	~100%	2 DS PO q12h

\*Administer at least 2 hours before and 6 hours after divalent cations (calcium, magnesium, aluminum, dairy). Administration of continuous tube feeds may reduce efficacy

€ - Preferred

‡ - *Enterococcus* only

1 – Antibiotics not listed in this chart are not routinely recommended for use for patients with bacteremia or upper urinary tract infections. Considerations for other oral  $\beta$ -lactams are provided in Appendix 2

2 – Oral antibiotic therapy should preferentially be used in patients meeting the following criteria, assuming *in vitro* susceptibility:

- Ability to take oral medications reliably
- Clinical stability
- No concerns for diminished absorption (e.g., short-gut syndrome, unavoidable drug-drug interactions)



Appendix 2. Oral  $\beta$ -lactam dosing for bacteremia, pyelonephritis, and other non-cystitis urinary tract infections for when fluoroquinolones and trimethoprim-sulfamethoxazole cannot be used

Antibiotic	Bioavailability	Dosing (normal renal function)
Amoxicillin-clavulanate	70 – 80% (amoxicillin)	875mg PO q8h
Cefpodoxime	50%	400mg PO BID
Cephalexin	95%	1000mg PO q6h

Should only be used in patients with definitive source control when applicable, resolution of clinical signs and symptoms of infection, and at least 3 days of prior intravenous therapy. Should be used ONLY in consultation with ID and when fluoroquinolones and trimethoprim-sulfamethoxazole are not options. Available pharmacokinetic / pharmacodynamic (PK/PD) data, using contemporary PK/PD targets, do not support the use of oral  $\beta$ -lactam agents as definitive therapy for non-cystitis urinary tract infections, with or without bacteremia. However, published clinical data and experience on the use of oral  $\beta$ -lactams as definitive therapy do suggest that they have a role in many patients although the risk of recurrence and treatment is likely marginally higher in comparison to fluoroquinolones and trimethoprim-sulfamethoxazole. Additionally, the role of prior active therapy, definitive source control, and other patient-specific factors must be considered.

Thus, the use of oral  $\beta$ -lactams for non-cystitis urinary tract infections with or without bacteremia must be evaluated with patient-specific risk-benefit considerations in mind, including the potential harms of central intravenous line placement, treatment failure / recurrence, or alternative oral therapies..

**References**

<sup>1</sup> Nicolle LE, et al. Infectious Diseases Society of America Guidelines for the Diagnosis and Treatment of Asymptomatic Bacteriuria in Adults. [Clin Infect Dis 2005;40:643-654.](#)

<sup>2</sup> Sousa R, et al. Is Asymptomatic Bacteriuria a Risk Factor for Prosthetic Joint Infection? [Clin Infect Dis 2014;59:41-47.](#)

<sup>3</sup> Gupta K, et al. International Clinical Practice Guidelines for the Treatment of Acute Uncomplicated Cystitis and Pyelonephritis in Women: A 2010 Update by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases. [Clin Infect Dis 2011;52:e103-e120.](#)

<sup>4</sup> Hooton TM, et al. Diagnosis, Prevention, and Treatment of Catheter- Associated Urinary Tract Infection in Adults: 2009 International Clinical Practice Guidelines from the Infectious Diseases Society of America. [Clin Infect Dis 2010;50:625-663.](#)

<sup>5</sup> Harris PN, et al.  $\beta$ -lactam and  $\beta$ -lactamase inhibitor combinations in the treatment of extended-spectrum  $\beta$ -lactamase producing Enterobacteriaceae: time for a reappraisal in the era of few antibiotic options? [Lancet Infect Dis 2015;15:475-485.](#)

<sup>6</sup> Gandhi T, et al. Importance of urinary tract infection to antibiotic use among hospitalized patients. [Infect Control Hosp Epidemiol 2009;30:193-5.](#)

<sup>7</sup> Yahav D, et al. Seven Versus 14 Days of Antibiotic Therapy for Uncomplicated Gram-negative Bacteremia: A Noninferiority Randomized Controlled Trial. [Clin Infect Dis, 69 \(7\), 1091-1098 2019 Sep 13.](#)

<sup>8</sup> Tyrannical paper

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*The recommendations in this guide are meant to serve as treatment guidelines for use at Michigan Medicine facilities. If you are an individual experiencing a medical emergency, call 911 immediately. These guidelines should not replace a provider’s professional medical advice based on clinical judgment, or be used in lieu of an Infectious Diseases consultation when necessary. As a result of ongoing research, practice guidelines may from time to time change. The authors of these guidelines have made all attempts to ensure the accuracy based on current information, however, due to ongoing research, users of these guidelines are strongly encouraged to confirm the information contained within them through an independent source.*

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