Urinary Tract Infection and Asymptomatic Bacteriuria Guidance

Urinary tract infection (UTI) is the most common indication for antimicrobial use in hospitals, and a significant proportion of this use is inappropriate or unnecessary.[1] The Antimicrobial Stewardship Program at the Nebraska Medical Center has developed guidelines to facilitate the evaluation and treatment of UTIs.

Ordering of Urine Culture: Urine cultures should only be obtained when a significant suspicion for a UTI exists based on patient symptoms. Urine culture data should always be interpreted taking into account the results of the urinalysis and patient symptoms. In the urinalysis, the presence of leukocyte esterase suggests WBC are present while nitrites suggest that gram-negative organisms are present. Neither of these findings is diagnostic of a UTI. **Before obtaining a urine culture, it is important to replace any existing urinary catheter and do not draw cultures from a urine drainage bag.**

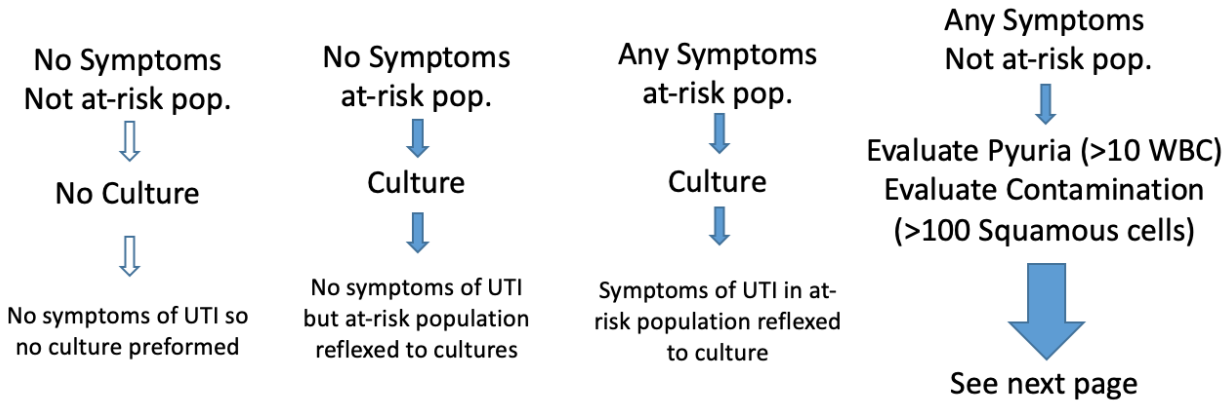
UTI Evaluation Order Panel

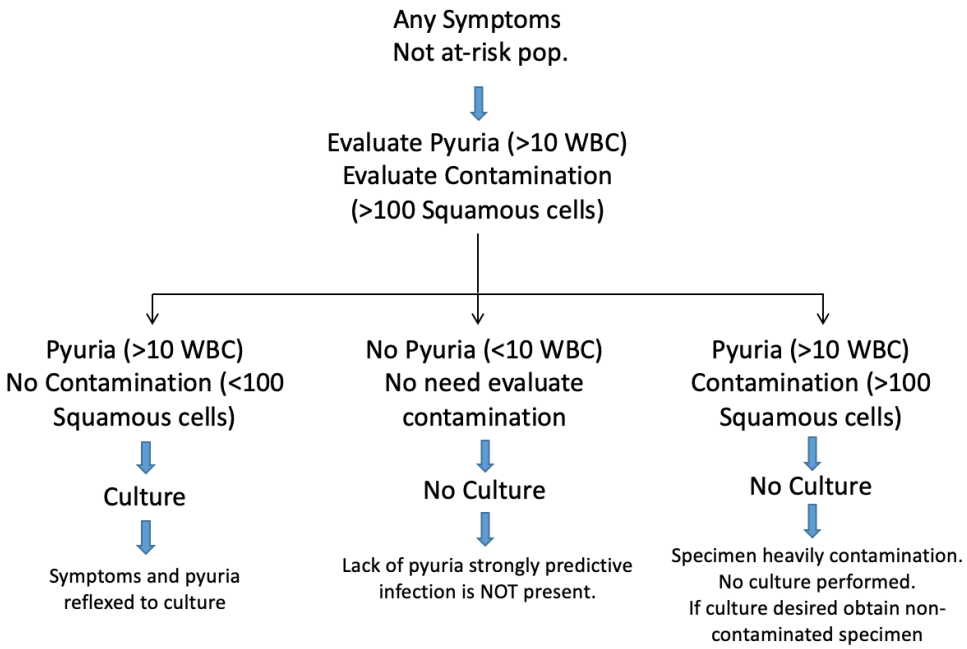
Assess symptoms

- No symptoms
- Symptoms are typical (dysuria, new onset frequency or urgency, suprapubic or CVA tenderness) or atypical (fever and unable to assess UTI symptoms, acute hematuria, etc.)

Assess if "at-risk" population

- Pregnant, impending urologic surgery with risk of mucosal bleeding





Indication for urinalysis with reflex culture:

- When signs or symptoms of a urinary tract infection are present
- In patients who cannot provide history (e.g., intubated) **and** have sepsis without an explainable source (should always be paired with urinalysis)

Urine analysis/culture NOT recommended:

- Change in urine color, odor, or turbidity – these are typically due to patient hydration and not indicators of infection
- Patient lacks symptoms of UTI
- Automatically in workup of fever or sepsis – patients who can provide a history should not have a urine culture obtained as part of fever evaluation unless symptoms suggest a UTI is present
- Pre-operatively except in urologic surgery where mucosal bleeding is anticipated
- When a urinary catheter is placed or changed
- Upon admission without signs of infection
- After treatment of UTI to document cure

Interpretation of Urine Culture: Bacteria are frequently noted on urinalysis and cultured from urine specimens. The presence of bacteria in the urine may indicate one of three conditions: 1) specimen contamination; 2) urinary tract infection (UTI); or 3) asymptomatic bacteriuria (ASBU). When evaluating the clinical significance of a urine culture, these three conditions must each be considered and classification should be based upon history and exam findings coupled with urine findings. Specimen contamination should always be considered, as this is common, particularly in female patients. High numbers of squamous cells on the urinalysis (>100) suggests contamination and results of the culture should generally be ignored. Samples with squamous cells 20-100 should be interpreted with caution.

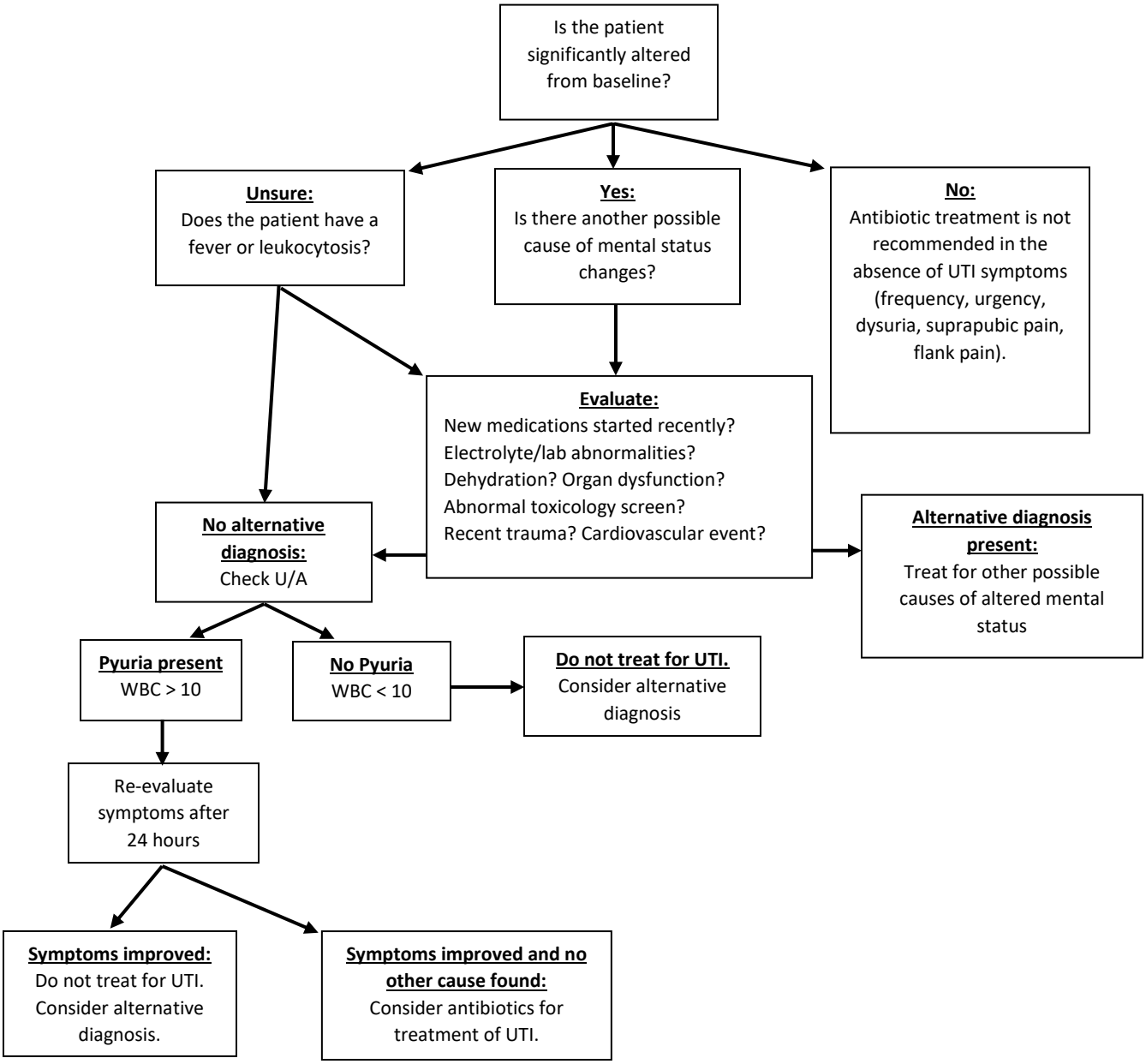
It is important to recognize that pyuria is not an indication for treatment. Pyuria is the presence of an increased number of polymorphonuclear leukocytes in the urine (generally >10 WBC/hpf) and is evidence for genitourinary tract inflammation. Pyuria can be seen in patients with catheter use, sexually transmitted diseases, interstitial nephritis, or ASBU. The absence of pyuria is a strong indicator that a UTI is not present and is useful in ruling out a UTI.

In patients with a positive urine culture, where no contamination exists, clinicians must determine if the patient is exhibiting **symptoms** of a UTI. Symptoms typical of a UTI are urinary frequency or urgency, dysuria, new onset hematuria, suprapubic pain, costovertebral tenderness or fever. Patients with a urinary catheter in place may have more vague symptoms such as new onset or worsening fever, chills, pelvic discomfort, unexplained leukocytosis, or acute hematuria.

Altered mental status (AMS) without urinary or systemic symptoms is no longer an indication for antimicrobial therapy in patients being evaluated for UTI. Based on recommendations from the Infectious Diseases Society of America (IDSA) and the American Medical Directors Association (AMDA), we recommend in clinically stable patients **antibiotics can be held and other causes of AMS be assessed while UTI only be considered if new symptoms arise or no other cause is found**.[2,20]

Dehydration is a very common cause of altered mental status in elderly patients. Providing hydration along with active monitoring is the best treatment for this condition. Susceptibility rates of flouroquinolones range from 30-70% against *E.coli* isolated in residents of long-term care facilities. Although delirium can make assessment of symptoms difficult in this population, most patients with altered mental status and no clear signs of infection will improve without antibiotics based on our experience.

Evaluating Altered Mental Status in Elderly Patients



Adapted from: Management of UTI and Asymptomatic Bacteriuria. Northwestern Memorial Antimicrobial Stewardship Program https://asp.nm.org/uploads/9/0/7/8/90789983/management-of-urinary-tract-infections-and-asymptomatic-bacteriu.pdf

Asymptomatic Bacteriuria

Patients with positive urine cultures who lack symptoms of a UTI have the diagnosis of **asymptomatic bacteriuria**. ASBU is more common in some patient populations and the prevalence increases with advancing age (**Table 1**). It is also associated with sexual activity in young women and is more prevalent in patients with impaired urinary voiding or indwelling urinary devices.

Table 1: Prevalence of Asymptomatic Bacteriuria in Selected Populations[2]

Population	Prevalence, %
Children	
Girls	1-2
Boys	<1
Healthy Women	
Premenopausal	1-5
Pregnant	1.9-9.5
Postmenopausal (age 50-70 years)	2.8-8.6
Persons with diabetes	
Women	9-27
Men	0.7-11
Elderly persons in the community (≥70 yrs.)	
Women	10.8-16
Men	3.6-19
Elderly persons in a long-term care facility	
Women	25-50
Men	15-50
Persons with spinal cord injuries	
Intermittent catheter use	23-89
Sphincterotomy and condom catheter placement	57
Patients undergoing hemodialysis	28
Patients with indwelling catheter use	
Short-term	3%-5%/day catheter
Long-term	100
Persons with kidney transplant	
First month post-transplant	23-24
1 mo-1 y post-transplant	10-17
>1 y post-transplant	2-9

Screening for and treating ASBU patients should only occur if the bacteriuria has an associated adverse outcome (such as development of a symptomatic urinary tract infection, bacteremia, progression to chronic kidney disease, etc.) that can be prevented by antimicrobial therapy. There are two clinical situations in which these criteria are clearly met, which is a change from previous guidance.

1. **Pregnant women** should be screened and treated for ASBU, as they have a significantly increased risk of developing pyelonephritis as well as experiencing a premature delivery and delivering a low birth weight infant.
2. **Prior to transurethral resection of the prostate (TURP) or any other urologic procedure with a risk of mucosal bleeding**, patients should be screened for bacteriuria, as it has been associated with a major increase in the risk for post-procedure bacteremia and sepsis. Treatment of ASBU in both these situations has been demonstrated to prevent these complications.

Table 2: IDSA Guideline Recommended Indications for the Screening and Treatment of ASBU[2]

Screen and Treat	DO NOT Screen and Treat

• Pregnant women (at least once in early pregnancy)
  ○ 4-7 days; shortest effective course should be used
• Prior to urologic procedure with risk of mucosal bleeding (e.g., TURP, etc.)
  ○ 1-2 dose short course started 30-60 mins prior to procedure
	• Children
	• Healthy, nonpregnant women
	• Healthy, postmenopausal women
	• Older persons living in the community
	• Elderly residents of long-term care facilities
	• Patients with diabetes
	• Kidney transplant recipient with surgery >2 months prior
	• Any other solid organ transplant
	• Spinal cord injury
	• Indwelling urethral catheter
	• Elective non-urologic surgery
	• Placement or presence of artificial urine sphincters or penile prostheses
	• Asymptomatic funguria

Unfortunately, many patients with ASBU receive treatment from which they do not benefit and by which they are likely harmed. The unnecessary treatment of ASBU can lead to antibiotic resistance, adverse drug effects, *C. difficile* infection, and unnecessary costs of medical care. Gandhi and colleagues described antibiotic use for 3 months on a single medicine ward with 54% (224/414) of patients treated with antimicrobials and UTI the most common diagnosis (N=49). Of those who were treated for a UTI, 32.6% had no symptoms suggestive of a UTI.[3] In another study, Cope et al. analyzed 280 catheterized patients at a VA with 58.6% considered to have ASBU. Thirty-two percent of ASBU patients received treatment (inappropriately) with three patients developing *C. difficile* infection.[4] Linares et al. found 26% of 117 patients with ASBU at their institution were treated inappropriately for an average of 6.6 days and the treatment resulted in two cases of *C. difficile* infection and one case of QT prolongation. They then introduced an electronic reminder that did not decrease the incidence of inappropriate treatment (still 26%) but decreased duration of therapy to 2.2 days with no antibiotic adverse events noted.[5]

Patients at Nebraska Medicine are not excluded from this inappropriate treatment. An analysis of 68 patients with positive urine cultures on two medical wards at NMC over 3 months revealed that 22 (32.4%) were asymptomatic using a very liberal definition of symptoms. Antimicrobials were inappropriately prescribed to 36.4% (8/22) of those with ASBU. This resulted in two patients developing clinically significant diarrhea with one of them being diagnosed with a *C. difficile* infection.

The take home message is that treatment of ASBU is common and results in significant patient harm. Clinicians should be aware of this when making decisions about the treatment of possible UTI.

Treatment of Urinary Tract Infections in Adults

Uncomplicated vs. Complicated UTIs

If it is determined that a patient has a urinary tract infection based on symptoms, UA, and urine culture, a decision must be made on how to treat the infection. Multiple factors play a role deciding on the most appropriate therapy choice and duration including: clinical classification of UTI (cystitis or pyelonephritis), severity and complexity of UTI (complicated or uncomplicated), patient allergies, location of patient (hospital, community, or long-term care facility), recent history of UTI or antibiotic exposure, previous urinary pathogens isolated, and cost of agent to be prescribed.

Patients with cystitis can generally be separated into two clinical groups: *complicated* and *uncomplicated.* Uncomplicated UTI's are typically defined as episodes of acute cystitis occurring in healthy, nonpregnant women with no history suggestive of urinary tract abnormalities. In patients with uncomplicated UTIs, *E. coli* is responsible for 75-95% of infections and empiric therapy should be directed at this pathogen.

Those not meeting the above simple criteria of uncomplicated cystitis should not automatically be classified as complicated, however.

Complicated UTIs are those that occur in patients who have urinary tract abnormalities, instrumentation or immune function that predisposes them to treatment failure. According to the American Urological Association some of the most common factors include:

Anatomic or functional abnormality of urinary tract	• Male gender, pregnancy, outlet obstruction, stone disease, neurogenic bladder, vesicoureteral reflux
Urinary instrumentation or foreign bodies	• Catheters, stents, nephrostomy tubes
Systemic disease / immunosuppresion	• Diabetes, organ transplantation, renal failure

Treatment of Uncomplicated Cystitis at Nebraska Medicine

Uncomplicated cystitis is defined by the presence of typical lower urinary tract symptoms (dysuria, frequency, urgency, hematuria) and lack of upper tract symptoms (see "Treatment of Pyelonephritis" below) in an otherwise healthy female without urogenital abnormalities.

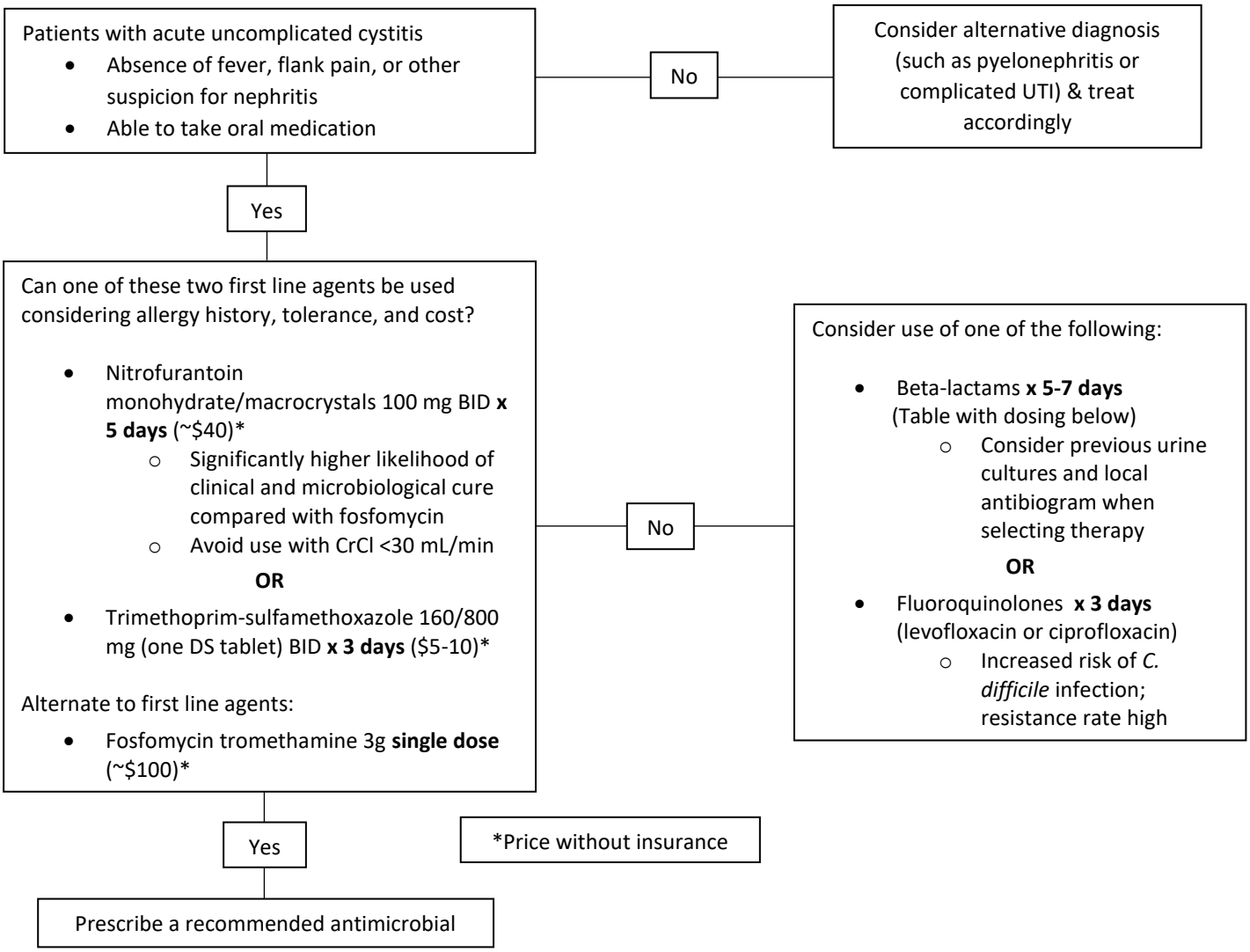


Table 3: Specific Beta-Lactam Treatment Regimens for Acute Uncomplicated Cystitis

Agent and Regimen	Duration
Cephalexin 500 mg BID	5-7 days[1]
Cefuroxime 250 mg BID	5-7 days[1]
Cefdinir 300 mg BID	5-7 days[1,9]
Cefpodoxime-proxetil 100 mg BID	*5-7 days[7]
Amoxicillin-clavulanate 500 mg BID	5-7 days[1,8]

**Limited data suggest that 3 days of cefpodoxime may be sufficient for uncomplicated UTI, but conflicting data exist. Use clinical judgment when determining duration of therapy with this agent.*

Treatment of Complicated UTI at Nebraska Medicine

Complicated UTIs are generally UTIs that occur in patients who have abnormalities of the urinary tract or immune function that predisposes them to treatment failure. Some of these factors include:

- Male
- Diabetes
- Pregnancy
- Hospital acquired infection
- Renal failure
- Urinary tract obstruction
- Presence of an indwelling urethral catheter, stent, nephrostomy tube or urinary diversion
- Recent urinary tract instrumentation
- Functional or anatomic abnormality of the urinary tract
- History of urinary tract infection in childhood
- Renal transplantation
- Bacteremia without signs and symptoms of pyelonephritis
- UTI with a known source of infection that is inadequately controlled
- Urinary stones

Much less data is available to guide treatment recommendations in this patient group. *E. coli* is still the most common pathogen in complicated UTIs, but other pathogens such as *Klebsiella*, *Proteus*, and *Enterobacter spp.* are also noted. The pathogens causing complicated UTIs are generally more diverse and more drug resistant, and specific guidelines for this syndrome are not available. The guidance below is separated into outpatient and inpatient management. Inpatients with complicated UTI's should have therapy based on previous culture results, severity of illness, and the local antibiogram. Catheter-associated urinary tract infections (CAUTI's) are typically grouped with complicated UTI's, but they have their own specific guidance further below within this document.

Treatment duration has traditionally been 10-14 days, but recent data suggest that 7 days of therapy for complicated UTI's, even in men, is adequate and not associated with increased risk of recurrence.[6,10] Recent data also suggest that durations of 5-7 days are non-inferior to longer courses with regards to both clinical and microbiological cure rates, even in bacteremic patients.[11] This data is especially strong with fluoroquinolones.[12-14] The main exception to these shorter courses is in patients with complex urogenital abnormalities, who appear to need longer courses to prevent microbiological failure.[11] Based on these data, treatment durations **of 7 days** are generally recommended. Patients with known kidney stones that have not been removed or those not responding to therapy may require 10-14 days.

Treatment of Complicated UTI at Nebraska Medicine

Table 4: Outpatient Management

Complicated Cystitis
1. Trimethoprim-sulfamethoxazole 160/800 mg (one DS tablet) BID **x 7 days** OR 2. Levofloxacin 500 mg PO daily or ciprofloxacin 500 mg PO BID x **5-7 days**
Alternatives with less data or less activity:
1. Nitrofurantoin 100 mg PO BID **x 7-10 days** a. Not recommended in patients with concern for pyelonephritis or CrCl <30 mL/min 2. Oral beta-lactams **x 7 days** a. Cephalexin 500 mg BID b. Cefdinir 300 mg BID c. Amoxicillin-clavulanate 500 mg BID

Table 5: Inpatient Management

Complicated Cystitis
Parenteral Beta-Lactams x 5-7 days 1. Ceftriaxone 1g daily (2g if ≥80 kg) OR 2. Ertapenem 1g IV q24h (Use if patient has history of an ESBL-producing organism) 3. Piperacillin/tazobactam 4.5g IV q8h (Use if patient has history of *Pseudomonas aeruginosa*)
Alternatives/Step-down agents:
1. Nitrofurantoin 100 mg PO BID x 7-10d a. Not recommended in patients with concern for pyelonephritis or CrCl <30 mL/min 2. Trimethoprim-sulfamethoxazole 160/800 mg (one DS tablet) BID x 7 days 3. Oral beta-lactams (based on susceptibility results) 7d a. Cephalexin 500 mg BID b. Cefdinir 300 mg BID c. Amoxicillin-clavulanate 500 mg BID

Treatment of Pyelonephritis at Nebraska Medicine

The presence of pyelonephritis is suggested by the presence of upper urinary tract symptoms such as fever, CVA tenderness, nausea, vomiting, and signs of severe sepsis. Patients with pyelonephritis should be evaluated for hospitalization and a decision made on the site of care based on severity of illness and host factors (ability to take oral agents, allergies, history of antimicrobial resistance, home support, etc.).

An important factor to consider when choosing therapy for pyelonephritis is the likelihood of bacterial resistance to common therapies. Numerous studies have been published evaluating risk factors for resistance in UTI pathogens and common **risk factors associated with the presence of multi-drug resistant (MDR) pathogens have generally included**:

- Residence in a long-term care facility
- Greater than 5 days of antibiotics in the previous 90 days
- History of recurrent UTIs
- History of having an MDR urinary pathogen
- Greater than 5 days in a hospital within the last 90 days

These risk factors particularly identify patients at risk for resistance to fluoroquinolones and/or 3rd-generation cephalosporins (typically via production of an extended-spectrum beta-lactamase (ESBL)). It should be noted that baseline *E. coli* resistance to quinolones at TNMC is roughly 25% while resistance to 3rd-generation cephalosporins such as ceftriaxone is much less (around 10%).

Non-hospitalized/early pyelonephritis:

- Oral Levofloxacin 750mg daily or ciprofloxacin 500 mg BID OR
- Oral trimethoprim-sulfamethoxazole (TMP-SMX) 160/800 mg (1 double-strength tab) BID

Due to high resistance rates in *E. coli*, **all** patients should receive an initial one-time intravenous dose of ceftriaxone 1 gram or a consolidated 24-hour dose of an aminoglycoside (i.e. gentamicin 5 mg/kg)

Patients requiring hospitalization: Fluoroquinolones and TMP/SMX are not recommended for empiric treatment in patients admitted with pyelonephritis due to high rates of resistance (~25%). When susceptibilities results return, patients may be de-escalated to a FQ or TMP/SMX if they are susceptible.

No risk factors for multi-drug resistant organisms:

1. Ceftriaxone 1g IV q24h (2g if ≥80kg)
2. **Severe allergy to the above**: Refer to Nebraska Medicine allergy guidance document. https://www.unmc.edu/intmed/divisions/id/asp/clinical-pathways/docs/penicillin-allergy-guidance.pdf

Risk factors for multi-drug resistant organisms:

1. Piperacillin/tazobactam 4.5g IV q8h, infused over 4 hours **OR**
2. Ertapenem 1g IV q24h (Use if patient has history of an ESBL-producing organism) **OR**
3. Cefepime 1g q6h
4. **Severe allergy to all the above**: Refer to Nebraska Medicine allergy guidance

In patients with septic shock, consider the addition of:

1. Gentamicin 7 mg/kg IV q24h (extended-interval dosing)
2. Vancomycin per pharmacy consult (sepsis from a urinary source is rarely due to a Gram positive pathogen)

The addition of other antimicrobials (gentamicin, vancomycin) should be based upon severity of illness and likelihood of resistance.

In the treatment of stable patients with pyelonephritis, studies have demonstrated that oral antibiotics are just as effective as intravenous antibiotics**. Intravenous antibiotic use should be reviewed at 48 hours and transitioned to oral therapy if possible**, based on patient response to therapy and susceptibility pattern of microbe.

Treatment Duration: Traditionally pyelonephritis has been treated for 10-14 days, but several recent studies have demonstrated that patients treated with fluoroquinolones for 5-7 days had similar cure rates to those treated for 14 days.[11-14,19] When patients are initially treated with an IV beta-lactam and the isolate is susceptible, a total treatment course of 7 days is adequate if parenteral therapy is continued or transitioned to oral fluoroquinolones after culture results are known.[18] When transitioning to an oral beta-lactam, less is known about the optimal duration and therefore 10 days of total therapy is typically used. TMP/SMX has historically been used for 14 days in pyelonephritis; however, limited data suggest that 7 days of TMP/SMX may have similar rates of reoccurrence to 7 days of ciprofloxacin in patients with pyelonephritis due to *E coli*.[15]

Table 5: Treatment Duration for Pyelonephritis

Agent	Duration of Therapy
Fluoroquinolones (levofloxacin, ciprofloxacin)	5-7 days
Beta-lactams	Parenteral: 7 days Oral: 10-14 days
TMP/SMX	10-14 days

Catheter-Associated Urinary Tract Infections (CA-UTIs)[16,17]

Diagnosis: In patients with indwelling urethral or suprapubic catheters or those who receive intermittent catheterization, UTIs typically presents without the usual lower urinary tract symptoms of dysuria, frequency, or urgency. Despite this, CA-UTI is defined by the presence of both symptoms and a positive urine culture:

- Symptoms and/or signs compatible with UTI may include: new onset or worsening of fever, rigors, malaise, or lethargy with no other identified cause; flank pain; costovertebral angle tenderness; unexplained leukocytosis, new onset hematuria; or pelvic/suprapubic discomfort
    - Symptoms in patients with spinal cord injury may also include increased spasticity, autonomic dysreflexia, or a sense of unease.
- ≥ 10_3 colony-forming units (cfu)/mL of ≥ 1 bacterial species in a single catheter urine specimen or in a midstream voided urine specimen from a patient whose urethral, suprapubic, or condom catheter has been removed within the previous 48 hours is considered a positive urine culture.

Pyuria and bacteriuria are very common in the presence of a urinary catheter are not an indication for treatment in patients who lack symptoms of a UTI.

Evaluation and Treatment (see algorithm below):

- Always obtain a urine culture prior to initiation of antimicrobial therapy.
    - If the indwelling catheter has been in place for > 2 weeks at the onset of CA-UTI and is still indicated, replace the catheter and obtain urine culture from new catheter.
    - If urinary catheter no longer indicated, remove catheter and obtain culture from a voided midstream urine specimen.
- Patients who have a CA-UTI and have had their catheter longer than 14 days should have the catheter exchanged
- Choose therapy based on severity of illness and risk factors for resistant pathogens
- CA-UTI's should be treated for the same duration as complicated UTI's.
- Oral therapy can be used for part or all of therapy assuming the organism is susceptible and the patient can tolerate oral therapy with adequate absorption.

Table 6: Treatment Options for CA-UTI

	First Line Therapy	Alternative Therapy
Mild/moderate illness – treat as per complicated cystitis guidance	TMP/SMX 1 DS Tab BID **OR** Levofloxacin 500 mg PO daily	Oral 3rd gen cephalosporins Ceftriaxone 1g IV daily (if previous pathogen resistant to FQ or hospitalized >5 days)
Suspicion for infection-related septic shock – treat as per MDR-risk pyelonephritis guidance	Piperacillin/tazobactam 4.5g IV q8h over 4 hours **OR** Cefepime 1g q6h **OR** *Ertapenem 1g IV daily **OR**	If allergy to all other agents, refer to NM Allergy Guidance

**Ertapenem is recommended in patients with a history of an ESBL-producing organism*

Catheter Removal

To improve patient care and decrease nosocomial infections, an Indwelling Urinary Catheter (IUC) Removal Protocol has been developed for all Nebraska Medicine patients. Protocol details and a list of IUC indications can be downloaded by utilizing this link to IUC Removal Protocol (CP NUR 04).

In short, an indication for placing an IUC will be required when ordering, and nursing will communicate with providers daily regarding the relevance of the indication and if it is still present. Free text orders or Nursing Communication orders are NOT accepted. The nurse must assess every shift for possible removal, and if during the patient's stay, the indication changes, the original order must be modified.

Table 7: Nebraska Medicine Approved Indications for an Indwelling Urinary Catheter

Indications	Nurse May Remove When
Acute urinary retention or bladder outlet obstruction NOT managed by bladder scanning and straight catheterization	**X**
Chronic indwelling catheter from home or another facility	**X**
Extensive abdominal injury (e.g., crush injury, bladder injury)	**X**
IUC placed by a physician due to "difficulty placing"	**X**
Hemodynamically unstable patient requiring hourly titration of fluids, vasopressors, inotropes or life-support therapy	**X**
Required frequent urine measurements (every 1-2 hrs) - UNABLE to obtain with other methods (external cath, urinal, etc.)	**X**
Gross hematuria/Continuous bladder irrigation	**X**
In incontinent patients to promote healing of wounds/incisions on the coccyx, sacrum, and/or perineal area	**X**
Patients undergoing *GU surgery/procedure* on structures contiguous/adjacent to the bladder or urinary tract	**X**
Improve comfort at end of life	Nurse may remove if requested by patient/family
Any medical illness where use of a bedpan, urinal, or bedside commode has a high likelihood of medical harm	Medical Illness has resolved *i.e. activity orders placed
Abdominal pressure monitoring	When abdominal pressure monitoring complete
Perioperative procedure	Remove after procedure
24-hour urine collection with incontinence or inability to collect	24 hour urine collection is complete

*Surgeries include: pancreatic transplant, kidney, bladder and/or urethra, GYN & GYN ONC, colorectal, difficult placement/placement with a guide wire, filliform and/or follower

Nebraska Medicine Urinary Antibiograms

Emergency Department Urinary Antibiogram Nebraska Medical Center Jan 1, 2017 - Dec 31, 2019 ED patients only, first isolate per patient	# Isolates	Amikacin	Ampicillin (Amox)	Amox/Clav	Cefazolin (1st) ◊	Cefoxitin (2nd)	Cefuroxime (2nd)	Ceftriaxone (3rd)	Cefepime (4th)	Daptomycin	Ertapenem	Gentamicin	Levofloxacin	Linezolid	Meropenem	Nitrofurantoin	Oxacillin	Pip/Tazo	Tetracycline	Tobramycin	Sulfa/Trim	Vancomycin
GRAM NEGATIVE ORGANISMS																						
Escherichia coli	1263	99	53	87	90	94	80	94	95	R	100	93	88	R	100	98	R	92	79	94	73	R
Klebsiella pneumoniae	155	100	R	95	94	91	83	94	94	R	99	97	96	R	100	36	R	93	84	96	89	R
Proteus mirabilis	75	100	93	100	94	100	97	97	98	R	100	90	82	R	100	R	R	98	R	90	78	R
Pseudomonas aeruginosa	41	97	R	R	R	R	R	R	90	R	R	85	80	R	85		R	92	R	97	R	R
Klebsiella oxytoca	23	100	R	90	56	90	78	86	86	R	100	95	100	R	100	100	R	86	85	95	95	R
Klebsiella (Enterobacter) aerogenes	22	100	R	R	R	0	0	90	100	R	95	100	100	R	100	0	R	95	100	100	100	R
Enterobacter cloacae	22	100	R	R	R	R	4	81	100	R	95	100	100	R	100	0	R	90	77	100	81	R
Citrobacter freundii complex	15	100	R	R	R	0	R	93	100	R	100	100	93	R	100	75	R	100	71	100	80	R
Citrobacter koseri	11	100	R	100	27	100	90	100	100	R	100	100	81	R	100	100	R	100	100	100	81	R
GRAM POSITIVE ORGANISMS																						
Staphylococcus aureus	23	R	0	81				76		100		95	73	100		100	78		95	R	95	100
Staphylococcus epidermidis	31	R	0	31				46		100		100	63	100		100	45		93	R	67	100
Enterococcus faecalis	77	R	100		R	R	R	R	R	100	R	R	80	98		98			21	R	R	100
◊ = Reflects susceptibility to oral cephalexin																						
Use caution interpreting results with <30 isolates				R = intrinsically resistant										Blanks indicate not routinely tested								

Outpatient Urinary Antibiogram Nebraska Medicine Jan 1, 2017 - Dec 31, 2019 Outpatients only (clinics and ED discharges), first isolate per patient	# Isolates	Amikacin	Ampicillin (Amox)	Amox/Clav	Cefazolin (1st) ◊	Cefoxitin (2nd)	Cefuroxime (2nd)	Ceftriaxone (3rd)	Cefepime (4th)	Daptomycin	Ertapenem	Gentamicin	Levofloxacin	Linezolid	Meropenem	Nitrofurantoin	Oxacillin	Pip/Tazo	Tetracycline	Tobramycin	Sulfa/Trim	Vancomycin
GRAM NEGATIVE ORGANISMS																						
Escherichia coli	911	99	57	87	91	94	82	95	96	R	99	92	86	R	100	98	R	94	78	92	77	R
Klebsiella pneumoniae	140	100	R	94	96	91	88	97	97	R	100	97	97	R	100	44	R	96	84	97	91	R
Proteus mirabilis	54	98	92	100	96	100	96	100	100	R	100	96	92	R	100	R	R	100	R	96	85	R
Pseudomonas aeruginosa	20	95	R	R	R	R	R	R	95	R	R	90	85	R	95		R	95	R	100	R	R
Citrobacter freundii complex	19	100	R	R	R	R	R	84	100	R	100	89	100	R	100	90	R	94	84	89	84	R
Citrobacter koseri	19	100	R	100	63	100	84	100	100	R	100	100	100	R	100	90	R	100	94	100	100	R
Klebsiella oxytoca	17	100	R	71	52	71	64	82	82	R	100	82	94	R	100	100	R	82	82	82	70	R
Klebsiella (Enterobacter) aerogenes	11	100	R	R	R	R	0	100	100	R	100	100	100	R	100	33	R	100	90	100	100	R
GRAM POSITIVE ORGANISMS																						
Staphylococcus aureus	13	R	0	100				100		100		100	84	100		100	92		92	R	100	100
Staphylococcus epidermidis	17	R	0	57				56		100		88	58	100		100	52		76	R	47	100
Enterococcus faecalis	78	R	100		R	R	R	R	R	100	R	R	94	98		100			35	R	R	100
◊ = Reflects susceptibility to oral cephalexin																						
Use caution interpreting results with <30 isolates				R = intrinsically resistant										Blanks indicate not routinely tested								

Inpatient Urinary Antibiogram **Nebraska Medical Center** **Jan 1, 2017 - Dec 31, 2019** Admitted patients only, first isolate per patient	# Isolates	Amikacin	Ampicillin (Amox)	Amox/Clav	Cefazolin (1st) ◊	Cefoxitin (2nd)	Cefuroxime (2nd)	Ceftriaxone (3rd)	Cefepime (4th)	Daptomycin	Ertapenem	Gentamicin	Levofloxacin	Linezolid	Meropenem	Nitrofurantoin	Oxacillin	Pip/Tazo	Tetracycline	Tobramycin	Sulfa/Trim	Vancomycin
GRAM NEGATIVE ORGANISMS																						
Escherichia coli	1034	99	51	85	87	87	71	90	91	R	99	90	75	R	99	97	R	89	75	90	73	R
Klebsiella pneumoniae	220	99	R	89	89	75	81	90	90	R	99	94	93	R	99	45	R	88	75	93	83	R
Proteus mirabilis	106	100	84	100	91	84	92	95	94	R	100	83	62	R	100	R	R	95	R	85	71	R
Pseudomonas aeruginosa	91	97	R	R	R	R	R	R	90	R	R	76	69	R	86		R	90	R	93	R	R
Klebsiella oxytoca	53	100	R	100	45	92	64	83	88	R	98	98	96	R	98	100	R	83	90	96	94	R
Enterobacter cloacae	28	100	R	R	R	R	10	78	96	R	92	100	96	R	100	0	R	89	81	100	85	R
Citrobacter freundii complex	25	100	R	R	R	R	R	72	96	R	96	92	92	R	96	100	R	84	84	92	92	R
Klebsiella (Enterobacter) aerogenes	24	100	R	R	R	R	4	79	100	R	100	100	95	R	100	0	R	87	88	100	100	R
Citrobacter koseri	17	100	R	80	41	100	94	100	100	R	100	100	88	R	100	100	R	94	92	100	88	R
Morganella morganii	12	100	R	R	R	100	R	58	91	R	100	83	66	R	100	R	R	100	44	100	58	R
Serratia marcescens	12	100	R	R	R	R	R	50	91	R	100	100	100	R	100	R	R	75	9	83	91	R
GRAM POSITIVE ORGANISMS																						
Staphylococcus aureus	52	R	0	70				65		100		98	59	100		98	63		94	R	100	100
* **Methicillin-resistant *S. aureus***	19	R	R	R	R	R		R	R	100	R	94	10	100		94	R	R	94	R	100	100
Staphylococcus epidermidis	27	R	0	38				52		100		88	44	100		100	48		88	R	51	100
Enterococcus faecalis	132	R	100		R	R	R	R	R	100	R	R	77	97		100			26	R	R	100
Enterococcus faecium	29	R	20		R	R		R	R	55	R	R	20	92		48			16	R	R	51
* **Vancomycin-resistant *E. faecium***	15	R	0		R	R		R	R	60	R	R	0	92		58			7	R	R	0
*subset of group above	◊ = Reflects susceptibility to oral cephalexin																					
Use caution interpreting results with <30 isolates	R = intrinsically resistant														Blanks indicate not routinely tested							

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