

Urinary Tract Infection (Cystitis and Pyelonephritis): Adult

Genitourinary

Clinical Decision Tools for RNs with Additional Authorized Practice [RN(AAP)s]

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Background

A urinary tract infection (UTI) can occur in the urethra, bladder, ureter, or kidney, can be classified as uncomplicated or complicated, and can be recurrent (Huether, 2019).

Acute cystitis is an inflammation of the bladder epithelium and the most common site of a UTI, which is usually caused by bacteria from intestinal flora (Huether, 2019).

Pyelonephritis is characterized by an infection of one or both of the renal parenchyma and renal pelvis, often producing localized flank or back pain combined with systemic symptoms such as fever, chills, and nausea (Huether, 2019). Bacteria may be introduced into the urinary tract from fecal contamination or unprotected intercourse, particularly anal (Conner, Thomas, & Porter, 2019). Fungi (especially *Candida* species) should be suspected in complicated UTI cases that fail to respond to antibiotic therapy (Conner et al., 2019). The most common bacterial pathogen in males and females is *Escherichia coli* (*E. coli*), the causative organism in 80% to 90% of cases of uncomplicated cystitis.

Enterobacteriaceae (e.g., *Klebsiella*, *Proteus mirabilis*, *Enterobacter*, *Pseudomonas*, *Serratia*) are less common, but often the cause of complicated UTI cases including pyelonephritis (Conner et al., 2019).

Immediate Consultation Requirements

The RN(AAP) should seek immediate consultation from a physician/NP when any of the following circumstances exist:

- altered level of consciousness,
- sepsis (e.g., fever, tachycardia, hypotension, tachypnea, altered mental status),
- renal failure,
- recurrent pyelonephritis (within one year) after a course of appropriate therapy,
- immunocompromised client (e.g., diabetic, multiple sclerosis),
- history of renal stones or other urologic concerns (e.g., urinary tract obstruction, neurogenic bladder),
- prior urologic surgery,
- gross hematuria,
- acute abdominal pain,
- immunocompromised client,
- new onset edema, and/or
- complicated UTIs (e.g., male client; client with an indwelling catheter) (Interprofessional Advisory Group [IPAG], personal communication, October 2, 2019).

Classification

Uncomplicated UTI
<ul style="list-style-type: none">• A UTI is considered uncomplicated when it occurs in clients who have a normal, unobstructed genitourinary tract; no history of recent instrumentation, and whose symptoms are confined to the lower urinary tract.• Uncomplicated UTIs are most common in young, sexually active women.
Complicated UTI
<ul style="list-style-type: none">• A complicated UTI is an infection of the lower or upper urinary tract in the presence of an anatomic abnormality, a functional abnormality, or a urinary catheter.• All males and pregnant females are considered to present with complicated UTIs.
Recurrent UTI
<ul style="list-style-type: none">• A recurrent UTI is a symptomatic UTI that follows resolution of an earlier episode, usually after appropriate treatment. No single definition of the frequency of recurrent UTI exists but two uncomplicated, culture positive UTIs in 6 months or three or more infections per year are commonly understood to be “recurrent”.• Recurrence may be related to an anatomical cause and warrant further investigation.

Pyelonephritis

- Pyelonephritis has a wide spectrum of presentation, from mild illness to septic shock. It is more common in women because it is frequently caused by fecal flora that colonize the vaginal introitus and subsequently ascend along the urinary tract to the kidney.
- Most cases (75% to 95%) are caused by ascension of gram-negative organisms from the bladder including *Escherichia coli* (over 80% of cases), *Proteus mirabilis*, *Klebsiella*, and *Pseudomonas aeruginosa*.

(Anti-infective Review Panel, 2019; Conner et al., 2019; Huether, 2019; RxFiles Academic Detailing Program, 2021)

Predisposing and Risk Factors

Predisposing and risk factors for acute cystitis include:

- female anatomy (e.g., short urethra),
- sexually active,
- pregnancy,
- recent antibiotic use,
- spermicide use,
- estrogen deficiency (e.g., postmenopausal females),
- indwelling catheter,
- diabetes mellitus,
- immunosuppression,
- inadequately treated prostatitis,
- neurogenic bladder, and
- urinary tract obstruction (e.g., benign prostatic hypertrophy, renal stones) (Conner et al., 2019; Huether, 2019).

Predisposing and risk factors for pyelonephritis include:

- female anatomy (e.g., short urethra),
- recent untreated or undertreated UTI,
- episode of acute pyelonephritis within the last 12 months,
- older adults who are institutionalized or hospitalized,
- immunocompromised clients,
- anatomical abnormalities (e.g., ureterovesical reflux),
- urinary obstruction,
- stress incontinence,
- multiple or recurrent UTIs,
- renal disease,
- renal trauma,
- pregnancy,
- metabolic disorders (e.g., diabetes mellitus),

GU | Urinary Tract Infection (Cystitis and Pyelonephritis) -

- indwelling catheter,
- neurogenic bladder,
- female sexual trauma, or
- urogenital instrumentation (Conner et al., 2019; Huether, 2019).

Health History and Physical Exam

Subjective Findings

The circumstances of the presenting complaint should be determined. For acute cystitis these include:

- sudden onset of symptoms;
- dysuria (pain or burning during urination);
- urgency (a sudden, almost uncontrollable need to urinate);
- frequency;
- sensation of incomplete bladder emptying;
- blood in urine;
- lower abdominal pain or cramping;
- offensive odour of urine;
- nocturia;
- altered mental status or vague abdominal discomfort, especially in the elderly;
- sudden onset of urinary incontinence; and/or
- low back pain (Anti-infective Review Panel, 2019; Conner et al., 2019; Huether, 2019).

For pyelonephritis these include:

- fever ($> 38^{\circ}\text{C}$ oral), rigours, or chills;
- nausea and vomiting;
- abdominal, back, flank, or groin pain may be present (e.g., costovertebral angle tenderness);
- headache;
- malaise;
- dysuria, frequency, and urgency may or may not be present;
- fatigue;
- diarrhea;
- cloudy foul-smelling urine; or
- mental status changes or general deterioration, especially in the elderly (Conner et al., 2019; Huether, 2019).

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For male clients, enquire as to all of the above symptoms plus symptoms that may indicate prostatitis, including:

- hesitancy,
- slow urinary stream,
- dribbling of urine,
- nocturia,
- suprapubic tenderness and urethral discomfort (Conner et al., 2019).

Objective Findings

Physical findings for acute cystitis may include suprapubic tenderness on palpation of the abdomen.

The signs and symptoms of pyelonephritis may include:

- moderately to acutely ill appearance;
- fever (> 38°C oral) and chills;
- tachycardia;
- decreased blood pressure (e.g., septic shock);
- mild, generalized abdominal discomfort may be present;
- mild to severe pain with deep abdominal palpation of kidney may be present; and/or
- costovertebral angle tenderness to percussion may be present (Conner et al., 2019; Huether, 2019).

Urinary Tract Infection Symptoms

The following chart provides guidance on symptom severity. Moderate to severe symptoms (or infections) require immediate consultation with a physician/NP.

Local Symptoms	General Symptoms	Systemic Symptoms	Systemic Symptoms
These symptoms are typical of UTI (acute cystitis).	These symptoms are suggestive of mild pyelonephritis.	These symptoms are suggestive of moderate to severe pyelonephritis.	These symptoms are suggestive of severe pyelonephritis.
<ul style="list-style-type: none">• dysuria,• frequency,• urgency, and/or• bladder tenderness.	<ul style="list-style-type: none">• fever,• flank pain, and/or• nausea.	<ul style="list-style-type: none">• fever,• rigours,• dehydration, and/or• vomiting.	<ul style="list-style-type: none">• circulatory failure,• organ dysfunction,• organ failure, and/or• altered level of consciousness.

(Conner et al., 2019; IPAG, personal communication, October 2, 2019)

Differential Diagnosis

The following should be considered as part of the differential diagnosis for acute cystitis:

- tumours,
- pyelonephritis,
- vaginitis,
- sexually transmitted infections,
- pelvic inflammatory disease,
- interstitial cystitis,
- prostate disorders (e.g., benign prostatic hypertrophy, prostatitis), or
- infection in other sites of the genitourinary tract (e.g., epididymis) (Conner et al., 2019; Huether, 2019).

The following should be considered as part of the differential diagnosis for pyelonephritis:

- acute cholecystitis with fever,
- lower lobe pneumonia,
- perforated abdominal organ,
- appendicitis,
- acute pancreatitis,
- pelvic inflammatory disease,
- renal colic (kidney stone),
- renal cancer,
- bladder obstruction,
- musculoskeletal pain,
- shingles,
- prostatitis,
- ectopic pregnancy, or
- diverticulitis (Johnson & Russo, 2018).

Making the Diagnosis

Presumptive diagnosis of UTI in female clients can be made if either dysuria and frequency are present or the dipstick urinalysis shows a positive result for nitrite or leukocyte esterase. Women with recurrent UTI may accurately self-diagnose. Urinary tract infections are less common in males and alternate diagnoses should be considered. Elderly clients with UTIs may present with atypical symptoms (e.g., delirium) (Conner et al., 2019).

Clinical diagnosis of acute pyelonephritis is based on a combination of history and physical findings suggestive of pyelonephritis (fever, chills, flank pain, nausea, vomiting, costovertebral angle tenderness), recent or concurrent cystitis, and urine dipstick result positive for leukocytes and nitrites (Conner et al., 2019; Huether, 2019). The diagnosis is confirmed with a positive urine culture result.

Investigations and Diagnostic Tests

Diagnostic tests for UTIs in males and females include dipstick urinalysis and urine culture. In acute cystitis, a dipstick urinalysis typically indicates pyuria (leukocyte esterase) and the presence of red blood cells (Conner et al., 2019). The presence of nitrites in the urine are typically the result of the reduction of nitrates by gram-negative bacteria (e.g., *E. coli*). Gram-positive bacteria such as *S. saprophyticus* and *Enterococcus* do not produce nitrites (Huether, 2019). In acute cystitis, a urine culture is only indicated if the diagnosis is unclear or if the client has recurrent infections (greater than three infections per year) and antibiotic resistance is suspected. Other situations where urine culture is recommended include all complicated UTI cases, persistent or recurrence of symptoms within one month of empirical antibiotic therapy, or client presents with atypical symptoms (Anti-infective Review Panel, 2019; Conner et al., 2019).

The diagnosis of acute pyelonephritis is made by urine culture, urinalysis, and clinical signs and symptoms (Huether, 2019). A midstream urine for urinalysis is often positive for bacteria, proteinuria, leukocyte esterase, urinary nitrites, hematuria, pyuria, and white blood cell casts (Conner et al., 2019). However, the urinalysis results may be altered by: current antibiotic therapy, esterase in the presence of kidney stones, tumours, urethritis, or contamination, creating a false positive result. Furthermore, the nitrites may provide a false negative result if the bladder has not been full for at least four hours (e.g., diuretic use), and if the uropathogen is a gram-positive bacteria (e.g., *S. saprophyticus*) (Huether, 2019). The gold standard confirmatory test of acute pyelonephritis is a urine culture (Johnson & Russo, 2018). The urine culture typically will show $\geq 10,000$ CFU/mL of a single uropathogen. A urine culture must be collected in all pregnant females.

Management and Interventions

Goals of Treatment

The primary goals of immediate treatment are to relieve symptoms, eradicate infection, prevent ascending infection, or in the case of pyelonephritis damage to the kidneys, prevent recurrent infection, and prevent complications (Huether, 2019).

Early or mild pyelonephritis infections may be treated on an outpatient basis in those clients who:

- are hemodynamically stable,
- are young and otherwise healthy,
- have mild general symptoms (low-grade fever, normal, or slightly elevated peripheral leukocyte count without vomiting),
- are able to tolerate oral medications and fluids,
- have stable coexisting medical conditions, and
- for whom adequate follow-up has been arranged and is likely to occur (Anti-infective Review Panel, 2019; Johnson & Russo, 2018).

Non-Pharmacological Interventions

The RN(AAP) should recommend, as appropriate, the following non-pharmacological options:

- Drink eight to 10 glasses of water and other fluids every day.
- Empty bladder as soon as the urge is felt.
- Females should wipe from front to back after using the toilet.
- Females should void before and immediately after intercourse (Conner et al., 2019; Johnson & Russo, 2018).

Pharmacological Interventions

The pharmacological interventions recommended for the treatment of UTIs are in accordance with the *Anti-infective Guidelines for Community-acquired Infections* (Anti-infective Review Panel, 2019) and the *RxFiles: Drug comparison charts* (Rx Files Academic Detailing Program, 2021).

Treatment of recurrent cases of acute cystitis should be guided by culture and sensitivity results. All cases of complicated UTIs, except pregnant females, should be referred to a physician/NP. Treatment options for acute cystitis in pregnancy are listed below.

Oral Antibiotics

	Drug	Dose	Route	Frequency	Duration
Adult (uncomplicated acute cystitis)					
	Nitrofurantoin (Macrobid)	100 mg	p.o.	b.i.d.	5 days
OR	Sulfamethoxazole-Trimethoprim	400/80 mg, 2 tabs	p.o.	b.i.d.	3 days
OR	Sulfamethoxazole-Trimethoprim	800/160 mg, 1 tab	p.o.	b.i.d.	3 days
OR	Trimethoprim	200 mg	p.o.	once daily	3 days
OR	Fosfomycin	3 g mixed in ½ cup water	p.o.	once	n/a

Treat all pregnant women. Do not prescribe nitrofurantoin in pregnancy at term (36-42 weeks gestation) or during labour.

	Drug	Dose	Route	Frequency	Duration
Adult (pregnant client)					
	Amoxicillin	500 mg	p.o.	q8h	7 days
OR	Cephalexin	250 to 500 mg	p.o.	q.i.d.	7 days
	Drug	Dose	Route	Frequency	Duration
Adult (pregnant client)					
OR	Nitrofurantoin (Macrobid)	100 mg	p.o.	b.i.d.	5- 7 days
OR	Fosfomycin	3 g mixed in ½ cup water	p.o.	once	n/a
Adult (First line for mild pyelonephritis)					
	Sulfamethoxazole-Trimethoprim (SMX/TMP)	400/80 mg, 2 tabs	p.o.	b.i.d.	10-14 days
	Drug	Dose	Route	Frequency	Duration
OR	Sulfamethoxazole-Trimethoprim (SMX/TMP)	800/160 mg, 1 tab	p.o.	b.i.d.	10-14 days
OR	Trimethoprim	100 mg	p.o.	b.i.d.	10-14 days

Alternatives to SMX/TMP and trimethoprim should be considered when local resistance is anticipated to be > 20% and if there is a history of recurrent UTI and previous treatment with SMX/TMP.

	Drug	Dose	Route	Frequency	Duration
Adult (Second line for mild pyelonephritis)					
	Ciprofloxacin	500 mg	p.o.	q12h	7-14 days
OR	Amoxicillin/ Clavulanate	500 mg	p.o.	q8h	7-14 days
OR	Amoxicillin/ Clavulanate	875 mg	p.o.	q12h	7-14 days

Analgesics and Antipyretics

	Drug	Dose	Route	Frequency	Duration
Adult					
	Acetaminophen	500-1000 mg (maximum dose of 4 g/day)	p.o.	q4-6h prn	5-7 days
AND/ OR	Ibuprofen	400-600 mg (maximum dose of 3200 mg/day)	p.o.	q6-8h prn	5-7 days

Client and Caregiver Education

The RN(AAP) provides client and caregiver education as follows:

- Counsel on appropriate use of medications (dose, frequency, side effects, the need to complete the entire course of treatment, etc.).
- Instruct proper perineal hygiene (wiping from front to back) to prevent recurrence.
- Wear cotton underclothes versus nylon to prevent moisture accumulation.
- Inform that harsh soaps or feminine hygiene products can irritate the urethra and encourage showers instead of tub baths or bubble baths to prevent urethral irritation.
- Encourage barrier protection (e.g., condom) during intercourse.
- Advise to avoid the use of spermicide.
- Advise to report recurrence of symptoms immediately.
- Teach double void (void, wait three minutes, void again) in clients with post void residual.
- Increase fluid intake to achieve light coloured urine.
- Advise to establish a voiding routine every two to three hours (Conner et al., 2019; Huether, 2019).

Monitoring and Follow-Up

Non-pregnant young or middle-aged clients diagnosed with acute cystitis require no follow-up if symptoms resolve with treatment. Pregnant clients should be seen following treatment to ensure infection has resolved, where typically a urine for culture and sensitivity is repeated (Connor et al., 2019).

The RN(AAP) should reassess the client diagnosed with pyelonephritis in 24-48 hours to determine clinical response to therapy. If there is no improvement after 72 hours of therapy or if symptoms are worsening, consult a physician/NP. The client should also be reviewed after completion of therapy to assess for continuing symptoms. If the client is asymptomatic, except for pregnant clients, there is no need to repeat the urinalysis and culture.

Complications

The following complications may be associated with acute cystitis:

- pyelonephritis or sepsis,
- renal abscess,
- acute urinary outlet obstruction, and
- recurrent infection (Conner et al., 2019).

The following complications may be associated with pyelonephritis:

- acute or chronic renal failure (rare following acute pyelonephritis),
- renal abscess,
- sepsis,
- focal renal scarring,
- renal papillary necrosis,
- emphysematous pyelonephritis and/or cystitis,
- respiratory dysfunction, and
- preterm labour and low birth weight infant in pregnancy (Conner et al., 2019; Huether, 2019).

Referral

Refer to a physician/NP if client presentation is consistent with those identified in the *Immediate Consultation Requirements* section, clients who do not respond to prescribed treatment, or clients who have recurrent UTIs (IPAG, personal communication, October 2, 2019).

References

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