



Diagnosis and Assessment of Urinary Tract Infections

Presenter

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Objectives

- Define Urinary Tract Infections (UTI) and differentiate the types
- Recite risk factors and symptoms of UTIs
- Discuss urinalysis vs urine culture
- Access causes of and guideline-based treatment options for UTIs

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UTI's are the most frequently diagnosed infection in long-term care residents

Approximately 10 million visits to health care providers are due to UTIs each year in the United States

UTI's account for over one-third of all nursing home-associated infections

Rowe TA, Juthani-Mehta M. Urinary tract infection in older adults. *Aging health*. 2013 Oct;9(5):10.2217/ahe.13.38. doi: 10.2217/ahe.13.38. PMID: 24391677; PMCID: PMC3878051.

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Definition of UTI

- **Asymptomatic Bacteriuria:** $\geq 10^5$ cfu/mL voided specimen or chronic foley, or $\geq 10^2$ cfu/mL from a new catheterized specimen with NO urinary symptoms
- **Acute uncomplicated cystitis:** typical urinary symptoms in an otherwise healthy non-pregnant adult.
- **Complicated cystitis or pyelonephritis:** lower or upper tract UTI in patient with underlying risk of treatment failure
 - (diabetes, pregnancy, renal failure, obstruction or anatomic abnormality, indwelling device, recent instrumentation, transplant, immunosuppression, hospital-acquired)
- **Catheter-associated UTI:** presence of symptoms or signs of UTI with no other identifiable source of infection with $\geq 10^3$ cfu/mL

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Risk Factors for UTI

Common Risks

- Female Anatomy
- Menopause
- Blockages in the urinary tract
- Suppressed immune system
- Sexual activity
- Certain types of birth control
- Catheter use
- Recent urinary procedure

Common risks for older adults

- Exposure to nosocomial pathogens
- Comorbidities
- History of UTIs
- Prostatic hypertrophy causing obstruction in men
- Catheter use

Hu KK, Boyko EJ, Scholes D, et al. Risk factors for urinary tract infections in postmenopausal women. Arch Intern Med. 2004;164(9):989–993.

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Symptoms of UTIs

Lower Urinary Tract Infection

- Urgency
- Frequency
- Dysuria
- Supra-pubic tenderness
- In postmenopausal women:
 - Abdominal pain
 - Back pain
 - Chills
 - Constipation

Systemic Infection

- More severe, systemic presentation
- Suprapubic pain
- Costovertebral angle tenderness (Flank Pain)
- Fever
- Chills
- Elevated WBC count
- Nausea
- Vomiting

Upper Urinary Tract Infection

- New onset or worsening fever
- Rigors
- Altered mental status
- Malaise or lethargy with no other identified cause
- Flank pain
- Costovertebral angle tenderness
- Acute hematuria
- Pelvic discomfort

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Non-specific symptoms

Anorexia

Confusion

Decline in
functional status

Falls

Non-specific symptoms DO NOT automatically mean resident has an infection!

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Causes of non-specific symptoms

- Anorexia
 - Medical conditions: Cancer, depression, or dementia
 - Dental problems (tooth ache or poorly fitting dentures)
 - New medication started that changes the taste of food
 - Examples: ACE inhibitors (lisinopril), Statins (atorvastatin/lovastatin), Thyroid medication (levothyroxine), Diuretics (furosemide), metformin, antibiotics (ciprofloxacin/azithromycin), etc.
- Confusion
 - Dehydration
 - Electrolyte imbalance (low sodium or calcium)
 - Low or high blood sugar
 - New medication
 - Pain



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Causes of non-specific symptoms

- Decline in functional status
 - Dehydration
 - Decreased physical activity
 - Pain
- Falls
 - Dehydration
 - New medication
 - Changes in blood pressure
 - Diabetes
 - Inner Ear problems



Criteria for Diagnosis of Symptomatic UTI

Without an Indwelling Urinary Catheter

SHEA/CDC (revised McGeer)	McGeer criteria 1991	Loeb criteria
Swelling or tenderness of the testes, epididymis or prostate or: Fever or leukocytosis and at least one of the following or In the absence of fever and leukocytosis at least two of the following:	Three of the following criteria:	Acute dysuria alone or: Fever (>37.9 C or 1.5C increase in baseline) plus one of the following:
Acute costovertebral angle pain or tenderness	Fever \geq 38 C or chills	New or worsening urgency
Suprapubic pain	New or increased burning on urination, frequency, or urgency	Frequency
Gross hematuria	New flank or suprapubic pain or tenderness	Suprapubic pain
New or marked increase in incontinence	Change in character of urine	Gross hematuria
New or marked increase in urgency or frequency	Worsening of mental or functional status (includes new or increased incontinence)	Costovertebral angle tenderness
		Urinary incontinence
PLUS positive urine culture		

Criteria for Diagnosis of Symptomatic UTI

With an indwelling urinary catheter

SHEA/CDC (modified McGeer)	McGeer criteria 1991	Loeb criteria
Fever, rigors or new-onset hypotension	Fever \geq 38 C or chills	Fever (37.9C or 1.5C increase in baseline)
Acute change in mental status or acute functional decline and leukocytosis	New flank or suprapubic pain or tenderness	New costovertebral tenderness
New-onset suprapubic pain or costovertebral angle pain or tenderness	Change in character of urine	Rigors (shaking chills)
Purulent discharge from around the catheter or acute pain, swelling or tenderness of the testes, epididymis or prostate	Worsening of mental or functional status	New onset of delirium

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IDSA Guideline for Diagnosis

- For uncomplicated cystitis and pyelonephritis:
 - Urine culture and susceptibility testing should be performed, initial empirical therapy should be tailored appropriately
- For CA-UTI:
 - Urine culture should be obtained from the freshly placed catheter
 - If catheter is discontinued, culture from a voided midstream urine specimen

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When to get cultures

Patients without Urinary Catheters		
Appropriate Dysuria, suprapubic pain, flank pain, Costovertebral angle (CVA) tenderness, or septic shock	Uncertain Fever or systemic leukocytosis with no other known cause	Inappropriate Altered mental status, or change in urine characteristics (color, sediment, smell)
Patients with Urinary Catheters		
Appropriate Dysuria, suprapubic pain flank pain, Costovertebral angle (CVA) tenderness, or septic shock	Uncertain Fever, systemic leukocytosis with no other known cause, or delirium*	Inappropriate Change in urine characteristics (color, sediment, smell)

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Urinalysis

- | | | |
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| <div style="background-color: #800000; color: white; border-radius: 50%; width: 40px; height: 40px; margin: 0 auto; display: flex; align-items: center; justify-content: center;">4#</div> <ul style="list-style-type: none"> • Is the sample contaminated? | <div style="background-color: #800000; color: white; border-radius: 50%; width: 40px; height: 40px; margin: 0 auto; display: flex; align-items: center; justify-content: center;">5#</div> <ul style="list-style-type: none"> • Urine color doesn't determine a UTI | <div style="background-color: #800000; color: white; border-radius: 50%; width: 40px; height: 40px; margin: 0 auto; display: flex; align-items: center; justify-content: center;">6#</div> <ul style="list-style-type: none"> • What is the pH of the urine? |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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Urinalysis

7#

- Are the following Positive or Negative?
 - Nitrite
 - Leukocyte esterase
 - WBC

8#

- Is there blood in the urine?

9#

- Reflex to culture

Bono MJ, Leslie SW, Reygaert WC. Urinary Tract Infection. [Updated 2022 Nov 28]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK470195/>

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Urinalysis results

Test	Usual (Normal) Range	Indicators of Infection
Bacteria	Absent	Any amount
Leukocyte esterase	Absent	Positive
WBC	<5	Pyuria: WBC>10
Nitrite	Absent	Positive
RBC	<5	Hematuria common infection
Epithelial cells	<5	<5=good urine sample High level indicates contamination with skin flora
pH	4.5-8	pH >8 if urea-splitting organism is present

<https://www.uspharmacist.com/article/interpretation-of-urinalysis-and-urine-culture-for-uti-treatment>

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Urine culture

- GOLD standard
- Determines bacteria within the urine
- Results in 24-48 hours
- If greater than 2 bacteria grow: high suspicion of contamination



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Urine Culture Interpretation

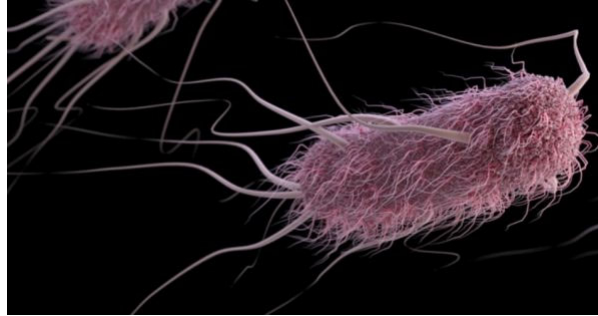
Culture Report	Interpretation
No Growth	Urine is sterile and infection not likely
<100,000 CFU/ML of 1 or 2 organisms (Clean Catch) OR <1,000 CFU/ML of 1 or 2 organisms (Cath)	In most cases, 1 or 2 organisms present in very low numbers does not indicate infection, but represents slight contamination with normal urethral flora and/or colonizing bacteria during collection.
>100,000 CFU/ML of 1 or 2 organisms (Clean Catch) OR >1,000 CFU/ML of 1 or 2 organisms (Cath)	Growth may represent true infection if the organism is a potential uropathogen. Identification and susceptibility testing will be performed
Lactobacillus spp Diphtheroids (except <i>Corynebacterium ureolyticum</i>) Streptococcus viridians Micrococcus spp Bacillus spp, not anthracis Staph spp. in mixed cultures (except for <i>S. aureus</i> and <i>S. saprophyticus</i>)	These organisms are not normally considered potential uropathogens. They are normal urethral flora and/or colonizing bacteria from the skin, vaginal or rectal areas. Susceptibility testing is not routinely performed.
Mixed growth consistent with normal urethral flora and/or colonizing bacteria. Multiple organisms are growing, however none are potential uropathogens. Heavy mixed growth containing ≥ 3 potential uropathogens, none predominant.	When 3 or more potential uropathogens grow in these quantities, with none predominant, indicates that contamination during collection is likely

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Common Bacteria

E.Coli

- Klebsiella pneumoniae
- Staphylococcus saprophyticus
- Proteus mirabilis
- Other Less common:*
- Enterococcus faecalis
- Pseudomonas aeruginosa
- Citrobacter freundii
- Serratia marcescens



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Sensitivity testing

-Used to determine if bacteria is sensitive, intermediate, or resistant to the antibiotic

-Lists MIC (Minimum Inhibitory Concentration) for each antibiotic

Sample Type : URINE

CULTURE AND SENSITIVITY (VITEK)

Organism Isolated: *Klebsiella pneumoniae* Colony Count: $< 10^4$ CFU/ml

Antibiotics	Interpretation	MIC Value (µg/ml)	MIC Ref Range(µg/ml)	S(≤)	I	R(>)
Ampicillin	RESISTANT	(32)	8	16	32	
Piperacillin+Tazobactam	SENSITIVE	(4)	16	32-64	128	
Cefepime	SENSITIVE	(1)	8	16	32	
Ceftriaxone	SENSITIVE	(1)	1	2	4	
Cefoperazone+Sulbactam	SENSITIVE	(8)	"	"	"	
Ertapenem	SENSITIVE	(0.5)	0.5	1	2	
Imipenem	SENSITIVE	(0.5)	1	2	4	
Meropenem	SENSITIVE	(1)	"	"	"	
Amikacin	SENSITIVE	(2)	16	32	64	
Gentamicin	SENSITIVE	(1)	4	8	16	
Ciprofloxacin	SENSITIVE	(0.25)	1	2	4	
Colistin	SENSITIVE	(0.5)	2	"	4	
Nitrofurantoin	RESISTANT	(128)	32	64	128	
Tigecycline	SENSITIVE	(0.5)	1	2	4	
Trimethoprim+Sulfamethoxazole	SENSITIVE	(20)	40	"	80	
Amoxycylav	SENSITIVE	(2)	8	16	32	
Cefoxime	SENSITIVE	(2)	8	16	32	
Nalidixicacid	SENSITIVE	(4)	16		32	

Method: Conventional aerobic culture and identification and sensitivity testing by automated vitek 2 system

Comment : Insignificant bacteruria. Please correlate clinically

INTERPRETATION OF MIC (Minimal Inhibitory Concentration µg/ml) (Ref. CLSI M100S22)

- The MIC number is the lowest concentration of drug that inhibits the growth of a given strain of bacteria.
- The antibiotic panels and MIC reference ranges for micro-organisms are designed based on CLSI guidelines.
- The MIC value should be interpreted based on the range tested. The MIC value for one antibiotic cannot be compared with the MIC value of another antibiotic.
- Sensitive indicates (S) : Effective at lowest dilution tested.
Intermediate indicates (I) : May be effective in high dosages.
Resistant indicates (R) : Unlikely to be effective.

Treatment Options

- Asymptomatic bacteriuria
 - Antibiotics give no benefit in this situation and can cause harm!!!



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Treatment Options

UTI Treatment Options

Uncomplicated (Cystitis)	Nitrofurantoin 100 mg twice daily x 5 days TMP-SMX 160/800 mg twice daily x 3 days Fosfomycin 3 g x1 Dose Ciprofloxacin 500 mg twice daily x 3 days Cephalosporin for 3-7 days Do NOT use amoxicillin empirically
Pyelonephritis	Ciprofloxacin 500 mg twice daily for 5 days TMP-SMX 160/800 mg twice daily for 5-14 days If IV is needed: Ceftriaxone 1 gm daily

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Prevention of UTI

- Vaginal Estrogen
- Cranberry-controversial
- Limit indwelling catheter and discontinue use as soon as possible
- Hydration
- Practice good hygiene

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Prophylactic Antibiotics

- Only for patients with recurrent UTI's
- Usually a lower dose than treatment dosing
- Common antibiotics: Nitrofurantoin, TMP/SMX, or cephalexin
- Duration of prophylactic antibiotics is unclear
- Per IDSA guideline: should NOT be routinely used in patients with catheters

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Risk vs Benefit of Prophylactic Antibiotics

Clinical Infectious Diseases

MAJOR ARTICLE



The Benefits and Harms of Antibiotic Prophylaxis for Urinary Tract Infection in Older Adults

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<https://academic.oup.com/cid/article/73/3/e782/6141409>

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Resident Case

- A 75-year-old male resident has a 3-day history of dysuria, urinary frequency, hesitancy, dribbling of urine, and transient hematuria. He denied fever, chills, nausea, vomiting, scrotal pain, or back pain.
- What is our first step?
 - Obtain a urinalysis

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Resident Urinalysis

Table. Case Patient's Urinalysis Test Results

	Result	Reference Standards/Ranges
Color	Yellow, hazy	Yellow
Specific gravity	1.005	1.005-1.030
pH	7	5.5-7.5
Blood	1+	Negative
Protein	Negative	Negative
Nitrite	1+	Negative
Leukocyte esterase	3+	Negative
Bacteria	3+	None-few/hpf
White blood cells	40-100/hpf	0-5/hpf
Red blood cells	2/hpf	0-5/hpf
Epithelial cells	0-5/lpf	None-few/lpf

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Resident Case

- Resident's urine is then refluxed to culture
- Grows E.coli
 - Sensitive to nitrofurantoin and cipro
 - Resistant to TMP/SMX
- Continue treatment for complicated cystitis

- Do we need to test for cure after 7 days?

NO

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Resident Case

- A nursing home resident in her 80s has a history of falls, cognitive impairment, and incontinence. In the past 2 years, she was thought to have a urinary tract infection (UTI) on 8 occasions and received antibiotic therapy 6 times.
- Symptoms that triggered an evaluation for UTI included increased confusion, urinary frequency, cloudy urine, lethargy, hallucinations, and falls.
- On this occasion, the family reports that she “doesn’t look right,” but the nursing staff states she is not confused. The patient reports no dysuria or abdominal pain but does chronically complain of voiding frequently. The nursing staff takes her temp and she is afebrile.

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Criteria for Diagnosis of Symptomatic UTI

With an indwelling urinary catheter

SHEA/CDC (modified McGeer)	McGeer criteria 1991	Loeb criteria
One of the following criteria:	Two of the following criteria:	At least one of the following criteria:
Fever, rigors or new-onset hypotension	Fever \geq 38 C or chills	Fever (37.9C or 1.5C increase in baseline)
Acute change in mental status or acute functional decline and leukocytosis	New flank or suprapubic pain or tenderness	New costovertebral tenderness
New-onset suprapubic pain or costovertebral angle pain or tenderness	Change in character of urine	Rigors (shaking chills)
Purulent discharge from around the catheter or acute pain, swelling or tenderness of the testes, epididymis or prostate	Worsening of mental or functional status	New onset of delirium
PLUS positive urine culture		

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Resident Case

Urinalysis

- Leukocyte esterase +
- Nitrite +
- Neutrophils +
- Bacteria +

Culture

- 1000 CFU/ml
- E.coli
 - Sensitive to all antibiotics except Ampicillin



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Resident Case

Remember the electrolyte panel that was ordered?

- Potassium elevated at 6
- Recently started on spironolactone

****Patient didn't have a UTI, had Hyperkalemia****

Drug interaction with TMP/SMX and spironolactone can cause hyperkalemia thus could have worsened her hyperkalemia!!!

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Examples of Antibiotic Stewardship in Action

■ UTI Assessment tool

ASSESSMENT

Resident WITH indwelling catheter
The criteria are met to initiate antibiotics if one of the below are selected

No Yes

- Fever of 100°F (38°C) or repeated temperatures of 99°F (37°C)*
- New back or flank pain
- Acute pain
- Rigors / shaking chills
- New dramatic change in mental status
- Hypotension (significant change from baseline BP or a systolic BP <90)

Resident WITHOUT indwelling catheter

Criteria are met if one of the three situations are met

No Yes

- 1. Acute dysuria alone

OR

- 2. Single temperature of 100°F (38°C) and at least one new or worsening of the following:
 - urgency suprapubic pain
 - frequency gross hematuria
 - back or flank pain urinary incontinence

OR

- 3. No fever, but two or more of the following symptoms:
 - urgency suprapubic pain
 - frequency gross hematuria
 - incontinence

* For residents who regularly run a lower temperature, use a temperature of 2°F (1°C) above the baseline as a definition of a fever.

"Toolkit 1. Suspected UTI SBAR Toolkit." Ahrq.gov, 2012

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Examples of Antibiotic Stewardship in Action

- Duration limitations for treatment in uncomplicated cystitis
 - Project start in 2019 at Missouri Slope Lutheran Care Center in Bismarck
 - 255 Skilled bed nursing care facility
 - Created evidence-based policy



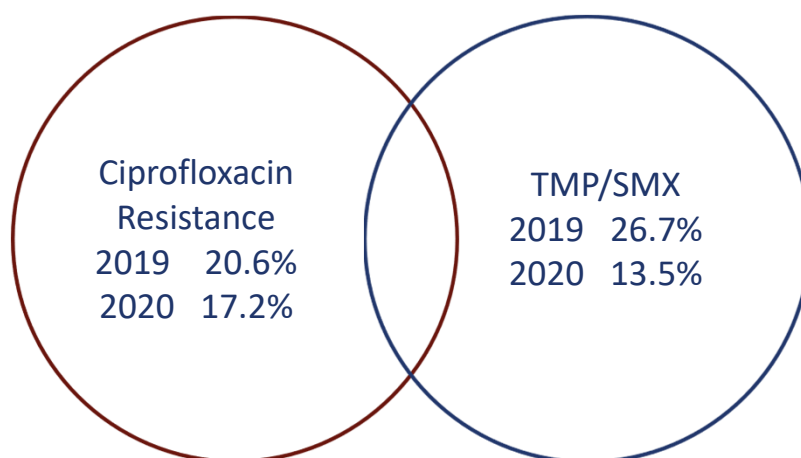
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Duration Limit Results

	MAY 1ST, 2018, TO APRIL 30TH, 2019	MAY 1ST, 2019, TO APRIL 30TH, 2020
Total # of UTI's	79	89
Duration of Treatment	7.25 days	5.86 days
Duration with beta-lactams	7.77 days	6.56 days
Duration with fluoroquinolones	6.78 days	5.44 days
Duration with nitrofurantoin	7.67 days	5.82 days
Duration with SMZ/TMP	7.05 days	5.74 days

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Resistance Rates



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Diagnostic Stewardship in Action

- Create an algorithm for when to test urine
 - Example: Symptom Free Pee...Let it be!

For healthcare providers

Urinary Tract Infection (UTI) & Asymptomatic Bacteriuria (ASB)

When to Test for Urine Infections Background



Do not send

1. Do not test for changes in urine colour, cloudiness or smell alone.
2. Do not test urine for infection in asymptomatic patients, unless septic, pregnant or undergoing invasive urologic procedure.
3. Do not test urine for infection in older adults unless there is a strong clinical suspicion of a UTI.



Wait

1. Diagnosis of UTI should not be assigned without typical UTI symptoms.
2. Non-specific changes in older adults: weakness, falls, aggression and confusion do not mean that the patient has a UTI.
3. Individualize care and investigate for other causes of non-specific changes. Consider: dehydration, pain, medications, sleep disturbances, constipation, hypoxia, hypoglycemia, environment changes, other infections

Dehydration is the most common cause of non-specific changes. Cloudy or foul smelling urine is NOT a UTI. Rehydration (unless fluid restricted) will resolve symptoms in many patients. Consider clysis, IV fluids and regular fluid "rounds" to increase intake in patients with swallowing or communication difficulties.



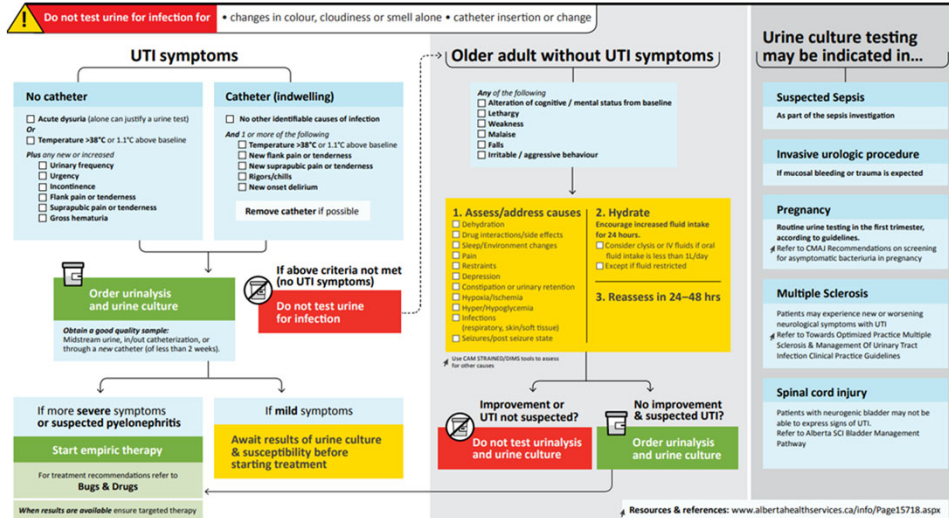
Order

Order urinalysis and culture for the following typical UTI symptoms in patients without urinary catheters:

- Acute dysuria (painful urination). Dysuria alone can justify testing
- Or
- Temperature >38°C
- Plus any new or increased
 - New or increased frequency, urgency, or incontinence
 - Flank pain / suprapubic pain
 - Blood in the urine

For physicians & nurses

Evidence-based criteria for urinary infection testing | Adults



September 2019
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Diagnostic Stewardship in Action

- Partner with local emergency room
 - Work to remove unnecessary urinalysis orders off order sets
 - Create a culture follow up workflow
 - Who is looking at cultures when they result
 - How are they being communicated to the LTCF
 - Improve communication when residents are sent to ER
 - I.E. nurse to nurse or SBAR that goes with resident
 - Provide clear communication why resident is being sent to ER
 - Create collaboration between ED and LTCF's administrators to provide feedback on inappropriate antibiotic orders
 - Educate ED physicians on the criteria the LTCF uses to define infections

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**Do not treat
asymptomatic
bacteriuria**

**Cultures determine
definitive treatment**

There are many opportunities for
antimicrobial stewardship with UTIs.

For non-specific symptoms
a full workup is helpful

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Thank You!



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