

Judicious use of urine testing and antibiotics is important to improve patient outcomes, prevent adverse events, and minimize antibiotic resistance¹⁻⁷

- **UTI is a clinical diagnosis (not a laboratory diagnosis).** Prior to culture, ensure individual is symptomatic. Do not culture if asymptomatic. Differentiate **symptomatic vs asymptomatic bacteriuria by looking for symptoms** (see right for "Typical UTI Signs & Symptoms"). See RxFiles: [UTI Chart](#), [UTIs in LTC Infographic](#); [Choosing Wisely LTC](#).
- Saskatchewan: see SHA *Firstline* app / website for UTI guidelines ([adult](#), [lower UTI LTC](#)).¹

ASYMPTOMATIC Bacteriuria ^S1-7

- **Routine urine screening & treatment is NOT recommended in asymptomatic older adults** except if undergoing genitourinary surgery / procedures.⁵ Choosing Wisely ([patient tool](#))
- A positive urinalysis or culture in the absence of symptoms (see right) **does not indicate a true infection but rather indicates colonization** (i.e. asymptomatic bacteriuria).
- The urinary tract can be non-sterile and there is a high prevalence of asymptomatic bacteriuria in older adults (the bladder is normally colonized in many older adults).
 - The prevalence of asymptomatic bacteriuria in older adults:⁸
 - is up to 19% in the community.
 - is up to **50% in long-term care.**
 - is **100% in individuals with a long-term indwelling catheter.**
- Changes in the urine (e.g. smell, cloudiness) **or** mental status alone, without localized genitourinary symptoms, does **NOT** indicate a UTI. See AMMI Canada [Provider Poster](#).
- Treatment of asymptomatic bacteriuria with an antibiotic vs placebo / no treatment does **NOT** decrease mortality, symptomatic UTI, or improve mental state.⁹ Tools for Practice^{23,10-16}
- **STOPP criteria:** antibiotics in asymptomatic bacteriuria (no indication for an antibiotic).¹⁷

The Many Risks Associated with Unnecessary Antibiotics for Asymptomatic Bacteriuria¹⁻⁷

- ↑ Risk of adverse effects e.g. rash, diarrhea, candidiasis **NNH≈18** (6.5% antibiotic vs 0.8% no antibiotic).¹⁸ 8.5x ↑ risk of *C. diff* requiring tx within 3wks of an antibiotic in LTC residents (who did not meet minimum criteria for UTI) vs the rest of the cohort.¹⁹
- ↑ Risk of antibiotic resistance resulting in individuals with difficult-to-treat infections:
 - ↑ UTI-related hospitalization adjusted OR (aOR) ~2.3 or reconsultation aOR ~11.²⁰
 - ↑ Risk of resistant bacteria (limits use of 1st line antibiotic options resulting in need for IV therapy e.g. ceftriaxone; also potential risk resistant bacteria may spread to others, especially in LTC homes via residents, staff, family, or other visitors).
- ↑ Risk of drug interactions, see next page.
- Unnecessary medication cost (~\$20 to \$40/antibiotic course) & environmental impact.

It's HARD to Ignore a Positive Culture & Sensitivity (C&S) Test Result¹⁻⁷

- Asymptomatic bacteriuria will produce a positive urine culture and sensitivity (and the urinalysis or dipstick may be positive, too) despite the absence of an active infection. See above the prevalence of asymptomatic bacteriuria in older adults.
- **The presence of symptoms must be relied upon for diagnosis**, and a urine culture only serves to direct antibacterial selection e.g. tailor empiric antibiotic.
- Over-testing (testing when symptoms are not present) combined with prevalent colonization of the bladder in older adults will not only result in unnecessary testing expenses and antibiotic use but may result in clinicians overlooking the real cause and diagnosis of a non-specific symptom. See AMMI Canada [Letter to Resident / Family Tool](#).

Assessment for a UTI in LTC Residents (i.e. SYMPTOMATIC Bacteriuria)^{1-7,21-27}

Use the checklist to ensure minimum threshold is met prior to further investigations.²⁵ Loeb

Non-catheterized Resident - Typical UTI Signs and Symptoms Criteria⁹⁻¹⁵

- Acute dysuria (pain on urination) **AND/OR**
- Two or more of the following:
- Fever* (temperature ≥38°C or ≥1.5°C increase above baseline on ≥2 occasions/12 hours)
 - New urgency (or marked increase)
 - New frequency (or marked increase)
 - New urinary incontinence
 - Suprapubic pain
 - Flank pain
 - Gross hematuria

Catheterized Resident - Typical UTI Signs and Symptoms Criteria

- No other identifiable cause **AND**
- One or more of the following:
- Fever* (temperature ≥38°C or ≥1.5°C increase above baseline on ≥2 occasions/12 hours)
 - Flank pain
 - Shaking / Chills
 - New onset delirium (as determined by the confusion assessment method [[CAM](#)])
- * **Fever:** older adults may present with a muted or absent fever. Some may even present hypothermic. Caution: assess if the individual recently received medication(s) that can mask a fever or lower baseline temperature (e.g. acetaminophen, NSAIDs).

Provider tools: AMMI Canada [guidance poster](#), [myths](#); Choosing Wisely [9 practice changes](#).

Do not let non-specific symptoms (i.e. non-typical UTI symptoms) complicate the assessment as these symptoms may be due to a variety of causes other than a UTI.²⁸⁻³¹

- **Foul smelling or cloudy urine** are not symptoms of a urinary tract infection but usually indicate dehydration. May also be related to diet, medication, or hygiene.
- A **change in mental status, fatigue, a fall, or ↓ appetite** may be due to: constipation, depression, pain, dehydration, poor sleep, skin breakdown, metabolic imbalance (e.g. hypoglycemia, ↓ Na⁺), head trauma, environmental change, drug interaction or AE, etc.

Consider a range of possible causes to prevent missing the real diagnosis. In hemodynamically stable individuals, causes of non-specific symptoms may be evaluated by "active monitoring" (e.g. the following & more frequent vitals) for 24-48 hours:⁶

- Encourage or assist in increasing **fluid intake** up to 1 litre for 24 hours (except if fluid restricted e.g. heart failure, chronic kidney disease). AMMI Canada: [tool to track fluids](#).
- Encourage or assist in increasing **mobility** for 24 hours.
- **Assess & address alternative causes for non-specific symptoms**; for example:
 - Order CBC, renal panel, electrolytes. Do a complete [delirium](#) workup, see [CAM](#) or Geri-RxFiles: [Dementia & Cognitive Impairment](#) page 108. Assess perineal skin.
- **Reassess in 24 to 48 hours for progression of symptoms or change in clinical status:**
 - If typical urinary symptoms develop, treat as a UTI – see next page.
 - If non-specific symptoms continue, reconsider diagnosis e.g. infection at another site.
 - If symptoms resolve, no further work-up is required.

Urinary Tract Infections (UTI) in Older Adults

In an individual who meets criteria for symptomatic bacteriuria e.g. typical UTI signs or symptoms (see previous page) **OR** those with non-specific symptoms that progressed to typical UTI symptoms after “active monitoring” and addressing other causes:

- Before starting empiric antibiotic therapy, collect mid-stream urine as samples from bedpans or pedibags are often contaminated and have a high false positive rate.
 - If unable to obtain a urine sample from a resident who **does not have an indwelling catheter**, use a condom catheter in men & in-and-out catheterization in women.
 - If the resident has had an **indwelling catheter <14 days**, collect urine via aspiration of the catheter tubing port (i.e. do not collect from the urine/collection bag).
 - If the resident has had an **indwelling catheter ≥14 days**, **change catheter prior** to obtaining urine sample (often, removal of catheter & hydration is all that is required).
 - When symptoms of a UTI develop in a catheterized individual, changing the catheter before collecting urine improves the accuracy of urine culture results. This may also improve the response to antibiotic therapy by removing the biofilm that likely contains the infecting organism(s) and that can serve as a source for reinfection. Biofilms can also cause persistent infections that are resistant to antimicrobial therapy.
- Label sample, including date and time, and refrigerate immediately.
- Send sample for urine C&S. There is uncertainty around the clinical utility of urinalysis in older adults; some recommend not sending urinalysis as risk of overtreatment outweighs benefits in LTC ^{1 SHA, 5 Choosing Wisely} while others still send, see below. ³²⁻⁴⁰
- If fever and other UTI systemic symptoms (e.g. flank pain), consider blood cultures.

A prospective cohort over 3 years (~14,500 individuals, median ~76 years) found **diagnostic stewardship (reducing unnecessary urine cultures) decreased antibiotic use for asymptomatic bacteriuria from ~30% at baseline to ~17% (95% CI ~14% to ~20%)**.³²

Why is it important to obtain a urine culture & sensitivity (C&S) in older adults?³²⁻⁴⁰

- **Urine culture & sensitivity do not diagnose a UTI. Rather urine culture & sensitivity confirm the bacterium and antibiotic susceptibility, directing antibiotic selection.**
- Treatment algorithms & antibiograms are helpful but both have caveats to consider:
 - Treatment algorithms may include broad geographic resistance rates vs local data.
 - Local antibiograms may report sensitivities for all versus separating out by type of sample (e.g. urine) or population (e.g. long-term care residents).
 - Samples more likely to be collected in complicated, skewing data for uncomplicated.
- Resistance rates are increasingly limiting ability to use certain antibiotics empirically. e.g. IDSA 2010 suggests selecting alternative empiric therapy if local resistance is >20% with TMP/SMX for uncomplicated UTI & >10% with fluoroquinolones for pyelonephritis.

What is the role of urinalysis in Long-term Care Residents?³²⁻⁴⁰

- **Urinalysis does not diagnose a UTI. There is an evolving understanding of urinalysis' limited accuracy in ruling in or out a UTI in older adults. Choosing Wisely: do not ask for urinalysis in LTC residents (harms of test triggering overtreatment outweigh benefits).**⁵
Examples of concerns:
 - Urine samples can be positive for leukocyte esterases (pyuria) without an infection, especially if long-term catheter in place. **Of LTC residents with asymptomatic bacteriuria, more than 90% (men & women) will have pyuria.**⁴¹⁻⁴⁵
 - Nitrites can be positive in asymptomatic bacteriuria or negative in a true (symptomatic) UTI due to a gram-positive uropathogen e.g. *Enterococcus*.

If symptomatic UTI, consider empiric antibiotic therapy after urine sample taken.

- If mild, some may await urine C&S results before initiating empiric antibiotic.
 - If the initial symptoms have improved already without an antibiotic when urine C&S is reported, treatment with an antibiotic is not required.^{5 Choosing Wisely}
- If severe +/- hemodynamic instability, start empiric antibiotic prior to C&S results.

Select empiric antibiotic therapy based on the following parameters:¹⁻⁷

- Potential pathogen. Review previous urine C&S results. If not available:
 - Most UTIs including indwelling catheters <30d: *E. coli* is most common pathogen.
 - Long-term indwelling catheters (≥30 days): usually polymicrobial.
- Local antibiograms/resistance rates, when available (general: Sanfords, Bugs&Drugs).
 - SK Health Authority *Firstline* (app or [website](#)), Saskatoon Area: [LTC urine isolates](#).
- Recent antibiotic use and response (e.g. UTI relapse/treatment failure or reinfection).
- Presence of antibiotic allergies.
- Renal function. **If most recent SCr was >3-6 months ago, obtain a more current SCr.**
- Consider drug-drug interactions, for example:⁴⁶
 - **S** FQ and QT-prolonging agents, see pg Geri-RxFiles: [QT prolongation](#) pg 44.
 - **B** use TMP/SMX with caution in those with ↓ CrCl and concurrent ACEi/ARB/ARNI (↑ risk of TMP-associated hyperkalemia).
 - **B** avoid when possible warfarin & TMP/SMX or ciprofloxacin (↑ bleed risk).
 - **B** TMP/SMX or ciprofloxacin and phenytoin (↑ risk of phenytoin toxicity).
 - **B** avoid when possible ciprofloxacin & theophylline (↑ risk of theophylline toxicity).
 - FQ or TMP/SMX & sulfonylureas or insulin (↑ risk of hypoglycemia, see [LTC Tool](#)).
 - FQ & cations e.g. Ca⁺⁺, Fe⁺ (↓ FQ absorption, space >2hrs or hold during FQ course).
- Consider potential adverse effects, weigh risk for each patient.
- Local long-term care facility drug formulary and/or public or private drug coverage.

Review urine C&S results once available to guide antibiotic selection.

- If bacteria is present in the urine, use the narrowest spectrum antibiotic as per C&S.
- If bacteria is **not** present in the urine, discontinue empirically started antibiotic as UTI unlikely. Rehydrate (up to 1 litre) for 24 hours. Investigate for other conditions.
- A urine sample is likely contaminated if the urine C&S shows ≥3 organisms (may also be reported as “mixed flora” on urine culture & sensitivity).
- Yeast likely reflects colonization, esp in those catheterized, and **does not** require an antifungal. If asymptomatic, stop empiric antibiotic. If symptomatic, change catheter, repeat urine culture, & if positive discuss with ID as true candida UTIs are rare.

Determine antibiotic treatment duration and assess antibiotic response in 48 to 72 hrs.

- See page 85 for uncomplicated cystitis & page 86 for complicated or pyelonephritis.
 - Depending on the type of UTI or antibiotic used, a range of durations provided.
 - If good response at 48-72hrs, treat for shorter duration within suggested range e.g. if 7-10d suggested & good response at 48 to 72hrs, then treat for 7 days.^{Expert}
- Men: traditionally considered complicated due to potential prostate involvement, but some may be treated as uncomplicated. See [RxFiles Trial Summary](#): RCT of ~300 males found 7 days of TMP/SMX or ciprofloxacin non-inferior to 14 days of antibiotic therapy in ~70 years afebrile outpatients.⁴⁷ **If prostate involvement, longer duration required.**
- **DO NOT** repeat urine culture & sensitivity (i.e. “test of cure”) after treatment completion when the older adult is asymptomatic.^{5 Choosing Wisely}

Urinary Tract Infections (UTI) in Older Adults

Empiric Therapy for UNCOMPLICATED Cystitis^{1-7,17,21,46,48}

- Post-menopausal women and men were traditionally considered “complicated”; however evolving data and experience support treating as “uncomplicated”.
- **Treatment duration: post-menopausal women**, depending on antibiotic, **3-7 days** (3 days: trimethoprim & sulfamethoxazole, trimethoprim, fluoroquinolone; 5 days: nitrofurantoin; 5 to 7 days: beta-lactam, some prefer x 7d[^]); **men ≥7 days**.

1ST LINE EMPIRIC THERAPY

See right regarding concerns with SK resistance rates to *E.coli*

Nitrofurantoin **SB**
MACROBID / MACRODANTIN
100mg po BID cc MACROBID or 50 to 100mg QID cc MACRODANTIN
⚠ **CrCl <30mL/min to <45mL/min:** not recommended {administer with food (cc) to ↓ GI adverse events}

Trimethoprim & Sulfamethoxazole (TMP/SMX)
B BACTRIM / SEPTRA / COTRIMOXAZOLE
⚠ **SK: if available, review prior urine C&S & if sensitive may use as empiric.** ^{Expert}
1 DS (double strength) tablet 800/160mg po BID, or 2 single-strength tablets of 400/80mg po BID
⚠ **CrCl 15 to 30mL/min:** half the dose
⚠ **CrCl <15mL/min:** not recommended

Trimethoprim (TMP) **B**
PROLOPRIM
⚠ **SK: if available, review prior urine C&S & if TMP/SMX sensitive may use as empiric.** ^{Expert}
200mg po daily or 100mg po BID
⚠ **CrCl 15 to 30mL/min:** half the dose
⚠ **CrCl <15mL/min:** not recommended

Cephalexin KEFLEX
⚠ **SK: not usually for empiric therapy, but option if unable to use other 1st line agents.**
250 to 500mg po QID
⚠ **CrCl 10 to 50mL/min:** 250 to 500mg po BID to TID
⚠ **CrCl <10mL/min:** 250 to 500mg po daily to BID

2ND LINE EMPIRIC THERAPY

See right regarding concerns with SK resistance rates to *E.coli*.

Amoxicillin/Clav CLAVULIN
⚠ **SK: may be used 1st line given E.coli resistance to traditional 1st line agents.**
875/125mg po BID cc or 500/125mg po TID cc
⚠ **CrCl <30mL/min:** 500/125mg po BID cc {administer with food (cc) to ↑ absorption & ↓ GI AEs}

Ciprofloxacin CIPRO, CIPRO XL **SB**
⚠ **SK: ciprofloxacin resistance rates for E.coli: 2023 (urinary) ~29% & ~58% LTC.**
250mg po BID or 500mg XL po daily
⚠ no dose ↓ required for uncomplicated UTI if short duration ^{Expert}

Levofloxacin LEVAQUIN **S**
250mg po daily ⚠ no dose ↓ required ^{Expert} (above re: cipro)

Norfloxacin NOROXIN **S**
400mg po BID
⚠ **CrCl 10-50 mL/min:** 400mg daily-BID; **CrCl <10:** 400mg daily

Fosfomycin MONUROL
^{Some recommend 1st line.} ^{DSA}
^{SK, Sanfords: reserve for 2nd/3rd line.}
3g powder sachet po before meal x 1 dose (dissolve powder in ½ cup of water; orange flavoured)
⚠ no dose ↓ required x 1 dose

Additional Potential Antibiotic Options for Uncomplicated UTIs:

- **Amoxicillin** AMOXIL 500mg po TID or 1g po BID ⚠ **CrCl <50mL/min:** 500mg po BID
○ **Do not use empirically** given resistance, but option if sensitive on C&S. ⚠ **SK: see high resistance.**
- **Cefixime** SUPRAX 400mg po daily ⚠ **CrCl <20mL/min:** 200mg [half tablet] po daily
- **USA: Pivmecillinam** PIVYA ^{FDA 2024} 185mg po TID x 5 days

Antibiotics to AVOID for UTIs:

- **Moxifloxacin** AVELOX : **DOES NOT CONCENTRATE IN THE URINE;** do NOT use to treat UTIs.

Antibiotics for UNCOMPLICATED Cystitis (listed alphabetically)

Colour Coding: When the antibiotic may be an option When the antibiotic may be problematic

Antibiotic	Considerations for Older Adults
Amoxicillin AMOXIL RA	<ul style="list-style-type: none"> • 1st Line: for an UNCOMPLICATED UTI when susceptibility is confirmed with a C&S (ideal) or local % susceptibility is high • Caution with empiric use in regions with HIGH RESISTANCE RATES • SK amoxicillin resistance for E.coli: 2023 (urinary) ~40 & ~53% LTC
Amoxicillin/Clavulanate CLAVULIN RA	<ul style="list-style-type: none"> • 2nd Line: for an UNCOMPLICATED UTI; SK may be used 1st line given HIGH RESISTANCE RATES to other antibiotic options • SK amox/clav resistance for <i>E.coli</i>: 2023 (urinary) ~13% & ~27% LTC • Broader spectrum than other options e.g. nitrofurantoin
Cephalexin KEFLEX RA	<ul style="list-style-type: none"> • 1st Line: for an UNCOMPLICATED UTI when susceptibility is confirmed with a C&S (ideal) or local % susceptibility is high • Caution with empiric use in regions with HIGH RESISTANCE RATES • SK cephalexin resistance for E.coli: 2023 (urinary) ~11% & ~25% LTC (cefazolin urine isolate predicts cephalexin susceptibility to <i>E.coli</i>, <i>Proteus mirabilis</i>, <i>Klebsiella</i>)
FLUOROQUINOLONE S Ciprofloxacin CIPRO, - XL B Levofloxacin LEVAQUIN Norfloxacin NOROXIN	<ul style="list-style-type: none"> • 2nd Line: for an UNCOMPLICATED UTI; also option for ESBL UTI • Ciprofloxacin: UTI caused by <i>Pseudomonas aeruginosa</i> • Broader spectrum than other options e.g. nitrofurantoin • Caution with empiric use in regions with HIGH RESISTANCE RATES • SK cipro resistance rates for E.coli: 2023 (urinary) ~29% & ~58% LTC • S QT-prolonging agent, see Geri-RxFiles: QT Prolongation pg 44 • B Caution ↑ seizure, confusion, tendon rupture if ↓ CrCl see left • B Avoid with: theophylline ↑ theophylline toxicity, warfarin ↑ bleeding risk
Moxifloxacin not used in UTI (see bottom left)	
Fosfomycin MONUROL SK: possible C&S results upon request	<ul style="list-style-type: none"> • Role: some suggest 1st line UNCOMPLICATED UTI others suggest as non-1st line; consider reserving for: ESBLs, <i>Pseudomonas</i>, or treatment failure. Efficacy: 1 RCT (~500 females, ~44yrs) found ↓ clinical cure NNH=18 (58% vs 70% nitrofurantoin); another RCT (~750 females, ~33yrs) found no difference between these
Nitrofurantoin B MACROBID / MACRODANTIN	<ul style="list-style-type: none"> • 1st Line: for an UNCOMPLICATED UTI, or UTI caused by ESBL • SK resistance rates for E.coli: 2023 (urinary) ~3% & LTC ~12% • Previous concern with use in males; however, evolving data and experience supports use in uncomplicated UTI (ensure no systemic symptoms, no kidney or prostatic involvement) • B Adverse events e.g. pulmonary; less likely with short duration
Trimethoprim & Sulfamethoxazole (TMP/SMX) B BACTRIM / SEPTRA / COTRIMOXAZOLE B ⚠ Avoid if CrCl <15mL/min	<ul style="list-style-type: none"> • 1st Line: for an UNCOMPLICATED UTI, or UTI caused by ESBL • Avoid in individuals with a SULFA ALLERGY (SMX component) • SK TMP/SMX resistance for E.coli: 2023 (urinary) ~22% & 33% LTC • B TMP: ↑ hyperkalemia risk with ACEi, ARB, ARNI & ↓ CrCl • B SMX: avoid with: phenytoin ↑ phenytoin toxicity, warfarin ↑ bleeding risk
Trimethoprim (TMP) B PROLOPRIM B	<ul style="list-style-type: none"> • 1st Line: for an UNCOMPLICATED UTI, patient with a SULFA ALLERGY, or SULFA INTERACTION (e.g. phenytoin, warfarin) • TMP resistance not routinely assessed in Canada; if urine C&S shows resistant to TMP/SMX, then assumed resistant to TMP • B TMP: ↑ hyperkalemia risk with ACEi, ARB, ARNI & ↓ CrCl

[^]Beta-lactams are an option in long-term care (historically thought to be less effective in UTIs based on older studies).

Urinary Tract Infections (UTI) in Older Adults

Empiric Therapy for **COMPLICATED** or **PYELONEPHRITIS**^{1-7,17,21,46,48}

- **Complicated:** any UTI in males or females with structural abnormality, **urinary catheter**, urinary stent, urinary retention, renal or perinephric abscess, BPH, diabetes (especially if neuropathy or poorly controlled), or those who are immunosuppressed, etc.
 - **Treatment duration: typically 7 to 10 days.** If delayed response may extend treatment duration to 14 days.
- **Pyelonephritis** “upper UTI”: UTI typically with systemic symptoms e.g. fever, chills, flank pain.
 - **Treatment duration: if uncomplicated, typically x 5 days (quinolones) to 7 days (other antibiotic options); if complicated** (see above definition), typically **x 7 to 10 days.** If delayed response may extend to 14 days.

1ST LINE EMPIRIC THERAPY See right regarding concerns with SK resistance rates to *E.coli*.

Trimethoprim & Sulfamethoxazole (TMP/SMX) <small>B</small> BACTRIM / SEPTRA / COTRIMOXAZOLE <small>SK: if available, review prior urine C&S & if sensitive may use as empiric^{Expert}</small>	1 DS (double strength) tablet 800/160mg po BID, or 2 single-strength tablets of 400/80mg po BID <small>CrCl 15 to 30mL/min: half the dose</small> <small>CrCl <15mL/min: not recommended</small>
Amoxicillin/Clavulanate <small>CLAVULIN</small>	500/125mg po TID cc or 875/125mg po BID cc <small>CrCl <30mL/min: 500/125mg po BID cc</small> {administer with food (cc) to ↑ absorption & ↓ GI AEs}
Ciprofloxacin <small>CIPRO, CIPRO XL</small> <small>SB</small> <small>SK: ciprofloxacin resistance rates for <i>E.coli</i>:^{2023 (urinary) ~29% & ~58% LTC}</small>	500mg po BID or 1 gram XL po daily <small>CrCl ≤30mL/min: max 500mg/day</small>
Levofloxacin <small>LEVAQUIN</small> <small>S</small>	500 to 750mg po daily <small>CrCl 20 to 49mL/min: 500mg x 1 dose, then 250mg daily</small> <small>CrCl 10 to 19mL/min: 500 to 750mg po x 1 dose, then 250 to 500mg po every 48 hours</small>

2ND LINE THERAPY

Trimethoprim (TMP) <small>B</small> <small>PROLOPRIM</small> <small>SK: if available, review prior urine C&S & if TMP/SMX sensitive may use as empiric^{Expert}</small>	200mg po daily or 100mg po BID for upper UTI 200mg po BID for complicated UTI <small>CrCl 15 to 30mL/min: half the dose</small> <small>CrCl <15mL/min: not recommended</small>
--	--

Additional Potential Antibiotic Options for Complicated UTIs:

- **Ceftriaxone** ROCEPHIN 1g IV x 1 dose; high resistance rates to other options & awaiting C&S results
- **Cefixime** SUPRAX 400mg po daily CrCl <20mL/min: 200mg [½ tablet] daily
- **Cephalexin** KEFLEX 500mg po QID; may use as **step-down therapy** if sensitivity confirmed via C&S
- **Norfloxacin** NOROXIN 400mg po BID CrCl 10-50mL/min: 400mg daily-BID CrCl <10: 400mg daily

Antibiotics to **AVOID** for Complicated UTIs:

- **Amoxicillin** AMOXIL: not recommended for **COMPLICATED UTI** or **UPPER UTI** (unless combo with clav)
- **Fosfomycin** MONUROL: not recommended for a **COMPLICATED UTI** or **UPPER UTI**
- **Moxifloxacin** AVELOX: **DOES NOT CONCENTRATE IN THE URINE**; do NOT use to treat UTIs
- **Nitrofurantoin** MACROBID / MACRODANTIN: **DOES NOT CONCENTRATE IN THE KIDNEY OR PROSTATE**; not recommended for a **COMPLICATED UTI** or **UPPER UTI**
- USA: Pivmecillinam PIVVA FDA 2024: not recommended for **COMPLICATED UTI** or **UPPER UTI**

Antibiotics for **COMPLICATED** or **PYELONEPHRITIS** (listed alphabetically)

Colour Coding: When the antibiotic may be an option When the antibiotic may be problematic

Antibiotic	Considerations for Older Adults
Amoxicillin/Clavulanate <small>CLAVULIN</small> <small>RA</small>	<ul style="list-style-type: none"> • 1st Line: for COMPLICATED UTI or PYELONEPHRITIS • SK amox/clav resistance for <i>E.coli</i>:^{2023 (urinary) ~13% & ~27% LTC} • Broader spectrum agent than other options e.g. TMP/SMX
FLUOROQUINOLONE <small>RS</small> Ciprofloxacin <small>CIPRO, - XL</small> <small>B</small> Levofloxacin <small>LEVAQUIN</small> Norfloxacin <small>NOROXIN</small>	<ul style="list-style-type: none"> • 1st Line: COMPLICATED or PYELONEPHRITIS when low resistance • Fluoroquinolones: UTI caused by ESBL bacteria • Ciprofloxacin: UTI caused by <i>Pseudomonas aeruginosa</i> • Broader spectrum than other options e.g. TMP/SMX • Caution with empiric use in regions with HIGH RESISTANCE RATES • SK cipro resistance rates for <i>E.coli</i>:^{2023 (urinary) ~29% & ~58% LTC} • <small>S</small> QT-prolonging agent, see Geri-RxFiles: QT Prolongation pg 44 • <small>B</small> Caution ↑ seizure, confusion, tendon rupture if ↓ CrCl see left • <small>B</small> Avoid with: theophylline ↑ theophylline toxicity, warfarin ↑ bleeding risk
See left note on moxifloxacin	
Trimethoprim & Sulfamethoxazole (TMP/SMX) <small>B</small> <small>RA</small> <small>BACTRIM / SEPTRA / COTRIMOXAZOLE</small> <small>(see trimethoprim below)</small>	<ul style="list-style-type: none"> • 1st Line: for COMPLICATED UTI, PYELONEPHRITIS, or ESBL bacteria • Avoid in individuals with a SULFA ALLERGY (SMX component) • SK TMP/SMX resistance for <i>E.coli</i>:^{2023 (urinary) ~22% & 33% LTC} • <small>B</small> <small>CrCl <15mL/min: not recommended</small> • <small>B</small> TMP: ↑ hyperkalemia risk with ACEi, ARB, ARNI & ↓ CrCl • <small>B</small> SMX: avoid with: phenytoin ↑ phenytoin toxicity, warfarin ↑ bleeding risk
Trimethoprim (TMP) <small>PROLOPRIM</small> <small>B</small> <small>RA</small>	<ul style="list-style-type: none"> • 2nd Line: COMPLICATED UTI or PYELONEPHRITIS; also an option if SULFA ALLERGY or SULFA INTERACTION (e.g. phenytoin, warfarin) • TMP resistance not routinely assessed in Canada; if urine C&S shows resistant to TMP/SMX, then assumed resistant to TMP • <small>B</small> TMP: ↑ hyperkalemia risk with ACEi, ARB, ARNI & ↓ CrCl

[^]Beta-lactams are an option in long-term care (historically thought to be less effective in UTIs based on older studies).

Recurrent **UNCOMPLICATED** UTIs in Women^{1-4,7,49-52}

- Recurrent UTIs:** ≥2 **culture positive** UTIs in 6 mos or ≥3 in 12 mos (same or different organism) with no structural/functional abnormalities or other complicating factors.
- Recurrent UTI Prophylaxis Options** (See RxFiles Chart: [UTI](#), Table 2). Some pearls:
- **Ensure adequate hydration if able.** RCT (~140 ♀, ~35yrs, ~3 UTIs/yr) found drinking 1.5L of water/day, in addition to usual fluids (~1L/day), decreased cystitis episodes.⁵³
 - **Consider vaginal estrogen** (cream, tab, ring) **START 2023**. Meta-analysis (5 RCTs, 324 post-menopausal women) found ↓ UTIs vs placebo **NNT≈7/6-12mos** (~10% vaginal estrogen vs ~24% placebo). No benefit with po estrogen.⁵⁴ See RxFiles Chart: [Menopause](#).
 - USA:CDN backorder²⁴ **Consider methenamine.** RCT x12mos (~240♀, ~50yr, ~6 UTI/yr) non-inferior: methenamine 1g BID ~1.4 UTIs/person vs antibiotic daily 0.89 UTIs/person.⁵⁵
 - **Cranberry:** mixed; some suggest e.g. 240mL daily-BID (caution ↑BG), 500-1000mg/d.⁵⁶
 - **D-mannose:** limited; RCT (~600 ♀, ~58yr, ~4 UTIs/yr) no benefit 2g/d vs placebo x6mos.⁵⁷
 - Probiotics: limited data; caution in those ↑ aspiration risk. See RxFiles Chart: [Probiotics](#).
 - **Multiple antibiotic prophylaxis strategies exist, individualize based on patient.**
 - If continuous prophylaxis, **monitor for benefit and consider stopping in 6 to 12 months.** B Nitrofurantoin: potential for toxicity e.g. pulmonary, [RxFiles Q&A](#) hepatic, & peripheral neuropathy, [RxFiles Q&A](#) especially with long-term use.⁴⁶

Geri-RxFiles: UTIs in Older Adults

Abbreviations: ↓ = dose for renal dysfunction **ac**=before meals **ACEi**=angiotensin converting enzyme inhibitor **AE**=adverse event(s) **AMMI**=Association of Medical Microbiology and Infectious Diseases of Canada **amox**=amoxicillin **aOR**=adjusted odds ratio **ARNI**=angiotensin receptor-neprilysin inhibitor **ARB**=angiotensin II receptor blocker **AGS**=American Geriatrics Society Beers Criteria for potentially inappropriate medication use in older adults **BG**=blood glucose **BID**=twice daily **BPH**=benign prostatic hyperplasia **C.diff**=*Clostridium difficile* **CAM**=confusion assessment method **CBC**=complete blood count **cc**=with food **CI**=confidence interval **cipro**=ciprofloxacin **Clav**=clavulanate **CrCl**=creatinine clearance **C&S**=culture & sensitivity **d**=day(s) **DS**=double strength (1DS tab= 160/800mg) **E.coli**=*Escherichia coli* **ESBL**=extended spectrum beta-lactamases **FQ**=fluoroquinolones **ID**=infectious diseases **IDSA**=Infectious Diseases Society of America **hr**=hour(s) **IV**=intravenous **L**=litre(s) **LTC**=long-term care **min**=minute(s) **mL**=millilitres **mo(s)**=month(s) **Na⁺**=sodium **NNH**=number needed to harm **NNT**=number needed to treat **NSAID**=non-steroidal anti-inflammatory drug(s) **po**=oral **QT**=QT interval **QID**=four times daily **RCT**=randomized controlled trial **S**=STOPP (screening tool of older persons' prescriptions) **Scr**=serum creatinine **SHA**=Saskatchewan Health Authority **SK**=Saskatchewan **SMX**=sulfamethoxazole **SOGC**=Society of Obstetricians and Gynaecologists of Canada **TID**=three times daily **TMP**= trimethoprim **TMP/SMX**=Cotrimoxazole, Septra, Bactrim or trimethoprim/sulfamethoxazole **UTI**=urinary tract infection **yr(s)**=year(s)

Acknowledgements: Written by Margaret Jin. Updated by Marlys LeBras (2019, 2024).

Thanks to our reviewers: Loren Regier (2019, 2024), Brent Jensen (2019, 2024), Julia Bareham (2019), Jessica Visentin (2024), Tanya Nystrom (2024), Kristin Schmidt (2024), Margaret Jin (2024), Marc Legge (2024).

Disclosures: No conflicts of interest are reported by the authors.

Disclaimer: RxFiles Academic Detailing is part of the College of Pharmacy and Nutrition at the University of Saskatchewan. The content of this work represents the research, experience and opinions of the authors and not those of the University of Saskatchewan. Neither the authors nor the University of Saskatchewan nor any other party who has been involved in the preparation or publication of this work warrants or represents that the information contained herein is accurate or complete, and they are not responsible for any errors or omissions or for the result obtained from the use of such information. Any use of the materials will imply acknowledgment of this disclaimer and release any responsibility of the University of Saskatchewan, its employees, servants or agents. Readers are encouraged to confirm the information contained herein with other sources.

Clinician Tools:

- [Choosing Wisely: Using antibiotics wisely in long term care](#)
 - Poster available clinical areas in long term care encouraging clinicians to, “reflect before you collect”
 - Practice change handout including recommendations to help optimize antibiotic prescribing for asymptomatic bacteriuria in long term care
- Association of Medical Microbiology and Infectious Disease Canada (AMMI Canada)
 - Toolkit: [Symptom Free Pee Resources - AMMI](#)
- Saskatchewan
 - [Firstline: Antimicrobial treatment guidelines for common infections](#) (app also available)
 - [ABCs for Diagnosing UTIs in continuing care](#)
 - [Frequency of Long-term Urinary Catheter Replacement in continuing care](#) (2015)
- Alberta Health Services
 - [Urine testing algorithm in long term care](#) (2023)
 - [Clinician evidence-based criteria for urinary infection testing](#) (2019)
 - [Understanding asymptomatic bacteriuria](#) (2016)
- Public Health Ontario
 - [Urinary tract infection program: Reducing antibiotic harms in long term care](#) (2019)
- BC Provincial Academic Detailing
 - [Urinary tract infections in primary care and long term care](#) (2016)
- Public Health England
 - https://assets.publishing.service.gov.uk/media/5f89809ae90e072e18c0ccc2/UTI_diagnostic_flowchart_NICE-October_2020-FINAL.pdf (2020)
- Australian Government – Aged Care Quality and Safety Commission (published 2021, updated 2024)
 - [Clinical pathways for suspected UTIs forms | Aged Care Quality and Safety Commission](#)
- [CADTH: Treatment of urinary tract infection in elderly – clinical effectiveness and guidelines](#) (2015)

Patient Tools:

- [Choosing Wisely: Antibiotics for urinary tract infections in older people – When you need the and when you don't](#)
- [AMMI Canada: Symptom Free Pee – Let it be](#)

- [Public Health Ontario: Urinary tract infection program: Frequently asked questions for residents and family](#) (2019)
- [Alberta Health Services: Antimicrobial stewardship in continuing care: Frequently asked questions](#) (2015)
- [Saskatchewan: The basics of UTI prevention and identification in continuing care settings](#) (2014)
- [Saskatchewan: UTIs in teenagers and adults](#) (2023)

GERI-RxFiles UTI References:

General Resources:

1. **Firstline. Saskatchewan Health Authority**; 2024. App Accessed March 2024.
2. **Bugs & Drugs**: An antimicrobial/infectious disease reference. Alberta Health Services, Alberta Health, British Columbia of Health Pharmaceutical Services Division; 2024.
3. **Sanford Guide Committee**. The Sanford Guide to Antimicrobial Therapy, 54th Edition. Antimicrobial Therapy, INC; 2024.
4. Anti-infective Review Panel. **Anti-infective guidelines for community-acquired infections**. Toronto: MUMS Guideline Clearinghouse; 2024.

Asymptomatic Bacteriuria:

5. **Choosing Wisely**. Long-term Care: Antibiotics, Practice Change Recommendations for **Asymptomatic Bacteriuria in LTC**. Available at: [Choosing Wisely: Using antibiotics wisely in long term care](#).
6. Edith Blondel-Hill, David Patrick, Caroline Nott, Kim Abbass, Tim TY Lau, and Greg German. **AMMI Canada** position statement on **asymptomatic bacteriuria**. Journal of the Association of Medical Microbiology and Infectious Disease Canada 2018 3:1, 4-7. Toolkit available: [Symptom Free Pee Resources - AMMI](#).
7. Nicolle LE, et al. Clinical Practice Guideline for the Management of **Asymptomatic Bacteriuria: 2019 Update by the Infectious Diseases Society of America**. Clin Infect Dis. 2019 May 2;68(10):e83-e110.
Nicolle L, Bradley S, Colgan R, Rice J, Schaeffer A, Hooton T. Infectious Diseases Society of America Guidelines for the Diagnosis and Treatment of Asymptomatic Bacteriuria in Adults. Clinical Infectious Disease. **2005**;40:643-54.
8. Colgan R, Nicolle LE, McGlone A, Hooton TM. Asymptomatic Bacteriuria in Adults. Am Fam Physician. 2006 Sep; 15;74(6):985-990. See Table 1 for prevalence percentages.
9. Young J, Pasay D, Allan M. **Tools for practice**. March 6, 2023. **Asymptomatic bacteriuria in the elderly**: Don't drug the bugs?
10. Krzyzaniak N, Forbes C, Clark J, et al. Br J Gen Pract. 2022; 72(722):e649-e58.
11. Henderson JT, Webber EM, Bean SI. JAMA. 2019; 322(12):1195-1205.
12. Trestioreanu AZ, Lador A, Sauerbrun-Cutler MT, et al. Cochrane Database Syst Rev. 2015; 4(4): CD009534.
13. Köves B, Cai T, Veeratterapillay R, et al. Eur Urol. 2017 Dec; 72(6):865-868.
14. Potts L, Cross S, MacLennan WJ, et al. Arch Gerontol Geriatr. 1996; 23(2):153-61.
15. Dasgupta M, Brymer C, Elsayed S. Arch Gerontol Geriatr. 2017 Sep; 72:127-134.
16. Joo P, Grant L, Ramsay T, et al. BMC Geriatr. 2022 Nov 29; 22(1):916.
17. O'Mahony, D., Cherubini, A., Guiteras, A.R. et al. **STOPP/START** criteria for potentially inappropriate prescribing in older people: version 3. Eur Geriatr Med (2023).
O'Mahony D, O'Sullivan D, Byrne S, O'Connor MN, Ryan C, Gallagher P. STOPP/START criteria for potentially inappropriate prescribing in older people: version 2. Age Ageing. 2014 Oct 16.
18. Krzyzaniak N, Forbes C, Clark J, Scott AM, Mar CD, Bakhit M. Antibiotics versus no treatment for asymptomatic bacteriuria in residents of aged care facilities: a systematic review and meta-analysis. Br J Gen Pract 2022;72(722):e649-e658.
19. Rotjanapan P, Dosa D, Thomas KS. Potentially inappropriate treatment of urinary tract infections in two Rhode Island nursing homes. Arch Intern Med 2011;171:43.
20. Aryee, A., Rockenschaub, P., Robson, J., Ahmed, Z., Nic Fhogartaigh, C., Ball, D., Hayward, A., & Shallcross, L. (2024). Assessing the impact of discordant antibiotic treatment on adverse outcomes in community-onset UTI: a retrospective cohort study. The Journal of antimicrobial chemotherapy, 79(1), 134–142.

Other:

- Biggel M, Heytens S, Latour K, Bruyndonckx R, Goossens H, Moons P. Asymptomatic bacteriuria in older adults: the most fragile women are prone to long-term colonization. BMC Geriatr 2019;19.
- Tsan L, Langberg R, Davis C, et al. Nursing home-associated infections in Department of Veterans Affairs community living centers. Am J Infect Control 2010;38:-6. doi: 10.1016/j.ajic.2009.12.009 pmid: 20656129.
- Alberta Health Services (AHS). [Appropriateness of Care: Asymptomatic Bacteriuria | Alberta Health Services](#). Accessed August 17, 2023.
- Nicolle LE. Urinary tract infections in the older adult. Clin Geriatr Med 2016;32(3): 523-38. Epub 2016 Apr 18.

Assessment and Treatment of a UTI in Older Adults / LTC Residents:

21. Gupta K, Hooton TM, Naber KG et al; **Infectious Diseases Society of America**; European Society for Microbiology and Infectious Diseases. 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 Mar 1;52(5):e103-20. (archived)
22. Hooton TM, Bradley SF, Cardenas DD, et al. **Infectious Diseases Society of America**. 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;50:63. doi: 10.1086/650482 pmid: 20175247.
23. Stone ND, Ashraf MS, Calder J, et al. Surveillance definitions of infections in long-term care facilities: **revisiting the McGeer criteria**. *Infect Control Hosp Epidemiol*. 2012; 33(10):965–77.
24. McGeer A, Campbell B, Emori TG, et al. Definitions of infection for surveillance in long-term care facilities. *Am J Infect Control*. 1991; 19(1):1–7.
25. **Loeb M**, Bentley DW, Bradley S, et al. Development of minimum criteria for the initiation of antibiotics in residents of long-term-care facilities: results of a **consensus conference**. *Infect Control Hosp Epidemiol* 2001;22:120–4.
26. Mody, L. Approach to infection in the older adult. In: UpToDate, Post, TW (Ed), UpToDate, Waltham, MA, 2024.
27. Daynamed: Infections in Older adults. Available from: [Infections in Older Adults - DynaMed](#).
28. Rowe TA, Jump RLP, Andersen BM, Banach DB, Bryant KA, Doernberg SB, Loeb M, Morgan DJ, Morris AM, Murthy RK, Nace DA, Crnich CJ. Reliability of nonlocalizing signs and symptoms as indicators of the presence of infection in nursing-home residents. *Infect Control Hosp Epidemiol*. 2022 Apr;43(4):417-426.
29. Nace DA, Drinka PJ and Crnich CJ. Clinical uncertainties in the approach to long-term care residents with possible urinary tract infection. *J Am Med Dir Assoc* 2014;15:133–139.
30. Nicolle LE, SHEA Long-Term-Care-Committee. Urinary tract infections in long-term-care facilities. *Infect Control Hosp Epidemiol* 2001;22: 167–175.
31. Nicolle LE, Yoshikawa TT. Urinary tract infection in long-term-care facility residents. *Clin Infect Dis* 2000;31:757–761.
32. Vaughn, V. M., Gupta, A., Petty, L. A., Malani, A. N., Osterholzer, D., Patel, P. K., Younas, M., Bernstein, S. J., Burdick, S., Ratz, D., Szymczak, J. E., McLaughlin, E., Czilok, T., Basu, T., Horowitz, J. K., Flanders, S. A., & Gandhi, T. N. (2023). A Statewide Quality Initiative to Reduce Unnecessary Antibiotic Treatment of Asymptomatic Bacteriuria. *JAMA internal medicine*, 183(9), 933–941.
33. Piggott, K. L., Trimble, J., & Leis, J. A. (2023). Reducing unnecessary urine culture testing in residents of long term care facilities. *BMJ (Clinical research ed.)*, 382, e075566.
34. Zhang Y. (2023). Urine testing in elderly people-what about the negative predictive value?. *BMJ (Clinical research ed.)*, 383, 2346.
35. Cooper MA. The Diagnosis and Management of UTI in >65s: To Dipstick or Not? The Argument For Dipsticks. *Infect Prev Pract*. 2020 May 8;2(3):100064.
36. Joseph A. The Diagnosis and Management of UTI in >65s: To Dipstick or Not? The Argument Against Dipsticks. *Infect Prev Pract*. 2020 May 7;2(3):100063.
37. Advani SD, Polage CR, Fakhri MG. Deconstructing the urinalysis: A novel approach to diagnostic and antimicrobial stewardship. *Antimicrob Steward Healthc Epidemiol*. 2021;1(1):e6.
38. Gupta K, O'Brien W, Gallegos-Salazar J, Strymish J, Branch-Elliman W. How Testing Drives Treatment in Asymptomatic Patients: Level of Pyuria Directly Predicts Probability of Antimicrobial Prescribing. *Clin Infect Dis*. 2020 Jul 27;71(3):614-621.
39. Amenta EM, Jump RLP, Trautner BW. Bacteriuria in older adults triggers confusion in healthcare providers: A mindful pause to treat the worry. *Antimicrob Steward Healthc Epidemiol*. 2023 Jan 9;3(1):e4.
40. Anderson CM, VanHoose JD, Burgess DR, Burgess DS, Schadler A, Porterfield JZ, Wallace KL. Appropriateness of antibiotic use in patients with and without altered mental status diagnosed with a urinary tract infection. *Antimicrob Steward Healthc Epidemiol*. 2022 Dec 13;2(1):e198.
41. Nicolle LE. Asymptomatic bacteriuria in the elderly. *Infect Dis Clin North Am*. 1997 Sep;11(3):647-62.
42. Boscia JA, Abrutyn E, Levison ME, et al: Pyuria and asymptomatic bacteriuria in elderly ambulatory women. *Ann Intern Med* 110:404, 1989.
43. Nicolle LE, Harding GKM, Kennedy J, et al: Urine specimen collection with external devices for diagnosis of bacteriuria in elderly incontinent men. *J Clin Microbiol* 26:1115, 1988.
44. Nicolle LE, Muir P, Harding GKM, et al: Localization of site of urinary infection in elderly institutionalized women with asymptomatic bacteriuria. *J Infect Dis* 157:65, 1988.
45. Rodgers K, Nicolle LE, McIntyre M, et al: Pyuria in institutionalized elderly subjects. *Can J Infect Dis* 2:142, 1991.
46. American Geriatrics Society **2023 updated AGS Beers Criteria**® for potentially inappropriate medication use in older adults. *J Am Geriatr Soc*. 2023 Jul;71(7):2052-2081.
The American Geriatrics Society 2012 Beers Criteria Update Expert Panel. *American Geriatrics Society updated Beers criteria for potentially inappropriate medication use in older adults. J Am Geriatr Soc*2012;60:616-31. Updated 2015.
47. Drekonja DM, Trautner B, Amundson C, Kuskowski M, Johnson JR. Effect of 7 vs 14 Days of Antibiotic Therapy on Resolution of Symptoms Among Afebrile Men With Urinary Tract Infection: A Randomized Clinical Trial. *JAMA*. 2021 Jul 27;326(4):324-331.
48. Lutters M, Vogt-Ferrier NB. Antibiotic duration for treating uncomplicated, symptomatic lower urinary tract infections in elderly women. *Cochrane Database Syst Rev*. 2008;(3):CD001535.

Other:

- Piggott, K. L., & Leis, J. A. (2024). When urine testing to rule out infection does more harm than good. *Canadian family physician Medecin de famille canadien*, 70(9), 551–554.

- Pharmacists Letter. Detail-Document: Choosing a UTI Antibiotic for Elderly Patients. December 2011.
- Matthews SJ, Lancaster JW. Urinary tract infections in the elderly population. *Am J Geriatr Pharmacother*. 2011 Oct;9(5):286-309.
- Grigoryan L, Trautner BW, Gupta K. Diagnosis and Management of Urinary Tract Infections in the Outpatient Setting: A Review. *JAMA* 2014;312(16):1677-84.
- Langenstroer MC, Jolles S, Hossin T, Nora A, Bahrainian M, Crnich C, Taylor L. Antibiotic postprescribing modification opportunities among nursing home residents treated for urinary tract infection. *Infect Control Hosp Epidemiol*. 2023 Jun;44(6):875-880.
- Yoshikawa, T, Norman D. Geriatric Infectious Disease: Current concepts on diagnosis and management. *J Am Geriatr Soc* 2017;65:631-41.
- Rodriguez-Mañás L. Urinary tract infections in the elderly: a review of disease characteristics and current treatment options. *Drugs Context*. 2020 Jul 8;9:2020-4-13.
- Lutters M, Vogt-Ferrier NB. Antibiotic duration for treating uncomplicated, symptomatic lower urinary tract infections in elderly women. *Cochrane Database Syst Rev*. 2008 Jul 16;(3):CD001535.
- Vogel T, Verreault R, Gourdeau M et al. Optimal duration of antibiotic therapy for uncomplicated urinary tract infection in older women: a double-blind randomized controlled trial. *CMAJ*. 2004 Feb 17;170(4):469-73.
- Ferraro G, Ambrosi G, Bucci L et al. Fosfomycin trometamol versus norfloxacin in the treatment of uncomplicated lower urinary tract infections of the elderly. *Chemotherapy*. 1990; 36 Suppl 1:46-9.
- McIsaac W, Moineddin R, Meaney C et al. Antibiotic-resistant *Escherichia coli* in women with acute cystitis in Canada. *Can J Infect Dis Med Microbio Autumn* 2013; 24(3):143-149.
- Singh N, Gandhi S, McArthur E, Moist L, Jain AK, Liu AR, Sood MM, Garg AX. Kidney function and the use of nitrofurantoin to treat urinary tract infections in older women. *CMAJ*. 2015 Jun 16;187(9):648-56.

Recurrent UTI:

49. Anger JT, Bixler BR, Holmes RS, Lee UJ, Santiago-Lastra Y, Selph SS. Updates to Recurrent Uncomplicated Urinary Tract Infections in Women: AUA/CUA/SUFU Guideline. *J Urol*. 2022 Sep;208(3):536-541.
50. Huang AJ, Grady D, Mody L. Recurrent Urinary Tract Infection in Older Outpatient Women. *JAMA Intern Med*. 2024 Aug 1;184(8):971-972.
51. Epp A, Larochelle A.No. 250 - Recurrent Urinary Tract Infection. *J Obstet Gynaecol Can* 2017;39(10):e422-e43.
52. Grabe M, Bartoletti R, Bjerklund Johansen TE, et al. Guidelines on Urological Infections. European Association of Urology (EAU), 2015. Accessed August 18, 2018
https://uroweb.org/wp-content/uploads/19-Urological-infections_LR2.pdf.
53. Hooton TM, Vecchio M, Iroz A, Tack I, Dornic Q, Seksek I, Lotan Y. Effect of Increased Daily Water Intake in Premenopausal Women With Recurrent Urinary Tract Infections: A Randomized Clinical Trial. *JAMA Intern Med*. 2018 Nov 1;178(11):1509-1515.
54. Chen YY, Su TH, Lau HH. Estrogen for the prevention of recurrent urinary tract infections in postmenopausal women: a meta-analysis of randomized controlled trials. *International Urogynecology Journal*. 2021 Jan;32:17-25.
55. Harding C, Mossop H, Homer T, et al. Alternative to prophylactic antibiotics for the treatment of recurrent urinary tract infections in women: multicentre, open label, randomised, non-inferiority trial. *BMJ*. 2022;376:e068229. doi:10.1136/bmj-2021-0068229.
56. Williams G, Stothart CI, Hahn D, Stephens JH, Craig JC, Hodson EM. Cranberries for preventing urinary tract infections. *Cochrane Database Syst Rev*. 2023 Nov 10;11(11):CD001321. Jepson RG, Williams G, Craig JC. Cranberries for preventing urinary tract infections. *Cochrane Database Syst Rev* 2012;(10):CD001321.
57. Hayward G et al. (2024). **d-Mannose** for Prevention of Recurrent Urinary Tract Infection Among Women: A Randomized Clinical Trial. *JAMA internal medicine*, 184(6), 619–628.

Search Terms

Bacteriuria	83
Catheter	83
Urinary tract infection	83
UTI	83
Urinalysis	84
Urinary tract infection	84
UTI	84
Amoxicillin	85
Amoxicillin/Clavulanate	85
AMOXIL	85
Antibiotic	85
AVELOX	85
BACTRIM	85
Cefixime	85
Cephalexin	85
CIPRO	85
Ciprofloxacin	85
CLAVULIN	85
COTRIMOXAZOLE	85
Cystitis	85
Fluoroquinolone	85
Fosfomycin	85
KEFLEX	85
LEVAQUIN	85
Levofloxacin	85
MACROBID	85
MACRODANTIN	85
MONUROL	85
Moxifloxacin	85
Nitrofurantoin	85
Norfloxacin	85
NOROXIN	85
PROLOPRIM	85
SEPTRA	85
Sulfamethoxazole	85
SUPRAX	85
Trimethoprim	85
Urinary tract infection	85
UTI	85
Amoxicillin	86
Amoxicillin/Clavulanate	86
AMOXIL	86
Antibiotic	86
AVELOX	86
BACTRIM	86
Cefixime	86
Cephalexin	86
CIPRO	86
Ciprofloxacin	86
CLAVULIN	86
COTRIMOXAZOLE	86
Cranberry	86
Fluoroquinolone	86
Fosfomycin	86
KEFLEX	86
LEVAQUIN	86
Levofloxacin	86
MACROBID	86
MACRODANTIN	86
MONUROL	86
Moxifloxacin	86
Nitrofurantoin	86
Norfloxacin	86
NOROXIN	86
Pivcedillinam	86
PIVYA	86

Probiotics	86
PROLOPRIM	86
Pyelonephritis	86
SEPTRA	86
Sulfamethoxazole	86
SUPRAX	86
Trimethoprim	86
Urinary tract infection	86
UTI	86
Urinary tract infection	87
UTI	87
Catheter	88
Urinary tract infection	88
UTI	88
Pivecillinam	85
PIVYA	85

Other:

- Perrotta C, Aznar M, Mejia R, Albert X, Ng CW. Oestrogens for preventing recurrent urinary tract infection in postmenopausal women. *Cochrane Database Syst Rev.* 2008 Apr 16;(2):CD005131.
- Bakhit M, Krzyzaniak N, Hilder J, et al. Use of **methenamine hippurate** to prevent urinary tract infections in community adult women: a systematic review and meta-analysis. *Br J Gen Pract.* 2021 Jan 17:BJGP.2020.0833.
- Lee BS, Bhuta T, Simpson JM, et al. **Methenamine hippurate** for preventing urinary tract infections. *Cochrane Database Syst Rev.* 2012 Oct 17;10:CD003265.
- Davidson SM, Brown JN, Nance CB, Townsend ML. Use of Methenamine for Urinary Tract Infection Prophylaxis: Systematic Review of Recent Evidence. *Int Urogynecol J* 2024; 35:483.
- Chwa A, Kavanagh K, Linnebur SA, Fixen DR. Evaluation of methenamine for urinary tract infection prevention in older adults: a review of the evidence. *Ther Adv Drug Saf.* 2019;10:2042098619876749. doi:10.1177/2042098619876749.
- Allan M, Nicolle L. Cranberry juice/tablets for the prevention of urinary tract infection: naturally the best? *Tools for Practice*, March 4, 2013.
- Stapleton AE, Dziura J, Hooton TM, Cox ME, Yarova-Yarovaya Y, Chen S, et al. Recurrent urinary tract infection and urinary Escherichia coli in women ingesting cranberry juice daily: a randomized controlled trial. *Mayo Clin Proc* 2012;87(2):143-50.
- Wang CH, Fang CC, Chen NC, et al. **Cranberry-Containing** Products for Prevention of Urinary Tract Infections in Susceptible Populations: A Systematic Review and Meta-analysis of Randomized Controlled Trials. *Arch Intern*
- Barbosa-Cesnik C, Brown MB, Buxton M, et al. **Cranberry juice** fails to prevent recurrent urinary tract infection: results from a randomized placebo-controlled trial. *Clin Infect Dis.* 2011 Jan;52(1):23-30.
- Kranjčec B, Papeš D, Altarac S. **D-mannose** powder for prophylaxis of recurrent urinary tract infections in women: a randomized clinical trial. *World J Urol.* 2014 Feb;32(1):79-84.
- Lenger SM, Bradley MS, Thomas DA, et al. **D-mannose vs other agents** for recurrent urinary tract infection prevention in adult women: a systematic review and meta-analysis. *Am J Obstet Gynecol.* 2020;223(2):265.e1-265.e13.
- Cooper TE, Teng C, Howell M, et al. **D-mannose** for preventing and treating urinary tract infections. *Cochrane Database Syst Rev.* 2022 Aug 30;8(8):CD013608.
- Schwenger EM, Tejani AM, Loewen PS. **Probiotics** for preventing urinary tract infections in adults and children. *Cochrane Database Syst Rev.* 2015 Dec 23;(12):CD008772.
- Grin PM, Kowalewska PM, Alhazzan W, Fox-Robichaud AE. Lactobacillus for preventing recurrent urinary tract infections in women: meta-analysis. *Can J Urol.* 2013 Feb;20(1):6607-14. Review. PubMed PMID: 23433130.
- Toh S, Boswell-Ruys C, Lee B, Simpson J, Clezy K. Probiotics for preventing urinary tract infection in people with neuropathic bladder. *Cochrane Database of Systematic Reviews.* 2017, Issue 9. Art. No.: CD010723.
- Albert X, Huertas I, Pereiró II, Sanfélix J, Gosalbes V, Perrota C. Antibiotics for preventing recurrent urinary tract infection in non-pregnant women. *Cochrane Database Syst Rev.* 2004;(3):CD001209.
- Finley CR, Falk J, Korownyk CS. Antibiotic prophylaxis for urinary tract infection. *Can Fam Physician.* 2022 Dec;68(12):896.
- Langford BJ, Brown KA, Diong C, Marchand-Austin A, Adomako K, Saedi A, et al. The benefits and harms of antibiotic prophylaxis for urinary tract infection in older adults. *Clin Infect Dis* 2021;73(3):e782-91.
- Dueñas-García OF, Sullivan G, Hall CD, Flynn MK, O'Dell K. Pharmacological Agents to Decrease New Episodes of Recurrent Lower Urinary Tract Infections in Postmenopausal Women. A Systematic Review. *Female Pelvic Med Reconstr Surg.* 2016 Mar-Apr;22(2):63-9.
- Rudenko N, Dorofeyev A. Prevention of recurrent lower urinary tract infections by long-term administration of fosfomicin trometamol. Double blind, randomized, parallel group, placebo controlled study. *Arzneimittelforschung* 2005;55(7):420-7.

