Urinary Tract Infections (UTIs)

- Most common causative pathogen: *E. coli* (>80% of cases)
- Other pathogens include: *Klebsiella pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa, Staphylococcus saprophyticus; Enterococcus faecalis*
- Collateral damage: Ecological adverse effects of drug therapy (i.e., development of bacterial resistance and *Clostridioides difficile* infection); usually associated with broad spectrum systemic agents
- There are no specific guidelines for the treatment of UTIs in older adults. Treatment options are extrapolated from treatment guidelines.

Medication	Geriatric Dosing	Clinical Pearls
Acute cystitis		
Nitrofurantoin	100 mg PO BID	Beers criteria were updated in 2023 to show it is safe and effective as long as CrCl is >30 mL/minute; recommended duration of therapy is 5-7 days; cannot be used for pyelonephritis
Trimethoprim/sulfamethoxazole	1 double strength tablet (160 mg/800 mg) PO BID	Should only use empirically if local resistance to *E. coli* is <20%; recommended duration of therapy is 3 days in otherwise healthy women – older adults usually require longer duration of therapy (7 days); may cause hyperkalemia; can't be used in patients with sulfa allergy
Fosfomycin	3 g PO once	One time dose is recommended for otherwise healthy women; lower efficacy compared with trimethoprim/sulfamethoxazole; older adults usually require multiple doses; cannot be used for pyelonephritis
Ciprofloxacin Levofloxacin	• 250-500 mg PO BID • 250-750 mg PO daily	High risk of collateral damage; should only be used when 1st line treatment options cannot be used; are associated with some serious adverse reactions including QT prolongation and tendon rupture

Amoxicillin/clavulanate Cephalexin Cefaclor Cefpodoxime Cefdinir	• Standard adult dosing	Have lower efficacy compared to first-line options; should be reserved for patients who cannot receive first-line options

- Older adults with pyelonephritis often necessitate hospital admission. Parenteral ceftriaxone is the most commonly used agent for *empiric* treatment.
- Catheter colonization by bacteria is inevitable in older adults with an indwelling catheter. Essentially every catheter will be colonized within 31 days of insertion. Do **not** use antibiotics for prophylaxis.
- Screening for bacteriuria and treatment for asymptomatic bacteriuria is **not** recommended for older adults unless they are undergoing an invasive urologic procedure.

***Clostridioides difficile* Infection (CDI)**

- All systemic antibiotics are associated with a risk of CDI. High risk antibiotics include clindamycin, aminopenicillins, broad spectrum cephalosporins, with fluoroquinolones being the highest risk class of antibiotics.
- Antibiotic exposure is the single largest risk factor for CDI.
- Fidaxomicin is first-line treatment option for non-severe, severe disease, and 1st recurrence.
- Metronidazole is not recommended as 1st or 2nd line unless there are contraindications to fidaxomicin and to oral vancomycin. Metronidazole should only be used empirically for fulminant CDI in IV formulation dosed q8h in combination with high-dose oral vancomycin.
- Oral vancomycin plus intravenous metronidazole is recommended for fulminant cases. Add rectal instillation of vancomycin if ileus is present.
- Duration of therapy is 10 days
- Fecal microbiota transplantation should be considered in patients with 3 or more cases of CDI.
- Bezlotoxumab can be added to a standard of care treatment option to reduce the risk of CDI recurrence.

Community-Acquired Pneumonia (CAP)

- Most common causative bacterial pathogens*: Streptococcus pneumoniae, Haemophilus influenzae, Mycoplasma pneumoniae, Chlamydophila pneumoniae, Legionella pneumophila*
- Less common bacterial pathogens: *Staphylococcus aureus, Pseudomonas aeruginosa*

- Macrolide monotherapy is not recommended for the *empiric* treatment of CAP because pneumococcal resistance in the U.S. is > 30%
- Duration of therapy is 5 to 7 days
- If patient has prolonged QTc or other cardiovascular precautions doxycycline preferred over azithromycin.

Medication	Geriatric Dosing	Clinical Pearls
Tetracycline		
Doxycycline	100 mg IV/PO BID	Photosensitivity; Avoid co-administration of oral doxycycline with cations; must be combined with a beta-lactam for hospitalized patients
Beta-lactams		
Amoxicillin	1 g PO TID	Does not cover atypicals, but cover other most likely pathogens; must be combined with a macrolide or fluoroquinolone for hospitalized patients
Amoxicillin/clavulanate	2 g PO BID	
Cefpodoxime	200 mg PO BID	
Ceftriaxone	1-2 g IV/IM daily	
Cefuroxime	500 mg PO BID	
Macrolides		
Azithromycin	500 mg on day 1, then 250 mg on days 2-5 500 mg IV/PO daily	Cover atypical pathogens; no longer recommended as monotherapy due to rise in pneumococcal resistance; may cause QT prolongation; azithromycin is used more commonly due to less drug interactions
Clarithromycin	500 mg PO BID	
Fluoroquinolones		
Levofloxacin	750 mg IV/PO daily	Cover most likely pathogens; pneumococcal resistance is uncommon; ciprofloxacin should not be used empirically due to lack of pneumococcal coverage; are associated with some serious adverse reactions including QT prolongation and tendon rupture
Moxifloxacin	400 mg IV/PO daily	

Hospital-Acquired Pneumonia (HAP)

- Most common causative pathogens: MRSA, *Pseudomonas aeruginosa*, *E. coli*, and *Klebsiella pneumoniae*
- Treatment depends on MRSA prevalence, risk of multidrug-resistant organisms, and risk of mortality (e.g. septic shock, need for mechanical ventilation)
- MRSA prevalence is >20% in the vast majority of hospitals in the U.S.
- If low risk of mortality, no IV antibiotics in the last 90 days, and **MRSA prevalence ≤20%**, use a single agent active against both *Pseudomonas* and MSSA
- If low risk of mortality, no IV antibiotics in the last 90 days, and **MRSA prevalence >20%**, use an agent active against *Pseudomonas* in combination with vancomycin or linezolid
- If high risk of mortality, IV antibiotics in the last 90 days, lack of anti-pseudomonal agent with less than 10% resistance or structural lung disease, use two agents active against *Pseudomonas* (i.e. a beta-lactam plus a fluoroquinolone or an aminoglycoside) in combination with vancomycin or linezolid
- Duration of therapy is 7 days pending clinical improvement

Immunizations

- Older adults are eligible for a wide variety of vaccines, most importantly influenza, pneumococcal, herpes zoster, and COVID-19 vaccines.
- All older adults without a contraindication should receive a recommended age appropriate influenza vaccine each year preferably in October. Live attenuated influenza vaccine, quadrivalent (LAIV4) is **not** indicated in people aged ≥50 years.
- Pneumococcal conjugate vaccine, 20-valent (PCV20) is recommended for adults ≥65 years; patients may receive one dose only.
- Pneumococcal conjugate vaccine, 15-valent (PCV15) followed by pneumococcal polysaccharide vaccine, 23-valent (PPSV23) 1 year later is recommended for adults ≥65.
- No additional doses are indicated for adults ≥65 if PCV15 or PCV20 were administered at a younger age.
- Recombinant zoster vaccine (RZV) is the only zoster vaccine now recommended in the immunization tables for the prevention of herpes zoster in adults aged ≥50 years; patients should receive 2 doses of RZV separated by 2 – 6 months.

Drug – disease or drug-drug contraindications

- Carbapenem contraindicated with valproic acid with profound reduction of serum valproic acid levels – alternative agent to replace valproic acid must be performed
- Linezolid typically causes thrombocytopenia when utilized for more than 14 days
- Cefepime neurotoxicity greatest risk factors
    - Older adults over 65 years old
    - Presenting with acute kidney injury
    - Septic presentation

- Daptomycin is contraindicated in use for pneumonia indication as it is not clinically effective due to surfactant-to-surfactant interaction
- Fidaxomicin contraindicated in patients with severe macrolide allergies
- Moxifloxacin contraindicated for urinary tract infections
- Metronidazole known disulfiram like interaction with alcohol counseling pearl – not a true contraindication
- Rifampin may cause liver failure even in a patient with a healthy liver and is contraindicated in patients with liver dysfunction
- Nitrofurantoin long-term use associated with peripheral neuropathy, pulmonary toxicity, and hepatoxicity

Antibiogram

- Are only useful when trying to identify empiric therapy for a patient or empiric therapy for an organization based on historical antibiotic likelihood to cover that organism. Once a pathogen is known and you have susceptibility data the antibiogram is no longer useful for selecting an antibiotic for that specific pathogen.
- For *E. coli* below which agent would be best for oral urinary empiric therapy for this organization?

Species	Amoxicillin+ clavulanic acid	Ampicillin	Ampicillin+Sulbactam	Piperacillin+Tazobactam	Cefazolin	Cefuroxime	Ceftriaxone	Ceftazidime	Cefepime	Cefoxitin	Aztreonam	Gentamicin	Tobramycin	Amikacin	Ertapenem	Imipenem	Meropenem	Ciprofloxacin	Levofloxacin	Trimeth+Sulfa	Tetracycline	Nitrofurantoin
Citrobacter freundii	R	R	R	89% (106)	R	R	84% (106)	87% (106)	100% (115)	R	86% (64)	94% (115)	94% (115)	100% (40)	94% (54)	100% (42)	100% (64)	93% (106)	86% (113)	86% (106)	94% (34)	94% (104)
Klebsiella aerogenes	R	R	R	88% (169)	R	R	85% (169)	88% (169)	99% (156)	R	90% (93)	100% (126)	100% (108)	NED			99% (136)	99% (169)	98% (169)	99% (169)	98% (84)	32% (114)
Enterobacter cloacae	R	R	R	85% (372)	R	R	81% (270)	83% (385)	95% (373)	R	83% (228)	98% (385)	98% (302)	100% (121)	90% (118)	92% (99)	98% (275)	96% (385)	96% (373)	95% (385)	92% (176)	41% (291)
Escherichia coli	85% (4539)	59% (9075)	68% (8376)	97% (9075)	85% (8559)	91% (911)	95% (8766)	97% (8265)	97% (9075)	96% (2290)	96% (2907)	92% (9075)	94% (6272)	99% (2766)	99% (3595)	99% (2446)	99% (6380)	84% (8685)	82% (8934)	81% (7419)	86% (1978)	98% (7178)
ESBL E. coli	43% (93)		41% (44)	90% (93)								58% (93)					98% (93)	30% (93)	31% (87)	59% (93)		99% (87)
Klebsiella oxytoca	87% (127)		79% (270)	96% (270)	68% (111)	86% (59)	95% (292)	98% (270)	99% (292)	96% (91)	96% (171)	99% (292)	99% (269)	100% (127)	98% (66)	100% (76)	100% (194)	97% (270)	98% (288)	95% (292)		91% (241)
Klebsiella pneumoniae	97% (541)	R	89% (1084)	96% (1119)	88% (1100)	93% (167)	97% (1194)	98% (1119)	98% (1170)	82% (337)	97% (640)	98% (1194)	97% (1038)	100% (449)	99% (485)	100% (321)	99% (786)	95% (1119)	93% (1173)	94% (1194)	88% (388)	46% (1128)
Proteus mirabilis	98% (295)	86% (611)	93% (553)	99% (611)	73% (595)	96% (91)	97% (595)	98% (569)	98% (592)	94% (144)	98% (217)	94% (611)	95% (523)	100% (207)	99% (228)	23% (154)	99% (378)	92% (520)	92% (601)	89% (611)	R	R
Pseudomonas aeruginosa	R	R	R	92% (819)	R	R	R	93% (780)	93% (798)	R	NED	92% (207)	99% (621)	100% (161)	R	62% (199)	94% (579)	89% (780)	84% (797)	R	R	R
Serratia marcescens	R	R	R	80% (41)	R	R	NED	81% (68)	87% (68)	R	86% (58)	100% (37)	85% (68)				95% (58)	82% (68)	72% (58)	100% (37)	NED	R