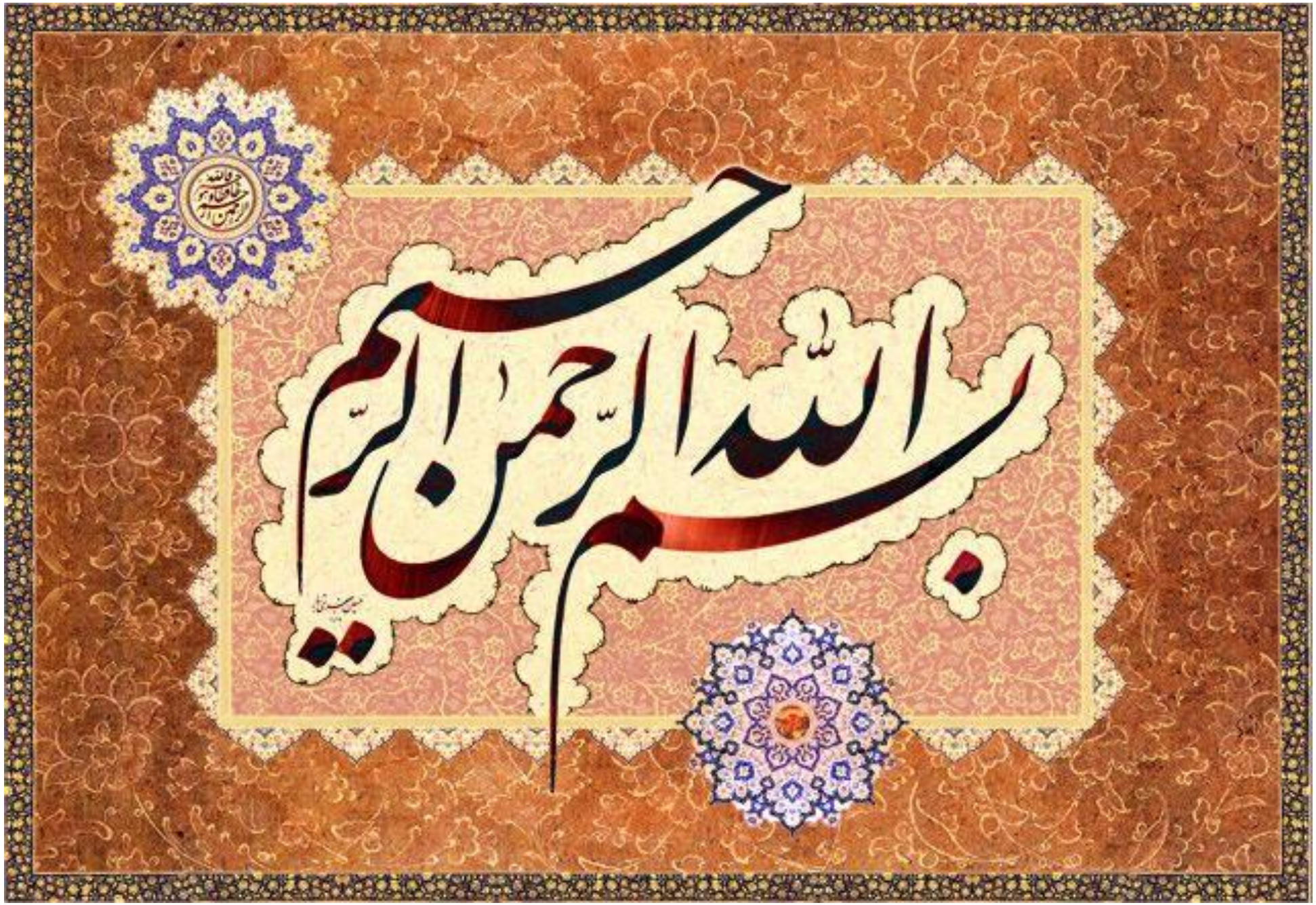
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Infections in Older Adults

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PREDISPOSITION OF OLDER ADULTS TO INFECTION

Risk factors for infection in older adults are numerous:

- comorbid illness,
- polypharmacy,
- functional status (physical, cognitive, sensory),
- place of residence,
- and individual variations in physiologic changes that accompany age (e.g., declining glomerular filtration rate, reduced gag/cough reflexes).

Comorbid Illness

- The most important cofactor for infection in older adults is the accumulation of comorbid disease with age (e.g., diabetes mellitus, renal failure, chronic pulmonary disease, edema, immobility).
- These comorbidities most often result in reduced local innate immunity.
- For example, COPD:
  - impaired mucociliary clearance,
  - alveolar macrophage dysfunction,
  - and suppressed cough mechanism,

substantially increasing the risk for lower respiratory tract infection in older adults with COPD.

Comorbid Illness

- Comorbid diseases in older adults with infection can also be important predictors for worse outcomes—more important than age itself.
- Cognitive decline and other barriers that delay diagnosis or reduce adherence to medical regimens often necessitate hospitalization of older adults in circumstances.

Waning Immunity With Age (Immune Senescence)

- There is an underlying waning of immune responses that accompany old age even in the absence of comorbidity; this is called immune senescence.
- Immune senescence is not merely a global state of reduced immunity but a dysregulation of immune responses at multiple levels. Both innate and adaptive responses are significantly dysregulated.

Waning Immunity With Age (Immune Senescence)

- innate immune components that decline with age include:
  - physical barriers such as:
    - skin integrity,
    - cough/gag reflex,
    - mucociliary clearance,
    - and gastric acid.
  - impaired PMN
  - dysregulation of inflammatory responses
  - a chronic, low-level inflammation present in older adults

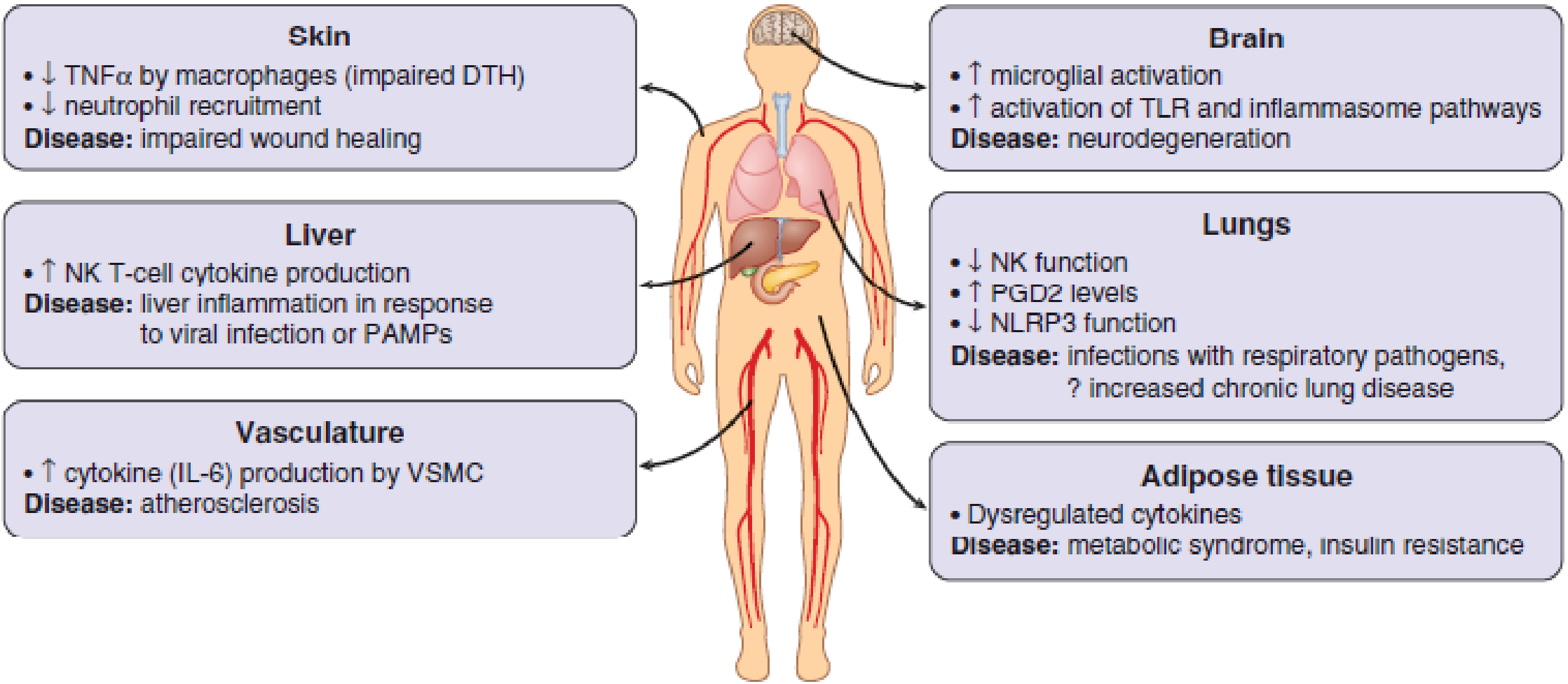


FIG. 310.1 Innate immune changes with aging and consequences in specific organ systems. *DTH,* Delayed-type hypersensitivity (response); *IL-6,* interleukin-6; *NK,* natural killer; *NLRP3,* NLR family pyrin domain containing 3; *PAMPs,* pathogen-associated molecular patterns; *PGD2,* prostaglandin D2; *TNF-α,* tumor necrosis factor-α, *VSMC,* vascular smooth muscle cell. *(Reprinted with permission from Shaw AC, Goldstein DR, Montgomery RR. Age-dependent dysregulation of innate immunity.* Nat Rev Immunol. *2013;13:875–887.)*

Nutrition

- Protein-energy malnutrition (PEM) is common in older adults; 30% to 60% of subjects ≥65 years of age admitted to the hospital have PEM, which is linked to:
  - delayed wound healing,
  - pressure ulcer formation,
  - risk of CAP and nosocomial infection,
  - longer hospital stays,
  - and increased mortality.

PEM often goes unrecognized outside the hospital, but even mild PEM (i.e., seniors with a serum albumin of 3.0–3.5 g/dL) demonstrate reduced vaccine responses. Despite this, the role of high-protein/high-calorie nutritional supplements for preventing infection or boosting immune responses remains controversial and largely an open question except for those with specific indications (e.g., wound healing).

Nutrition

- Specific micronutrient deficiencies in older adults have also been linked to:
  - poor immune function // vitamin B12 deficiency and inadequate pneumococcal vaccine responses
  - and risk of infection (e.g., vitamin D deficiency linked to risk of tuberculosis [TB] and *Clostridioides difficile* [formerly *Clostridium difficile*] infection).

Nutritional supplements have been studied as a means to reduce infection risk and boost immunity in older adults, and all experts agree that if true deficiency exists it should be corrected. However, in otherwise healthy adults with normal or “insufficient” (but not deficient) vitamin levels the answer is less clear.

Social and Environmental Factors

- Additional “social determinants of health” combine to influence infection risk in seniors. Population-based studies reveal that lower income is associated with higher rates of CAP and invasive pneumococcal infections among older adults.
- Lower socioeconomic status (SES) may predispose to infection due reduced access to care, which is well documented in seniors, but low SES is also associated with increased exposure to infectious agents (e.g., grandparents raising young children more often), poor nutrition, and increased risk of comorbid disease (e.g., asthma and exacerbations due to pollution/tobacco exposure).

Social and Environmental Factors

Environment plays a distinct role in long-term care (i.e., nursing home) residents, who have a particularly high incidence of:

- respiratory,
- genitourinary (GU),
- gastrointestinal (GI),
- and skin infections

Close contact between residents and staff plays a key role in the spread of respiratory infections (e.g., influenza, respiratory syncytial virus [RSV]), or infections transmitted by contact (e.g., *Streptococcus pyogenes, C. difficile*

PRESENTATION OF INFECTION IN SENIORS

- Infection, even serious life-threatening infection, frequently presents with atypical features in older adults:
  - trivial,
  - nonspecific declines in function or mentation
  - and underlying illness (e.g., congestive heart failure or diabetes mellitus) may be exacerbated by infection,

  leading older adult patients to seek medical attention for symptoms related to comorbidity rather than infection.

The most fundamental sign of infection, fever, is absent in up to one-third of older adults with serious infection:

- lower mean baseline body temperatures
- temperature increases in response to pyrogens are diminished with advanced age.

often leads to delayed diagnosis and treatment.

PRESENTATION OF INFECTION IN SENIORS

- Cognitive impairment may also contribute to the difficulty of diagnosing infection in older adults, with patients unable to communicate symptoms. This can lead to overdiagnosis, as well when colonization (e.g., asymptomatic bacteriuria) is often assumed to be the cause of nonspecific symptoms. Clinicians often have a lower threshold to pursue objective assessments (e.g., laboratory and radiologic evaluations) for infection in cognitively impaired older adults, given the difficulty interpreting subtle function changes and the absence of classic signs of infection noted above. Although a high index of suspicion is warranted, clinicians should be cautioned not to overevaluate and to interpret results carefully.
- The poor usefulness of culture data in some situations (e.g., swab cultures of skin surface wounds or urine cultures when catheters are present) in which positive cultures are a certainty can lead to overdiagnosis and over treatment (see later)

PRESENTATION OF INFECTION IN SENIORS

- Changes in anatomy and physiology due to age and/or comorbidity may confound interpretation of diagnostic evaluations as well. Studies suggest the sensitivity of TTE is 85% to 90% in adults age ≤55 years but is reduced to <50% for those older than 70 years. More frequent use of transesophageal echocardiogram (TEE) is therefore needed in seniors, where sensitivity returns to 85% to 90% and specificity is not reduced.

ANTIBIOTIC MANAGEMENT IN SENIORS

Antimicrobial Treatment

- Age and comorbidity change drug distribution, metabolism, excretion, and interactions. Antibiotic dose reductions are occasionally required in the older adults due to reduced renal function or predisposition to specific side effects, but the most prevalent complications include drug interactions, which are more frequent because older adults more commonly take multiple medications.
- Further, slowed gastric motility, decreased absorption, increased adipose tissue, and coadministration of other drugs can decrease blood levels of antimicrobials in older adults, and of course antibiotics reach tissues via blood flow, so poor perfusion to the site of infection, particularly in skin and soft tissue infections of the lower extremities, may reduce efficacy.

ANTIBIOTIC MANAGEMENT IN SENIORS

- Adherence may be limited by:
  - poor cognitive function,
  - inadequate understanding of the drug regimen,
  - impaired hearing or vision,
  - and polypharmacy,

and studies suggest that any regimen requiring greater than twice-daily dosing is associated with very poor adherence rates.

Pneumonia

Older adults have a markedly increased risk of pneumonia versus young adults. Comorbid cardiovascular and lung disease enhance risk, but age-related changes in physiology also contribute. Impaired mucociliary clearance with delayed clearance of secretions by the mucociliary mechanisms correlate with pneumonia risk. Further, chest wall mobility and compliance decline with advancing age due to loss of mobility and muscle strength, as well as changes in the rib cage when kyphosis or scoliosis is present. Lung compliance is reduced owing to impaired elastic recoil, which results in air trapping, higher residual volumes, and increased work of breathing. Finally, neurologic changes with age lead to “silent aspiration” secondary to reduced ability to cough, lower gag reflex, and frequent coexisting mental status changes or dementia.

Pneumonia

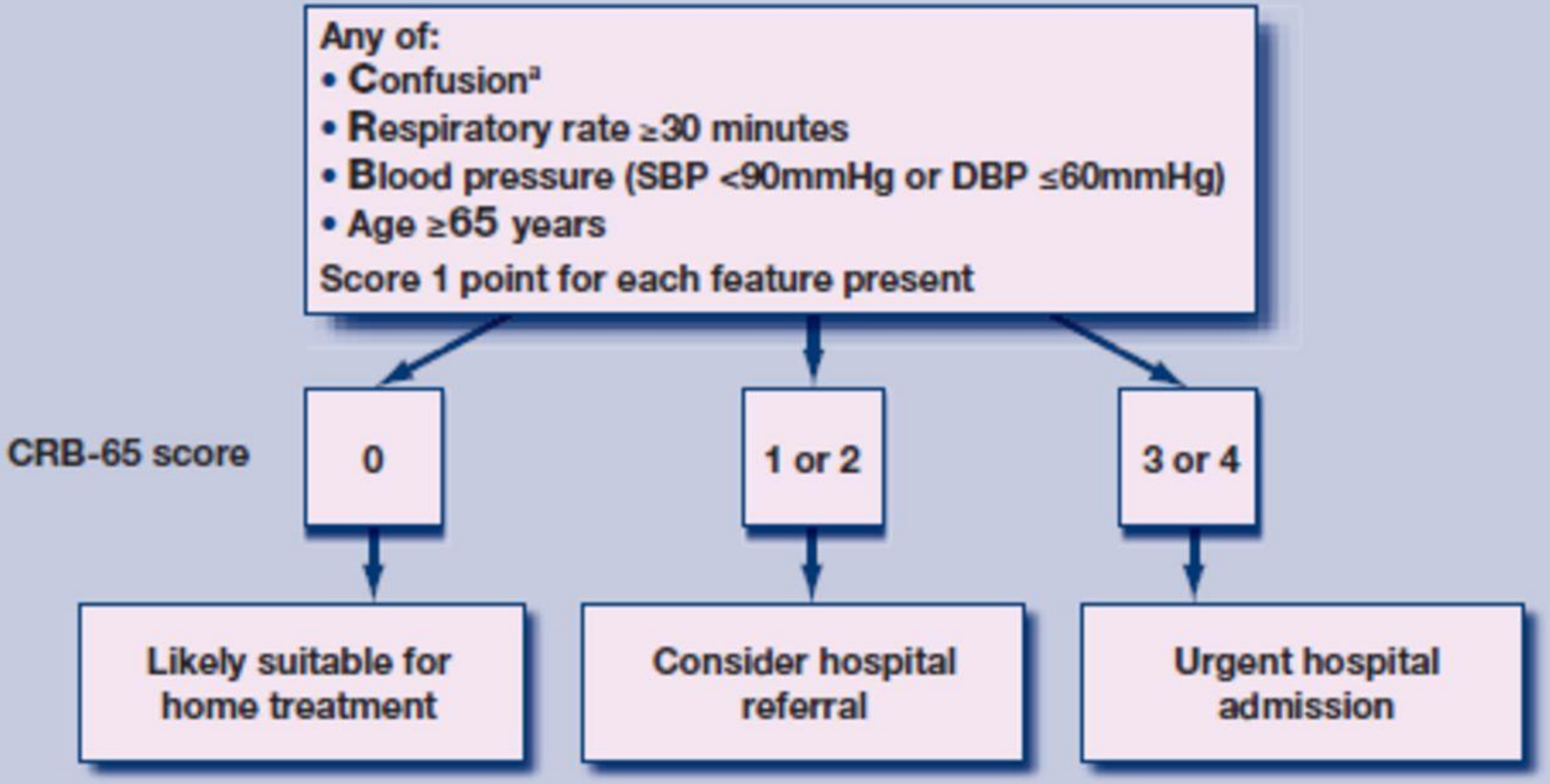
- The most common microbiologic causes of pneumonia in seniors are greatly impacted by place of residence. Seniors who dwell in long-term care facilities are more likely to have *Staphylococcus aureus*, gram-negative bacilli, and multidrug-resistant organisms isolated from clinical specimens than noted in specimens from community-dwelling seniors. Viral infection causing lower respiratory disease severe enough to require hospitalization is more common in seniors, especially those in long-term care. Outbreaks of influenza or RSV have been well documented in long-term care and need to be met quickly with prompt infection control measures and, when possible, chemoprophylaxis and vaccination strategies to limit spread.

Pneumonia

- Antimicrobial therapy recommendations for seniors are similar to those of all adults with pneumonia. Adjunct therapy with corticosteroids in those with severe community-acquired disease and a vigorous inflammatory response (usually defined as C-reactive protein >150 mg/L) has been recommended, as it appears to result in lower rates of respiratory failure and reduced length of intensive care unit (ICU) and hospital stay, although it has not been shown to reduce mortality.

CURB-65	Clinical Feature	Points
C	Confusion	1
U	Urea > 7 mmol/L	1
R	RR ≥ 30	1
B	SBP ≤ 90 mm Hg OR DBP ≤ 60 mm Hg	1
65	Age > 65	1

CURB-65 Score	Risk group	30-day mortality	Management
0 -1	1	1.5%	Low risk, consider home treatment
2	2	9.2%	Probably admission vs close outpatient management
3-5	3	22%	Admission, manage as severe



DBP = diastolic blood pressure; SBP = systolic blood pressure. [a]Defined as a Mental Test Score of ≤8, or new disorientation in person, place or time. Predicted 30-day mortality: CRB-65 score 0 = 1.2%. CRB-65 score 1 or 2 = 8.2%. CRB-65 score 3 or 4 – 31.3%.

TABLE 67.5 Guide to Empirical Choice of Antimicrobial Agent for Treating Adult Patients With Community-Acquired Pneumonia (CAP) or Health Care–Acquired Pneumonia (HCAP)

PATIENT CHARACTERISTICS	PREFERRED TREATMENT OPTIONS
Outpatient	
Previously Healthy	
No recent antibiotic therapy	Macrolide,[a] or doxycycline (100 mg 2 times/day)
Recent antibiotic therapy[b]	A respiratory fluoroquinolone[c] alone, an advanced macrolide[c] plus oral β-lactam[d]
Comorbidities (COPD, Diabetes, Renal Failure or Congestive Heart Failure, or Malignancy)	
No recent antibiotic therapy	An advanced macrolide plus oral β-lactam or a respiratory fluoroquinolone
Recent antibiotic therapy	A respiratory fluoroquinolone alone or an advanced macrolide plus a β-lactam
Suspected aspiration with infection	Amoxicillin-clavulanate or clindamycin (600 mg IV q8h or 300 mg PO q6h)
Influenza with bacterial superinfection	Vancomycin, linezolid, or other coverage for MRSA or CA-MRSA[f]
Inpatient	
Medical Ward	
No recent antibiotic therapy	A respiratory fluoroquinolone alone or an advanced macrolide plus an intravenous β-lactam[g]
Recent antibiotic therapy	An advanced macrolide plus an intravenous β-lactam, or a respiratory fluoroquinolone alone (regimen selected will depend on nature of recent antibiotic therapy)
Intensive Care Unit (ICU)	
Pseudomonas infection is not a concern	A β-lactam[g] plus either an advanced macrolide or a respiratory fluoroquinolone
Pseudomonas infection is not a concern, but patient has a β-lactam allergy	A respiratory fluoroquinolone, with or without clindamycin
Pseudomonas infection is a concern[h] (cystic fibrosis, impaired host defenses)	Either (1) an antipseudomonal β-lactam[i] plus ciprofloxacin (400 mg IV q8h or 750 mg PO q12h), or (2) an antipseudomonal agent plus an aminoglycoside[j] plus a respiratory fluoroquinolone or a
Pseudomonas infection is a concern but the patient has a β-lactam allergy	Aztreonam (2 g IV q8h) plus aminoglycoside plus a respiratory fluoroquinolone
Health Care–Associated Pneumonia[k]	Either (1) an antipseudomonal β-lactam plus ciprofloxacin or levofloxacin, or (2) an antipseu agent plus an aminoglycoside plus a respiratory fluoroquinolone or a macrolide plus vanco linezolid (for MRSA coverage)

Outpatient

- ***Previously Healthy***
- No recent antibiotic therapy Macrolide(Azithromycin (500 mg once daily), clarithromycin (250–500 mg 2 times/day), erythromycin (250–500 mg 4 times/day), or doxycycline (100 mg 2 times/day)
- Recent antibiotic therapy(past 3 months, excluding the current episode of infection) A respiratory fluoroquinolonec alone, an advanced macrolide plus oral β-lactame
- Such treatment is a risk factor for drug-resistant *Streptococcus pneumoniae* and possibly for infection with gram-negative bacilli. Depending on the class of antibiotics recently given, one or another of the suggested options may be selected. Recent use of a fluoroquinolone should dictate selection of a nonfluoroquinolone regimen, and vice versa.
- Moxifloxacin (400 mg once daily), gemifloxacin (320 mg once daily) or levofloxacin (750 mg once daily).

Outpatient

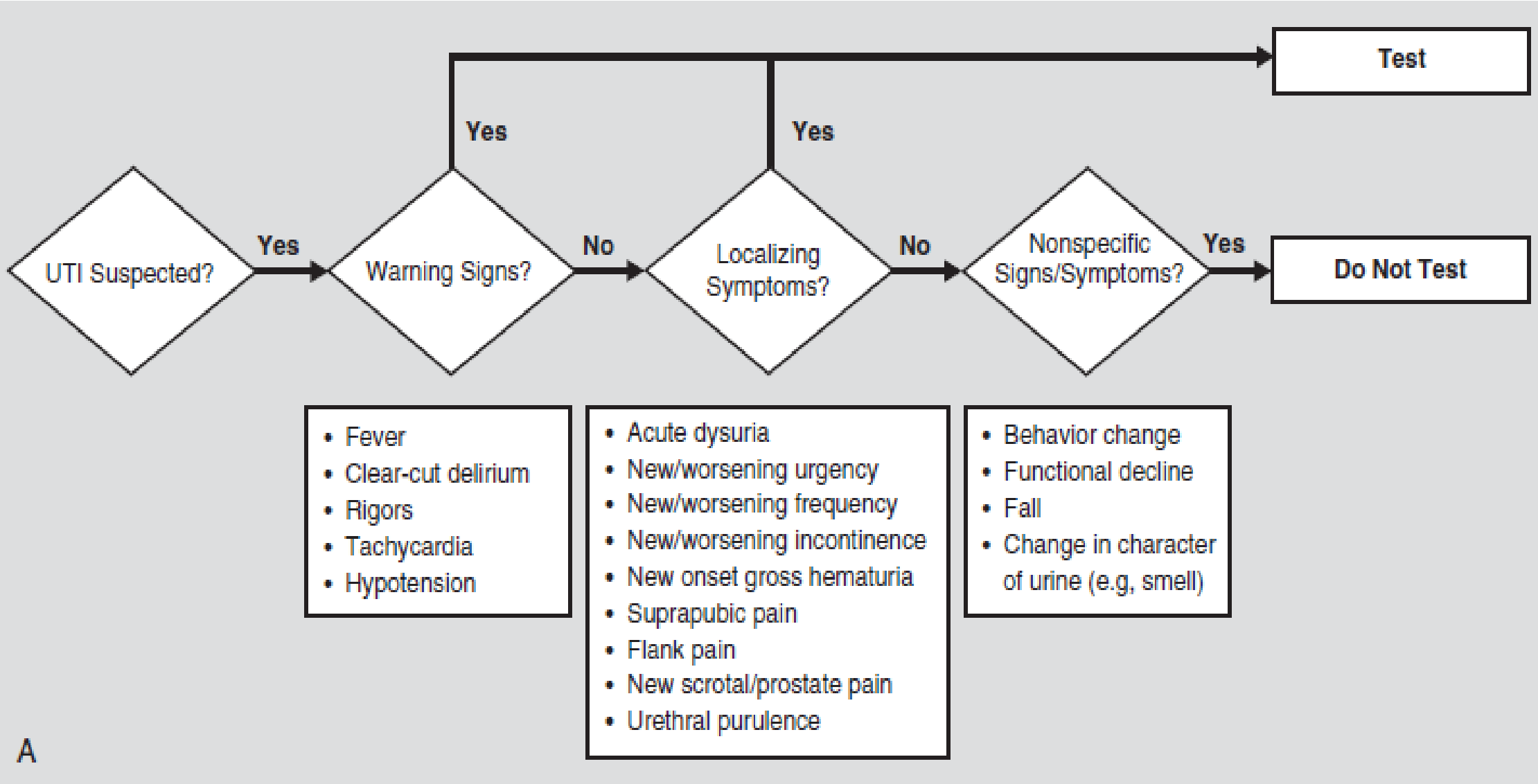
- ***Comorbidities (COPD, Diabetes, Renal Failure or Congestive Heart Failure, or Malignancy)***
- No recent antibiotic therapy An advanced macrolide plus oral β-lactam or a respiratory fluoroquinolone
- Recent antibiotic therapy A respiratory fluoroquinolone alone or an advanced macrolide plus a β-lactam(High-dose amoxicillin (1 g, 3 times/day), high-dose amoxicillin-clavulanate (2 g, 2 times/day).
- Suspected aspiration with infection Amoxicillin-clavulanate or clindamycin (600 mg IV q8h or 300 mg PO q6h)
- Influenza with bacterial superinfection Vancomycin, linezolid, or other coverage for MRSA or CA-MRSA

Urinary Tract Infection

- Asymptomatic bacteriuria (ASB) is defined as the presence of bacteria in the urine, *with or without pyuria*, in the absence of clinical symptoms indicating a urinary tract infection (UTI). ASB is common in seniors, with rates of community-dwelling older adults (women > men) of up to 50% and even higher in long-term care residents. Much has been written about the prevalence of ASB in seniors, the importance of differentiating asymptomatic bacteriuria from true UTI, and the difficulties in making the diagnosis of UTI in seniors with subtle symptoms.
- Possible reasons for the high frequency of asymptomatic bacteriuria in older patients include obstructive uropathy from the prostate (with resultant instrumentation) and loss of the bactericidal activity of prostatic secretions in men, poor emptying of the bladder because of prolapse in women, soiling of the perineum from fecal incontinence in demented women, and neuromuscular diseases and increased instrumentation and bladder catheter usage in both genders.

Urinary Tract Infection

- Testing for UTI in older adults should occur *only* when suggestive clinical symptoms (new fever, new/worse incontinence, dysuria, flank pain, delirium) are present because laboratory tests alone cannot differentiate ASB from UTI.
- Second, the role of laboratory testing for UTI is primarily to *exclude* the diagnosis of UTI; with VERY rare exception, treatment for UTI should not be given to any older adult with a negative urinalysis or urine culture.
- Third, active monitoring and oral hydration even when testing shows bacteriuria and/or pyuria may successfully be used to manage seniors *without* antibiotic use in those who do not have obvious urinary tract symptoms in situations that often prompt testing (e.g., mild temperature elevations of 99°–100°F, minor confusion/mental status change, “strong–smelling” urine).


Test
Yes
Yes
UTI Suspected?
Yes
Warning Signs?
No
Localizing Symptoms?
No
Nonspecific Signs/Symptoms?
Yes
Do Not Test
• Fever
• Clear-cut delirium
• Rigors
• Tachycardia
• Hypotension
• Acute dysuria
• New/worsening urgency
• New/worsening frequency
• New/worsening incontinence
• New onset gross hematuria
• Suprapubic pain
• Flank pain
• New scrotal/prostate pain
• Urethral purulence
• Behavior change
• Functional decline
• Fall
• Change in character of urine (e.g, smell)
A

Urinary Tract Infection

- The lower tract symptoms result from bacteria producing irritation of urethral and vesical mucosa, causing frequent and painful urination of small amounts of turbid urine. Patients sometimes complain of suprapubic heaviness or pain. Occasionally, the urine is grossly bloody or shows a bloody tinge at the end of micturition. Fever is generally absent with cystitis and, if present, should suggest upper tract infection. In a male, presence of fever with only symptoms of cystitis may indicate acute prostatitis.

Urinary Tract Infection

- The classic clinical manifestations of pyelonephritis include fever (sometimes with chills), flank pain, and frequently lower tract symptoms (e.g., frequency, urgency, and dysuria). At times the lower tract symptoms antedate the appearance of fever and upper tract symptoms by 1 or 2 days. It should be recognized that the symptoms described, although classic, may vary greatly. Flank tenderness or discomfort is frequent in upper tract infection in adults and is more intense when there is obstructive disease.

Urinary Tract Infection

TABLE 72.4 Bacterial Count by Direct Examination of Urine[a]

Sample	Unstained (×400)	Stained (×1000)
Uncentrifuged sample	$\geq 0^6$	$\geq 10^5$
Centrifuged sample	$\geq 10^5$	$\geq 10^4$

[a]Colony-forming units (CFU)/mL extrapolated from the finding of one bacterium per microscopic field.

TABLE 72.6 Recommendations for Initial Therapy of Urinary Tract Infection in Adults

PARAMETER	ORAL[a]	PARENTERAL (SWITCH TO ORAL WHEN RESPONSE OCCURS)
Uncomplicated Pyelonephritis		
GNB or no urine Gram stain available	CP 7 days, LV 5 days; if cannot use FQ, TMP-SMX 14 days + 1 dose CT or AM	FQ or extended-spectrum β-lactam (e.g., CT) ± AM or carbapenem
GPC in chains	Amoxicillin, 14 days	Ampicillin
GPC in clusters	Linezolid or TMP-SMX, 14 days	Vancomycin
Complicated Pyelonephritis		
Nonpregnant women or men	As for uncomplicated pyelonephritis; duration 10–14 days	Extended spectrum β-lactam ± AM, FQ, carbapenem[d]
Pregnant women	Extended spectrum β-lactam; or TMP-SMX[b] only if known sensitive; both for 14 days	Extended spectrum β-lactam ± AM
Uncomplicated Cystitis		
Nonpregnant women	Nitrofurantoin, 5 days; or fosfomycin, 1 dose; or TMP-SMX, 3 days; or pivmecillinam, 3–7 days	

TABLE 72.6 Recommendations for Initial Therapy of Urinary Tract Infection in

PARAMETER	ORAL[a]	PARE… RESPONSE OCCURS)
Complicated Cystitis		
Women or men	FQ or nitrofurantoin, 7 days; or fosfomycin, 1 dose	
Pregnant women	Cephalexin, 3–5 days; or fosfomycin, 1 dose; or nitrofurantoin,[c] 7 days; or TMP-SMX,[b] 3 days if sensitive	

[a]Preferred if the patient is reliable, compliant, hemodynamically stable, and able to take oral therapy.
[b]TMP-SMX should be avoided in the first and third trimesters.
[c]Nitrofurantoin should be avoided in the first trimester.
[d]Ceftazidime-avibactam is a potential option for infections due to carbapenem-resistant Enterobacteriaceae or multidrug-resistant (MDR) *Pseudomonas;* ceftolozane-tazobactam is another potential option for MDR *Pseudomonas.*
GNB, Gram-negative bacilli; *GPC,* gram-positive cocci.
Oral Drugs and Dosages:
CP, ciprofloxacin 500 mg bid or 1000 mg daily.
LV, levofloxacin 750 mg daily.
TMP-SMX, trimethoprim-sulfamethoxazole 160/800 mg bid.
FQ, fluoroquinolone—ciprofloxacin 500 mg bid or 1000 daily or levofloxacin 750 mg daily.

Oral Drugs and Dosages:—cont'd
Amoxicillin 875 mg bid.
Linezolid 600 mg bid.
Nitrofurantoin 100 mg bid.
Fosfomycin 3 g once.
Pivmecillinam 400 mg bid.
Cephalexin 500 mg qid.
Parenteral Drugs and Dosages:
FQ, fluoroquinolone—ciprofloxacin 400 mg q12h or levofloxacin 500 mg daily.
CT, ceftriaxone 2 g/d.
AM, aminoglycoside (e.g., gentamicin 5 mg/kg/day).
Ampicillin 2 g q4h.
Vancomycin 15 mg/kg bid.
Carbapenem (e.g., imipenem 500 mg q6h or ertapenem 1 g daily).

Herpes zoster

- Herpes Zoster (HZ) is the result of reactivation of latent varicella zoster virus (VZV) and occurs most frequently in older adults. Generally, HZ presents as a unilateral, self-limited dermatomal rash.
- Postherpetic neuralgia (PHN) is a common sequela; presenting as severe pain that persists after the rash has resolved. It occurs more commonly in older age and can be very debilitating.

Herpes zoster

- The lifetime risk of HZ in the general population ranges from 20–30% but the risk increases dramatically after 50 years of age with a lifetime risk of HZ reaching 50% at age 85 years. Current estimates point to more than 1 million cases of HZ in the United States every year, costing the United States Healthcare system 5 billion USD annually. HZ, originally not thought to occur more than once in an individual, is now estimated to recur in approximately 6.4% of immunocompetent people. The recurrence rate is higher among the immunocompromised population.

Herpes zoster

- Classically, reactivation of VZV presents as a unilateral dermatomal rash (*i.e.*, does not cross the midline) which is initially maculopapular on an erythematous base, evolves into vesicular-pustular appearance which after 7–10 days begins to crust over and heals within 2–4 weeks.

Herpes zoster

- **Postherpetic neuralgia (PHN)**

- A consensus definition for PHN is still to be determined, as definitions to date have been arbitrary ranging from 1 month to 6 months after rash onset. The conventional definition is ‘pain continuing 90 days past the diagnosis of HZ or rash onset’. The incidence of PHN after HZ ranges from 5–30% and occurs in 50% of HZ affected individuals greater than 85 years.-It is considered the most debilitating sequelae of HZ since it impairs the affected individual’s quality of life across all 4 health domains: physical, psychological, functional and social.

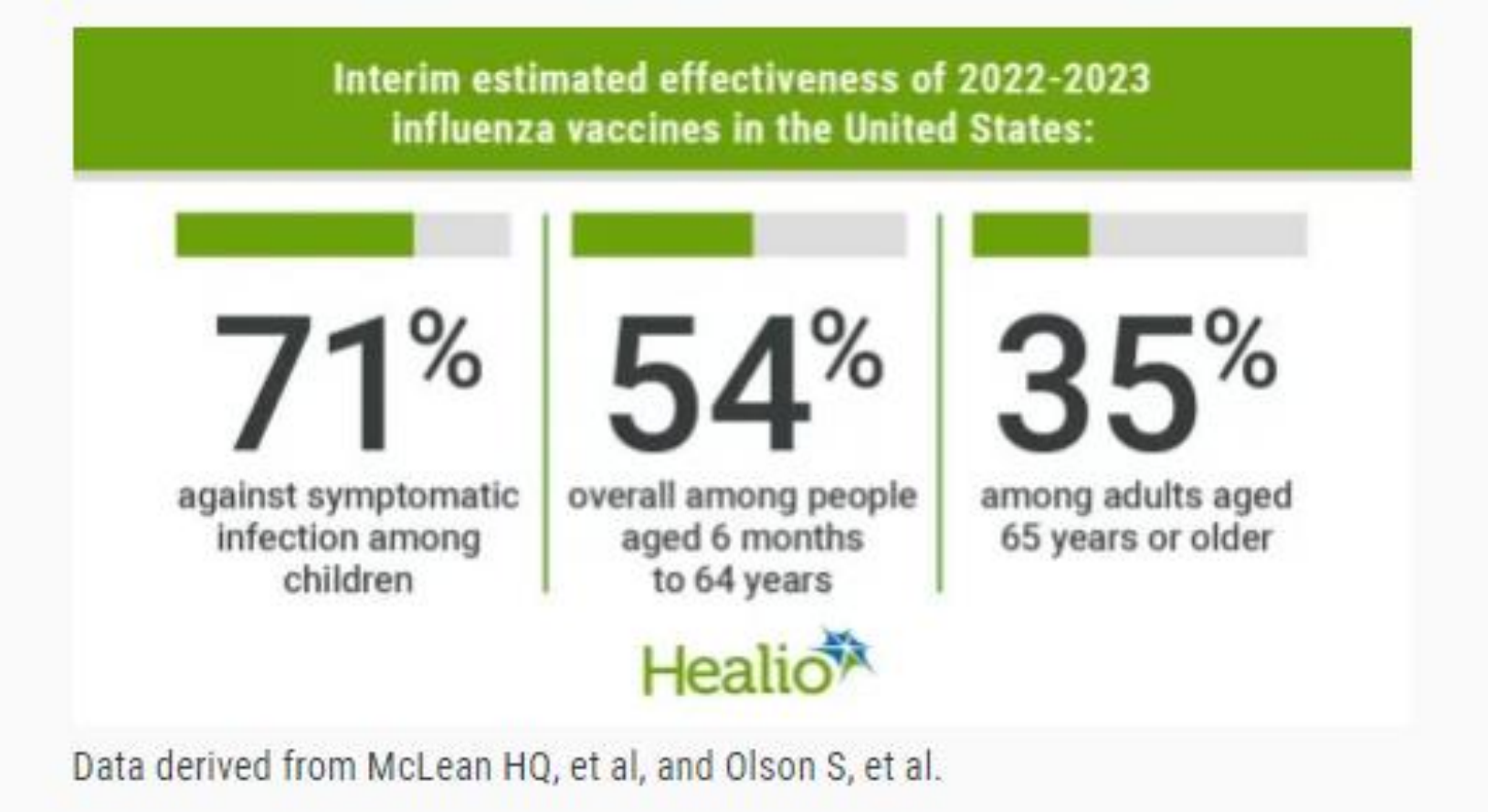
Pharmacologic therapies used in the treatment of Herpes Zoster and Postherpetic neuralgia

Antiviral agents	HZ	PHN	Recommended dose
Acyclovir (oral)	+	–	800 mg 5 times daily for 7–10 days.
Famiciclovir (oral)	+	–	500 mg every 8 hours for 7 days.
Valacyclovir (oral)	+	–	1 gm every 8 hours for 7 days.
Brivudine (oral)	+	–	125 mg once daily for 7 days. Product licensed in various countries; *not currently available in the United States*
Acyclovir (IV)	+	–	10 to 15 mg/kg every 8 hours until clinical improvement; switch to oral regimen to complete a 10 to 14 day course when formation of new lesions has ceased and signs/ symptoms of visceral infection areimproving.

Pharmacologic therapies used in the treatment of Herpes Zoster and Postherpetic neuralgia

Analgesic agents			
Acetaminophen	+	–	Used for mild pain
NSAIDS	+	–	Used for mild pain
Oxycodone	1st line	3rd line	5 mg every 4 hours as needed, carefully titrate upwards by 5 mg 4 times daily every 2 days for pain control. Dosage needs to be converted to a long-acting opioid analgesic and combined with a short acting medicationfor breakthrough pain.
Tramadol	±	3rd line	50 mg once or twice daily, increase by 50–100 mg daily in divided doses every 2 days as tolerated. Maximum dose of 400 mg daily or 300 mg daily if older than 75 years.
Gabapentin	2nd line	2nd line	300 mg at bedtime or 100–300 mg 3 times daily, increase by 100–300 mg 3 times daily every 2 days as tolerated. Maximum dose of 3,600 mg daily.
Pregabalin	2nd line	2nd line	75 mg at bedtime or 75 mg twice daily, increase by 75 mg twice daily every 3 days astolerated. Maximum dose is 600 mg daily.
Nortryptyline	3rd line	2nd line	25 mg at bedtime, increase by 25 mg daily every 2–3 days as tolerated. Maximum dose 150 mg daily. * TCAs have similar efficacy to gabapentin orpregabalin, but cause more serious adverse events.[31]

Influenza vaccine



COVID-19 vaccination

- **Primary series:** 2-dose series at 0, 4-8 weeks (Moderna) or 2-dose series at 0, 3-8 weeks (Novavax, Pfizer-BioNTech)
- **People ages 65 years and older** have the option to receive 1 additional bivalent mRNA vaccine dose at least 4 months after the first dose of a bivalent mRNA vaccine

Pneumococcal vaccination

- If PCV15 is used, this should be followed by a dose of PPSV23 one year later. The minimum interval is 8 weeks and can be considered in adults with an immunocompromising condition†, cochlear implant, or cerebrospinal fluid leak.
- If PCV20 is used, a dose of PPSV23 is NOT indicated.

Zoster vaccination

- **Age 50 years or older*:** 2-dose series recombinant zoster vaccine (RZV, Shingrix) 2–6 months apart (minimum interval: 4 weeks; repeat dose if administered too soon), regardless of previous herpes zoster or history of zoster vaccine live (ZVL, Zostavax) vaccination.
- ***Note:** Serologic evidence of prior varicella is not necessary for zoster vaccination.

Refrences

- MANDELL, DOUGLAS, AND BENNETT’S PRINCIPLES AND PRACTICE OF INFECTIOUS DISEASES, NINTH EDITION ISBN: 978-1-4557-4801-3
- John AR, Canaday DH. Herpes Zoster in the Older Adult. Infect Dis Clin North Am. 2017 Dec;31(4):811-826. doi: 10.1016/j.idc.2017.07.016. PMID: 29079160; PMCID: PMC5724974.