

# Infections in Older Adults



Mary Morgan Scott, MD<sup>a</sup>, Stephen Y. Liang, MD, MPH<sup>b,\*</sup>

## KEYWORDS

- Infections • Pneumonia • Urinary tract infection • Gastrointestinal infections
- Skin and soft tissue infections • Elderly • Emergency department
- Antimicrobial stewardship

## KEY POINTS

- Older patients with infection can present atypically (altered mental status, lack of fever).
- Symptoms of chronic conditions common in the elderly can mimic infectious symptoms.
- Diagnosis should be made considering all patient factors, including history, risk factors, presentation, and objective data.
- Asymptomatic bacteriuria is common in the elderly and should not be treated with antibiotics.
- Unnecessary use of antibiotics contributes to increased morbidity and emergence of drug-resistant pathogens.

## INTRODUCTION

The world's population is aging. A 2015 report estimates that, by 2050, the world's population aged 65 years and older will have increased by almost 150%.<sup>1</sup> In the United States, it is estimated that, by 2035, the elderly will account for more than one-fifth of the population.<sup>2</sup> As the number of elders in the United States increases, so will the number presenting to US emergency departments (EDs). In 2009 to 2010, elders accounted for 15% of all ED visits. The rate of ED visits increased with age, 511 per 1000 persons aged 65 years and older compared with 832 per 1000 persons aged 85 and older.<sup>3</sup>

A substantial number of ED visits and hospitalizations in the elderly are related to infectious diseases (IDs). In 2012 alone, US elders had more than 3 million visits to the ED for IDs, representing 13.5% of all geriatric ED visits that year. This number was more than the rates of both myocardial infarction and congestive heart failure combined. Lower respiratory tract infections, urinary tract infections (UTIs), and septicemia accounted for most ID-related ED visits.<sup>4</sup> ID-related hospitalization rates are consistently higher in the geriatric population and have steadily increased over the

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<sup>a</sup> Department of Medicine, Washington University School of Medicine, 660 S. Euclid Avenue, Campus Box 8066, St. Louis, MO 63110, USA; <sup>b</sup> Divisions of Emergency Medicine and Infectious Diseases, Washington University School of Medicine, 4523 Clayton Avenue, Campus Box 8051, St Louis, MO 63110, USA

\* Corresponding author.

E-mail address: [syliang@wustl.edu](mailto:syliang@wustl.edu)

past 2 decades.<sup>5,6</sup> The nation's elderly tend to have longer and more costly hospitalizations for IDs compared with younger patients.<sup>6,7</sup>

Considering the anticipated steady increase in the elderly population, their consistent and increasing use of EDs and hospitals, and the significant burden of IDs on these visits, emergency physicians must be prepared to effectively evaluate and treat elderly patients presenting with possible infection. This requirement can be especially challenging because elderly patients frequently present atypically.

## AGING AND THE ATYPICAL PRESENTATION

A loss of integrity in physical barriers (such as skin), decreased effectiveness of both the innate and adaptive immune systems, and disease-induced and iatrogenic immunosuppression all put elders at greater risk of contracting and ineffectively fighting infections. The mucociliary apparatus and cough/gag reflex help prevent unwanted material from entering the lower respiratory tract. Both are impaired in the aging population. In addition to natural barrier breakdown, iatrogenic perturbation with implanted medical devices such as cardiac pacemakers and defibrillators, heart valves, prosthetic joints, and indwelling urinary catheters can serve as a nidus of infection.

The aging immune system places elders in a chronic state of immunosuppression, called immunosenescence. Both the adaptive and innate immune systems decline in efficacy with age. The bone marrow produces fewer naive B cells ready to react to new antigens.<sup>8</sup> Thymic involution by the fifth decade leaves elders with reduced numbers of available naive T cells, and a breakdown of T-cell homeostasis by the seventh decade results in a dramatically decreased repertoire of T cells.<sup>9</sup> The T cells that remain tend to have defects that inhibit their ability to effectively proliferate in response to antigen activation and contribute to decreased protective antibody response following vaccination.<sup>10,11</sup> Older dendritic cells have been shown to activate B cells 70% less effectively than in younger people.<sup>12</sup> Neutrophils, macrophages, and natural killer cells all take a similar hit in functionality.<sup>13–15</sup>

Unsurprisingly, elders with infections tend to present differently than their younger counterparts. Nonspecific symptoms commonly seen in the elderly include confusion, generalized malaise/fatigue, failure to thrive, difficulty ambulating with frequent falls, weight loss, and urinary incontinence, none of which are specific to an infectious cause. Presence of dementia and polypharmacy can make history-taking difficult and/or unreliable. In addition, the tendency of patients to associate some symptoms with normal aging can lead to delays in presentation and underrepresentation of symptoms.

Atypical presentation has been associated with increased mortality in the elderly.<sup>16</sup> In a recent study of patients aged 65 years or older, altered mental status and malaise/fatigue did not predict diagnosis of bacterial infection; however, fever greater than 38.0°C was largely predictive.<sup>17</sup> The presence of fever is a helpful benchmark, but fever is absent or blunted in up to a third of elderly patients with an acute infection.<sup>18</sup> In addition, elders tend to have lower baseline temperatures, suggesting that a normal febrile response in elders may not reach traditional fever cutoffs,<sup>19,20</sup> and development of fever can be delayed by as much as 12 hours.<sup>21</sup>

## PNEUMONIA AND INFLUENZA

### *Incidence and Mortality*

Pneumonia and influenza remain the leading causes of infectious death in the older population.<sup>22</sup> One in 20 people aged 85 years or older have a new episode of

community-acquired pneumonia (CAP) every year.<sup>23</sup> Those aged 65 years and older account for more than 90% of influenza-related mortality in the United States every year.<sup>24</sup> Age-related changes in lung function and comorbid conditions increase risk of pneumonia (**Table 1**) and reduce the elder's ability to successfully recover from respiratory infections, often making these events a trigger of further functional decline.

### Presentation

Atypical presentation of pneumonia is common in elders. The classic triad of fever, dyspnea, and productive cough may be absent in more than 40% of elders with pneumonia.<sup>25,26</sup> Instead, they may present with delirium or other acute change in mental status, generalized fatigue, decreased functional status, urinary incontinence, and falls.<sup>27,28</sup> Older adults with pneumonia tend to report fewer symptoms than their younger counterparts, and a change in mental status is often the sole indication of an acute decline caused by infection. Incidence of tachypnea has been shown to increase with age and may indicate an underlying pulmonary process in an otherwise atypical presentation.<sup>25</sup>

### Diagnosis

All patients presenting to the ED with suspicion of pneumonia should receive a chest radiograph. Clinical features and examination findings alone are notoriously inaccurate in diagnosing pneumonia.<sup>29,30</sup> If the initial chest radiograph is negative but clinical suspicion remains high, a chest computed tomography (CT) scan can be considered.<sup>31</sup> The 2007 Infectious Diseases Society of America (IDSA)/American Thoracic Society (ATS) guidelines suggest empiric initiation of antibiotics and repeat chest radiograph in 24 to 48 hours.<sup>32</sup> Further recommendations regarding diagnostic testing depend on the severity and treatment setting. Per 2019 IDSA/ATS guidelines, pneumococcal and *Legionella* antigen testing can be considered in patients with severe CAP (**Box 1**). Blood and sputum cultures should be obtained in patients with severe CAP and in those empirically treated for methicillin-resistant *Staphylococcus aureus* (MRSA) or *Pseudomonas aeruginosa*. Influenza testing should be done if in season. Procalcitonin measurements are not recommended by the IDSA to help determine whether or not to initiate antibiotics.<sup>33</sup>

Several prognostic tools, such as the Pneumonia Severity Index and the CURB-65 (Confusion; Uremia, blood urea nitrogen >7 mmol/L or 20 mg/dL; Respiratory rate ≥30 breaths per minutes; Blood pressure, systolic <90 mmHg or diastolic ≤60 mmHg; Age ≥65 years) criteria have been used for decades as decision aids to determine which patients with CAP can be safely managed as outpatients.<sup>34,35</sup> However, recent studies have suggested these tools may not be as accurate in older individuals, citing inappropriate emphasis on age and the lack of assessment of comorbidities such as

**Table 1**  
Risk factors for pneumonia and aspiration

Risk Factors for Pneumonia	Risk Factors for Aspiration
Tobacco use	Impaired cough reflex
Lung cancer	Impaired mucociliary apparatus
Chronic obstructive pulmonary disease	Impaired swallowing mechanism
Asthma	
Dementia	
Stroke	

functional status.<sup>36,37</sup> Emergency physicians should use these tools with caution and ultimately rely on their own best clinical judgment when deciding whether a patient needs hospitalization. The 2007 IDSA/ATS CAP severity criteria can also be used to determine level of care (see **Box 1**).

### Management

Antibiotic management of CAP is summarized in **Table 2**. Fluoroquinolones should be used with caution in the elderly because they can increase the risk of life-threatening side effects, including aortic dissection and aortic aneurysm rupture.<sup>38,39</sup> They should be reserved for situations when other treatment options are prohibited. Macrolides as monotherapy should also be used cautiously because of high resistance patterns in some areas.

If the patient has risk factors for MRSA or *Pseudomonas* (previous infection with these organisms or recent intravenous [IV] antibiotics), coverage for these organisms should be added to the regimen. Cultures should be obtained (eg, nasal MRSA polymerase chain reaction [PCR]) and, if negative, additional coverage should be discontinued. Risk factors such as residence in a nursing home, recent hospitalization, and chronic dialysis that defined the health care-associated pneumonia classification in previous guidelines have been abandoned because they do not consistently identify individuals at higher risk for antibiotic-resistant pathogens.<sup>40</sup> Current guidelines do not recommend routinely adding anaerobic coverage for suspected aspiration pneumonia unless there is suspicion for lung abscess or empyema.<sup>33,41,42</sup> Evidence suggests timely administration of empiric antibiotics (within 4–8 hours of arrival to the hospital) results in reduced mortality.<sup>43,44</sup> Patients with pneumonia who test positive for influenza should be given antiviral therapy regardless of timing of symptom onset.<sup>33</sup>

#### Box 1

##### Criteria for diagnosis of severe community-acquired pneumonia

2007 IDSA/ATS criteria for diagnosis of severe CAP

Defined as presence of either 1 major or 3 or more minor criteria

##### Minor criteria

- Respiratory rate  $\geq 30$  breaths/min
- $P_{aO_2}/F_{iO_2}$  ratio  $\leq 250$
- Multilobar infiltrates
- Confusions/disorientation
- Uremia (blood urea nitrogen level  $\geq 20$  mg/dL)
- Leukopenia<sup>a</sup> (white blood cell count  $< 4000$  cells/ $\mu$ L)
- Thrombocytopenia (platelet count  $< 100,000/\mu$ L)
- Hypothermia (core temperature  $< 36^\circ$ C)
- Hypotension requiring aggressive fluid resuscitation

##### Major criteria

- Septic shock with need for vasopressors
- Respiratory failure requiring mechanical ventilation

<sup>a</sup>Caused by infection alone (ie, not chemotherapy induced).

Adapted from Mandell LA, Wunderink RG, Anzueto A, et al. Infectious Diseases Society of America/American Thoracic Society consensus guidelines on the management of community-acquired pneumonia in adults. Clin Infect Dis Off Publ Infect Dis Soc Am. 2007;44 Suppl 2:S27-72.

	<b>Treatment</b>	<b>Duration</b>
Outpatient without comorbidities	Monotherapy with amoxicillin, doxycycline, or a macrolide	At least 5 d and should not be discontinued until the patient is afebrile for at least 48 h and clinically improving
Outpatient with comorbidities <sup>a</sup>	(1) Amoxicillin/clavulanate, (2) cephalosporin plus macrolide or doxycycline, or (3) monotherapy with a respiratory fluoroquinolone (levofloxacin or moxifloxacin)	Patients initially started on intravenous antibiotics may transition to equivalent oral therapy when they are clinically improving,
Inpatient	(1) Combination therapy with a beta-lactam (ampicillin-sulbactam, cefotaxime, ceftriaxone) and a macrolide (azithromycin or clarithromycin) or (2) monotherapy with a respiratory fluoroquinolone	hemodynamically stable, and can tolerate oral medications

<sup>a</sup> Comorbidities such as chronic cardiac, pulmonary, hepatic, or renal disease; diabetes; alcoholism; malnourishment; or asplenia.

Data from Metlay JP, Waterer GW, Long AC, et al. Diagnosis and Treatment of Adults with Community-acquired Pneumonia. An Official Clinical Practice Guideline of the American Thoracic Society and Infectious Diseases Society of America. *Am J Respir Crit Care Med.* 2019;200(7):e45-e67.

Elders tend to have extended recovery times, and many do not return to their previous functional status. Given the extensive burden these infections can have on the geriatric population, routine pneumococcal and influenza vaccination is warranted.

## URINARY TRACT INFECTION

### *Prevalence and Risk Factors*

The incidence of UTI is second only to respiratory infections in adults more than 65 years old. It is the most common infection diagnosed in nursing home residents.<sup>45–47</sup> UTI is more common in women, but the incidence in men increases with age.<sup>48</sup> Functional disability and neurogenic bladder resulting from stroke, Alzheimer's and Parkinson's disease, as well as bladder outlet obstruction from prostatic hypertrophy in men contribute to urinary retention and allow microorganisms to colonize and proliferate. Urinary incontinence, urogynecologic surgery, and chronic indwelling urinary catheters promote bacterial seeding of the urinary tract.

### *Diagnosis and Asymptomatic Bacteriuria*

Diagnostic criteria for UTI and asymptomatic bacteriuria (ASB) are defined in [Table 3](#).<sup>49</sup> ASB is common in the geriatric population.<sup>50,51</sup> In people living in long-term care facilities, the prevalence of ASB may be as high as 50% in women and 35% in men.<sup>52</sup> Current IDSA guidelines recommend against treating ASB in the geriatric population because this has not been shown to improve outcomes.<sup>53</sup>

Distinguishing between ASB and true UTI is challenging in older patients. Many elders regularly experience urinary incontinence, increased frequency or urgency,

Term	Definition
Pyuria	>10 WBC/mm <sup>3</sup> per HPF
Bacteriuria	Urinary pathogen of $\geq 10^5$ CFU/mL
Laboratory-confirmed UTI	Pyuria (>10 WBC/mm <sup>3</sup> /HPF) plus bacteriuria ( $\geq 10^5$ CFU/mL)
Asymptomatic bacteriuria	Bacteriuria in the absence of genitourinary signs or symptoms
Symptomatic UTI	Bacteriuria in the presence of genitourinary symptoms (ie, dysuria, suprapubic pain or tenderness, frequency, or urgency)
Uncomplicated UTI	Genitourinary symptoms (ie, dysuria, suprapubic pain or tenderness, frequency, or urgency) with evidence of pyuria plus bacteriuria in a structurally normal urinary tract
Complicated UTI	UTI occurring in a patient with evidence that infection extends beyond the bladder

*Abbreviations:* CFU, colony-forming units; HPF, high-power field; WBC, white blood cells.

Adapted from Rowe TA, Juthani-Mehta M. Diagnosis and Management of Urinary Tract Infection in Older Adults. *Infect Dis Clin North Am.* 2014;28(1):75-89.

dysuria, and pelvic pain even when infection is not present. More than half of women aged 80 years and older experience urinary incontinence, with a third experiencing it several times a week.<sup>54</sup> These symptoms can reflect other conditions often seen in the elderly, such as bladder and pelvic floor dysfunction, atrophic vaginitis in women, and prostatic hypertrophy and chronic prostatitis in men. Patients with neurogenic bladder and UTI tend to present with back pain, increased spasticity, and urinary incontinence.<sup>55</sup>

Vague presentations are clouded by shortcomings of the urinalysis (UA) or dipstick (Table 4). Proper collection technique is paramount to ensure reliability. Even when

Dipstick Finding	Suggests	Limitation
Positive leukocyte esterase	Pyuria	False-positive with contamination, concurrent trichomoniasis, use of medication, or consumption of food that colors the urine red
Positive nitrite	Presence of nitrate-reducing bacteria (Enterobacteriaceae)	Absent with non-nitrate-reducing bacteria ( <i>Staphylococcus saprophyticus</i> and <i>Enterococcus</i> )

Data from Gupta K, Hooton TM, Naber KG, et al. 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;52(5):e103-e120; and Oplinger M, Andrews CO. Nitrofurantoin contraindication in patients with a creatinine clearance below 60 mL/min: looking for the evidence. *Ann Pharmacother.* 2013;47(1):106-111.

the clinical presentation and UA suggest a UTI, culture data may take several days to result. In 1 study, 43% of elderly patients diagnosed with UTI in the ED ended up having a negative culture, and 95% of those were inappropriately treated with antibiotics.<sup>56</sup>

Clinicians should be wary when accepting UTI as the explanation for a patient's vague constellation of symptoms. Other disease processes may be overlooked at the sight of a positive UA. In a nonseptic patient, UA should only be sent when there is a clinical suspicion for UTI.

### **Management**

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*Escherichia coli* is the most common pathogen isolated from urine cultures in older adults. Other commonly isolated organisms include *Klebsiella*, *Proteus*, and *Enterococcus* spp. *Klebsiella* and *Proteus* spp are seen most frequently in nursing home residents.<sup>57,58</sup> The prevalence of multidrug-resistant organisms (MDROs) is higher in long-term care residents but is growing in community populations as well. The higher incidence of MDROs in nursing home residents is attributed in part to more frequent and inappropriate use of antibiotics.

According to the 2010 IDSA guidelines, preferred antibiotics for treatment of uncomplicated UTI include:

- Nitrofurantoin monohydrate/macrocrystals (100 mg twice a day for 5 days) or
- Trimethoprim-sulfamethoxazole (160/800 mg twice a day for 3 days)

Fosfomycin (3 g, single dose) is an alternative but has been shown to have inferior efficacy compared with other regimens. Beta-lactams such as amoxicillin-clavulanate, cefdinir, cefaclor, and cefpodoxime-proxetil are appropriate alternatives when other regimens cannot be used. Fluoroquinolones should be avoided. Antibiotics with local resistance prevalence greater than 20% should only be used if urine culture with antimicrobial sensitivities is available.<sup>59</sup>

Nitrofurantoin use may be limited in older individuals with impaired renal function. However, data have shown that it is safe and effective to treat acute UTI in patients with creatinine clearance greater than 30 mL/min.<sup>60,61</sup> In patients with history of UTI caused by MDROs, initial treatment should be selected with previous resistance patterns in mind. In all cases, antibiotics should be tailored to susceptibility data if available from urine culture.

### **GASTROINTESTINAL INFECTIONS**

Gastrointestinal infections in the elderly are common, and the effects of such are often underappreciated. Elders are at greater risk for severe dehydration in the setting of diarrheal illness because of decreased thirst perception, which places elders at greater risk for complications such as malnutrition, electrolyte abnormalities, and orthostatic hypotension resulting in falls.<sup>62</sup>

#### ***Clostridioides difficile***

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*C difficile* is the most common cause of acute bacterial diarrhea in nursing homes, skilled nursing facilities, and hospitals.<sup>63</sup> Its incidence has doubled over recent years, with rates higher in patients aged 65 years and older.<sup>64</sup> It is primarily related to the use of antibiotics. Presentation typically involves acute onset of watery diarrhea, abdominal pain, and leukocytosis, but can be as severe as fulminant colitis with sepsis, intestinal perforation, and death.<sup>62</sup>

Antibiotics most frequently associated with *C difficile* infection include clindamycin, fluoroquinolones, and to a lesser extent third-generation cephalosporins; however, any antibiotic has the potential to cause infection.<sup>65–67</sup> Longer exposure and exposure to multiple antibiotics increase risk.<sup>68</sup> The use of proton pump inhibitors, diuretics, and nonsteroidal antiinflammatory medications, which are frequently used in older adults, has also been associated with increased risk.<sup>69–71</sup>

A liquid stool sample should be sent for nucleic acid amplification testing (NAAT) or enzyme immunoassay (EIA). NAAT is generally preferred to EIA for its higher specificity, but NAAT does not test for active *C difficile* toxin and therefore is positive even in asymptomatic carriers. Repeat testing is of no clinical utility if performed within 7 days.<sup>72–74</sup>

In addition to discontinuing the responsible antibiotic agent, the IDSA recommends the following regimens for treatment of initial *C difficile* infection:

- Vancomycin 125 mg by mouth 4 times daily for 10 days, or
- Fidaxomicin 200 mg by mouth twice daily for 10 days

Metronidazole is no longer recommended as first-line therapy and should only be used if the agents discussed earlier are not available. For patients with recurrent infections, options include using a vancomycin taper or using fidaxomicin if vancomycin was used for the initial episode. For frequent recurrent episodes, the addition of rifaximin or fecal transplant can be considered.<sup>74</sup>

### **Other Gastrointestinal Infections**

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Other common causes of acute infectious diarrhea in older patients include viral and bacterial gastroenteritis and foodborne illness. *Salmonella*, *Shigella*, and *Campylobacter jejuni* are frequent causes of bacterial diarrhea in elders.<sup>62</sup> Older patients with these infections may present atypically. In 1 study of patients with *Campylobacter*, only 18% of those greater than 75 years old had bloody diarrhea, compared with 92% of those in the age cohort 5 to 24 years old. Similar findings were reported in those with *Salmonella*.<sup>75</sup> *Salmonella* is the most commonly identified pathogen in nursing home outbreaks of bacterial gastroenteritis, accounting for 52% of outbreaks and 81% of deaths.<sup>76</sup>

Maintaining adequate hydration (either enteral or parenteral) is the most important intervention in older patients with diarrheal illness. Empiric antibiotic therapy is not recommended except when presentation is consistent with *Shigella* or in patients who have recently traveled internationally with temperatures greater than 38.5°C and/or signs of sepsis. When indicated, empiric therapy should include either ciprofloxacin or azithromycin. Antibiotics should not be used in patients infected with toxin-producing bacteria.

## **SKIN AND SOFT TISSUE INFECTIONS**

The skin serves as a crucial barrier to prevent entrance of pathogens into the human body. Aging skin is dry and thin, making it susceptible to tears and abrasions that provide convenient portals of entry for pathogens. Common skin infections in the elderly population include bacterial infections (cellulitis, erysipelas, necrotizing fasciitis) and herpes zoster.

### **Cellulitis and Erysipelas**

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Cellulitis and erysipelas are usually caused by gram-positive bacteria, and they can often be distinguished clinically. Erysipelas is a superficial infection of the dermis



with a rash that tends to be sharply demarcated. Cellulitis involves the deeper subcutaneous tissues and is more ill-defined. Both tend to occur more often in the lower extremities of older patients. Differential diagnoses to exclude include chronic venous stasis and venous thromboembolism. Venous stasis changes are usually bilateral, whereas infection is more likely to present unilaterally.<sup>77</sup> Blood cultures should be obtained in patients with malignancy, underlying immunosuppression, and those with systemic symptoms (ie, hypotension and high fever). Skin swabs and biopsy cultures are usually of low yield and are not recommended but can be considered in the at-risk populations described above.

For uncomplicated cellulitis and erysipelas, IDSA guidelines recommend covering for streptococci and MSSA (Table 5).<sup>78</sup> MRSA coverage is usually not necessary unless the patient has risk factors such as penetrating trauma, especially from IV drug use. IV antibiotics should be reserved for more severe infections requiring hospitalization and for patients who are immunocompromised or have signs of systemic inflammatory response.

### Necrotizing Soft Tissue Infections

Necrotizing fasciitis (NF) is a severe deep soft tissue infection traversing muscle fascia and subcutaneous fat. It can present similarly to cellulitis. Distinguishing characteristics include (1) pain out of proportion to presentation; (2) hard, wooden feel of the subcutaneous tissue when palpated; (3) signs of systemic toxicity; (4) failure to respond to initial antibiotics; and (5) palpable crepitus or evidence of skin necrosis.<sup>78</sup> NF is a clinical diagnosis, and imaging studies such as CT or MRI are of limited utility. Many times,

Infection	Pathogen	Antimicrobial	Duration
Cellulitis/ erysipelas	<i>Streptococcus</i> , <i>S aureus</i> (uncommon in erysipelas)	<b>Covering streptococci and MSSA</b> IV: cefazolin PO: amoxicillin, amoxicillin-clavulanate, cephalexin, clindamycin <b>Covering MRSA:</b> IV: vancomycin, daptomycin, linezolid PO: doxycycline, clindamycin, TMP-SMX <b>Covering MRSA and streptococci:</b> PO: clindamycin alone or doxycycline/TMP-SMX + beta-lactam	5 d, can be extended if no improvement
Necrotizing fasciitis	<i>Streptococcus</i> , <i>Staphylococcus</i> , <i>Vibrio vulnificus</i>	Polymicrobial: MRSA coverage + (1) piperacillin- tazobactam, (2) carbapenem, (3) ceftriaxone + metronidazole, or (4) fluroquinolone + metronidazole. Clindamycin should be added for antitoxin effect	Should be continued until no further debridement and afebrile 48–72 h
Herpes zoster	Varicella zoster virus	Acyclovir 800 mg 5 times daily or valacyclovir 1000 mg TID or famciclovir 500 mg TID	7 d

**Abbreviations:** MSSA, methicillin-sensitive *S aureus*; PO, orally; TID, 3 times daily; TMP-SMX, trimethoprim-sulfamethoxazole.

**Data from** Stevens DL, Bisno AL, Chambers HF, et al. Practice Guidelines for the Diagnosis and Management of Skin and Soft Tissue Infections: 2014 Update by the Infectious Diseases Society of America. Clin Infect Dis. 2014;59(2):e10-e52.

diagnosis and subsequent urgent surgical treatment of NF is delayed in the elderly when vague complaints are thought to be explained by other infectious causes.<sup>79,80</sup> NF should remain on the differential in geriatric patients until symptoms are reliably explained by other causes and the patient is improving clinically.

Initial management involves surgical debridement and broad-spectrum antibiotics. The most commonly identified pathogens include *Streptococcus pyogenes*, *S aureus*, and *Vibrio vulnificus*. Causative bacteria may be identified via blood cultures or tissue cultures obtained in the operating room. Patients at risk for polymicrobial infection include those with perianal abscesses or surgical procedures involving the bowel, decubitus ulcers, IV drug users, and those with perivaginal infections.<sup>78</sup> **Table 5** outlines suggested initial antibiotic regimens. Antibiotics should be narrowed based on culture data and continued until there is no need for further debridement and the patient is clinically improving and afebrile for 48 to 72 hours.

### **Herpes Zoster**

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Herpes zoster (shingles) is caused by the reactivation of latent varicella zoster virus. Patients may experience pain in a dermatomal distribution for 1 to 3 days before the vesicular skin eruption. The rash is described as clusters of vesicles on an erythematous base that evolve into pustules and eventually crust over. Patients are contagious until all lesions have turned into crusted plaques. Treatment with antivirals (see **Table 5**) is important to shorten duration of illness and for the prevention of postherpetic neuralgia, which is especially common in the elderly, occurring in approximately 50% of patients aged 60 years and older.<sup>81</sup> Treatment initiation more than 72 hours after onset of lesions is of unclear utility unless there are new lesions still forming.<sup>82</sup> Patients with ophthalmic zoster or disseminated zoster should be treated with IV acyclovir.<sup>83</sup> Patients with Ramsey-Hunt syndrome respond better when treated with both an antiviral agent and prednisone (1 mg/kg for 5 days).<sup>84</sup> Vaccination with recombinant zoster vaccine is indicated in immunocompetent patients aged 50 years and older. Those with a history of herpes zoster should also receive vaccination. Timing of vaccination after infection is not clearly defined but is generally recommended after the acute phase of infection has resolved or within 1 year.<sup>85</sup>

### **ANTIMICROBIAL STEWARDSHIP**

Emerging antimicrobial resistance now poses a serious threat to public health. According to the Centers for Disease Control and Prevention (CDC), the most urgent threats currently are *Candida auris*, *Clostridioides difficile*, carbapenem-resistant Enterobacteriaceae and *Acinetobacter*, and drug-resistant *Neisseria gonorrhoeae*.<sup>86</sup> Every year, 2.8 million people are infected with an antibiotic-resistant infection, and more than 35,000 people die.<sup>87</sup> Aggressive application of antimicrobial stewardship is crucial because the rate of emerging resistance currently far outpaces the development of new antimicrobials.<sup>88,89</sup>

The goal of antimicrobial stewardship is to treat infection with minimal toxicity to the patient and minimal contribution to development of resistance. The 4 Ds of antimicrobial stewardship, initially described by Joseph and Rodvold,<sup>90</sup> are (1) right **drug**, (2) right **dose**, (3) **deescalation** to pathogen-directed therapy, and (4) right **duration** of therapy (**Table 6**). Some institutions have added a fifth D for right **diagnosis**, which emphasizes the need to prevent unnecessary use of antibiotics.

By carefully assessing every patient and making decisions using these principles, clinicians can contribute to the safe and effective use of antimicrobials and ensure

<b>Table 6</b>	
<b>Five Ds of antimicrobial stewardship</b>	
Right diagnosis	Rule out noninfectious causes and treat with antimicrobials appropriate for the suspected infection
Right drug	Choose a drug or drugs that cover clinically suspected microbes, taking into account local resistance patterns
Right dose	Make sure each antimicrobial is dosed appropriately for infection source and patient factors such as weight and renal function
Deescalation	As soon as possible, narrow coverage to pathogens isolated in culture. Discontinue expanded coverage for patients without risk factors for drug resistance
Right duration	Make sure antimicrobials have a stop date consistent with established recommendations. Ensure patients take all medication as prescribed

medicine stays on the winning side of the battle against antimicrobial resistance. When in doubt regarding any of the principles discussed earlier, consultation with an infectious disease specialist is encouraged. Referencing local antibiograms is also recommended to aid in understanding of local resistance patterns and provide direction in antibiotic prescribing tailored to the specific geographic region and patient population.

## SUMMARY

Infections in older patients can prove diagnostically challenging. Age-related factors affecting the immune system in elderly individuals contribute to nonspecific presentations. Other age-related factors and chronic conditions cloud the picture with symptoms that may or may not point to an infectious diagnosis. Delay in administration of antimicrobials can lead to poor outcomes; however, unnecessary administration of antimicrobials can lead to increased morbidity in older patients and contribute to the emergence of MDROs. When evaluating an older patient for infection in the ED, careful clinical assessment and consideration of patient history and risk factors are critical. Objective data should be interpreted with these factors in mind. When necessary, antimicrobials should be chosen that are appropriate for the diagnosis and deescalated as soon as possible.

## CLINICS CARE POINTS

- Older patients with infection can present atypically (altered mental status, lack of fever).
- Symptoms of chronic conditions common in the elderly can mimic infectious symptoms.
- Diagnosis should be made considering all patient factors, including history, risk factors, presentation, and objective data.
- Asymptomatic bacteriuria is common in the elderly and should not be treated with antibiotics.
- Unnecessary use of antibiotics contributes to increased morbidity and emergence of drug-resistant pathogens.

## DISCLOSURE

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