Infections in the Elderly

Kent B. Crossley and Phillip K. Peterson

From the Department of Medicine, Section of Infectious Diseases, St. Paul-Ramsey Medical Center, St. Paul, and the Department of Medicine, Section of Infectious Diseases, Hennepin County Medical Center and University of Minnesota Medical School, Minneapolis, Minnesota

Why should every clinician know something about the management of infections in the elderly? First, consider the numbers, the so-called “geriatric demographic imperative.” In 1900, about 15 million people were aged 65 years or older (<1% of the global population). In 1992, 342 million people were in this age group (6.2% of the population), and by the year 2050, this number is projected to expand to 2.5 billion (about 20% of the world’s population). Second, elderly individuals are at increased risk of having or dying from virtually every serious infectious disease, such as pneumonia, meningitis, endocarditis, cellulitis, and infections of the urinary and gastrointestinal tracts. Third, many of these infections are preventable and, if diagnosed and treated promptly, are not necessarily associated with any greater mortality than those in young adults. Finally, since most clinicians have family members, if not patients, who are elderly, it is important to be alert to the “unusual” presentation of life-threatening infections in the elderly.

Before discussing the special considerations of infections in the elderly, it should be pointed out that a clinically satisfactory definition of the term elderly is lacking. The arbitrary use of chronological age (i.e., older than 60, 65, or 70 years of age) does not account for substantial variability in the rate of physiological aging. Indeed, only a small proportion of the population who are older than 60 years of age is “geriatric” (i.e., has chronic medical problems associated with growing old).

Some of the literature on infections in the elderly may highlight features that are common in true geriatric patients and may not be representative of all elderly individuals, most of whom are healthy. Similarly, although aging of the immune system is thought to play a role in the exacerbation, increased mortality, and the subtle or atypical presentations of many life-threatening infections in the elderly, chronic medical problems (e.g., diabetes, chronic lung disease, congestive heart failure, malignancy, dementia, and malnutrition) may be equally or more important as comorbid conditions. An additional factor of note is where the elderly patients reside. There are considerable data about the occurrence of infections in residents of long-term-care facilities; these patients are particularly at risk for some types of nosocomial infections (e.g., methicillin-resistant *Staphylococcus aureus* infection) that are endemic in nursing homes and for other types of infections (e.g., catheter-associated urinary tract infection) that are associated with treatment methods used in nursing homes.

In this article, we will review information about infections that are common in the elderly. We will also address issues of prevention and decisions about the selection of empiric antibacterial therapy (table 1).

**Urinary Tract Infections**

Asymptomatic bacteriuria (defined as \(\geq 10^5\) organisms/mL of urine in the absence of symptoms) becomes increasingly common in old age. About one in 10 elderly men and twice this proportion of older women will be bacteriuric. A number of studies of the consequences of asymptomatic bacteriuria in the elderly have indicated that antibiotic therapy is not beneficial [1, 2]. There are two issues: treatment usually is followed by a rapid relapse of bacteriuria, and adverse effects of antibiotic administration in older individuals are frequent.

The organisms that cause urinary tract infection in the ambulatory elderly are very similar to those causing this infection in other ambulatory populations. In nursing homes, however, the bacteria encountered are more similar to those that are seen in hospital settings (i.e., *Escherichia coli, Klebsiella*, and *Proteus*). Pyuria is a usual accompaniment of bacteriuria, but \(~40\%\) of women with pyuria in one study were not bacteriuric [3].
Decisions about outpatient therapy for symptomatic urinary tract infection in the elderly are very similar to those made regarding infections in younger individuals. More-resistant organisms are likely to be recovered from the urine of nursing home residents, individuals who have received previous antibiotic therapy, patients who have recently been in the hospital, and patients with recurrent urinary tract infections. Remember that both S. aureus and enterococci are causes of clinical urinary tract infection in the elderly. These organisms are not susceptible to the usual agents prescribed as therapy for infections due to gram-negative bacteria; for this reason, it is important that gram staining of urine be performed.

Parenteral therapy is usually appropriate for individuals who are ill and require inpatient care. If gram-negative organisms are revealed by gram staining, one of the broad-spectrum β-lactam agents with activity against Pseudomonas aeruginosa (e.g., ceftazidime or ticarcillin/clavulanate) or ciprofloxacin would be a good initial therapeutic choice. If gram-positive organisms are seen, vancomycin would be most appropriate. Patients who are at risk for having infection with multiply resistant gram-negative organisms can be treated with imipenem or another broad-spectrum β-lactam agent with an aminoglycoside. Relatively low doses (e.g., 1 mg/[kg·d]) of aminoglycosides may be used effectively because of the dramatic concentration of these agents in the urine. If the patient’s condition does not improve, the fever remains, or positive results of urine gram staining continue, it is necessary to rule out an obstruction or a perinephric abscess.

Urinary catheters may be associated with the development of symptomatic infection in older individuals, particularly if the catheters are occluded. Catheter-associated bacteriuria typically is caused by a continually changing series of different bacterial species. Providencia is an unexpectedly common cause of this type of bacteriuria. Catheters should be avoided whenever possible, although mortality related to indwelling catheters appears to occur primarily in severely debilitated individuals. If patients with indwelling catheters have symptomatic infection, they should be treated empirically with one of the agents previously discussed.

There are limited data on short-term antibiotic therapy for lower urinary tract infections in elderly patients. We recommend a 3- to 5-day course of antibiotic therapy for older women.

Table 1. Antibiotics recommended as initial (empiric) therapy for the elderly.

<table>
<thead>
<tr>
<th>Infection</th>
<th>Antibiotic(s)</th>
<th>Comment(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute fever, unidentified source</td>
<td>Imipenem</td>
<td>Renal failure, seizure disorder: use alternative agent</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>Gram-negative organisms: third-generation cephalosporin, broad-spectrum penicillin with β-lactamase inhibitor, trimethoprim-sulfamethoxazole, or quinolone</td>
<td>Consider ceftazidime if in nursing home or is recurrent infection; use in combination with low-dose aminoglycoside if resistant organisms are probable</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>Gram-positive organisms: vancomycin</td>
<td>Active against enterococci, staphylococci, and streptococci</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>Third-generation cephalosporin (cefotaxime or ceftriaxone)</td>
<td>Other treatment regimens active against Bacteroides, enteric gram-negative organisms, and staphylococci also may be used</td>
</tr>
<tr>
<td>Pressure sores</td>
<td>Broad-spectrum β-lactam agent with β-lactamase inhibitor (e.g., ticarcillin/clavulanate)</td>
<td>Modify as appropriate after results of gram staining, culture, and antibiotic susceptibility testing are available</td>
</tr>
<tr>
<td>Infective endocarditis</td>
<td>Vancomycin with gentamicin</td>
<td>Listeria monocytogenes is not susceptible to cephalosporin</td>
</tr>
<tr>
<td>Infectious diarrhea</td>
<td>Ciprofloxacin or other quinolone</td>
<td></td>
</tr>
<tr>
<td>Meningitis</td>
<td>Third-generation cephalosporin plus ampicillin</td>
<td></td>
</tr>
<tr>
<td>Septic arthritis</td>
<td>Nafcillin or vancomycin</td>
<td></td>
</tr>
</tbody>
</table>

NOTE. Therapy should be modified as appropriate after results of gram staining, culture, and antibiotic susceptibility testing are available.
with bladder infections. In men, the possibility of a prostatic focus must be considered, and if one is identified, antibiotic treatment should be continued for at least 14 days.

**Pneumonia**

Pneumonia is one of the most important causes of infectious morbidity and mortality in adults. The frequency of bacterial pneumonia clearly increases with age. Whether pneumonia is nosocomial or community-acquired, it is an expensive infection to treat and is associated with significant mortality. This increased mortality is probably due in part to delay in the initiation of antibiotic therapy because of the nonspecific or "atypical" presentation of pneumonia in elderly patients. Cough, pleuritic chest pain, fever, and leukocytosis, for example, are commonly absent in elderly patients with pneumonia. As is also true for other potentially life-threatening infections, an altered mental status may be the first sign of pneumonia.

Viral pneumonias are relatively infrequent in the elderly. Although the risk of morbidity or mortality from complications of influenza in older individuals is increased, the incidence of viral pneumonia and other viral diseases is relatively low in comparison with that among younger adults. Pneumonia due to respiratory syncytial virus is a possible exception. It is interesting that this virus has been identified as a significant cause of respiratory illness in residents of nursing homes.

The bacterial causes of pneumonia in the elderly are also somewhat different from those of pneumonia in younger age groups. Both staphylococcal pneumonia and pneumonia due to gram-negative bacteria seem to be especially common in older individuals (including residents of long-term-care facilities and persons living in the community). Although *Streptococcus pneumoniae* remains the single most important cause of pneumonia in the elderly, gram-negative bacteria (e.g., *Haemophilus influenzae*, *Moraxella catarrhalis*, and *E. coli*) as a group are responsible for most lower respiratory tract infections in this population. Empiric antibiotic therapy should provide coverage for both gram-positive and gram-negative bacteria (table 1). Since elderly patients are at increased risk for *Legionella pneumophila* infection, erythromycin should be added to the therapeutic regimen if a history of clinical findings suggests this diagnosis or improvement is not seen within the first few days of therapy.

Because of the larger number of potential pathogens causing pneumonia in the elderly and because of the increased mortality rate, aggressive efforts are sometimes made to make an etiological diagnosis. Both sputum and blood should be cultured. Bronchoalveolar lavage should be considered for obtaining a sputum specimen; however, the risks of this procedure often outweigh the benefits in this clinical setting.

**Tuberculosis**

The resurgence of tuberculosis in the United States has drawn attention to immigrant and inner-city populations as major risk groups. However, tuberculosis continues to be a very important diagnosis to consider for older individuals. As a rule, patients are infected at a relatively early age with *Mycobacterium tuberculosis*, and clinical disease develops due to reactivation with advancing age. A variety of factors appear to be responsible for an increase in the frequency of tuberculosis in the elderly. These factors include waning cellular immunity, which may occur naturally as a consequence of aging ("immunosenescence") or be due to poor nutrition, diabetes, or use of corticosteroid therapy. Nursing homes are always potential sites for outbreaks, and regular skin testing of employees and residents with tuberculin is now required by the Occupational Safety and Health Administration.

Skin testing should be done by means of the intradermal (Mantoux) technique. A two-step technique (to unmask tuberculin reactivity due to the "booster" phenomenon) is also recommended for elderly individuals. The frequency with which tuberculin testing and chest roentgenography ought to be done is a function of where the patient resides and the extent of tuberculous infection in the community. Stead and Dutt [1] found that nearly one-third of nursing home residents in Arkansas had positive skin tests. These patients need to be followed up closely, and the development of fever, weight loss, cough, or lymphadenopathy or evidence of renal dysfunction should all be considered as possible clues for tuberculosis.

Symptoms of tuberculosis may be atypical in older individuals. Disseminated disease is also more frequent in the elderly. The expected symptoms of tuberculosis (night sweats, cough, fever, and hemoptysis) are all less common in older individuals.

Preventive therapy with isoniazid is not indicated for an older individual who has a positive skin test without other risk factors for reactivation of disease. However, if a patient's skin test has recently converted, isoniazid prophylaxis should be used. Stead and Dutt [4] suggested that the frequency of serious toxic effects from isoniazid among older individuals is low. A 300-mg dose of isoniazid should be given once a day for 6–12 months. If symptoms that may reflect toxicity (nausea, vomiting, malaise, etc.) develop while isoniazid is being administered, results of liver function tests should be monitored. If the transaminase level is >500 U/L, therapy should be stopped. If the elevation in this level is less extreme, a lower dosage of 150 mg/d can be given for a period of 3 days. If this dosage is tolerated, the regular regimen can be reinitiated.

**Pressure Sores/Skin Infections**

Seriously compromised older individuals often have pressure sores. Generally, these sores occur in patients who have impaired mobility and result from ischemia. These lesions are often complicated by local infection, cellulitis, osteomyelitis, or bacteremia.

Efforts to prevent development of pressure sores are very important. Frequent turning of patients or alternating pressure
mattresses appear to be useful. Once a pressure sore develops, the lesion should be kept clean and dry. A variety of topical therapies have been used, but data indicating that any of these treatments are beneficial are limited. Topical antibiotics are not effective; systemic antibiotic therapy should be used only for ulcers that are thought to be associated with cellulitis or underlying infection.

In general, the bacterial etiology of infected pressure sores is polymicrobial. Both anaerobic and aerobic organisms are often recovered, although it is difficult to distinguish colonizing from invasive isolates. It is important to rule out underlying osteomyelitis, which is often associated with persistent or recurrent infection.

Cellulitis in elderly individuals may resolve slower than cellulitis in younger patients. In recent winters, there have been numerous outbreaks of group A β-hemolytic streptococcus infection associated with bacteremia in nursing homes. Physicians need to be aware of these outbreaks and to institute prompt therapy directed against group A streptococcal infection in elderly patients at the first signs of cellulitis.

One other cutaneous infection that is common in older individuals is herpes zoster. Again, reactivation of the intracellular microorganism varicella-zoster virus is due to waning of cell-mediated immunity with age. Herpes zoster is commonly associated with protracted and disabling pain in elderly patients. Although newer antiviral compounds hold promise for the prevention of postherpetic neuralgia, it is not yet clearly established that any treatment regimen is effective.

Bacteremia

Bacteremia is more frequent and more often fatal in older individuals. The urinary tract, intraabdominal sites, and the lungs are the most common sources of community-acquired bacteremia in the elderly. In long-term-care facilities, the sources of bacteremia in most patients are (in decreasing order of frequency) the urinary tract, skin and subcutaneous infections, and the respiratory tract. The organisms recovered from blood cultures include staphylococci and streptococci (patients with skin infections), gram-negative enteric bacteria or enterococci (patients with urinary tract infection), and anaerobes or gram-negative organisms (patients with biliary or other intraabdominal sources of infection). Pulmonary infection associated with bacteremia commonly involves S. pneumoniae, H. influenzae, group B Streptococcus, S. aureus, or gram-negative enteric organisms.

Infective Endocarditis

Infective endocarditis is most frequently seen in elderly individuals. Over one-half of patients with endocarditis are older than 60 years of age. The reasons for this predilection for the elderly appear to include surgically implanted valves and prosthetic material, the use of intravascular devices, and the longer survival in recent years of patients who have underlying cardiac valve diseases. The rates of morbidity and mortality associated with endocarditis are much higher among older patients than among younger individuals.

Infective endocarditis in older people may be particularly difficult to diagnose. Signs and symptoms are notoriously nonspecific (e.g., confusion, weight loss, malaise, and weakness) and often are ascribed to other diseases or “old age.”

Enterococci (usually from the urinary tract) and Streptococcus bovis (from a colonic source) are particularly common as causes of endocarditis in older people. A high proportion of patients who have S. bovis endocarditis will be found to have colonic carcinoma. Staphylococci, enterococci, and streptococci are usually etiologic agents of infective endocarditis in patients who have prosthetic valves.

Infectious Diarrhea

Diarrhea is a special problem in the nursing home setting. Outbreaks occur often during the winter months; the Norwalk agent and rotavirus both have been implicated as causes of diarrhea. Clostridium difficile has been associated with outbreaks of diarrhea in residents of long-term-care institutions.

The risk of death associated with diarrhea is increased in older individuals. Older patients are at particular risk for acquiring infection because of achlorhydria, decreased intestinal motility associated with medications, and frequent use of antibiotics. Although not universally endorsed, antibiotic therapy for patients older than 50 years of age who have uncomplicated salmonella gastroenteritis has been recommended [5]. It has also been suggested that the likelihood of serious fluid and electrolyte imbalance in older individuals with shigella gastroenteritis may be reduced by antibiotic therapy.

Meningitis

As with other infections we have discussed in this article, the case-fatality rate associated with bacterial meningitis is much higher among the elderly; one study reported a case-fatality rate of 55% among the elderly vs. an overall case-fatality rate of 10% [6].

It is well appreciated that the organisms causing meningitis in older patients are different from those causing meningitis in younger individuals. Most notably, Listeria monocytogenes is a particularly frequent cause of meningitis in the elderly. Other organisms that are common causes in older patients include S. pneumoniae, M. tuberculosis, and gram-negative bacilli. Neisseria meningitidis and H. influenzae are uncommon causes of meningitis in aged patients.

It is important to remember that penicillin-resistant isolates of S. pneumoniae have been isolated from older individuals in nursing homes. For elderly patients with suspected meningitis,
initial (empiric) therapy should be designed to provide coverage for *S. pneumoniae*, gram-negative bacilli, and *Listeria*, which requires combination antibiotic therapy (table 1).

**Septic Arthritis**

About one-quarter of patients with septic arthritis are older than 60 years of age. Recovery of joint function in the elderly is less adequate, and mortality rates associated with these infections are higher. Septic arthritis is often seen in joints damaged by preexistent rheumatoid arthritis or degenerative disease. The organism most commonly isolated from elderly patients with septic arthritis is *S. aureus*, but gram-negative bacilli may also be recovered. The knee is the joint most frequently involved. Pain, for some reason, seems to be less pronounced in older individuals, and muscle spasm is not commonly present.

**Fever**

A salient feature of the clinical presentation of serious infections in the elderly is a blunting or absence of diagnostically useful symptoms and signs, including the hallmark of an infectious disease process: fever. An increased frequency of afebrile elderly patients with pneumonia, bacteremia, infective endocarditis, and intraabdominal infections has been reported [7–9]. The absence of fever in these conditions is due to both technical and physiological factors. First, reliance on oral thermometry may give a false impression of afebrileaxia, since an exaggerated discrepancy between rectal (core) and oral or axillary temperatures has been observed in the elderly [10]. In addition, the normal temperature of elderly individuals appears to be lower than that of young adults, although there are limited data from large groups of healthy as well as frail subjects spanning the elderly age range. From a practical standpoint, an oral temperature of >37.2°C (99°F) should be regarded as elevated in patients older than 65 years of age. Second, besides technical issues, an aging-associated physiological basis for impairment of the fever response to infection has been observed. Therefore, a high index of suspicion of serious infection is required in the appropriate clinical setting in the absence of fever.

When fever is recognized, diagnostic assessment and therapy should be guided by the patient’s history and the results of a physical examination. In the absence of any localizing symptoms, signs, or preliminary laboratory findings, occult bacterial infection should be suspected in an elderly patient with the new onset of fever. Because of the possibilities of bacteremia, intraabdominal infection, or bacterial endocarditis, after obtaining two or three blood samples for culture, empiric broad-spectrum antibiotic therapy should be instituted (table 1). This treatment should be followed by prompt radiographic assessment of the abdomen, looking for evidence of hepatobiliary tract infection or an abscess associated with the large bowel or genitourinary tract.

Occult bacterial infection also is high on the list of causes of fever of unknown origin in the elderly (table 2). Other frequent causes of fever of unknown origin in older people include neoplasm and connective tissue disorders (giant-cell arteritis, in particular), which occur at about equal frequency. Lymphoma is the most common neoplasm, and most lymphomas are intraabdominal.

**Empiric Therapy**

In table 1, we provide guidelines for initial antibiotic therapy for older individuals. The following general principles have influenced these recommendations. First, wherever possible, try to avoid aminoglycoside therapy for older individuals since many safer, less-toxic alternatives are now available. Second, because of decreased renal and hepatic function in older individuals, doses of antimicrobials that are somewhat lower than the maximum dose that might be employed for younger individuals can be used. Thus, 500 mg of ciprofloxacin twice a day will yield serum levels in someone in their 70s comparable with those that 750 mg twice a day would yield in a person in their 30s. Finally, therapy with a broad-spectrum antimicrobial agent should often be initiated until an etiological diagnosis is established. Of utmost importance is the initiation of therapy early in the course of infection when the clinical manifestations may be subtle or nonspecific.

**Pharmacologic Considerations**

A number of physiological changes that occur in advanced age may impact the absorption, distribution, metabolism, and
elimination of many antibiotics. There is good evidence that the risk of toxic effects related to antibiotics is increased in older people [11]. Dosing should be carefully monitored for older individuals. Even with commonly used β-lactam agents (e.g., orally administered cephalosporins), it may be appropriate to reduce doses somewhat.

**Prevention**

Prevention of infection in older individuals is, to some degree, a matter of continuing to ensure a healthy lifestyle. Regular exercise and a balanced diet are important. Careful attention to personal hygiene and regular medical care might be expected to promote this end.

Among specific recommendations for older individuals, immunization should strongly be encouraged at appropriate intervals. Diphtheria and tetanus toxoids should be administered once every 10 years. Pneumococcal polysaccharide vaccine is recommended for all individuals older than 60 years of age. It is increasingly being suggested that patients at high risk for pneumococcal infection (e.g., those who are asplenic) receive repeated immunizations at 6-year intervals. However, routine reimmunization of elderly individuals is not recommended at this time. Influenza virus vaccine has been shown to be cost-effective by reducing the rate and expense of hospitalizations of elderly patients and has decreased the number of deaths of older individuals. Given the growing number of individuals who are entering the elderly age group, increased attention is likely to be focused on the development of better vaccines as well as other measures for preventing untimely deaths of older persons.

**References**


**Suggested Additional Readings**


This test affords you the opportunity to assess your knowledge and understanding of the material presented in the preceding clinical article, "Infections in the Elderly," by Kent B. Crossley and Phillip K. Peterson, and to earn continuing medical education (CME) credit.

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Certificates of CME credit will be awarded on a per volume (biannual) basis. Each answer card must be submitted within 3 months of the date of the issue.

This program is made possible by an educational grant from Roche Laboratories.

1. Asymptomatic bacteriuria is
   A. Equally common in men and women.
   B. Important to treat promptly.
   C. Best treated with trimethoprim-sulfamethoxazole.
   D. Usually not an indication for antibiotic treatment.

2. Catheter-associated urinary tract infections in nursing home residents are
   A. Rarely the cause of mortality except in individuals who are severely debilitated.
   B. Commonly caused by Candida.
   C. Rarely caused by Providencia.
   D. Not appropriate to treat empirically.

3. Pneumonias in older people are
   A. Frequently caused by viruses.
   B. More commonly caused by gram-negative bacteria and staphylococci than are those in younger individuals.
   C. Often caused by respiratory syncytial virus.
   D. Inexpensive infections to treat.

4. Tuberculosis in the elderly in the United States is
   A. Uncommon.
   B. Never appropriately managed with prophylactic isoniazid.
   C. Not a potential serious problem in nursing homes.
   D. Evidenced by positive skin tests for nearly one-third of nursing home residents in some studies.

5. Clinical tuberculosis in older individuals is
   A. More commonly disseminated.
   B. Often caused by M. bovis.
   C. Usually associated with the same symptoms and signs as those in younger individuals.
   D. Rarely accompanied by a positive skin test.

6. Soft-tissue infections associated with pressure sores in older people are often
   A. Polymicrobial.
   B. Caused by fungi.
   C. Best treated with granulated sugar.
   D. Preventable with prophylactic gentamicin.

7. Bacteremic infections in the elderly are uncommonly from
   A. Intraabdominal sites.
   B. Urinary tracts.
   C. Lungs.
   D. Dermatitis.

8. Bacterial endocarditis in the elderly is
   A. More common than that in younger individuals.
   B. Easier to diagnose.
   C. Not associated with significant mortality.
   D. Rarely caused by enterococci.

9. A frequent cause of meningitis in older individuals is
   A. Neisseria meningitidis.
   B. Haemophilus influenzae.
   C. Group B streptococci.
   D. Listeria monocytogenes.

10. Prevention of infection in older individuals is appropriately done by
    A. Encouraging regular exercise and a balanced diet.
    B. Seeking regular medical care.
    C. Arranging appropriate immunizations.
    D. All of the above.