

Principles of Antimicrobial Therapy in Older Adults



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KEYWORDS

- Antibiotics • Pharmacokinetics • Aging • Long-term care
- Antimicrobial stewardship

KEY POINTS

- Antibiotic use is common in older adults; a significant proportion of this use is unnecessary, overly broad in spectrum, or the duration is too prolonged.
- Unnecessary antibiotic use contributes to complications, such as drug toxicity, other side effects, and alterations in normal flora that may result in secondary infections that may be difficult to treat.
- Understanding how body habitus, blood flow, and metabolism alter antibiotic distribution, levels, and dosing in the older adult can help minimize drug toxicity.
- Diagnosis of infection in older adults is challenging. Understanding what criteria are helpful for the diagnosis of infection and initiation of antibiotics in this population is helpful to minimize the unnecessary use of antibiotics.

INTRODUCTION

In general, older adults have more underlying conditions that predispose them to infection with more frequent complications and greater mortality. Recent studies of Medicare Part D data suggest that overall older adults receive more antibiotics than insured younger adults and children accounting for 1.10 versus 0.88 antibiotics per person per year, respectively.¹ In assisted living and nursing homes, antibiotic use increases to 2.53 to 4.56 versus 3 to 5 antibiotics per resident year.^{2,3} Antibiotic use has also been shown to be particularly intensive at the end of life in frail dependent patients with severe irreversible dementia.⁴ Less is known about prescription of antibiotics in the ambulatory care setting. In one national survey of ambulatory care visits in the United States from 2007 to 2009, 8% of adults aged 60 years and older received an antibiotic; the antibiotics prescribed were significantly more likely to be broader in spectrum than those prescribed for younger patients (**Box 1**).⁵

Conflicts of Interest: None.

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Box 1**Facts about antibiotic use in older adults**

- Antibiotic use is common in older adults
 - In assisted living facilities
 - In long-term care facilities
 - Who are functionally dependent with severe dementia
- The antibiotics used to treat older adults tend to be broader in spectrum
- Unnecessary antibiotic use may contribute to
 - Drug toxicities
 - Hypersensitivity reactions
 - Secondary infections
 - Antibiotic resistance

IMPACT OF ANTIBIOTIC USE IN OLDER ADULTS

More antibiotic use in older adults does not necessarily confer more benefit. A significant proportion of older adults receive antibiotics for inappropriate indications or the duration of therapy is too long. Inappropriate prescribing for adults ranges from 26% in residents of assisted living facilities to 25% to 75% of nursing home residents.^{6,7}

Furthermore, older adults who receive an antibiotic are also significantly more likely to have a complication of antibiotic use, such as an adverse drug event. Older adults aged 65 years and older accounted for 13.5% of adverse events related to antibiotics that required emergency room care in the United States from 2004 to 2006.⁸ The use of nitrofurantoin, a drug on the Beers Criteria list of “always inappropriate” drugs, was the third most common cause of medication-related adverse events in addition to trimethoprim-sulfamethoxazole and levofloxacin.⁹ Older adults who receive antibiotics are also more likely to have an adverse drug event than those who do not receive treatment.¹⁰ Although adverse events from antibiotics are half-again less likely than high-risk drugs, such as warfarin, insulin, and digoxin, the impact is not trivial.^{9,10} Adverse events, such as allergic and drug-drug interactions, other side effects, and drug toxicities may occur. In addition, antibiotics alter the patient’s normal flora (microbiome) and may contribute to secondary infections with *Clostridium difficile* or emergence of multidrug-resistant bacteria, such as methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant enterococci, extended-spectrum β -lactamase, or carbapenemase-producing gram-negative bacilli (GNB).^{11,12} Anticipating drug interactions, using appropriate doses, and minimizing the unnecessary use of antibiotics may help prevent adverse events in the elderly person and the emergence of antibiotic resistance.

AGING AND ANTIBIOTIC PHARMACOKINETICS

Aging influences the pharmacokinetics of antibiotics at multiple levels through its impact on the absorption, distribution, and elimination of these drugs. Absorption of antibiotics, which follows ingestion by oral or enteric routes, may be diminished by an increase in gastric pH and gastric emptying, atrophy of mucosal surfaces, and reduced intestinal motility, sphincter activity, and splanchnic blood flow with aging. Resulting reduced gastric acidity can slow the dissolution of tablets, impede drug release, and alter solubility of some drugs. Reduced gastrointestinal motility may facilitate the degradation of some drugs before they are absorbed (**Table 1**).^{13–15}

Once absorbed, the systemic distribution of antibiotics within various tissues is influenced by changes in drug solubility, intravascular protein concentration, alterations in body composition, and reduced cardiac output and organ blood flow.

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