Breaking the Chain of Infection in Older Adults

A Review of Risk Factors and Strategies for Preventing Device-Related Infections

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KEYWORDS

• Infection prevention • Multidrug-resistant organisms • Indwelling devices
• Older adults • Antimicrobial stewardship

KEY POINTS

- Device-related infections are a leading cause of health care–associated infections in older adults.
- Indwelling devices are a risk factor for multidrug-resistant bacterial colonization.
- Host, pathogen, device, and environmental factors all contribute to the development of infection.
- Limiting utilization of these devices and practicing infection prevention techniques can reduce the likelihood of infection and limit transmission of multidrug-resistant pathogens.

INTRODUCTION

Device-related infections (DRIs) in older adults are a substantial cause of morbidity and mortality, and they place a significant economic burden on the health care system of the United States.[1–4] As the number of persons the over the age of 65 increases to 83.7 million by 2050, comprising 20% of the total US population, the incidence of health care–associated infections (HAIs), and DRIs in particular, is expected to increase accordingly.[5]

At the end of 2014, there were 1.4 million persons residing in long-term care facilities (LTCFs) in the Unites States, almost 10% of whom were over the age of 85.[6] Studies

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suggest that 5% to 7% of these residents will develop an HAI during their stay.[7,8] In the United States alone, up to 3.8 million HAIs occur in residents of LTCFs annually.[1,6]

Indwelling devices provide a portal of entry for potential pathogens to enter a susceptible host and set the stage for future infections. The most common indwelling devices are urinary catheters, which predispose patients to catheter-associated urinary tract infections (CAUTIs). Because of a variety of host factors in older adults, including medical illness and incontinence, approximately 13% of new admissions to skilled nursing facilities from acute care facilities have a urinary catheter in place at the time of admission.[9] Up to 22% of LTCF residents have a urinary catheter in place at any given time, indwelling for an average duration of 105 days.[9–12] In addition, an estimated 9% of home care recipients have an indwelling urinary catheter.[12]

The other 2 most commonly used indwelling devices in older adults are percutaneous feeding tubes and central venous catheters (CVCs), which include peripherally inserted central catheters (PICCs), central venous lines, midline catheters, and ports. An estimated 6% to 8% of all residents in LTCFs have a feeding tube, with higher rates in patients with cognitive impairments.[7,13,14] Because intravenous treatments, such as parenteral nutrition and antimicrobials, are increasingly delivered outside of the acute care setting, use of PICC lines in skilled nursing facilities has increased to a prevalence of at least 22%.[15]

Many factors interact to contribute to the frequency and severity of DRIs in older adults. The “Chain of Infection” is a general infection prevention framework that can be used to evaluate the major elements that lead to HAIs and to identify modifiable risk factors that can be targeted to reduce future infections (**Fig. 1**). Host factors, including immune dysfunction and fragile skin, provide an opening for opportunistic pathogens to invade and cause an infection. Bacterial factors, including antimicrobial resistance and biofilms, provide health care–associated organisms with competitive advantages for invasion and pathogenesis. Environmental factors, including contamination, provide a source of exposure for susceptible hosts. Finally, indwelling devices provide a portal of entry for pathogenic organisms to enter a susceptible host and cause infection. Elements of the model can be used to develop a multifaceted approach to treatment and prevention of these DRIs.[16–18]

Here, the authors first review host, pathogen, environmental, and device-related factors that put older adults at increased risk of DRI and then discuss strategies for reducing future infections.

HOST FACTORS

Host susceptibility is a major determinant of infection; age is a nonmodifiable risk factor that impacts immunity and infection risk in the setting of exposure to a potential pathogen. Physical and functional incapacity, combined with the immunologic changes of aging, including those caused by immunosuppressive medications, make older adults more susceptible to DRIs than their younger counterparts.

Aging is associated with a decline of functional innate and adaptive immunity, a process known as immunosenescence.[19] The underlying mechanisms are unclear, but measurable decreases in functional immunity occur. The total number of circulating immune cells does not decline, although remaining immune cells have diminished capabilities: neutrophils lose some of their capacity for phagocytosis; monocytes and macrophages undergo changes in their ability to release cytokines and provide immune regulation; and natural killer cells have reduced potential to respond to cytokine signaling.[19–21]