HHS Public Access

Author manuscript

Curr Opin Infect Dis. Author manuscript; available in PMC 2017 October 19.

Published in final edited form as:

Curr Opin Infect Dis. 2016 August ; 29(4): 388–393. doi:10.1097/QCO.0000000000000283.

Healthcare-Associated Infections in the Elderly: What's New

Morgan Jane Katz, MD and

Johns Hopkins University, Department of Medicine, Division of Infectious Disease, Baltimore, MD 21287

Mary-Claire Roghmann, MD, MS

Department of Epidemiology and Public Health, University of Maryland School of Medicine, Geriatrics Research Education and Clinical Center, VA Maryland Health Care System, Baltimore, MD 21044

Abstract

Purpose of review—The high risk population and current lack of knowledge regarding appropriate infection prevention in the long-term care setting has contributed to substantial rates of resistance and healthcare-associated infections in this arena. More evidence-based research on long-term care is necessary, particularly now that the elderly population is increasing.

Recent findings—Proposed government mandates highlight the urgent need to combat antimicrobial resistance in the long-term care setting. Recent studies focusing on unique strategies for the prevention of transmission and infection with multi drug resistant organisms in nursing homes are discussed, as well as attempts to formulate clear antimicrobial stewardship programs.

Summary—The long-term setting has unique challenges to instituting effective infection control precautions, therefore current accepted methods used in acute-care facilities need to be modified. Recent data suggest that prevention of transmission in long-term care (LTC) may be achieved with focus on high-risk patients or specific care-based activities rather than colonization status. Antimicrobial stewardship and consultation with specialized physicians may be important measures to combat resistance and adverse events in LTC. The prevention of unnecessary antibiotic use in palliative care may reduce rates of resistance as well as discomfort for terminal patients.

Keywords

Long-term care; Antimicrobial resistance; Elderly; Healthcare-associated infection; Infection Prevention

Introduction

The elderly population in America is now the fastest growing population in the United States [1]. A recent cross-sectional analysis of all emergency department (ED) visits in elderly U.S.

Corresponding Author: Phone: 410-245-1343, mkatz26@jhmi.edu.

Conflicts of Interest: None

Financial Support: None

adults reported infectious-disease (ID) related causes account for 13.5% of all visits, a higher burden than for myocardial infarction and congestive heart failure combined [2*]. In 2011, the financial burden of pneumonia and septicemia alone in patients >65 accounted for a direct cost of over 30 billion dollars; this number is expected to increase with the rising elderly population [3].

The risk of developing a healthcare-associated infection (HAI) increases linearly with age; a 2011 prevalence study reported a 11.5% HAI prevalence rate in patients over the age of 85, which decreases significantly with younger age (11.27% in 75–84 group, 10.64%% in 65–74, and 7.37% in patients under the age of 65)(p=.004)[4], Summarized in Table 1. While surgical site infections account for the largest proportion of HAIs in the under 65 group, HAIS in the elderly are primarily attributed to urinary tract infections and *Clostridium difficile*. The overall burden of HAIs in nursing homes is now estimated to exceed that of acute care facilities [5].

Between 2012 and 2050, the population aged 65 and over is projected to rise to 83.7 million, almost double its estimated population of 43.1 million in 2012[1]. This shift will likely be accompanied by a transfer of many elderly patients to long term care (LTC) facilities. The present review describes the emerging issues in HAI in the elderly population, and recent advances in infection prevention formulated to tackle this challenging dilemma.

Infection prevention and long-term care

Burden of multi-drug resistant organisms in long-term care

Multi-drug resistant organisms (MDRO), including methicillin resistant *S. aureus* (MRSA) and antibiotic resistant gram negative rods, are now more common in long-term care facilities than in acute care [6*], and the need to address this problem has never been more critical. Over 35% of nursing home residents are colonized with MDROs [6*7*8** 9] (Table 2), and new acquisition is common [9]; these facilities and long term acute care hospitals now serve as reservoirs for resistant organisms in the community.

The long-term care environment is uniquely suited to development and transmission of multi-drug resistance. Most residents in LTC have extensive histories of health care exposure, and many have chronic in-dwelling devices, such as feeding tubes or urinary catheters. Older age alone has been identified as a risk factor for colonization with MDROs, and the elderly are the vast majority in long-term care [10]. The nursing home environment itself can pose challenges in terms of infection control and prevention. While it is relatively easy in acute care facilities to screen, isolate, and cohort patients colonized with MDROs, this is difficult in LTC, where patients regularly dine together and participate in communal activities. Compounding these issues is a dramatic overuse of antibiotics in the LTC setting; 47–79% of nursing home (NH) residents have been reported to receive at least one round of antibiotics in the course of a year [10], and NH residents are more likely to receive antibiotics at least once than any other medication [6*].

Infection prevention (IP) programs in long-term care

The unique environment of long-term care facilities may require a different approach to infection prevention than what has been established and tested in acute care facilities. While active surveillance for MDROs is common in acute care, many LTC facilities lack the financial resources necessary to support this practice. Knowledge of colonization with MDROs in LTC may itself lead to more questions- the LTC serves a dual function as a home and a place for medical care, making it difficult to institute strict isolation precautions and cohort patients to distinct areas as is often done in acute care facilities. Significant knowledge gaps in terms of education of the infection preventionists in LTC facilities likely also contribute to the difficulty in instituting effective programs in this arena; among personnel in acute care facilities, 73% reported having certification in infection control, compared to only 2% of the personnel in LTC [11**].

Preventing transmission

Given these challenges, recent studies have attempted to identify alternative approaches to infection prevention in LTC. A recent randomized control trial in nursing homes formulated an infection prevention intervention targeted towards “high-risk” residents with urinary catheters or feeding tubes [12**]. Preemptive use of gowns and gloves was instituted for those with indwelling devices, along with active surveillance for MDROS and a formal interactive infection prevention education program for nursing home staff. The intervention resulted in a 23% reduction in the prevalence density rate for all MDROs in patients with indwelling devices. New acquisition of MRSA was significantly reduced (hazard ratio 0.78; p=.01) as well as clinically defined catheter associated urinary tract infection (CAUTI) (hazard ratio 0.54; $P = .04$) in the intervention group [12**].

Roghmann et al further evaluated the risk of transmission of multi-drug resistance through care-based activities in the NH environment. Transmission of MRSA was evaluated by culturing the gowns and gloves of healthcare workers after specific care activities were performed on NH residents. Transmission varied significantly depending on the care provided; high risk care activities associated with greater transmission rates included dressing, transferring, providing hygiene, changing linens, and toileting the resident (OR>1.0, p<.05). Low risk activities (OR<1.0, p<.05) involved providing medications and performing glucose monitoring [13**]. The study also showed that residents with chronic skin breakdown or pressure ulcers were more likely to transmit MRSA during high risk activities than those without potentially identifying another high risk resident on which to focus interventions.

A shift towards defining specific care-based interactions and resident risk factors which may increase the risk of transmission of MDROS may be more practical for the LTC setting. Active surveillance for MDROs in the LTC setting remains controversial. A recent randomized control trial evaluated the impact of screening and decolonizing for MRSA in nursing home residents; while the prevalence of MRSA carriage declined in both the control and the intervention groups, there was no statistically significant difference with the intervention [14*], suggesting that universal screening may not contribute to significant reduction in prevalence of MRSA in the nursing home setting. The use of barrier precautions

in LTC, where colonization status is often unknown, may be more feasible if reserved for patients deemed as “high-risk” (those with in-dwelling catheters or pressure ulcers) or during high-risk activities rather than for those colonized with MDROs, as is the practice in acute care facilities.

Preventing infection

Infection in the long term care population is associated with significant morbidity and mortality, high hospital readmission rates, and considerable health care expenditures [15* 16, 17, 18]. Pneumonia remains one of the most important infections leading to complications in long term care. A study from Japan found a positive correlation between high salivary bacterial counts in nursing home residents and the incidence of pneumonia [7*], suggesting that intensive oral care regimens to reduce oral bacterial burden may help to prevent the onset of respiratory disease. Despite these promising results, meta-analyses have not shown significant overall benefit of enhanced oral care for the prevention of pneumonia in ventilated patients [19,20*]. A recent pilot study instituting twice daily chlorhexidine rinses and upright positioning during feeding for nursing home residents was terminated for futility when the intervention showed no significant reduction in the incidence of pneumonia [21**].

The US Department of Health and Human Services declared the reduction of hospital acquired infections in LTC a national priority in 2013 [22]. Urinary tract infections were cited as a main area requiring focus due to the high rates of mis-diagnosis and associated unnecessary antibiotic use for these infections [22, 23]. The Agency for Research and Quality (AHRQ) subsequently formulated a new initiative to reduce catheter associated urinary tract infections (CAUTI) in LTC. The initiative, proposed in 2015, includes both a clinical education component as well as a socio-adaptive component created to enhance safety culture in the nursing home [15*]. Program effectiveness will evaluate changes in CAUTI rates, catheter utilization, and improvements in staff knowledge on CAUTI prevention and staff knowledge. Data of infection rates will be reported to CDC’s National Healthcare Safety Network (NHSN), allowing facilities to monitor and compare infection rates across the nation.

Antibiotic stewardship

Antibiotics account for 20% of the adverse drug events reported in nursing homes. The risk of infection with *Clostridium difficile*, a pathogen identified as an “urgent” threat by the CDC in 2013, is amplified eightfold following treatment with a suspected urinary tract infection [24]. *C. difficile* is increasingly prevalent in nursing homes, and is associated with significant morbidity and mortality. Most recent data evaluating the burden of disease reported a national incidence of 112,800 cases of nursing home onset CDI; 28% of these patients were admitted to the hospital within 7 days of the positive specimen, with 19% recurrence of infection, and 8% mortality rate within 30 days [25*].

Several prospective studies have shown that almost half of all antibiotic courses prescribed in nursing homes are unnecessary [26, 27, 28]. A recent open cohort study performed across

607 nursing homes in Canada assessed the risks of antibiotic overuse by evaluating the frequency of antibiotic related harms including *C. Difficile,* antibiotic resistant organisms, allergic reactions, and general adverse events occurring in nursing homes classified as high, medium, or low antibiotic use (defined as use days per 1000 resident days) [8**]. The research revealed a 24% increase in antibiotic related harms (including emergency department visits and hospitalizations related to *C. Difficile* infections) in patients residing in high use homes (P<.001). Each additional day of antibiotic use in a facility was associated with a 0.4% increased risk of antibiotic related harm for the resident, and this individual-level risk extended to patients residing in high risk homes who did not even directly receive antibiotics. It also showed a dramatic variability in prescribing practices across nursing homes, with a 10 fold variation in the rate of antibiotic use between low and high use homes.

Attempts to institute effective antibiotic stewardship programs in long term care facilities have been made [29, 30, 31, 32*], however the ideal approach remains unclear. A difference in staffing and patient care goals between LTCF and acute care facilities make it difficult to apply the same ASP principles used in acute care to long-term facilities [33]. Doernberg et al. instituted an antimicrobial stewardship program targeting the use of antibiotics for urinary tract infections (UTI) in three long term care facilities; the intervention included a weekly prospective audit and consultation with an ID pharmacist and ID physician for all antibiotics prescribed for urinary tract infections [34*]. Only 25% of the residents who were started on antibiotic therapy for UTI met clinical criteria for therapy; the intervention resulted in a 26% reduction in antibiotic prescription for UTIs; however, it did not show significant differences in the rate of resistant organisms or *C. difficile* infection. Another recent study in a veterans affairs LTCF implemented a formal on-site infectious disease consultation service with review of antimicrobial prescribing and on call specialists regarding appropriate prescribing practices; this resulted in a 30% reduction in antibiotic administration (P<.001) as well as a significant decline in *C. difficile* (P=.04)[35**]. A study implementing antimicrobial stewardship via the use of telemedicine in a long term acute care facility was promising: ID physicians and pharmacists reviewed antimicrobial prescription remotely and intervened via telemedicine, with a post-intervention significant reduction in total antimicrobial usage and healthcare acquired *C. difficile* infection [36**].

Much of the difficulty in formulating effective antibiotic stewardship programs in long-term care stems from the challenge of establishing a firm diagnosis of infection in nursing home residents. Older residents often have complicating comorbidities, blunted fever responses, or vague systemic symptoms which make definitive diagnosis problematic [10, 36**, 37, 38]. The most common infection leading to inappropriate antibiotic therapy is urinary tract infection, which accounts for 30–56% of antibiotics prescribed, with up to one third of these prescriptions for residents with asymptomatic bacteriuria [39]. Although the Society for Healthcare Epidemiology of America (SHEA) endorsed minimum clinical criteria for the initiation of antimicrobial therapy in nursing home patients back in 2001 [26], analysis shows that these guidelines are not often followed; a recent review of nursing homes in Boston reported that 78% of suspected and treated UTIs did not meet the minimum criteria for therapy [39].

Reducing antibiotic use in palliative care

The need for antimicrobial treatment during comfort care for the elderly has become an increasing focus over the past few years [40*]. Antimicrobials are commonly prescribed to patients that are deemed to be at the end of life even in the absence of adequate clinical symptoms supporting a bacterial infection, with 40% of patients receiving antimicrobials in their last two weeks of life [41**].

A prospective cohort study of 323 nursing home residents with advanced dementia revealed largely unwarranted overuse of antibiotics; only 44% of patients treated with antimicrobials for suspected infection actually met minimum clinical criteria for antimicrobial treatment initiation. Likely as a result, this group had very high MDRO colonization rates (67%). Acquisition of MDROs was associated with exposure to quinolones (adjusted hazard ratio [AHR], 1.89; 95% CI, 1.28–2.81) and 3rd and 4th generation cephalosporins (AHR, 1.57; 95% CI, 1.04–2.40) [41**]. This cohort was used in another analysis to compare survival and patient comfort scores in the patients who received and did not receive antimicrobial treatment for pneumonia [42]. Patient comfort scores in those treated with antimicrobials were significantly lower than those who were not (P=0.001), and this discrepancy increased with more aggressive antimicrobial therapy (IV vs. oral). While survival significantly improved in those patients treated with antimicrobials, there was no significant survival benefit in oral vs. intravenous vs. intramuscular therapy, suggesting oral therapy may be preferable for preserved comfort and improved survival if antimicrobial treatment is planned.

There is a growing need to further discuss and evaluate patient care goals upon admission to the nursing home. With the current overuse of antibiotics and evidence that this may be causing discomfort (and adverse effects) for the elderly patient, clear goals regarding the desire for prolonged survival vs. maximal comfort may significantly reduce the use of unnecessary antibiotics in patients who cite comfort as their top priority. Not only could this provide direct patient care advantages, but it may have downstream effects on resistance rates on the elderly population as a whole.

Conclusion

The elderly population is increasing exponentially, and healthcare-associated infections in long term care facilities now exceed that of acute care facilities. Preventing transmission in long-term care may be better achieved by targeting high-risk patients with indwelling catheters or pressure ulcers or during certain patient care activities. Improved antibiotic stewardship programs are a necessity in long-term care, as antibiotic overuse is common; there may be significant benefits to involving a specialized ID physician in antimicrobial decision making in nursing homes. While antibiotic administration is high in the last two weeks of life, it has been associated with decreased comfort in treated patients. There is an increasing need to evaluate and discuss patient goals and palliative care in order to avoid unnecessary interventions and further increase antimicrobial resistance.

Reference Section

1. Ortman BJM, Velkoff Va, Hogan H. An aging nation: The older population in the United States. Proc Econ Stat Adm US Dep Commer. 2014; 1964:1–28.

2*. Goto T, Yoshida K, Tsugawa Y, et al. Infectious disease-related emergency department visits of elderly adults in the United States, 2011–2012. J Am Geriatr Soc. 2015 This is a nationally representative cross-sectional analysis evaluating the public health burden of ID-related issues in the elderly population; results indicated substantial burden.

3. Torio, CM., Andrews, RM. [Accessed January 18, 2016] National inpatient hospital costs: the most expensive conditions by payer, 2011: Statistical Brief #160 - PubMed - NCBI. http://www.ncbi.nlm.nih.gov/pubmed/24199255

4. Cairns S, Reilly J, Stewart S, et al. The prevalence of health care-associated infection in older people in acute care hospitals. Infect Control Hosp Epidemiol. 2011; 32(8):763–767. [PubMed: 21768759]

5. Smith WP, Bennett G, Bradley S, et al. Shea/Apic Guideline: Infection prevention and control in the long-term care facility. Infect Control Hosp Epidemiol. 2008; 29(09):785–814. [PubMed: 18767983]

6*. Cassone M, Mody L. Colonization with Multi-Drug Resistant Organisms in Nursing Homes: Scope, Importance, and Management. Curr Geriatr reports. 2015; 4(1):87–95. This is a review of the current issues driving the cultivation of multi-drug resistant organisms in nursing homes.

7*. Kikutani T, Tamura F, Tashiro H, et al. Relationship between oral bacteria count and pneumonia onset in elderly nursing home residents. Geriatr Gerontol Int. 2015; 15(4) This is a survey of the effects of oral bacterial count on the development of pneumonia in elderly nursing home residents. Results identified high bacterial counts in the saliva of elderly patients as an independent risk factor for pneumonia onset.

8**. Daneman N, Bronskill SE, Gruneir A, et al. Variability in Antibiotic Use Across Nursing Homes and the Risk of Antibiotic-Related Adverse Outcomes for Individual Residents. JAMA Intern Med. 2015; 175(8):1–9. This is a longitudinal cohort study evaluating the effect of antibiotic use in nursing homes on adverse outcomes in individual residents. Results demonstrates an increased risk of antibiotic related-harms in high use homes and a wide variability of antibiotic prescriptions practices comparing individual nursing homes.

9. Fisch J, Lansing B, Wang L, et al. New acquisition of antibiotic-resistant organisms in skilled nursing facilities. J Clin Microbiol. 2012; 50(5):1698–1703. [PubMed: 22378900]

10. van Buul LW, van der Steen JT, Veenhuizen RB, et al. Antibiotic use and resistance in long term care facilities. J Am Med Dir Assoc. 2012; 13(6):568.e1–e13.

11**. Black SR, Weaver KN, Weinstein RA, et al. Regional infection control assessment of antibiotic resistance knowledge and practice. Infect Control Hosp Epidemiol. 2015; 36(4):381–386. Pilot survey comparing staff knowledge and assessment of MDROs in nursing homes and acute care facilities. The survey revealed stark differences in knowledge and human resources available in acute care vs. the nursing home setting. [PubMed: 25782891]

12**. Mody L, Krein SL, Saint SK, et al. A Targeted Infection Prevention Intervention in Nursing Home Residents With Indwelling Devices. JAMA Intern Med. 2015; 48109(5):1–10. Randomized control trial performed in 12 community based nursing homes which implemented a multi-modal intervention targeting high-risk nursing home residents with indwelling devices. Results showed a reduction in MDRO prevalence density, MRSA acquisition, and CAUTI infection rates.

13**. Roghmann M-C, Kristie Johnson J, Sorkin JD, et al. Transmission of Methicillin-Resistant Staphylococcus aureus (MRSA) to Healthcare Worker Gowns and Gloves During Care of Nursing Home Residents. Infect Control Hosp Epidemiol. 2015; 36(9):1050–1057. Observational study evaluating MRSA transmission in nursing homes. The study identified specific care based activities and patient characteristics associated with increased risk of transmission of MRSA in the nursing home. [PubMed: 26008727]

14*. Bellini C, Petignat C, Masserey E, et al. Universal screening and decolonization for control of MRSA in nursing homes: a cluster randomized controlled study. Infect Control Hosp Epidemiol. 2015; 36(4):401–408. A cluster randomized control study evaluating the effect of universal

screening and decolonization of MRSA positive nursing home patients showed no significant effect on MRSA rates compared to standard precautions alone. [PubMed: 25782894]

15*. Mody L, Meddings J, Edson BS, et al. Enhancing Resident Safety by Preventing Healthcare-Associated Infection: A National Initiative to Reduce Catheter-Associated Urinary Tract Infections in Nursing Homes. Clin Infect Dis. 2015; 61(1):86–94. Description of the national initiative to prevent catheter associated infections in nursing homes. [PubMed: 25814630]

16. Strausbaugh LJ, Joseph CL. The burden of infection in long-term care. Infect Control Hosp Epidemiol. 2000; 21(10):674–679. [PubMed: 11083186]

17. Teresi JA, Holmes D, Bloom HG, et al. Factors differentiating hospital transfers from long-term care facilities with high and low transfer rates. Gerontologist. 1991; 31(6):795–806. [PubMed: 1800253]

18. Ouslander JG, Diaz S, Hain D, Tappen R. Frequency and diagnoses associated with 7- and 30-day readmission of skilled nursing facility patients to a nonteaching community hospital. J Am Med Dir Assoc. 2011; 12(3):195–203. [PubMed: 21333921]

19. Alhazzani W, Smith O, Muscedere J, et al. Toothbrushing for critically ill mechanically ventilated patients: a systematic review and meta-analysis of randomized trials evaluating ventilator-associated pneumonia. Crit Care Med. 2013; 41(2):646–655. [PubMed: 23263588]

20*. Klompas M, Speck K, Howell MD, et al. Reappraisal of routine oral care with chlorhexidine gluconate for patients receiving mechanical ventilation: systematic review and meta-analysis. JAMA Intern Med. 2014; 174(5):751–761. Systematic review of the implementation of routine care for mechanically vented patients only showed clear benefits in reduction of pneumonia rates in post-op cardiac surgery patients; no benefit was noted for other groups. [PubMed: 24663255]

21*. Juthani-Mehta M, Van Ness PH, McGloin J, et al. A cluster-randomized controlled trial of a multicomponent intervention protocol for pneumonia prevention among nursing home elders. Clin Infect Dis. 2015; 60(6):849–857. A randomized control trial evaluating the effect of intensive oral care for the prevention of pneumonia in nursing home residents showed no significant reduction in the incidence of pneumonia or lower respiratory tract infection compared to regular oral care. [PubMed: 25520333]

22. [Accessed 2/29/16 at 1:44 pm] HHS FY 14–15 Agency Priority Goal: Improve Patient Safety. https://www.performance.gov/content/improve-patient-safety?view=public#overview

23. Wang L, Lansing B, Symons K, et al. Infection rate and colonization with antibiotic-resistant organisms in skilled nursing facility residents with indwelling devices. Eur J Clin Microbiol Infect Dis. 2012; 31(8):1797–1804. [PubMed: 22274858]

24. US Department of Health and Human Services, Centers for Disease Control and Prevention. [Accessed 2/29/16 at 1:47 pm] Antibiotic Resistance Threats in the United States. 2013. http://www.cdc.gov/drugresistance/threat-report-2013/pdf/ar-threats-2013-508.pdf

25*. Hunter JC, Mu Y, Dumyati GK, et al. Burden of Nursing Home-Onset Clostridium difficile Infection in the United States: Estimates of Incidence and Patient Outcomes. Open forum Infect Dis. 2016; 3(1):ofv196. National cross-sectional analysis on the impact of *C. difficile* infection in the nursing home showed substantial associated morbidity and mortality. [PubMed: 26798767]

26. Loeb M, Bentley DW, Bradley S, et al. Development of minimum criteria for the initiation of antibiotics in residents of long-term-care facilities: results of a consensus conference. Infect Control Hosp Epidemiol. 2001; 22(2):120–124. [PubMed: 11232875]

27. Rotjanapan P, Dosa D, Thomas KS. Potentially inappropriate treatment of urinary tract infections in two Rhode Island nursing homes. Arch Intern Med. 2011; 171(5):438–443. [PubMed: 21403040]

28. Loeb M, Simor AE, Landry L, et al. Antibiotic use in Ontario facilities that provide chronic care. J Gen Intern Med. 2001; 16(6):376–383. [PubMed: 11422634]

30. Vergidis P, Hamer DH, Meydani SN, Dallal GE, Barlam TF. Patterns of antimicrobial use for respiratory tract infections in older residents of long-term care facilities. J Am Geriatr Soc. 2011; 59(6):1093–1098. [PubMed: 21539527]

31. Hepburn MJ, Dooley DP, Skidmore PJ, Ellis MW, Starnes WF, Hasewinkle WC. Comparison of short-course (5 days) and standard (10 days) treatment for uncomplicated cellulitis. Arch Intern Med. 2004; 164(15):1669–1674. [PubMed: 15302637]

32*. Furuno JP, Comer AC, Johnson JK, et al. Using antibiograms to improve antibiotic prescribing in skilled nursing facilities. Infect Control Hosp Epidemiol. 2014; 35(Suppl3):S56–61. Antibiograms were developed based on clinical culture data in several skilled nursing facilities, with pre-post test analysis in a single skilled nursing facility showing an improvement in appropriate antimicrobial prescription practices after implementation of the use of the antibiogram. [PubMed: 25222899]

33. Pate PG, Storey DF, Baum DL. Implementation of an antimicrobial stewardship program at a 60-bed long-term acute care hospital. Infect Control Hosp Epidemiol. 2012; 33(4):405–408. [PubMed: 22418638]

34*. Doernberg SB, Dudas V, Trivedi KK. Implementation of an antimicrobial stewardship program targeting residents with urinary tract infections in three community long-term care facilities: a quasi-experimental study using time-series analysis. Antimicrob Resist Infect Control. 2015; 4(1):54. A time-series analysis evaluating the effect of weekly audit of antimicrobial prescription for urinary tract infections in a long-term care facility, which showed a significant increase in antimicrobial prescription for UTI post-intervention, but no reduction in the rates of MDROs. [PubMed: 26634119]

35**. Jump RLP, Olds DM, Seifi N, Drawz PE, Watts B, Bonomo RA. through an Infectious Disease Consultation Service: Keeping a. 2015; 33(12):1185–1192. Evaluation of the impact of on-site infectious disease consultation services in a veterans affairs long-term care facility, showing significant reductions in total antimicrobial prescription and *C. difficile* rates.

36**. Beaulac K, Corcione S, Epstein L, et al. Antimicrobial stewardship in a long-term acute care hospital using offsite electronic medical record audit. Infect Control Hosp Epidemiol/FirstView Artic. 2016:1–7. This is a time-series analysis implemented to measure the impact of antimicrobial stewardship with remote review of electronic medical records and intervention via telemedicine. Results were promising with a reduction in total overall antimicrobial usage as well as reduction in hospital acquired *C. difficile* infection.

37. Nicolle LE, Bentley DW, Garibaldi R, Neuhaus EG, Smith PW. Antimicrobial use in long-term-care facilities. SHEA Long-Term-Care Committee. Infect Control Hosp Epidemiol. 2000; 21(8): 537–545. [PubMed: 10968724]

38. Stuart RL, Wilson J, Bellaard-Smith E, et al. Antibiotic use and misuse in residential aged care facilities. Intern Med J. 2012; 42(10):1145–1149. [PubMed: 22472087]

39. D'Agata E, Loeb MB, Mitchell SL. Challenges in assessing nursing home residents with advanced dementia for suspected urinary tract infections. J Am Geriatr Soc. 2013; 61(1):62–6. [PubMed: 23311553]

40*. Juthani- M, Diseases I, Haven N, et al. Antimicrobials at the End of Life: An Opportunity to Improve Palliative Care and Infection Management. 2015:1–2. A commentary describing antimicrobial prescription in palliative care.

41**. Mitchell SL, Shaffer ML, Loeb MB, et al. Infection Management and Multidrug-Resistant Organisms in Nursing Home Residents With Advanced Dementia. JAMA Intern Med. 2014; 02131(10):1–8. A prospective cohort study evaluating antimicrobial prescription in nursing home patients with dementia showed high antibiotic use which rarely met the minimum clinical criteria for infection. The paper highlights the need to clarify patient care goals at the end of life.

42. Givens JL, Jones RN, Shaffer ML, et al. Survival and comfort after treatment of pneumonia in advanced dementia. Arch Intern Med. 2010; 170(13):1102–1107. [PubMed: 20625013]

Key Points

- The long-term care population is increasing, and healthcare-associated infections in these facilities now exceed that of acute care facilities.
- Preventing transmission in long-term care may be better achieved by targeting high-risk patients with indwelling catheters or pressure ulcers or during certain patient care activities.
- Improved antibiotic stewardship programs are a necessity in long-term care, as antibiotic overuse is common; there may be significant benefits to involving a specialized ID physician in antimicrobial decision making in nursing homes.
- While antibiotic administration is high in the last two weeks of life, it has been associated with decreased comfort in treated patients. There is an increasing need to evaluate and discuss patient goals and palliative care in order to avoid unnecessary interventions and further cultivate antimicrobial resistance.

Table 1

Prevalence of HAI in Age>65

Healthcare Associated Infections in the Elderly					
	Prevalence		**Distribution of infection**		**Mortality (overall)**
Health-care associated infection in age>65	<65	7.37%	Respiratory	20%	4%
	65–74	10.64%	Urinary Tract	17.9%	
	74–85	11.27%	Gastrointestinal	15.5%	
	>85	11.5%	Skin/soft tissue	10.9%	
			Bloodstream	4.5%	

Reference: Cairns, 2011

Table 2

Mean nursing home colonization rates, by organism

Nursing home colonization rates, by organism	
	Colonization Rates
MRSA	30%
VRE	33%
MDR GNR	20%
C. Difficile	4–30%

Reference: Cassone, 2015