

Infections in Residents of Nursing Homes

Catharina Matheï, MD, PhD^{a,*}, Luc Niclaes, MD^a,
Carl Suetens, MD, PhD^b, Béatrice Jans^b,
Frank Buntinx, MD, PhD^a

^a*Department of General Practice, KU Leuven, Kapucijnenvoer 33 blok J,
3000 Leuven, Belgium*

^b*Department of Epidemiology, Scientific Institute of Public Health,
J Wytsmanstraat 14, 1050 Brussels, Belgium*

Infections are very common in the setting of long-term care facilities and represent a major cause of morbidity and mortality among institutionalized elderly individuals. Some characteristics specific for the setting of a nursing home favor the spread of infectious diseases. Residents are clustered in a confined living arrangement and daily activities often take place in groups. Some residents are cognitively impaired and unable to follow basic hygiene precautions. Caregivers are often inadequately trained and may have little knowledge of the fundamental principles of infection control. As a consequence, adherence to hand washing in particular and other universal precautions is poor. Moreover, understaffing is a common problem in nursing homes. Nursing home residents are particularly susceptible to infections because they are physiologically old and often have comorbid underlying diseases that predispose them to site-specific infections. It is often difficult to diagnose infections in the elderly. As a result, the diagnosis and treatment may be delayed. These host and setting related factors facilitate direct or indirect transmission of infectious diseases among the residents in nursing homes.

Endemic infections as well as outbreaks are observed in nursing homes. Of particular concern are colonization and infection with antimicrobial drug resistant microorganisms. The most common endemic infections are respiratory, urinary, skin and soft tissue, and gastrointestinal infections.

* Corresponding author. Katholieke Universiteit Leuven, ACHG, Kapucijnenvoer 33 Blok J, 3000 Leuven, Belgium.

E-mail address: catharina.mathei@telenet.be (C. Matheï).

Respiratory infections include upper and lower tract infections. It is estimated that approximately 60% of lower respiratory infections represent pneumonia, which is often fatal [1]. Urinary tract infections are the most common in long-term care facilities for the elderly. Prevalence rates of bacteriuria are 25% to 50%, though most patients remain asymptomatic [2]. Skin and soft tissue infections include decubitus ulcers, infected vascular or diabetic foot ulcers, and other types of cellulites. Gastrointestinal infections primarily manifest as diarrhea.

Many fungi, viruses, bacteria, and parasites have been found responsible for causing outbreaks in nursing homes. The most common are outbreaks of respiratory infections caused by influenza, parainfluenza, and respiratory syncytial viruses. *Escherichia Coli*, *Salmonella*, *Clostridium difficile*, and small round enteric viruses are common causes of outbreaks of gastrointestinal infections. Outbreaks of scabies are also frequent in nursing homes.

Nursing home residents are at risk for colonization and infection with drug-resistant microorganisms, including methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *enterococcus*, penicillin-resistant *Streptococcus pneumoniae*, and gram-negative microorganisms with extended-spectrum beta-lactamases. Unlike acute-care hospitals, for which national and international networks are accumulating information on the prevalence of antibiotic resistance, the extent and significance of antibiotic resistance in nursing homes is still relatively unknown.

In this article, four infectious diseases very common in nursing homes—scabies, influenza, *Clostridium difficile*, and methicillin-resistant *Staphylococcus aureus*—will be discussed briefly, to demonstrate that the particularities of the specific setting of a nursing home and its elder residents may result in transmission dynamics of infectious agents behaving differently from those in other settings, such as acute hospitals.

Scabies

Scabies is an ectoparasite infestation caused by the mite *Sarcoptes scabiei hominis* and is transmitted by person-to-person contact. Although the infectious agent is endemic in impoverished communities, in industrialized countries outbreaks occur in well-confined settings such as kindergarten, acute-care facilities, and nursing homes [3]. Nosocomial scabies represents a challenge as health care workers may not be familiar with atypical forms and its containment is associated with a considerable workload and economic burden [4,5].

The pathognomic signs of scabies are burrows, erythematous papules, and generalized pruritus with nocturnal dominance. An atypical form, known as crusted scabies, presents as a psoriaform dermatitis with variable whitish scaling and mild or no pruritus [6]. In classic scabies the estimated number of mites per patient is 10 to 15, as compared with over 1 million

in crusted scabies. The numerous mites found in crusted scabies facilitate transmission through the environment. The crusts flake off, contaminate the environment, and mites survive in the environment for up to 3 days. By contrast, in classic scabies the environment plays a minor role in transmission. Crusted scabies are frequently found in immunocompromized patients, such as patients infected with HIV, patients receiving immunosuppressive therapy, individuals with mental retardation, and institutionalized elderly people. Within nursing homes, residents with unrecognized crusted scabies often constitute a source for spread of scabies to other residents and staff members [7].

Scabies outbreaks have been frequently documented in nursing homes. In a survey of 130 nursing homes in Canada, 25% reported cases of scabies among their residents during a 1-year period [8]. Over a 1-year period, 17% of Michigan's nursing homes reported scabies in the facility. In Oslo, Norway three scabies outbreaks occurred in three nursing homes over a period of 6 months [9]. The close contact between staff and residents and between visitors and residents in nursing homes may contribute to a repetitive and prolonged duration of scabies outbreaks. In a literature analysis of 44 scabies epidemics, the authors found six factors contributing to transmission and recurrent scabies in health care institutions [10]:

1. Once infected, a considerable number of patients are at risk of developing crusted scabies.
2. Many people are exposed through close contact.
3. There is a generally long diagnostic delay.
4. Insufficient survey of the epidemiological problem occurs.
5. Treatment failures occur.
6. Postintervention monitoring is incomplete.

Prompt recognition of scabies, followed by immediate implementation of preventive measures, is the cornerstone for the containment of a nosocomial outbreak.

Patients with suspected scabies should be isolated until 24 hours after treatment. Infection control measures differ between classic and crusted scabies. In classic scabies disposable gloves should be used during the 24 hours following treatment. Patients with crusted scabies should be hospitalized for treatment. When a case of crusted scabies is suspected, contact precautions should be strictly implemented, including the use of gloves, gowns, and shoe covers. A course of treatment should follow any skin-to-skin contact. Testing for scabies should be repeated when the patient becomes asymptomatic and 2 to 4 weeks after treatment completion. Fomites should only be handled by people wearing gloves. Clothing and linens should be machine washed in hot water. Carpets and furniture should be vacuumed and cleaned. Items that cannot be washed should be stored in plastic bags for 10 days at room temperature or placed in a freezer for 72 hours [11].

Influenza

Influenza presents a major source of morbidity and mortality. Older adults are at particular risk, given that 90% of influenza deaths occur in those aged 65 years and older [12]. Nursing homes, which generally have older and frailer residents, can experience attack rates up to 60% and case fatality rates as high as 55% [13]. Persons with underlying chronic diseases have higher rates of hospitalization and death during influenza epidemics, as compared with healthier persons. Influenza-associated morbidity and mortality are not only the consequence of complications like pneumonia, but may also result from exacerbations of underlying chronic diseases [14]. Residents of nursing homes are at higher risk of being exposed to influenza because the virus is more likely to be introduced and spread in an institutional setting. In addition to being in close contact with other residents, nursing home residents are also exposed to many other people, such as staff members, volunteers, and visitors. The high morbidity and mortality associated with influenza underscores the importance of annual immunization programs.

Though elderly people may have a relatively low antibody response to vaccine, studies have shown that when vaccinated nursing home residents become infected, their illness is often milder and of shorter duration than that of unvaccinated residents, and they are less likely to develop complications [15,16]. In a systematic review, the authors found that in nursing homes the overall effectiveness against pneumonia, hospitalization, and deaths from influenza was respectively 46%, 45%, and 42%, when vaccine matching was good. Moreover, they found all-cause mortality reduced by 60% [17]. However, vaccination showed a limited effectiveness in the prevention of influenza-like illness and none at all for the prevention of influenza.

Although there are currently no measures available to improve the immunologic response to influenza vaccine in the elderly, it is possible to decrease the risk of exposure to influenza by taking advantage of the added protection conferred by herd immunity. Numerous studies have demonstrated that nursing homes with high rates of vaccination among residents are less likely to experience outbreaks of influenza than those with lower vaccination rates [14].

Another strategy to reduce transmission within the setting of nursing homes involves vaccination of staff members. Because staff members are relatively young and healthy, they are more likely to develop protective postvaccination antibody titers than are the residents. Thus, high rates of vaccination among the staff may contribute substantially to the herd immunity within the nursing home by reducing the potential for both introduction and spread of the virus. Results of three recent studies have shown that staff immunization reduced mortality by 40%. The effective staff member vaccination rates in these three studies were 60%, 51%, and 48% [18–20]. Yet,

influenza vaccination coverage among health care workers remains suboptimal. Efforts should be made to achieve and sustain high levels of vaccination coverage among caregivers in nursing homes, including nurses, volunteers, and other persons in contact with the residents [21]. Even with high levels of vaccination coverage among residents and staff, influenza outbreaks still can occur [22].

Antiviral agents offer another option for controlling influenza in nursing homes. One of the most common causes of vaccine failure is antigenic drift. Because of the generally lower vaccine antibody response among nursing home residents, antigenic drift may reduce vaccine efficacy to a greater extent in this group than in more immunocompetent persons [14]. The proper use of antiviral agents provides another option for controlling influenza in nursing homes. They can limit the spread and stop outbreaks in early stages. When administered early after illness onset, they can also reduce severity and duration of uncomplicated influenza infections. The use of antiviral agents is most effective in stopping outbreaks when the drug is administered to all residents in the nursing home early in the course of the outbreak. This approach has been proven in several studies to effectively stop outbreaks in nursing homes [16,22,23].

Clostridium difficile

Diarrheal infections are common in nursing homes. The most commonly identified agent is *Clostridium difficile* (*C. difficile*) [24]. A spectrum of disease has been associated with *C. difficile*, ranging from mild diarrhea to potential fatal complications. Besides pseudomembranous colitis and toxic megacolon, complications, such as hypokalemia, gastrointestinal bleeding, and bowel perforation occur in up to 10% of patients with *C. difficile*-associated diarrhea (CDAD) [25]. However, residents of nursing homes with *C. difficile* are most often asymptomatic and will clear their feces by 2 months, although prolonged colonization for 3 months or longer has been observed [26]. An estimated 20% to 35% of patients with CDAD will experience at least one recurrent episode of CDAD. Relapse may arise from reinfection or germination of persisting spores into vegetative forms [27].

More than 80% of reported *C. difficile* infections occur in hospitalized or institutionalized adults aged 65 and older. In addition to antibiotic exposure—the main risk factor for a *C. difficile* infection—age-related changes in fecal flora, immune function, and the prevalence of chronic conditions have been implicated as causes of the high incidence of *C. difficile* in elder persons. CDAD is most often associated with broad-spectrum antibiotics, including third-generation cephalosporins and fluoroquinolones. The typical patient with *C. difficile* is an older man or woman who gets serious diarrhea during or immediately after antibiotic treatment. A more virulent strain of *C. difficile*, associated with poorer prognosis, is emerging and

caused by overuse of second- and third-generation fluoroquinolones, especially the C-8-methoxy fluoroquinolones [28].

The prevalence of *C. difficile* colonization in nursing homes in the absence of an outbreak has ranged from 4% to 20%. During outbreaks of CDAD, up to 30% of nursing home residents have been found to harbor *C. difficile* [26].

Patients with diarrhea caused by *C. difficile* typically have large numbers of organisms in their stool. After isolation of the symptomatic patient in an individual room, the environment of the patient will be contaminated within 24 hours. The environment, thus, can be considered as a secondary reservoir [29]. The spores of *C. difficile* can survive in the environment for weeks to months and resist heat, chemical disinfection, and dehydration very well. Contaminated toilets, telephones, and rectal thermometers have been implicated as potential sources of *C. difficile* outbreaks [30].

Direct transmission can occur between residents via feco-oral way, although direct transmission by spread from the hands of the personnel, fomites, or the nursing home environment presents the most important source of infection [31].

Since antibiotic use presents the main risk for acquisition of *C. difficile* at the institutional level, a rational use of antibiotics, together with measures designed to prevent spread of the organism, are the two main components to controlling *C. difficile* in nursing homes. In the case of CDAD, the first measure that should be considered is discontinuation of antimicrobial therapy [32]. Strict compliance with the universal precautions developed by the Centers for Disease Control protects other residents against infection with *C. Difficile*. Although most commonly used hand hygiene products, including alcohol-based products, are not sporidical, it has been observed that regular hand washing and wearing of gloves together are effective in preventing hand carriage by staff members [33,34]. To reduce spread it is recommended that patients with CDAD are placed in isolation until their diarrhea has resolved. Since recurrent CDAD is quite common, increased barrier precautions should be maintained for 7 to 10 days.

Given the widespread dissemination of *C. difficile* spores in the environment of patients with CDAD, environmental disinfection is recommended. Several studies have demonstrated that extensive environmental cleaning with a variety of disinfecting agents appears to decrease rates of new cases of CDAD [35,36]. Nevertheless, not many disinfectants have proven to effectively reduce surface contamination with *C. difficile* spores in the rooms of patients with CDAD. Solutions containing hypochlorite, which have been demonstrated to be effective to a certain degree, are currently recommended for environmental cleaning [37].

Methicillin-resistant *Staphylococcus aureus*

Worldwide, MRSA has become an increasingly common micro-organism since its emergence in the 1960s. The problem of MRSA is well documented

for the acute hospital setting. Numerous studies conducted in acute hospitals have identified admission from nursing homes as a major risk factor for MRSA carriage and vice versa [38]. Despite these studies, the epidemiology of MRSA within nursing homes has received limited attention. The available data show prevalence rates of MRSA colonization varying between 0% to over 40% [39]. MRSA prevalence in nursing homes shows a wide geographic variation and, within confined geographic areas, significant differences of MRSA prevalence between nursing homes have been observed [40]. It is not clear why MRSA is endemic or epidemic in some nursing homes while not in others. When colonized residents have been compared with noncarriers, increased age, underlying chronic disease, decreased mobility, impaired cognitive status, presence of intravenous, urinary, or enteral feeding devices, presence of wounds, recent use of antibiotics and recent hospital stay were frequently associated with MRSA carriage [40].

MRSA can be acquired *de novo* under the selective pressure of antibiotic use. Transferring patients between hospitals and nursing homes is common and some studies suggest that most nursing home residents acquire their MRSA carriage in a hospital rather than in the nursing home, creating a two-way flow of MRSA [41]. Little is known about the extent of transmission of MRSA within nursing homes. Transmission of MRSA seems rather uncommon in nursing homes, except in the case where MRSA is endemic or epidemic. This hypothesis is supported by the findings of a recent study in which the distribution of antibiograms of MRSA strains in different nursing homes was compared. It was found that in high prevalence institutions, the proportion of isolated MRSA strains showing the same antibiogram was higher when compared with low prevalence nursing homes [42].

It is assumed that indirect transmission from the hands of staff members presents the major mode of spread of MRSA within a nursing home. Direct transmission from resident to resident has been described, but seems rather uncommon. Although one study showed that the likelihood of MRSA carriage for a patient sharing a room with an MRSA-positive person was almost five times higher when compared with residents with an MRSA-negative roommate [42]. Likewise, the environment has been noted to be an uncommon source for transmission of MRSA within the setting of nursing homes [38].

Although it commonly causes only asymptomatic colonization, *Staphylococcus aureus* is a highly pathogenic organism with the potential to cause serious infections, such as blood-stream infections, pneumonia, endocarditis, skin and soft tissue infections, and bone and joint infections, often associated with significant morbidity and mortality [39]. While there is no evidence for MRSA being more virulent than Methicillin-susceptible *Staphylococcus aureus*, MRSA infections are significantly more difficult and costly to treat [43].

Much remains to be elucidated about the natural history of MRSA colonization in residents of nursing homes. Colonization with MRSA doesn't

necessarily translate into a higher risk for MRSA infection. One study showed that the incidence of MRSA infections among residents with MRSA colonization was comparable with the incidence among residents not colonized with MRSA [44]. A 3-year follow-up study of Belgian nursing home residents noted no excess hospitalizations or mortality among MRSA carriers, except in nursing home residents with severe disorientation in time and space [45]. It seems, based on the scarce data, that MRSA colonization as such is not harmful to residents in relatively good health.

Routine measures to control MRSA in nursing homes include adherence to the universal precautions and a rational use of antibiotics [38]. Surveillance cultures to identify MRSA carriers are not warranted. Patients colonized with MRSA should not be excluded from activities or isolated, as long as the colonized site can be covered and the patients are capable of performing good hygiene [40]. When cultures are obtained for clinical purposes, infection and colonization rates seem to increase and an outbreak is possible, thus more intensive infection control measures should be implemented. In the setting of an outbreak or high endemicity, survey of staff and residents for the presence of asymptomatic carriage and decolonization of asymptomatic carriers should be considered.

Infection control in nursing homes

An established body of information relating to the best practice of infection control and epidemiology exists for the acute hospital setting. However, preventive measures designed for acute hospitals cannot be transposed to the setting of nursing homes that easily. Besides setting and host-related factors, which make residents of nursing homes more vulnerable to certain infectious diseases or infectious diseases more easily transmissible, other differences between nursing homes and acute-care settings should be taken into account for the development and management of infection control. Generally, nursing homes have fewer resources. Employees with many other responsibilities may be responsible for infection control. The educational level of the staff may be lower than in acute-care facilities. Most facilities do not have on-site diagnostic laboratories or radiology capabilities. While older patients are often lacking physical signs and symptoms, diagnosis of infection is nevertheless often based primarily on clinical judgment. As a consequence, treatment is often empirical and broad-spectrum antibiotics are widely prescribed. The goals of nursing homes are inherently different than those of acute hospitals. In addition to providing skilled care and rehabilitation, these facilities serve primarily as a long-term residence for the elderly. Finally, limited research data are available to validate either overall infection programs or specific components of a program in nursing homes.

In the last two decades an increasing number of national and regional guidelines, surveillance, and infection control activities in nursing homes

have been produced in many countries [2]. These share their emphasis on the importance of adherence to universal infection control precautions, especially hand hygiene. Besides regular training of staff, this requires the availability of resources, such as hand-washing basins in each room, alcohol-based hand rub in each room or carried by the staff members themselves, and disposable gloves, gowns, and masks in the rooms if necessary. To ensure continued adherence to universal infection control precautions, ongoing supervision and fostering is indicated. Adherence to the universal infection control precautions is probably in most instances effective in preventing transmission of infectious diseases in nursing homes. Other measures often recommended to be part of the infection control strategy in nursing homes encompass the following:

Routine surveillance of infections seems critical in nursing homes, including regular review of available microbiological data obtained for clinical purposes, and identification of threshold infection rates that will prompt initiation of more aggressive infection control measures.

In the setting of an outbreak, cohorting or isolation of the infected patients might be indicated. It has been shown that isolation of nursing home residents is frequently accompanied by psychological distress, resulting in impairment of quality of life and deterioration of functional status. In the cases where isolation is unavoidable, effective ways of minimizing patient distress should be implemented [46].

Physicians should be educated regarding the proper use of antibiotics. Establishing criteria that, at a minimum, should be present before initiating antibiotics is a potentially important strategy for optimizing antibiotic use in nursing homes. Short-course, narrow-spectrum antibiotic therapy should be used whenever possible [47].

Appropriate immunizations should be offered to both residents and staff members through a preventive health program.

While substantial efforts have been made in managing infections in nursing homes, still many unanswered questions remain. This is reflected by the position paper by the Society for Healthcare Epidemiologist of America—Association for Professionals in Infection Control and Epidemiology on infection prevention and control in long-term care facilities, making recommendations which are evidence based [48]. Only five recommendations in these guidelines are supported by good to moderate quality of evidence: that is, by at least one randomized clinical trial or at least one well-designed clinical trial without randomization. These recommendations include hand-washing, tetanus-diphtheria immunization, annual influenza immunization, and hepatitis B and influenza immunizations for employees. All other recommendations are based on opinions of respected authorities. It is clear that further research is needed to evaluate the effectiveness of specific interventions to prevent and control infection in nursing homes.

Summary

Infectious diseases are a very common occurrence in nursing homes. While the reasons for preventing infections are the same in nursing homes and in acute hospitals, several considerations relevant to prevention of infection differ in nursing homes. Infection control measures should be based upon the particularities of the specific setting of a nursing home and its residents.

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