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Reimagining Infection Control in U.S. Nursing Homes in the Era of COVID-19

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ABSTRACT

Residents of nursing homes (NHs) are particularly susceptible to infection, and these facilities, particularly those that provide post-acute care services, are high-risk settings for the rapid spread of communicable respiratory and gastrointestinal illnesses, as well as antibiotic-resistant bacteria. The complexity of medical care delivered in most NHs has increased dramatically over the past 2 decades; however, the structure and resources supporting the practice of infection prevention and control in these facilities has failed to keep pace. Rising numbers of infections caused by *Clostridioides difficile* and multidrug-resistant organisms, as well as the catastrophic effects of COVID-19 have pushed NH infection control resources to a breaking point. Recent changes to federal regulations require NHs to devote greater resources to the facility infection control program. However, additional changes are needed if sustained improvements in the prevention and control of infections and antibiotic resistance in NHs are to be achieved.

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It is estimated that approximately 1.1 to 3.8 million infections occur in U.S. nursing homes (NHs) every year,^{1,2} and more than half of residents may be colonized with 1 or more types of antibiotic-resistant bacteria.^{3–5} The typical NH resident has an intrinsically higher risk of infection as a result of age-related immunosenescence and accumulation of multiple chronic health conditions that can lead to skin integrity impairment, bowel incontinence, bladder stagnation, reduced oral hygiene, and elevated risk of aspiration, as well as physical and cognitive functional impairments.^{6–8} Resident transitions between NHs and acute care facilities are common,^{9–11} and these individuals are often exposed to invasive medical devices^{6,12} and broad-spectrum antibiotics^{13,14} that increase the selection, overgrowth, and infections caused by *Clostridioides difficile*^{15,16} and multidrug-resistant organisms (MDROs).^{3,17,18} Several features of the

NH environment itself likely contribute to the high risk of infection and outbreaks observed in these facilities, including shared bedrooms and bathrooms, communal dining and shared activities, limited space for isolating residents with communicable illnesses, poor ventilation and air handling systems, the high frequency of contact between residents and care staff, and the limited capacity of residents with cognitive impairments to effectively adhere to recommended infection prevention behaviors.^{19,20}

Programs to prevent and control the spread of infection in U.S. NHs became increasingly common in the 1980s,^{20,21} and the Centers for Medicare and Medicaid Services (CMS) required implementation of infection control programs in all of its certified nursing facilities in 1992.²² Studies conducted in the subsequent decade revealed that, with notable exception,²³ the infection control program in most NHs largely consisted of a nurse with limited formal training and support from other facility staff who devoted less than 20 hours per week to their infection control duties, most of which was spent on conducting surveillance.²⁰ Unsurprisingly, lapses of infection control practice were among the most commonly cited deficiencies in U.S. NHs from 2000 to 2007.²⁴ Despite changes to the state survey process in 2009 that were intended to clarify the structure and process of the NH infection control program,²⁵ a nationwide survey conducted in 2014 found little evidence of change.²⁶ Moreover, a study found that infection control was the most commonly cited deficiency identified

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in U.S. NHs from 2013 to 2017, and 82% of facilities surveyed during this period had at least 1 infection control deficiency with 48% cited in multiple consecutive years.²⁷

Sweeping change to CMS NH regulations finalized in 2016²⁸ required U.S. NHs to implement an infection control program that included antibiotic stewardship and employing a trained infection preventionist whose main focus was oversight of the facility infection control program. A national survey conducted in 2018 documented improvement in NH practices focused on antibiotic stewardship, outbreak control, and prevention of urinary tract infections (UTIs),²⁹ suggesting some impact of the new regulations. Nevertheless, state surveyors continue to identify a high rate of deficiencies in infection control and prevention practice in U.S. NHs. A review of Certification and Survey Provider Enhanced Reports data collected during 26,201 inspections conducted in 14,894 U.S. NHs over 2 years (November 2017 to November 2019) identified 10,806 F880 (infection control) deficiencies given to 8464 NHs (57% of study sample).³⁰ Only a minority of the deficiencies were deemed to have caused actual resident harm or resulted in immediate jeopardy ($n = 81$; 0.75%), but the vast majority were associated with the potential for resident harm (98.3%), and 34.2% and 14.3% were deemed to be a pattern or widespread. Fifteen percent ($n = 2300$) of the facilities received 2 or more F880 citations during the study period. Facilities with multiple F880 citations were more likely to be for-profit, a higher percentage of residents funded by Medicaid, and a higher percentage of residents with invasive medical devices. A considerable amount of variation in how F880 citations were administered across the states was identified in this study. More than 50% of NHs in 31 states received at least 1 F880 citation, whereas administration of infection control deficiencies in other states was relatively sparse, which raises concern about how oversight of infection control practice in NHs is being conducted at the state level.

Unfortunately, the practice of infection prevention and control in NHs has failed to keep pace with the rising volumes of post-acute care now being delivered in many of these facilities.³¹ Although use of chronic indwelling urinary devices in NHs has decreased, up to 13% of newly admitted residents have a urinary catheter, as many as 22% have a central venous catheter, and up to 12% of residents have other types of invasive medical devices such as gastrostomy and tracheostomy devices.^{12,32} In addition, an increasing number of post-acute NH residents require postoperative wound care, and this population is particularly susceptible to wound-related complications and infection.³³ It is unclear if this higher complexity of care is associated with increasing numbers of infection in NHs, as nationally representative data, with the exception of UTI, MDROs, and *C. difficile*,³⁴ are limited but at least 1 study using the Minimum Data Set (MDS) suggests this may be the case.² Another consequence of the increasing volume of post-acute NH care is rising numbers of hospital readmissions,⁹ which creates an ideal environment for the concentration, amplification, and spread of MDROs within and from NHs.³ Indeed, many of the contemporary regional MDRO outbreaks can be traced back to NHs in one form or another.^{35–40} Moreover, mathematical models of emerging MDROs have repeatedly shown that NHs play a critical role in their regional spread, and that more robust efforts to combat spread within these facilities, particularly those that provide high volumes of post-acute care, will be needed to successfully contain these problematic pathogens.^{41–43}

Although outbreaks are an enduring feature of long-term care environments,^{44,45} the COVID-19 pandemic has laid bare the weaknesses of infection control programs in most U.S. NHs, with devastating consequences on residents and staff.⁴⁶ The vast majority of U.S. NHs have experienced at least 1 COVID-19 outbreak since the beginning of the pandemic, and large outbreaks involving more than 10% of a facility's census remain commonplace.⁴⁷ The effects of COVID-19 on NH residents and staff have been catastrophic; despite representing

only 0.5% of the U.S. population, 15% of the deaths caused by COVID-19 have occurred among NH residents ($n \sim 155,000$) and staff ($n \sim 2600$).⁴⁸ In addition to COVID-19, other respiratory and gastrointestinal infections are common occurrences in most NHs,⁴⁵ and an increasing number of outbreaks caused by high-consequence MDROs like carbapenemase-producing organisms³⁷ and *Candida auris*³⁵ are reported in facilities that provide high volumes of post-acute care. Although there are innate features of the NH environment that increase the risk of an outbreak,^{47,48} studies have shown the facility infection control program can play a critical role in limiting the size and consequences of outbreaks through rapid recognition of disease clusters, excluding ill staff and visitors, enhancing staff adherence to recommended infection control precautions, and coordinating effective compartmentalization of staff and potentially infected residents.⁴⁹

A Call for Reimagining Infection Prevention and Control in Nursing Homes

At a fundamental level, the NH infection control program has responsibility for a large number of processes that influence individual residents' risk of infection (see Figure 1). Under the current system, the facility infection preventionist is responsible for overseeing and managing these tasks with little support and assistance from other parts of the NH work system. Reviews and guidelines published before the rapid emergence of high-consequence MDROs and COVID-19, including those written by the author of this paper, go to great lengths to highlight the barriers to effective infection control in NHs.^{20,51,52} However, the dual challenges of rising complexity of medical care delivered in NHs and an increasing frequency of outbreaks caused by high-consequence pathogens require reimagining what is possible in this setting. In reimagining the NH infection control program, the author has structured suggestions for change using the Systems Engineering Initiative for Patient Safety framework, which expands on the basic structure-process-outcome framework to include reference to specific elements of the health care work system and their interrelationships (Figure 1).⁵⁰ Although a number of the proposed recommendations in the subsequent section of this article can be achieved with minor expansion and restructuring of existing resources, others will require substantial investment and time to implement successfully. The mechanisms by which investments to support the proposed recommendations are not addressed in the current article, but it is the author's belief that the reductions in preventable loss of life and disruptions to other facility care processes that undergird resident and staff quality of life will more than justify the costs.

Recommendations to Enhance Nursing Home Infection Prevention and Control Programs

People

The facility infection preventionist is arguably the most important component of a reimagined NH infection control program (Table 1). Regulatory changes finalized in 2016²⁸ included a requirement that NHs employ an infection preventionist who is on-site at least part-time. NHs with an infection preventionist who has received specific infection control training are more likely to report higher levels of adherence to recommended antibiotic stewardship and infection control practices.²⁹ The existing regulations stipulate NH infection preventionists should have specialized training, and the Centers for Disease Control and Prevention (CDC) has developed a basic introductory online infection control training curriculum.⁵³ This training introduces the new infection preventionist to basic infection control concepts and practices and should be viewed as the floor rather than

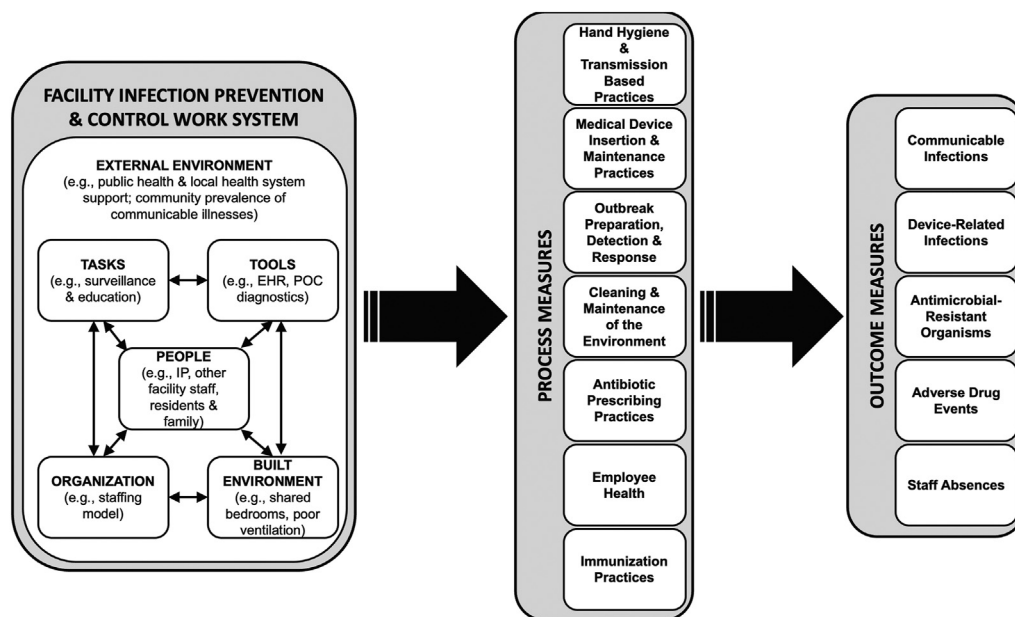


Fig. 1. NH infection control program work system. The NH infection control program is responsible for monitoring and effecting several facility practices (process measures) that influence the likelihood of different adverse outcomes (outcome measures) that can affect facility staff and residents. The facility infection preventionist (IP) is an important but small piece of the infection control program work system⁵⁰ that must be reimagined in order to better prevent and control the spread of infections in NHs. POC, point-of-care.

the ceiling of training requirements. Consequently, NHs should provide support for the facility infection preventionist to pursue additional training opportunities on an ongoing basis (**Recommendation 1.1**). States and national organizations should develop NH-specific infection control and prevention competencies and develop training resources to help NH infection preventionists achieve them (**Recommendation 1.2**).

Staffing requirements in NHs remains a controversial topic and there is only limited empirical evidence linking the amount of time the infection preventionist devotes to their infection control duties with the quality of the facility infection control program.⁵⁴ Nevertheless, recommendations for infection preventionist staffing ratios based on facility bed-size in U.S. hospitals^{55,56} and Canadian long-term care facilities⁵⁷ exist. The Canadian guidelines, which were developed by an expert panel convened in 2010, recommend NHs have 1 full-time infection preventionist for every 150 to 200 beds. Interim COVID-19 infection prevention and control recommendations recently published by the CDC go further, and recommend NHs with more than 100 beds or provide on-site ventilator or hemodialysis services have a full-time infection preventionist.⁵⁸ The role and responsibilities of health care infection preventionists have expanded considerably in the decade since these recommendations were promulgated, and more sophisticated staffing models based on the tasks performed by the facility infection control program are needed.⁵⁹ More research on the amount of time NH infection preventionists should devote to surveillance, staff education, occupational health, and quality improvement and how these responsibilities are affected by facility size and complexity of care provided in the facility should be pursued (**Recommendation 1.3**). Relatively low infection preventionist staffing may be appropriate for an NH that predominantly provides long-term care, but NHs that provide the highest levels of post-acute care services should be staffed to hospital infection control program standards (**Recommendation 1.4**).

Even under the most optimistic staffing models, it is unrealistic to expect the facility infection preventionist to oversee all necessary functions of the facility infection control program, nor will this

individual necessarily always be the most effective agent for influencing change in the facility. Consequently, it is critically important for the NH to have an infection control committee that meets regularly (**Recommendation 1.5**). At a minimum, the facility infection control committee should include key members of the facility leadership, including the administrator, director of nursing, and medical director. Given increased regulatory focus on antibiotic stewardship,⁶⁰ inclusion of the facility consultant pharmacist on the committee should be considered, particularly if the facility does not have a stand-alone antibiotic stewardship committee. The consultant pharmacist also can play a critical role in assisting the facility infection preventionist with antibiotic tracking and reporting activities and helping the facility develop antibiotic treatment protocols, identify staff training needs, and provide feedback and recommendations for improvement to facility prescribers (**Recommendation 1.6**).⁶¹ In a study recently conducted in Michigan NHs, the amount of time the infection preventionist devoted to infection control activities almost doubled from 20 to 38 hours per week during the COVID-19 pandemic.⁶² Submitting facility reports to the CDC's National Healthcare Safety Network (NHSN) and interfacility reporting activities accounted for much of the increased workload reported in this study. It is likely that CMS will continue to expand NH NHSN reporting requirements in the future, and one novel way facilities can better support their infection preventionist is to identify individuals within the facility who are already engaged in other administrative reporting tasks (eg, the MDS coordinator) who can offload the infection preventionist so they can focus more time on other important infection control-related tasks (**Recommendation 1.7**).

Tasks

Given the high frequency of citations for lapses in infection control practices reported in many NHs,^{24,27,30} greater emphasis is needed on staff education and monitoring adherence to important infection prevention behaviors such as hand hygiene, appropriate use of personal protective equipment (PPE), safe maintenance of invasive

Table 1
Recommended Changes to the NH Infection Prevention and Control Program

	Recommendation	Description
People	1.1	NH infection preventionists should have specialized infection control training
	1.2	Regulatory and professional organizations should develop infection control competencies and training resources specific to the NH setting
	1.3	The government and professional organizations should invest in research to identify the amount of time to be devoted to different infection control activities
	1.4	Infection control staffing in NHs that provide the highest complexity of post-acute care should mirror staffing employed in hospitals
	1.5	NHs should have an infection control committee comprised, at a minimum, by the facility administrator, director of nursing, and medical director
	1.6	Consultant pharmacists should be used to support key antibiotic stewardship activities
	1.7	NHs should find ways to use other facility staff, electronic medical record, and contracted microbiology laboratory to reduce the existing reporting burdens on the facility infection preventionist
Tasks	2.1	Facility nursing and nursing assistant staff should receive dedicated infection prevention and control education at hire and regularly throughout the year
	2.2	Staff education should be a core competency of the facility infection preventionist
	2.3	The infection preventionist should have sufficient time for their infection control duties
	2.4	Infection control duties performed by the infection preventionist should be prioritized over direct resident care duties
	2.5	NHs should develop pandemic and emergency preparedness plans
	2.6	Key facility stakeholders should regularly participate in preparedness tabletop exercises
	2.7	NHs with large referral volumes from hospitals should be active participants in regional and state emergency planning and response activities
Tools	3.1	NHs should find ways to use or purchase information systems to automate infection control surveillance activities
	3.2	Increase the use of rapid and point-of-care diagnostic microbiology testing in NHs
	3.3	Invest in research to better understand the benefits and optimal methods for implementing protective masking policies in NHs
	3.4	The government should invest in research to develop more effective vaccines and respiratory tract infection chemoprophylaxis treatments for use in NHs
Organization	4.1	NHs should invest more staffing and resources to educate staff about basic infection prevention practices
	4.2	NHs should invest more staffing and resources toward pandemic preparedness
	4.3	NHs should establish staffing structures that make the facility more resilient to outbreaks and health care–associated infections
Built Environment	4.4	NHs should physically segregate long- from short-stay residents and cohort staff to these areas when feasible
	5.1	NHs should be redesigned to eliminate shared resident bedrooms and bathrooms
External Environment	5.2	The government should fund research to determine if enhancements of NH indoor air quality can make these facilities more resilient to outbreaks caused by viral respiratory track pathogens
	6.1	Local hospitals and public health systems should provide greater materials and technical expertise to NHs to support their infection prevention and control activities
	6.2	The government should develop novel financing strategies to help not-for-profit NHs upgrade their aging infrastructure
	6.3	The government should increase funding of research focused on how to make NH environments more resilient to infection
	6.4	Redesign of financing and regulatory oversight to enhance the recruitment and retention of experienced NH infection preventionists
	6.5	Redesign of the system of regulatory oversight and financial penalties to drive infection prevention and control practice in NHs

medical devices, and early recognition of common transmissible infections (**Recommendation 2.1**). This should include infection control specific education at hire as well as regular ongoing training during dedicated staff in-services.⁶³ Educational activities should be directed at the facility certified nursing assistants given the prominent role they play in direct resident care activities.⁶⁴ Staff education should be considered a core competency of the facility infection preventionist and individuals in this role should devote adequate time to this activity (**Recommendation 2.2**).

Most NH infection preventionists have multiple additional non–infection control responsibilities,²⁶ although some, such as staff education, occupational health, quality improvement, and disaster preparedness, are well-aligned with infection control. It is, therefore, critical that facility leadership ensure the facility infection preventionist has sufficient time to devote to their infection control duties (**Recommendation 2.3**). The facility infection preventionist needs to understand and observe the clinical practice of the facility nursing staff and nursing assistants, but should have direct patient care duties only under the most dire staffing situations (**Recommendation 2.4**).

Although the pandemic preparedness of NHs improved from 2007 to 2020,⁶⁵ these facilities were under-prepared for the challenges they faced at the beginning of the COVID-19 pandemic.⁶⁶ NHs need to

develop pandemic and emergency response plans that address PPE supply, resident isolation, visitor exclusion, cohorting and furlough of staff, and communication channels with local hospital and public health officials (**Recommendation 2.5**). In addition, key facility staff should regularly engage in tabletop exercises to simulate emergencies the NH can expect to encounter (**Recommendation 2.6**). Finally, NH staff from facilities that provide large volumes of post-acute care (>100 post-acute care admissions per year⁶⁷) need to regularly participate in regional and state emergency planning, preparedness, and response activities (**Recommendation 2.7**).^{68,69}

Tools

Up to 80% of facilities now use an electronic health record (EHR) in one form or another.⁷⁰ Although use of the EHR has been shown to substantially reduce the amount of time hospital-based infection preventionists devote to surveillance,⁷¹ most NH infection preventionists continue to use pen and paper for the conduct of surveillance. Given the inordinate amount of time devoted to surveillance activities in NHs, finding ways to use the facility EHR to automate different tasks is a critical need (**Recommendation 3.1**).

Making actionable test results more accessible in NHs is another critical need (**Recommendation 3.2**). Point-of-care testing has been

used to rapidly assess inflammatory markers and identify infection with specific pathogens in ambulatory care settings,⁷² but their use in NHs has been more limited until recently. Point-of-care tests to measure C-reactive protein have been associated with reduced rates of antibiotic use,⁷³ and rapid antigen tests are widely used in NHs to rapidly identify COVID-19 infections. The use of rapid multiplex testing platforms also show promise for rapidly identifying the cause of respiratory tract infections and may help NHs more rapidly identify an outbreak.⁷⁴ Caution is needed, however, because misuse of certain multiplex platforms may lead to overdiagnosis and to overuse of antibiotics.⁷⁵

The use of effective PPE during the care of residents with an active transmissible infection is not controversial. Although data demonstrating the effectiveness of masking to prevent the spread of respiratory pathogens in NHs before COVID-19 were lacking,⁷⁶ universal masking has been widely practiced in NHs during the pandemic. Nevertheless, there are concerns that continuing widespread masking outside the context of an ongoing facility outbreak can impair resident quality of life and the level of protection masks provide in the era of widespread vaccination has been questioned.⁷⁷ Consequently, rigorous studies examining the benefits and implementation of protective masking policies in NHs should be a future funding priority (**Recommendation 3.3**).

Vaccination has been shown to significantly reduce the severity of infection for both influenza and COVID-19, but existing vaccines have less impact on preventing forward transmission.⁷⁸ Although there are several effective therapies for containing the spread of influenza in NHs,⁷⁹ the emergence of resistance can limit their effectiveness.⁸⁰ Monoclonal antibody treatments have been used to reduce the risk of infection among staff and residents of NHs experiencing a COVID-19 outbreak,⁸¹ but there are numerous challenges with their use at scale for chemoprophylaxis purposes. It is, therefore, important to continue to invest in research to develop and evaluate new vaccine candidates and chemoprophylactic treatments for COVID-19, influenza, and other transmissible pathogens commonly encountered in the NH environment (**Recommendation 3.4**).

Organization

As noted in the “Tasks” section, staff education and pandemic preparedness are core tasks that NH leadership need to support explicitly through staffing and resources (**Recommendations 4.1 & 4.2**). NHs with higher staffing ratios, lower rates of staff turnover, lower agency staff utilization, and lower numbers of staff who work in multiple NHs have been associated with favorable infection-related outcomes.^{82,83} Consequently, NHs should seek to optimize their staffing characteristics to reduce facility rates of infection and risk of severe outbreaks (**Recommendation 4.3**). Given higher rates of health care–associated infections and colonization and spread of MDROs among post-acute care residents, segregation of long- and short-term stay residents, as well as the staff caring for these individuals should be strongly considered (**Recommendation 4.4**). Sharing of Pandemic preparedness, separation of long-term stay and post-acute care populations, staffing (ratios, turnover, agency, part-time), staffing education

Built Environment

NHs with a higher degrees of resident crowding are more likely to experience larger and deadlier COVID-19 outbreaks.⁸⁴ Green House homes, which are smaller, use single rooms and bathrooms, and have consistent staffing, were substantially less likely to experience COVID-19 outbreaks as compared with traditional NHs.⁸⁵ These data provide compelling evidence to support the redesign and new construction of NH facilities that allow residents to be assigned to single rooms and

bathrooms (**Recommendation 5.1**), which should also greatly facilitate isolation of residents infected with potentially transmissible pathogens. The COVID-19 pandemic has resulted in a reevaluation of the mode by which many respiratory viral infections are transmitted.⁸⁶ The level of ventilation present in most NHs is far below that observed in the hospital setting.⁸⁷ However, the quality of evidence supporting a relationship between the low levels of ventilation in NHs and facility risk of experiencing a respiratory viral outbreak is quite limited,⁸⁸ so more research examining this relationship and effects of interventions to improve indoor air quality are needed (**Recommendation 5.2**).

External Environment

The COVID-19 pandemic has shown that state and local public health systems, as well as local health care systems, must provide better material and technical support around infection prevention and control to NHs (**Recommendation 6.1**).⁶⁹ Hospitals and NHs already actively collaborate on efforts to reduce readmission-sensitive conditions. Hospitals that find ways to extend their infection control resources and technical expertise to NHs in their referral networks have the potential to reduce avoidable readmissions and introduction of MDROs, which should generate benefits for both parties.⁸⁹

Several changes to existing state and federal government financing and oversight policies and practices are needed to achieve many of the recommendations proposed. Which changes to prioritize and how they will be achieved, although critically important, are beyond the scope of the current proposal and better left to those with more health care policy expertise. Major investment in upgrading the aging NH infrastructure is needed, and the government should identify various financing mechanisms that allow facilities to make these needed improvements in a manner that is equitable and minimizes the potential for inappropriate profit-taking (**Recommendation 6.2**). In addition, the government should increase funding to support research on identifying novel interventions to reduce the individual resident’s risk of infection and make NHs more resilient to outbreaks (**Recommendation 6.3**). This includes increased support for state and local quality improvement initiatives, as well as an examination of how existing oversight mechanisms can be better leveraged to support more consistent infection prevention and control practices in NHs. The funding and oversight of long-term care services needs to be redesigned in a manner that allows NHs to recruit, train, and retain experienced infection preventionist professionals and provide them with the necessary time to conduct the critical tasks for keeping the NH safe (**Recommendation 6.4**). Finally, there needs to be a fundamental rethinking of the oversight of infection prevention and control practices in NHs (**Recommendation 6.5**). This includes the following: (1) an examination of why there continues to be so much variation in the application of infection control–related survey deficiencies across states and individual surveyors and how this can be reduced; (2) consideration for subjecting facilities that provide on-site ventilatory and hemodialysis services to a separate, more rigorous, infection prevention and control survey; (3) consideration of a tiered survey approach that subjects facilities identified as having severe, pervasive, and/or persistent survey deficiencies to more rigorous review and monitored corrective action plans; (4) an examination of how NHs willing but struggling to improve can be more effectively linked to external improvement resources; and (5) an examination of how the existing financial penalty system can be better used to drive practice improvements or ownership change in those facilities demonstrating an unwillingness to improve.

Conclusions and Implications

NHs are ripe environments for the development and spread of infection, and these facilities play an important role in the regional

spread of high-consequence pathogens. The existing structure of the infection control program in most NHs is inadequate and requires major change for these settings to become safer and more resilient health care environments. The recommendations put forth in this article are not exhaustive, and implementing many will require significant change to existing financing and oversight structures. However, failing to act on most of these recommendations will lead to acceleration of infection-related problems in this critical component of our health care system.

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