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## Special Article

# Managing the Impact of COVID-19 in Nursing Homes and Long-Term Care Facilities: An Update



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## A B S T R A C T

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Older adults in nursing homes are at greatest risk of morbidity and mortality from SARS-CoV-2 infection. Nursing home residents constituted one-third to more than half of all deaths during the early waves of the COVID-19 pandemic. Following this, widespread adaptation of infection prevention and control measures and the supply and use of personal protective equipment resulted in a significant decrease in nursing home infections and deaths. For nursing homes, the most important determinant of experiencing a SARS-CoV-2 outbreak in the first instance appears to be community-transmission levels (particularly with variants of concern), although nursing home size and quality, for-profit status, and sociodemographic characteristics are also important. Use of visitation bans, imposed to reduce the impact of COVID-19 on residents, must be delicately balanced against their impact on resident, friend or family, and staff well-being. The successful rollout of primary vaccination has resulted in a sharp decrease in morbidity and mortality from SARS-CoV-2 in nursing homes. However, emerging evidence suggests that vaccine efficacy may wane over time, and the use of a third or additional vaccine “booster” doses in nursing home residents restores protection afforded by primary vaccination. Ongoing monitoring of vaccine efficacy in terms of infection, morbidity, and mortality is crucial in this vulnerable group in informing ongoing SARS-CoV-2 vaccine boosting strategies. Here, we detail the impact of SARS-CoV-2 on nursing home residents and discuss important considerations in the management of nursing home SARS-CoV-2 outbreaks. We additionally examine the use of testing strategies, nonpharmacologic outbreak control measures and vaccination strategies in this cohort. Finally, the impact of SARS-CoV-2 on the sector is reflected on as we emphasize the need for adoption of universal standards of medical care and integration with wider public health infrastructure in nursing homes in order to provide a safe and effective long-term care sector.

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Older adults resident in nursing homes or long-term care facilities represent those at greatest risk from infection with SARS-CoV-2, the cause of COVID-19 illness and the current pandemic.<sup>1,2</sup> In comparison

to their community-dwelling counterparts, older adults in nursing homes have greater levels of medical complexity, multimorbidity, frailty, and disability. Additionally, most older adults in nursing homes

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need assistance with personal care, and a significant number have cognitive impairment or dementia.<sup>3,4</sup> In addition, there are concerns of a lack of uniform medical care standards and insufficient integration of nursing homes in the wider infrastructure of public and secondary health care in many countries.<sup>5</sup> Collectively, this places older nursing home residents at greater risk of morbidity and mortality from viral infections, starkly highlighted in the first wave of the current pandemic where older nursing homes represented one-third to more than half of all deaths.<sup>6</sup>

Following the first wave, mortality significantly declined in nursing home residents as a result of widespread infection prevention and control measures, appropriate supply and use of personal protective equipment, and measures to increase temporarily medical supports in nursing homes.<sup>6,7</sup> Measures such as visitation bans and national lockdowns, which had a significant impact in the frequency of SARS-CoV-2 infections and outbreaks in nursing homes, represented significant challenges to the mental and emotional well-being of residents, their families, and nursing home staff.<sup>8–10</sup> Although the tremendous success of vaccination programs resulted in a sharp decline in infection and mortality rates in nursing home residents, management of breakthrough infections and associated outbreaks, particularly with variants of concern, is an ongoing challenge for the sector. This is particularly true in the face of waning vaccine efficacy over time and in periods of high community transmission, prompting the rapid and successful deployment of booster vaccinations in this cohort.<sup>11,12</sup> It is clear that surveillance of ongoing vaccine effectiveness and consistent reevaluation of the potential need for future vaccine boosters is of critical importance for the sector.

In the current narrative review, we discuss the impact of the SARS-CoV-2 pandemic on nursing homes, strategies to mitigate outbreaks, the success of mass vaccination as well as highlighting current and future challenges for the sector. We reflect on the particular challenges that are unique to nursing homes in managing suspected and confirmed SARS-CoV-2 infections and discuss the need for global development of and investment in a safe and effective long-term care sector.

## Clinical Presentation, Prevalence, and Risk Factors

### Clinical Presentation

Older nursing home residents with SARS-CoV-2 infection may present with symptoms that differ from their younger, community-dwelling counterparts. In addition to “typical” symptoms, including dyspnea, cough, pyrexia, headache, myalgia, anorexia, and fatigue, nursing home residents may also present with delirium, diarrhea, falls, behavioral change, seizures, reduced mobility, and other so-called atypical symptoms, although the use of such terminology risks overlooking these symptoms in daily practice.<sup>13–15</sup> Importantly, point-prevalence studies have demonstrated that a significant number (typically one-third to one-half) of older SARS-CoV-2–infected nursing home residents are asymptomatic or pre-symptomatic at the time of testing, which has represented a particular challenge in the early identification and management of suspected SARS-CoV-2 outbreaks.<sup>16–21</sup>

### SARS-CoV-2 Prevalence in Nursing Homes

Nursing homes were most affected by SARS-CoV-2 outbreaks during the first wave of the pandemic; however, estimates vary widely. During March–May 2020, an estimated one-third to two-fifths of Scottish and English nursing homes experienced an outbreak, mirrored internationally, although data may be limited because of lack of accurate diagnostic data during the first wave.<sup>22–25</sup> Following this, with changing epidemiology and adoption of infection prevention and control measures, personal protective

equipment usage, and the subsequent deployment of vaccination campaigns, SARS-CoV-2 prevalence in nursing homes decreased throughout 2020, including by 80.6% in one large English study.<sup>26</sup> Similarly, a German study examining data over 4 SARS-CoV-2 waves since March 2020 noted a significant decline in long-term care facility outbreaks during the third and fourth waves in comparison to first and second waves.<sup>27</sup> In an updated analysis, pooled data from 14 countries indicated a prevalence of 2.2% of occupied beds in Finland to 50% in the United States has been reported until October 2021, with most countries reporting previous infections in between 1/10th of 1/3rd of all residents infected.<sup>6</sup> More recent estimates of infection (and reinfection) prevalence, in the face of wide Omicron transmission, are unclear.

Most studies rely on diagnostic figures from outbreak characterization, screening and results of reverse transcription polymerase chain reaction (RT-PCR) testing for case identification. However, unique large-scale seroprevalence studies offer an insight into the true prevalence of past SARS-CoV-2 infection in residents. For instance, in the VIVALDI study, residents from 100 population-representative long-term care facilities in England underwent assessment for serial serum IgG antibodies throughout 2020.<sup>28</sup> Of these, a striking one-third had a reactive anti-nucleocapsid IgG result indicating previous infection.<sup>29</sup> However, antibody levels decay over time, and there may be a limited window in which these studies can be conducted to further clarify how many residents were infected with SARS-CoV-2 during the course of first waves of the pandemic.<sup>28,30</sup> Thus, further seroepidemiologic studies are warranted.

### Breakthrough Infections Postvaccination and Emergence of Variants of Concern

Despite declines in SARS-CoV-2 infection prevalence and successful vaccine rollout, breakthrough infections and outbreaks continued to occur throughout 2021, both in nursing home residents and staff previously vaccinated, increasing in number and scale prior to rollout of booster vaccine doses.<sup>31–37</sup> One report assessing data from 10 European Countries on 240 outbreaks from July to October 2021 noted this increasing risk, with 22.2% of residents affected, 10.2% of whom died.<sup>38</sup>

Importantly, evidence suggests that such “breakthrough” outbreaks postvaccination were associated with fewer case numbers per outbreak and both lower morbidity and mortality than the first 2 pandemic waves.<sup>27,38–40</sup> Increasingly, SARS-CoV-2 outbreaks in nursing home populations reflect circulating variants of concern, tied closely to strains circulating in the wider community. This includes documented outbreaks in nursing homes of the delta,<sup>41,42</sup> gamma,<sup>43,44</sup> alpha,<sup>45,46</sup> and beta<sup>47,48</sup> strains. Although early epidemiologic data for the Omicron variant suggest increased risk of infection and milder disease course compared to other variants of concern in vaccinated or previously infected individuals, the full impact of the Omicron variant on nursing homes is not currently clear.<sup>49,50</sup>

### Risk Factors for SARS-CoV-2 Infection in Nursing Homes

A body of research has emerged focusing on risk factors for SARS-CoV-2 outbreaks within nursing homes (Table 1). Most importantly, the likelihood of a SARS-CoV-2 outbreak appears most closely tied with the community-level prevalence of SARS-CoV-2 infection and nursing home size.<sup>22,25,51–55</sup> The relationship between staffing levels and likelihood of SARS-CoV-2 outbreaks is less certain, with both lower and higher staff numbers associated with likelihood of SARS-CoV-2 outbreaks in early reports.<sup>16,23,57,58,66</sup> However, there are issues apart from absolute staffing numbers that may influence this relationship. In a nationwide study in England, the likelihood of SARS-CoV-2 outbreak was significantly lower per unit increase in the

**Table 1**  
Risk Factors Associated With Experiencing a COVID-19 Outbreak in Nursing Homes and Long-Term Care Facilities

Risk Factor	References	Summary
Community transmission	22,25,51	<ul style="list-style-type: none"> <li>Scotland, N = 334 care homes: Increased likelihood of outbreak with rising community prevalence (OR = 1.2 per 100 cases/100,000 population increase)<sup>22</sup></li> <li>France, N = 943 nursing homes: Strong correlation (<math>R^2 = 0.71</math>) between population peaks and outbreak peaks in nursing homes<sup>25</sup></li> <li>Ontario, Canada, N = 770 facilities: Increased likelihood of outbreak with increasing regional prevalence<sup>51</sup></li> </ul>
Nursing home characteristics		
Nursing home size	22,25,51–55	<ul style="list-style-type: none"> <li>Scotland, N = 334 care homes: Increasing facility size (&gt;90 vs &lt;20 beds) linked with increased likelihood of outbreak (adjusted OR: 55)<sup>22</sup></li> <li>USA, N = 9395 facilities: Increased likelihood in medium (50–150 beds; adjusted OR: 2.63) and large (&gt;150 beds; adjusted OR 6.52) vs small (&lt;50 beds) facilities via public/state reports<sup>53</sup></li> <li>Systematic review, N = 36 studies in USA: Community prevalence and increasing nursing home size linked to greater likelihood of outbreak<sup>52</sup></li> </ul>
Nursing home design	56	<ul style="list-style-type: none"> <li>USA, N = 219 facilities: Non-traditional “Green House” Design associated with fewer outbreak cases<sup>56</sup></li> </ul>
Nursing home staffing		
Absolute staff numbers	57–59	<ul style="list-style-type: none"> <li>USA: Lowest quartile of unique employees associated with lower deaths than highest quartile (6.2 cases per 100 beds vs 11.9 per 100 beds) in US skilled nursing facilities<sup>58</sup></li> <li>France, N = 57 nursing homes: Significant correlation between staff and resident cases<sup>57</sup></li> <li>USA, N = 13,157 facilities: Increasing likelihood of outbreak with greater number of registered nurse hours<sup>59</sup></li> </ul>
Staff-resident ratio	23,60	<ul style="list-style-type: none"> <li>UK, N = 179 facilities: Lower staff-beds ratio an independent risk factor for likelihood of infection<sup>23</sup></li> <li>England, N = 5126 facilities: Reduced risk (adjusted OR: 0.63) of infection per unit increase in staff-bed ratio<sup>60</sup></li> </ul>
Staff statutory sick pay available	60	<ul style="list-style-type: none"> <li>England, N = 5126 facilities: Statutory sick pay available associated with reduced risk of resident infection (adjusted OR: 0.70)<sup>60</sup></li> </ul>
Staff cohorting	60	<ul style="list-style-type: none"> <li>England, N = 5126 facilities: Not cohorting staff in contact with infected residents associated with greater likelihood of infection (adjusted OR: 1.20)<sup>60</sup></li> </ul>
Frequent employment of agency nurses and carers	60	<ul style="list-style-type: none"> <li>England, N = 5126: Agency staff most days or every day associated with greater likelihood of infection (adjusted OR: 1.85)<sup>60</sup></li> </ul>
Nursing home quality and for-profit status		
Nursing home quality ratings	58,59,61–65	<ul style="list-style-type: none"> <li>USA, N = 123 facilities: Lower likelihood of outbreak with increasing CMS Five-Star Rating<sup>62</sup></li> <li>USA, N = 713 facilities: Higher CMS rating associated with lower likelihood of outbreak among staff and residents<sup>63</sup></li> <li>USA, N = 1223 facilities: CMS rating significantly linked to having both resident infection and death<sup>64</sup></li> <li>USA, N = 15,390: COVID-19 cases and deaths significantly higher in nursing homes with a lower rating<sup>65</sup></li> </ul>
For-profit status	60,63	<ul style="list-style-type: none"> <li>England, N = 5126 facilities: For-profit status associated with increased risk of outbreak (adjusted OR: 1.19)<sup>60</sup></li> <li>USA, N = 713 nursing homes: Greater outbreak size (12.7 times larger) in for-profit vs nonprofit counterparts<sup>63</sup></li> </ul>

OR, odds ratio.

staff-to-bed ratio and significantly lower in facilities that paid staff statutory sick pay.<sup>60</sup> Notably, staff caring for both infected and uninfected residents significantly increased risk of infection in residents as did frequent use of agency staff.<sup>60</sup> Thus, the link between staffing levels and outbreak likelihood may not reflect staff number, but other issues related to SARS-CoV-2 transmission between nursing home staff and residents, particularly in periods of high community transmission, which is closely coupled to outbreak likelihood.

A number of studies, mainly in the United States, have examined the relationship between nursing home quality and SARS-CoV-2 outbreaks, with conflicting findings.<sup>58,59,61</sup> Findings from a study in West Virginia examining the relationship between SARS-CoV-2 outbreaks and Centers for Medicaid & Medicare Services (CMS) Five-Star Quality Ratings reported a lower likelihood of outbreak with increasing rating, which was replicated in 2 Californian studies and in a large study of more than 15,000 Medicare- and Medicaid-certified nursing homes.<sup>62–65</sup> This was only partially explained by for-profit status.<sup>67</sup> A larger study of 8943 nursing homes in 23 states did not replicate this finding, although outbreak-affected nursing homes had more mean health deficiencies, emergency preparedness deficiencies, and substantiated complaints.<sup>68</sup> Overall, there does seem to be some evidence linking nursing home quality, staffing, and for-profit status with likelihood of outbreak, although this is yet to be fully elucidated.

Architectural design has been a relatively neglected consideration in pandemic preparedness of nursing homes, with evidence

suggesting that smaller Green House type nursing homes are associated with lower case numbers and mortality.<sup>56</sup> Within this context, other issues such as site location, ventilation, and access to outdoor space are likely to be important.<sup>69</sup>

### Risk Factors for Mortality From SARS-CoV-2 in Nursing Home Residents

#### Mortality from COVID-19 in Nursing Home Residents

Older nursing home residents comprised roughly one-third to half of deaths in the first wave of the SARS-CoV-2 pandemic.<sup>70–72</sup> Exact estimates vary by study design, methodology, and statistical approach; however, an excess number of total deaths in the first half of 2020 in nursing homes was reported. For instance, roughly 20,000 excess deaths in care homes in England and Wales and 15,000 excess deaths in France were reported during the first wave,<sup>73–75</sup> reflecting an excess in all-cause mortality for nursing home residents in 2020 compared with previous years.<sup>76</sup> A recent analysis of data from 14 countries until October 2021 that nursing home residents represented 11% of all COVID-19 deaths in Czech Republic and up to 50% in Belgium.<sup>6</sup> For residents infected with SARS-CoV-2, estimates of case-fatality vary from 20% to 50% for older nursing home residents, with a pooled estimate of 23% in one meta-analysis.<sup>77</sup>

An important concern in estimating nursing home COVID-19 deaths centers around the potential underreporting of deaths in some jurisdictions,<sup>78,79</sup> although this must be carefully balanced against the potential for retrospective attribution bias.<sup>80</sup> Mirroring the prevalence data reviewed above, mortality figures in nursing home residents decreased after the first wave, as seen in a study of more than 4 million older adults conducted in England.<sup>7</sup> The initial decline in mortality from March to November 2020 was seen with widespread infection prevention and control measures, personal protective equipment usage and experience managing COVID-19 illness<sup>81</sup> was followed by further reductions after mass vaccination, reviewed below.

### *Risk Factors for Mortality in Nursing Homes*

At an individual level, increasing age and frailty increase the risk of SARS-CoV-2 mortality among those infected.<sup>82–87</sup> Additionally, male sex,<sup>82–84,86,88,89</sup> dementia and neuropsychological conditions,<sup>82,86,90</sup> urinary and bowel incontinence,<sup>82</sup> diabetes,<sup>82</sup> chronic kidney disease,<sup>82,84,91</sup> cardiovascular disease,<sup>84</sup> previous pneumonia or respiratory disease,<sup>82</sup> greater levels of dependency,<sup>83,85,86,88</sup> malnutrition, and dehydration risk in addition to overall medical comorbidity<sup>92</sup> have all been associated with greater mortality from SARS-CoV-2 infection in nursing home residents. In terms of acute COVID-19 illness, symptomatic disease (particularly pyrexia and dyspnea), need for supplemental oxygen and oxygen desaturation, bilateral radiographic infiltrates and abnormalities on routine laboratory tests such as higher C-reactive protein (CRP) or interleukin-6 (IL-6), lymphopenia, lower GFR, hemoglobin concentration, hypernatremia, and reduced serum albumin have been associated with a greater risk of mortality in nursing home residents with SARS-CoV-2 infection (Table 2).<sup>92–95</sup>

At a facility level, several studies have reported significant associations between the racial and ethnic composition of nursing homes mortality from SARS-CoV-2 infection,<sup>96</sup> with higher mortality rates of non-White residents.<sup>97</sup> These system-level disparities have been replicated across multiple studies.<sup>98</sup> Similarly, area-level socioeconomic deprivation was associated with SARS-CoV-2 mortality in nursing home residents.<sup>99</sup>

A large study in England demonstrated greater mortality in larger homes and those belonging to a large provider, but no relationship between for-profit status and mortality.<sup>75</sup> A study in Connecticut, New Jersey, and New York reported more total beds, higher occupancy rates, and being a for-profit facility associated with greater mortality.<sup>100</sup> Although associations between nursing home quality and mortality are less clear, a 1-star CMS rating was associated with a 30% higher likelihood of death from SARS-CoV-2 in an American study of more than 15,000 nursing homes.<sup>65</sup> The link between quality and mortality has subsequently been replicated across several studies.<sup>64,98</sup> In sum, it appears that racial and ethnic composition, socioeconomic deprivation, and nursing home quality may be important factors in COVID-19 mortality risk. Risk factors for COVID-19 mortality in nursing home residents are summarized in Table 2.

### **SARS-CoV-2 Testing and Screening in Nursing Homes**

When discussing SARS-CoV-2 testing approaches, it is important to remember that incidence in nursing homes is closely coupled to community transmission and in many cases is asymptomatic or pre-symptomatic.<sup>101,102</sup> Overall, screening and testing strategies differ across jurisdictions in the early pandemic, but consensus largely supports regular point prevalence testing in periods of high community transmission before mass vaccination. Where an outbreak is identified, the evidence largely supports serial and universal swabbing of residents and staff, with most research conducted pre-vaccination.

RT-PCR, performed using nasopharyngeal/throat/saliva swab, is consistently the most reliable test in the diagnosis of SARS-CoV-2 infection.<sup>103,104</sup> The sensitivity of RT-PCR is about 90% in nursing home residents and can readily uncover asymptomatic and pre-symptomatic infection, although false negatives may occur.<sup>105</sup> Of note, PCR results may remain positive in nursing home residents for longer than 14 days, and indeed the rate of repeat positive tests in nursing home residents is significantly greater than those seen in younger adults.<sup>106,107</sup> The use of universal and serial RT-PCR during outbreaks has demonstrated efficacy in permitting the identification and isolation of residents with symptomatic and asymptomatic SARS-CoV-2 infection,<sup>108</sup> particularly in the early waves of the pandemic, when levels of community transmission are high before mass vaccination.

Many reports advocate for mass testing following the identification of a single suspected or confirmed case of SARS-CoV-2 infection, followed by repeated testing on days 4–7 in those with a negative result.<sup>109</sup> At the start of the pandemic, the absence of widespread testing was consistently highlighted as an important problem in many countries.<sup>109</sup> There is now strong evidence that mass testing following an identified SARS-CoV-2 case may rapidly identify additional cases in staff and residents not identified through targeted symptom-based testing.<sup>110–113</sup> In outbreak-free nursing homes during periods of low community transmission, the evidence is less clear. Although some benefit is seen with mass screening of residents,<sup>114</sup> some modeling studies suggest that the added benefits of mass universal screening in outbreak-free nursing homes are mostly negated when coupled with high-quality infection control practices, supporting the combination of outbreak testing with high-quality infection prevention and control measures.<sup>115</sup>

Concerns with cost and availability of RT-PCR testing in nursing home residents led many investigators to evaluate the use of rapid antigen testing in this context. Although rapid antigen tests demonstrate lower sensitivity than RT-PCR testing, they may identify residents with shedding of replication-competent virus and thus identify infectious rather than asymptomatic or presymptomatic individuals, and have demonstrated utility particularly in early outbreaks in nursing homes.<sup>116,117</sup> However, evidence supporting their use is more limited than RT-PCR. Early in the pandemic, approaches to screening also included screening of temperature and vital signs. However, use of temperature thresholds may fail to identify the majority of nursing home residents with SARS-CoV-2 infection,<sup>118</sup> and even with reducing fever thresholds, have limited sensitivity and specificity in the identification of SARS-CoV-2 infection,<sup>119</sup> making them unlikely to detect infection when used as a screening tool.<sup>120</sup>

In summary, testing strategies in nursing homes must take into account community-transmission, wider epidemiologic trends including mass vaccination, boosters, and emergence of variants of concern. The approach to testing in the current climate of widespread transmission of the Omicron variant in the community is less clear, but supports testing symptomatic individuals as well as close-contacts in nursing homes, in addition to mass testing once an outbreak is detected.

### **Key Issues in the Management of COVID-19 Outbreaks in Nursing Homes**

#### *Nonpharmacologic and Infection Control Measures*

Apart from the successful rollout of vaccinations within nursing homes, the most substantial impact on the number and severity of outbreaks has come from nonpharmacologic interventions targeted at mitigating the impact of SARS-CoV-2 outbreaks on residents. In line with testing strategies outlined above, swift identification of SARS-CoV-2 infection in nursing homes, appropriate use of



**Table 2**  
Risk Factors for Mortality in Nursing Home Residents

Risk Factor	References	Summary
<b>Individual characteristics</b>		
Age	82,84,87	<ul style="list-style-type: none"> <li>Sweden, N = 3731 residents: 30-day mortality greater aged &gt;80 y (adjusted OR 2.99) and &gt;90 y (adjusted OR 3.28) vs those aged &lt;70 y<sup>82</sup></li> <li>Spain, N = 2140 residents; N = 9121 from general population: Greater risk of mortality in nursing home residents aged &gt;80 y<sup>84</sup></li> <li>France, N = 480 infected residents: greater mortality risk in residents aged &gt;85 y (OR 2.36)<sup>87</sup></li> </ul>
Male sex	82–93	<ul style="list-style-type: none"> <li>Sweden, N = 3731 residents: Male sex associated with greater 30-day mortality (OR 2.60)<sup>82</sup></li> <li>USA, N = 5256 residents: women had a lower 30-day mortality than men (HR 0.69)<sup>93</sup></li> </ul>
Dementia and neuropsychological conditions	88,90,93	<ul style="list-style-type: none"> <li>Spain, N = 842 residents: Moderate/severe dementia associated with greater mortality (adjusted OR: 2.64)<sup>88</sup></li> <li>Netherlands, N = 1294 residents: Dementia associated with an increased 30-d mortality (HR: 1.3)<sup>90</sup></li> <li>USA, N = 5256 residents: Severe cognitive impairment associated with greater risk of 30-d mortality (OR: 2.79)<sup>93</sup></li> </ul>
Diabetes	82,93	<ul style="list-style-type: none"> <li>USA, N = 5256 residents: Diabetes associated with greater risk of 30-day mortality (OR: 1.21)<sup>93</sup></li> </ul>
Chronic kidney disease	84,91,92	<ul style="list-style-type: none"> <li>Sweden, N = 3731 residents: Diabetes associated with greater likelihood of COVID-19 mortality<sup>82</sup></li> <li>USA, N = 6798 residents: Poorer kidney function associated with greater likelihood of mortality<sup>91</sup></li> <li>Sweden, N = 3731 residents: Chronic kidney disease associated with greater mortality<sup>82</sup></li> <li>Canada, N = 5029 residents: Lower eGFR associated with greater mortality<sup>92</sup></li> </ul>
Cardiovascular disease	84,92	<ul style="list-style-type: none"> <li>Spain, N = 3567 residents: Cardiovascular Disease associated with mortality in 3567 nursing home residents (OR: 1.49)<sup>84</sup></li> <li>Canada, N = 5029: Cardiovascular comorbidities and heart failure associated with increased mortality<sup>92</sup></li> </ul>
Greater dependency and poorer physical function	88,92,93	<ul style="list-style-type: none"> <li>Spain, N = 842 residents: Greater Barthel Index associated with greater likelihood of mortality (adjusted OR: 5.03)<sup>88</sup></li> <li>Canada, N = 5029 residents: Poorer function on activities of daily living and pressure ulcer risk scores linked with greater mortality<sup>92</sup></li> <li>USA, N = 5256 residents: Functional dependence associated with greater mortality in 1185 residents admitted to hospital<sup>93</sup></li> </ul>
<b>COVID-19 illness characteristics</b>		
Symptomatic disease (pyrexia and dyspnea)	89,92–95	<ul style="list-style-type: none"> <li>Italy, N = 382 residents: Symptomatic illness associated with greater mortality (HR: 3.99)<sup>89</sup></li> <li>Spain, N = 1185 residents: Fever (OR:1.67) and dyspnea (OR: 1.66) associated with mortality in those admitted to hospital<sup>94</sup></li> </ul>
Bilateral pulmonary infiltrates	93,94	<ul style="list-style-type: none"> <li>Spain, N = 1185 residents: bilateral infiltrates on chest radiograph associated with greater mortality (OR: 1.98)<sup>93</sup></li> </ul>
Hypoxia	94	<ul style="list-style-type: none"> <li>Spain, N = 1185 residents: Hypoxia associated with 30-d inpatient mortality (OR: 2.05)<sup>94</sup></li> </ul>
Routine laboratory abnormalities	92–95	<ul style="list-style-type: none"> <li>Canada, N = 5029 residents: Lower hemoglobin, lymphocyte count, and serum albumin associated with higher mortality<sup>92</sup></li> </ul>
Higher C-reactive protein and interleukin-6 (IL-6)		<ul style="list-style-type: none"> <li>Spain, N = 1185 residents: High C-reactive protein (CRP) associated with mortality<sup>94</sup></li> </ul>
Lymphopenia, hypernatremia, lower albumin		<ul style="list-style-type: none"> <li>Italy, N = 50 residents: High IL-6 associated with mortality<sup>95</sup></li> </ul>
<b>Facility-level characteristics</b>		
Racial and ethnic composition of nursing homes	96–98	<ul style="list-style-type: none"> <li>USA, N = 13,123 facilities: Racial and ethnic composition linked to increased death rates in high-minority communities<sup>96</sup></li> <li>USA, N = 51,606 COVID-19 deaths: Mean number of deaths in nursing homes with the lowest proportion of White residents significantly greater than those with the greatest proportion of White residents<sup>97</sup></li> </ul>
Area-level socioeconomic deprivation	99	<ul style="list-style-type: none"> <li>England, N = 149 facilities: COVID-19 deaths more common in the most deprived quartiles of Income Deprivation Affecting Older People Index (IDAOPI) (IRR: 1.23)<sup>99</sup></li> </ul>
Larger nursing homes and larger providers	75,100	<ul style="list-style-type: none"> <li>USA, N = 1162 facilities: Greater number of total beds and a greater occupancy rate associated with greater likelihood of experiencing 6 or more COVID-19 deaths<sup>100</sup></li> <li>England, N = 29,542 deaths: Greater COVID-1–attributable death with large provider (OR 1.2) and larger vs smaller facilities (OR 13.3)<sup>75</sup></li> </ul>
For-profit status	100	<ul style="list-style-type: none"> <li>USA, N = 1162 facilities: For-profit status independently associated with greater likelihood of experiencing more than 6 COVID-19 deaths<sup>100</sup></li> </ul>
Nursing home quality	64,65	<ul style="list-style-type: none"> <li>USA, N = 1223 facilities: Significantly lower likelihood of death with a 5-star CMS rating<sup>64</sup></li> <li>USA, N = 15,390 facilities: 30% higher deaths in nursing homes with 1-star CMS ratings<sup>65</sup></li> </ul>

eGFR, estimated glomerular filtration rate; HR, hazard ratio; IRR, incidence rate ratio; OR, odds ratio.

PPE, and appropriate infection prevention and control measures have all demonstrated efficacy in managing individual outbreaks (Table 3).

Despite a large number of published studies, there is a lack of high-quality evidence in the literature supporting any one or composite measure. This is mainly driven by the need for urgent response in the containment of SARS-CoV-2 outbreaks in the pandemic, particularly in the first wave and a consequent lack of formal randomized controlled trials (clearly unethical given the severity of SARS-CoV-2 outbreaks in nursing homes). Several reviews have supported attention to appropriate use of personal protective equipment (and appropriate

training in same) and rigorous infection control procedures, including attention to meticulous hand hygiene and appropriate cohorting.<sup>121,122,124–128</sup>

A Cochrane review of nonpharmacologic measures to limit the spread of SARS-CoV-2 notes that most modeling studies and observational studies demonstrated uncertain results. Although visiting restrictions may reduce the number of infections and deaths, there was no clear evidence to support this.<sup>123</sup> This review did, however, support the use of protective masks, appropriate personal protective equipment use, cohorting, and surveillance measures.<sup>123</sup> It is difficult to estimate the true effect of any one nonpharmacologic intervention

**Table 3**  
Nonpharmacologic Approaches to Mitigate COVID-19 Outbreaks and Mortality in Nursing Homes and Long-Term Care Facilities

Mitigation Measures	References	Summary
Nursing home infection prevention and control measures		
Mass resident screening	121–123	<ul style="list-style-type: none"> <li>• Rapid systematic review of European, American, and Asian studies, N = 38 studies: Supports use of mass testing in outbreak-affected facilities<sup>121</sup></li> <li>• Cochrane Review, N = 11 modeling and 11 observational studies: Testing of new admissions and intensified testing of residents and staff after holidays may reduce infections<sup>123</sup></li> <li>• Cochrane Review, N = 11 modeling and 11 observational studies: Routine testing may reduce infection rates<sup>123</sup>; however evidence noted as uncertain</li> </ul>
Resident cohorting and physical separation of infected residents	121–129	<ul style="list-style-type: none"> <li>• Rapid systematic review of European, American, and Asian studies, N = 38 studies: supports cohorting protocols to reduce infection rates; however, data limited<sup>121</sup></li> <li>• Cochrane Review, N = 11 modeling and 11 observational studies: supports use of cohorting to reduce new infections but evidence remains uncertain<sup>123</sup></li> <li>• USA, N = 360 facilities: decline in weekly infection rates with implementation of infection prevention and control procedures<sup>122</sup></li> <li>• UK, agent-based modeling study: supports ongoing use of cohorting protocols in outbreak-affected nursing homes<sup>129</sup></li> </ul>
Promoting hand and respiratory hygiene	121,122,130	<ul style="list-style-type: none"> <li>• USA, N = 2580 residents: Greater implementation of hand and respiratory hygiene associated with lower infection rates<sup>130</sup></li> </ul>
Environmental cleaning	123,130	<ul style="list-style-type: none"> <li>• USA, N = 2580 residents: Greater implementation of environmental cleaning associated with lower infection rates<sup>130</sup></li> <li>• Cochrane Review, N = 11 modeling and 11 observational studies: Cleaning and environmental hygiene measures may reduce infection rates but evidence uncertain<sup>123</sup></li> </ul>
Personal protective equipment		
Supply of personal protective equipment	122,131,132	<ul style="list-style-type: none"> <li>• USA, N = 360 facilities: Rapid decline in infection rates following widespread use of personal protective equipment in a large cohort study<sup>122</sup></li> <li>• Cyprus, N = 5115 facilities: decline in infection rates during intervention period with adoption of personal protective equipment<sup>131</sup>;</li> <li>• USA, stochastic modeling study: Supports continued need for use of personal protective equipment in outbreak-affected facilities despite mass vaccination<sup>132</sup></li> </ul>
Training of staff in use of personal protective equipment	133	<ul style="list-style-type: none"> <li>• Belgium, N = 617 health care workers: Decreased infections when staff appropriately trained in personal protective equipment use<sup>133</sup></li> </ul>
Wider societal measures		
Visitation bans	123,129,134,135	<ul style="list-style-type: none"> <li>• USA, meta-population modeling study: Reduction in infection rate in areas imposing visitation bans<sup>134</sup></li> <li>• UK, agent-based modeling study: Reduced infections with visitation bans only when community prevalence where staff live considerably lower than prevalence where visitors live<sup>129</sup></li> <li>• UK, N = 57,713 individuals: “shielded” individuals had higher rates of infection, after adjustment for nursing home status<sup>135</sup></li> <li>• Cochrane Review, N = 11 modeling and 11 observational studies: Evidence uncertain to support visitation bans<sup>123</sup></li> </ul>
Interventions to support outbreak-affected nursing homes		
On site medicalization	136,137	<ul style="list-style-type: none"> <li>• Spain, N = 272 residents: On-site medicalization associated with a significantly greater composite of survival or optimal palliative care<sup>136</sup></li> <li>• USA, N = 215 residents: partnering with local hospitals successfully implemented, descriptive study<sup>137</sup></li> </ul>
Outreach teams	138,139	<ul style="list-style-type: none"> <li>• Netherlands, N = 41 long-term care organizations: Outbreak team monitoring successfully implemented, descriptive study<sup>138</sup></li> <li>• France, N = 63 facilities: Local multidisciplinary mobile team implemented to successfully manage outbreaks<sup>139</sup></li> </ul>
Telemedicine	140–143	<ul style="list-style-type: none"> <li>• USA, protocol development to identify telemedicine disruptions and solutions in supporting long-term care facilities: development and validation of several telemedicine platforms through quality improvement cycles<sup>142</sup></li> <li>• Europe, WONCA statement: expert consensus statement on the development of optimal telemedicine support<sup>143</sup></li> </ul>

because of spatial and temporal variation in transmission. Overall, it appears that there were lower rates of SARS-CoV-2 infection in facilities with greater infection prevention and control measures.<sup>130,131</sup>

Similarly, in studies from the first wave, facilities with personal protective equipment shortages were more likely to experience SARS-CoV-2 outbreaks,<sup>144</sup> with proper training of staff in the use of personal protective equipment crucial in reducing SARS-CoV-2 transmission.<sup>133</sup>

Importantly, modeling studies in nursing homes suggest an ongoing need for appropriate nonpharmacologic interventions even following the introduction of widespread vaccination, and lack of adherence to appropriate infection prevention and control procedures and provision or use of personal protective equipment in outbreak settings may mitigate some of the benefit of vaccination among residents.<sup>132</sup>

### *Impact of Wider Societal Measures and Visiting Bans on Mitigating COVID-19 Outbreaks*

An open question remains around the use of wider measures to prevent outbreaks in the first instance. Visitor bans widely adopted in several countries remained controversial, and many commentators note that the potential protection afforded must be balanced against the potential impact on residents' emotional and mental well-being. Although some evidence from modeling studies suggests that nursing home visiting bans were associated with a decrease in the basic reproductive number using a mechanistic meta-population model,<sup>134</sup> other evidence suggests that “shielding” of residents is not as effective as other nonpharmacologic measures such as appropriate infection prevention and control measures, and may be less effective in nursing home residents than shielding vulnerable adults in

the wider community at periods of high community transmission.<sup>129,135</sup> Thus, there is currently unclear evidence to support blanket visitor bans and shielding on older nursing home residents.

#### *On-Site Medicalization, Outreach Teams, and Telemedicine*

In managing a nursing home SARS-CoV-2 outbreak, a significant number of studies have emphasized the use of acute support (from hospital outreach teams, on-site medicalization interventions, and mobile geriatric medicine teams) in reducing hospital transfers and supporting outbreak management.<sup>136–138</sup> Support platforms have included access to multidisciplinary decision support, specialist phone hotlines, mobile geriatric medicine teams, and videoconferences on SARS-CoV-2 outbreak management.<sup>139,140</sup> Such platforms were developed in several countries and provided crucial support to nursing homes experiencing outbreaks.

A further area that saw increasing attention during the management of SARS-CoV-2 outbreaks in nursing homes is the use of telemedicine to support the provision of health care at a distance, reducing hospital admissions and improving medical care with geriatrician, psychiatric, and palliative care input in nursing homes.<sup>141</sup> Important aspects include staff motivation, engagement with the process, as well as dedicated time, equipment, and space for telemedicine consultations to occur.<sup>142</sup> However, although during the pandemic telemedicine was adopted to limit interaction, it may have negative effects on the quality of the doctor-patient relationship, the quality of physical examination, and provision of care.<sup>143</sup> The exact role of telemedicine in managing future outbreaks is yet to be fully elucidated, but has been a crucial support throughout the pandemic for outbreak-affected nursing homes.

#### *Advance Care Planning and Palliative Care in Nursing Homes During COVID-19*

The COVID-19 pandemic has a substantial impact on the provision of appropriate palliative care in nursing home settings and significantly disrupted the provision of appropriate end-of-life care.<sup>145</sup> For instance, in addition to other end-of-life routines not being followed, relatives were only present at time of death in a minority of cases in one study.<sup>146</sup> Additionally, in those dying from COVID-19, fewer discussions were had about end-of-life care in comparison to the year previous.<sup>146,147</sup> Similarly, studies have reported that in residents dying from COVID-19 illness, fewer physical examinations by doctors occurred prior to death, pain and oral health were less likely to be assessed, and fewer had formal palliative care input.<sup>148</sup>

A study in Dutch nursing homes during the first wave of the pandemic highlighted several features as part of advance care planning (ACP), including COVID-19 illness as the trigger for ACP discussion, a higher frequency of discussions, less face-to-face contact with decision makers, in addition to the additional discussion around intensive care unit admission as informing the provision of adequate end-of-life care.<sup>149</sup> Studies have reported several proactive measures to increase ACP in nursing homes during the pandemic, including online ACP training and information for staff and family members<sup>150</sup> and structured discussion tools, prioritized in individuals without an advanced care plan in place.<sup>151</sup>

#### **Clinical Efficacy of Vaccination in Nursing Homes**

The greatest impact on infection rates, morbidity, and mortality from SARS-CoV-2 in nursing homes has been mass vaccination programs. Impressive evidence from studies in tens of thousands of residents, staff, and health care workers has demonstrated an 81% to 90% reduction in SARS-CoV-2 infection across all groups accompanied by a significant reduction in mortality for nursing home residents at up to

6 months following primary vaccination.<sup>152,153</sup> Findings demonstrating decreased infection rates, spread of SARS-CoV-2, and mortality following primary vaccination have been widely replicated.<sup>26,154–159</sup> Although vaccine efficacy may have been reduced with the emergence of variants of concern, in particular with widespread circulation of the delta strain in several countries, vaccination in nursing home residents has demonstrated significant protection against infection, severe disease, and mortality in the context of widespread community transmission.<sup>160</sup>

However, recent evidence has emerged demonstrating a decline in vaccine efficacy over time following a primary course of vaccination. In VIVALDI, real-world vaccine efficacy measured in terms of infection and mortality in nursing home residents significantly declined after just 12 weeks.<sup>12</sup> Importantly, a “booster” or third vaccine dose restored vaccine efficacy and maximized immunity across all outcomes.<sup>12</sup> This is in line with strong evidence from large well-conducted studies demonstrating the restoration of vaccine efficacy following a third mRNA vaccine.<sup>161</sup> Additionally, evidence from Israel, the first country to administer booster vaccines to residents in long-term care facilities, demonstrated a reduction of 71% for overall infection and an 80% reduction in hospitalization in nursing home residents.<sup>11</sup> There is limited data on how long the protection afforded from a third dose of mRNA vaccine lasts in terms of SARS-CoV-2 infection and COVID-19 mortality. Findings such as those from VIVALDI support the need for ongoing surveillance of vaccine efficacy in this cohort to inform future vaccine and booster strategies in this vulnerable cohort.

#### **Humoral and Cellular Immune Responses to Vaccination in Nursing Home Residents**

A wealth of evidence has accumulated to support the immunogenicity of SARS-CoV-2 vaccination in older nursing home residents. Traditional vaccines (eg, influenza, pneumococcal, and herpes zoster) are typically less efficacious in this group, prompting early concern that this may be the case for SARS-CoV-2 vaccination. A large number of studies have now evaluated the immunogenicity of SARS-CoV-2 vaccination in residents by examining longitudinal effects of vaccination on measures of humoral and cellular immunity.

It is quite clear from these studies that the largest predictor of humoral and cellular immune responses is history of past SARS-CoV-2 infection.<sup>162,163</sup> Despite some studies, this has prompted authors to suggest that only a single vaccine dose may be required in those with past SARS-CoV-2 infection<sup>164,165</sup>; more recent longitudinal studies have suggested that 2 doses are required to reach population homogeneity in vaccine efficacy among nursing home residents.<sup>166</sup> Nevertheless, the clear effect of SARS-CoV-2 in shaping future immune responses to SARS-CoV-2 hints that with appropriate antigenic exposure, older nursing home residents can mount durable protective immune responses.

Studies examining humoral immune responses to vaccination have considered both postvaccination antibody titer (total IgG/IgA titers) and neutralization capacity (the ability of serum antibodies to inhibit the ACE2-spike receptor-binding domain interaction) to Wuhan strain SARS-CoV-2 and variants of concern antigens. Overall, humoral responses (both antibody titer and neutralization) in nursing home residents are significantly lower than their community-dwelling (and typically younger) counterparts.<sup>167</sup> Although detectable antibody titers and neutralization capacity are present in residents up to 7 months after primary vaccination,<sup>168,169</sup> titers and neutralization capacity significantly wane over time,<sup>170–172</sup> in particular for beta and gamma variants of concern.<sup>173</sup> The complex relationship between antibody waning and protection from breakthrough SARS-CoV-2 infection is yet to be fully elucidated.



In studies examining cellular immunity (typically assessed via T-cell interferon- $\gamma$  production on exposure to SARS-CoV-2 spike antigen), nursing home residents retained cellular immunity induced in the immediate period postvaccination to SARS-CoV-2 spike at 6 months despite significant decline in antibody titer over time.<sup>174,175</sup> However, this response was lower in residents than younger individuals<sup>176,177</sup> up to 6 months post primary vaccination.<sup>178</sup> Taken together, these early studies indicate a reduced immunogenicity of SARS-CoV-2 vaccines in older nursing home residents in comparison to their younger, community-dwelling counterparts (typically health care worker volunteers), supporting the use of a third vaccine dose in this cohort.

Recent evidence has emerged supporting the immunogenicity of a third or booster dose in nursing home residents producing antispikes, anti-receptor-binding domain, and neutralization titers above pre-booster levels.<sup>179</sup> In a longitudinal Canadian study, this represented 95% of residents achieving an antispikes level consistent with 80% protection from symptomatic infection, in comparison to 81% of residents achieving this level after their initial primary vaccine course.<sup>179</sup> This hints that vaccine boosters may allow a significantly greater duration of protection than the initial 6-month interval between primary vaccination and booster doses. Certainly, these data are in agreement with the epidemiologic data from studies such as VIVALDI (discussed above) in supporting the use of vaccine boosters after primary vaccination in nursing home residents. The duration of protection afforded from booster doses, in addition to the longitudinal kinetics of antibody responses postvaccination, in this cohort is yet to be determined and an area of active research and surveillance. This will be particularly important in moving from studies of humoral and cellular immunity to correlates of protection to SARS-CoV-2 infection in nursing home residents.

Currently, the exact relationship between antibody titers and breakthrough infections is still unclear. However, an important study in just under 400 residents from 7 nursing homes demonstrated an association between greater vaccine-induced anti-receptor-binding domain IgG levels and protection from infection in nursing homes experiencing an alpha variant of concern SARS-CoV-2 outbreak, encouraging further research into protective thresholds and clinical implications of waning antibody titers in this cohort.<sup>180</sup> Although many studies have longitudinally profiled measures of humoral and cellular immunity to SARS-CoV-2 in residents following vaccination, key “critical thresholds” are yet to be determined that afford residents protection from future SARS-CoV-2 infection. This is particularly important in population-level estimation of protection from SARS-CoV-2 outbreaks in nursing homes and in informing ongoing vaccination strategy, both in terms of the need for future vaccine boosters and the intervals at which this should occur in nursing home residents.

### Vaccination of Staff in Nursing Homes

Alongside vaccination of residents, vaccination against SARS-CoV-2 among staff members working in nursing homes is extremely efficacious. A recent study using data from 12,364 nursing homes in the United States demonstrated that lower staff vaccine coverage was associated with significantly greater additional SARS-CoV-2 infections and deaths in residents.<sup>181</sup> However, there have been significant barriers to vaccine uptake in some settings, with wide variation reported.<sup>182–184</sup> An early analysis of vaccination data in 14,900 American nursing homes reports that for-profit ownership was associated with lower rates of vaccine coverage, whereas increasing CMS Five Star Rating, a greater proportion of longer-tenured staff, and overall county-level vaccination were associated with greater uptake.<sup>185</sup>

In some jurisdictions, mandatory vaccination has been used as a condition of employment for care home staff.<sup>186,187</sup> Additionally, other measures have been deployed to encourage vaccine uptake among staff in nursing homes. Studies have demonstrated a significant impact of designated frontline staff champions, vaccination goals, nonmonetary rewards,<sup>188</sup> and have highlighted the importance of peer uptake on influencing vaccine hesitancy.<sup>189</sup> It is important to note the results of qualitative studies that have reported the presence of misinformation about vaccine development and side effects in some nursing home staff, highlighting the key role for both social and traditional media as an important source of reliable vaccination information.<sup>190,191</sup>

### Psychological Impacts of the COVID-19 Pandemic and Lockdown Measures

#### *Psychological Impact on Residents*

Both the COVID-19 pandemic itself in addition to infection control measures and visiting bans had profound impact on mental health and well-being of nursing home residents.<sup>8</sup> Throughout the first year of the pandemic, both the pandemic itself and visiting bans have been linked to increased risk of depressive symptoms in residents<sup>192</sup> in addition to worsening of preexisting depression.<sup>193</sup> Similarly, the prevalence of depressive symptoms significantly increased in comparison to prepandemic levels in one longitudinal study,<sup>194</sup> and studies have suggested a decline in cognitive function and an increase in depressive symptoms following the strict lockdown measures.<sup>195</sup>

Qualitative work has demonstrated the influence of strict lockdowns and visiting bans on feelings of loneliness in nursing home residents.<sup>196</sup> Data from the National Health and Aging Trends Study (NHATS) demonstrated a significant increase in symptoms of loneliness among residents as the pandemic progressed, with those unable to leave their room particularly vulnerable.<sup>197</sup> Similar findings from a Swiss study note the increased prevalence of subjective loneliness of residents in long-term care during the pandemic,<sup>198</sup> whereas a focus group study in Belgium noted loss of freedom, social life, autonomy, and recreational activities, impacting the basic psychological needs of residents.<sup>199</sup> Both the pandemic and strict lockdown measures have had a demonstrable impact on the mental health and well-being of nursing home residents. The exact impact of this is yet to be fully elucidated.

#### *Psychological Impact on Families*

As a result of strict lockdowns, many jurisdictions banned visits to nursing homes, with a substantial impact on both residents and families. Once visits were allowed, in many cases they were only allowed in the context of outdoor visits, with minimal contact and contact precautions in place.<sup>200</sup> Qualitative research from caregivers noted feelings related to physical separation, the inability of some individuals with cognitive impairment or dementia to understand the nature and rationale for visitation restrictions, and the need to stay connected to maintain the emotional and mental well-being of visitors.<sup>201</sup> Similarly, data from the Engaging Remotely in Care (ERiC) Study demonstrated low psychological and emotional well-being during the COVID-19 lockdown in previously regular visitors of residents, particularly evident among visitors of those with cognitive impairment.<sup>9</sup> For instance, in the ERiC study, visitors of those with cognitive impairment reported lower psychological and emotional well-being as measured using the WHO-5 well-being index.

Other studies have highlighted the importance of synchronous and familiar methods of communication such as telephone or email to maintain well-being in times of restrictions,<sup>202</sup> and indeed a systematic review recommends increased use of information and

communication technologies, family support groups, and the assignment of reference staff to each family.<sup>203</sup> Increasing the number of communication options, frequency of communication, and increased context-specific information has been emphasized to increase the satisfaction of communication during visitation bans in Dutch nursing homes.<sup>204</sup> Despite the impact of visiting restrictions on family members, most reported acceptance of visitation restriction policies.<sup>205</sup> However, the impact on visitors was particularly striking for individuals approaching end of life, where visitation bans and potential issues with communication may add to significant individual distress.<sup>206</sup>

### Psychological Impacts on Nursing Home Staff

Working during the pandemic has undoubtedly had a profound impact on care home staff. Nursing home staff working through the pandemic reported high levels of posttraumatic stress, mood disturbance, and moral injury.<sup>10</sup> Important exacerbating factors included social pressure from work, increase in working hours, high exposure to suffering, lack of personal protective equipment, staff shortages, and minimal senior support.<sup>207</sup> Similarly, lack of organizational support and a staff voice has been linked to increased perceptions of stress and anxiety in some nursing homes.<sup>208</sup> However, in the same cohorts, the importance of social support at work has been shown to promote professional satisfaction.<sup>209</sup> Studies examining staff resignations highlight the importance of effective employer communication, particularly in emergencies,<sup>210</sup> and an increased focus on communication and support, with access to mental health support, for nursing home staff is imperative at an organizational level.<sup>211</sup> Importantly, issues around low wages and lack of financial incentives may need to be resolved in order to attract and retain additional staff within the sector.<sup>211</sup>

### Implications for Practice, Policy, and Research

In the nursing home sector, quick adaptation in many (such as adaptation of infection prevention and control measures and the availability and use of personal protective equipment) resulted in a decrease in overall infection rates and deaths from COVID-19. However, the striking impact of the first wave swiftly demonstrated how ill equipped nursing homes were to contain the outbreak.<sup>212,213</sup> Nursing home residents represented between one-third and more than one-half of all nursing home deaths during the early waves of the pandemic and represent the group in society with the largest number of deaths from COVID-19 illness.

Following the early waves of the pandemic, both wider societal measures and those in nursing homes resulted in a decrease in the number of infections and deaths throughout much of 2020. Following the development and successful rollout of mass vaccination strategies, infections and deaths in nursing homes sharply declined; however, breakthrough infections, particularly with variants of concern, represent an ongoing concern for the sector. Importantly, risk factors for infections and outbreaks in nursing homes include SARS-CoV-2 community-transmission levels, nursing home size, quality and for-profit status, and wider societal measures. A wealth of high-quality evidence has emerged to support the effectiveness of both primary vaccination and vaccine booster doses in this group. Despite this, vaccine efficacy may wane over time and ongoing monitoring of infection levels and vaccine efficacy, particularly in the face of circulating variants of concern, is of crucial public health importance for the sector.

The sheer number of infections, outbreaks, and deaths experienced in nursing homes represented a significant challenge for the nursing home sector, one that has never been experienced. The unanticipated pandemic has indirectly laid bare several important deficiencies in the

nursing home sector—for instance the lack of universal adoption of standards and quality improvement in the sector.<sup>214,215</sup> Importantly, the pandemic highlighted the imperative quality improvement needed in the nursing home sector and the need to invest in a safe and effective long-term care sector into the future.

Important issues facing long-term care into the future include ensuring (1) recruitment and retention of a well-trained, geriatric medicine-attuned workforce; (2) adequate investment, financing, and regulation of the sector; (3) the coordination of many complex aspects of primary, secondary and multidisciplinary care within nursing homes; (4) optimal chronic disease and scheduled routine medical care (including vaccinations); (5) specialist input from geriatric medicine, psychiatry, and palliative medicine services; and (6) review of architectural design principles of nursing homes.<sup>214</sup> Importantly, many of these echo previous international guidance, including calls for universal adoption for standards of medical care by the European Geriatric Medicine Society in addition to position papers from the American Medical Directors Association (AMDA) and a recent report from the US National Academies of Science, Engineering, and Medicine.<sup>53,216,217</sup> Although a discussion on these standards and their implementation is beyond the scope of the current review, the COVID-19 pandemic has highlighted important deficiencies in the long-term care sector, necessitating the need for a reimagining in the provision of high-quality long-term care as we move forward.<sup>218,219</sup>

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