

## RESEARCH PAPER

# Asymptomatic carriage rates and case fatality of SARS-CoV-2 infection in residents and staff in Irish nursing homes

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## Abstract

**Background** SARS-CoV-2 has disproportionately affected nursing homes (NH). In Ireland, the first NH case COVID-19 occurred on 16 March 2020. A national point-prevalence testing programme of all NH residents and staff took place (18 April 2020 to 5 May 2020).

**Aims** to examine characteristics of NHs across three Irish Community Health Organisations, proportions with COVID-19 outbreaks, staff and resident infection rates symptom profile and resident case fatality.

**Methods** in total, 45 NHs surveyed, requesting details on occupancy, size, COVID-19 outbreak, outbreak timing, total symptomatic/asymptomatic cases and outcomes for residents from 29 February 2020 to 22 May 2020.

**Results** surveys were returned from 62.2% (28/45) of NHs (2,043 residents, 2,303 beds). Three-quarters (21/28) had COVID-19 outbreaks (1,741 residents, 1,972 beds). Median time from first COVID-19 case in Ireland to first case in these NHs was 27.0 days. Resident incidence was 43.9% (764/1,741)—40.8% (710/1,741) laboratory confirmed, with 27.2% (193/710) asymptomatic and 3.1% (54/1,741) clinically suspected. Resident case fatality was 27.6% (211/764) for combined laboratory-confirmed/clinically suspected COVID-19. Similar proportions of residents in NHs with 'early-stage' (<28 days) versus 'later-stage' outbreaks developed COVID-19. Lower proportions of residents in 'early' outbreak NHs had recovered compared with those with 'late' outbreaks (37.4 versus 61.7%;  $\chi^2 = 56.9$ ,  $P < 0.001$ ). Of 395 NH staff across 12 sites with confirmed COVID-19, 24.7% (99/398) were asymptomatic. There was a significant correlation between the proportion of staff with symptomatic COVID-19 and resident numbers with confirmed/suspected COVID-19 (Spearman's  $\rho = 0.81$ ,  $P < 0.001$ ).

**Conclusion** this study demonstrates the significant impact of COVID-19 on the NH sector. Systematic point-prevalence testing is necessary to reduce risk of transmission from asymptomatic carriers and manage outbreaks in this setting.

**Keywords:** nursing home, COVID-19, symptoms, residents, staff, older people

## Key Points

- COVID-19 has a substantial impact on nursing home residents and staff.
- A significant proportion of residents and staff with COVID-19 may be asymptomatic.
- Outbreak timing ('early' versus 'late') may impact clinical outcomes for residents.
- Systematic mass testing of nursing home residents and staff allows timely identification of asymptomatic individuals.
- Identification and isolation of asymptomatic individuals is essential for outbreak eradication and recovery in this setting.

## Background

SARS-CoV-2 and the related illness COVID-19 has disproportionately affected nursing homes (NH) since emerging in late 2019 [1]. NH residents are among the frailest in society, with multiple co-morbidities and high levels of care needs. NHs vary in size, staffing, governance and integration with wider health systems locally, nationally and internationally [2]. Policies on testing and reporting of COVID-19 in NHs differ between countries. Care home residents accounted for 53–82% of COVID-19-related deaths where confirmed and probable deaths are reported (Belgium, Canada, France, Ireland) [1]. Guidance published for long-term care facilities on infection prevention and management in the context of COVID-19 [3,4] can be challenging to implement due to variability in facilities.

Ireland has a 'mixed market' of NH provision. Public NHs, owned and operated by the government-funded Health Service Executive (HSE), and private NHs, by individual providers/provider entities. All are registered with the Health Information and Quality Authority and comply with regulations for standards of care [5]. There were 31,220 beds across 581 NHs in December 2018 [6]: the majority private NHs with ~25,000 residents and 121 (21%) public NHs with ~5,000 residents.

The first laboratory-confirmed COVID-19 case in Ireland occurred in the community on 29 February 2020 [7]. The first COVID-19 NH clusters were reported on 16 March 2020. The incidence of COVID-19 in long-term care residents in Ireland was 133/1,000 on 6 May 2020. As of 20 May 2020, 258 NH clusters were reported accounting for 4,872 cases and 851 deaths. The national COVID-19-related case-fatality figure for NH residents aged  $\geq 70$  years is 21% [7]. This may be an underestimate, failing to capture earlier attributable deaths.

Given emerging evidence on the impact of COVID-19 on NHs and on asymptomatic infection, the HSE directed a National Ambulance Service-led testing protocol in NHs followed by a national point-prevalence COVID-19 mass testing programme of all residents and staff in NHs from 18 April 2020 to 5 May 2020. Following this, systematic testing was completed at 2-week intervals as new NH COVID-19 cases were identified.

## Aims

To examine characteristics of NHs across three Irish Community Health Organisations (CHOs) in Dublin/Eastern Ireland, the proportion with COVID-19 outbreaks, symptom profile for staff and residents and resident mortality rates.

## Methods

An information sheet and survey document was distributed to lead Nursing and/or Medical Officers in 45 NHs across

three CHOs, followed by a telephone call to obtain consent and aid survey completion, ensuring correct interpretation of information. The survey was administered on one occasion, with data requested from 29 February 2020 to 22 May 2020 and deadline for returns set for 29 May 2020. Responses were anonymised with no site, resident or staff identifiers requested or retained.

Details were requested on NH occupancy (29 February 2020), total bed numbers, proportion of single rooms, COVID-19 outbreak details, date of first laboratory-confirmed COVID-19 resident and/or staff member, total symptomatic/asymptomatic cases and residents' clinical outcomes. Symptoms were defined as per public health guidance (cough, fever, dyspnoea) and 'new-onset' symptoms the medical officer/general practitioner felt reflective of emerging information on atypical symptoms. Asymptomatic cases (without symptoms 7 days either side of test) were identified in the national point-prevalence testing programme of residents and staff (18 April 2020 to 5 May 2020). Mass testing occurred on one occasion at each NH during this time and is systematically repeated at 2-week intervals where new COVID-19 cases were identified.

Laboratory-confirmed cases were those with 'detected' SARS-CoV-2 by real-time reverse transcription-polymerase chain reaction testing on nasopharyngeal swabs. Suspected cases were based on senior medical/nursing opinion of COVID-19 symptoms but resident unable/unwilling to complete testing or isolated awaiting results. COVID-19 deaths were those where confirmed/suspected COVID-19 was recorded as the official cause of death. Recovery was defined as an individual no longer in isolation; as per public health guidelines confirmed/suspected symptomatic individuals remained in isolation for 14 days (last 5 days without pyrexia) or for 14 days from testing date in the case of asymptomatic individuals.

For inclusion in analysis, an outbreak was defined as  $\geq 1$  resident with laboratory-confirmed COVID-19. NHs with one to two staff members and no residents affected weren't considered outbreaks on the basis that infection may have been acquired outside of the NH setting. An 'active' outbreak was defined as being within 28 days of symptom onset for most recent laboratory-confirmed case in a resident/staff member.

Data are reported as proportions (and percentages) and mean/median with standard deviation/interquartile ranges (IQR) as appropriate. Data on NH size (number of beds: <50, 51–100, >100) and occupancy (percentage of beds: <75, 75–85, 86–95, >95%) were categorised for between-group analysis. Median time from first confirmed COVID-19 case in Ireland to first case in included NHs was used to distinguish between 'early' and 'late' outbreaks in context of the first wave of pandemic. Comparisons of proportions between groups were carried out using a Chi-square statistic. Spearman Rank correlations were used to analyse correlations between variables. The World Medical Association—Declaration of Helsinki Ethical Principles

**Table 1.** Outbreak NH profile

	Public <i>N</i> = 4	Private <i>N</i> = 17	Total <i>N</i> = 21
Occupancy rate			
Date: 29 February 2020%, <i>n</i> (median, IQR)	95.1%, 157/165 (98.1%, 94.9–100%)	87.7%, 1,584/1,807 (97.6%, 85.1–98.6%)	88.3%, 1,741/1,972 (97.8%, 86.0–98.8%)
Date: 22/05/2020%, <i>n</i> (median, IQR)	75.2%, 124/165 (72.3%, 60.2–85.2%)	73.2%, 1,322/1,807 (80.3%, 69.4–86.7%)	73.3%, 1,446/1,972 (80.3%, 65.7–86.7%)
NH size (%), <i>n</i>			
<50 beds, <i>n</i>	4/4	1/17	5/21
50–100 beds	0/4	7/17	7/21
≥100 beds	0/4	9/17	9/21

were followed [8], adhering to all standards in the acquisition, anonymisation and reporting of data through consultation with the local research ethics committee.

## Results

Complete surveys were returned from 62.2% (28/45) of NHs representing 2,043 residents in 2,303 beds (median occupancy 96.7%, IQR 86.0–96.6%) on 29 February 2020. During the 83-day study period, 15.3% (312/2043) of residents died.

The first laboratory-confirmed case of COVID-19 in this series was on 16 March 2020. Median time from first COVID-19 infection in Ireland to first recorded cases in NHs (staff/residents) in this series was 27.0 days (IQR 22.5–40.5). Four recorded no cases in staff/residents. Three further NHs had ≤2 staff members and no residents with COVID-19. The remainder (21/28, 75.0%) were managed as active outbreaks and included in the study. There were 1,741 residents in 1,972 beds across these sites (median occupancy rate 96.7%, IQR 86.0–98.6%) on 29 February 2020. Of resident deaths recorded, 96.2% (300/312) occurred in ‘outbreak’ NHs with a mortality rate of 17.2% (300/1741).

### Outbreak NH profile

An outbreak was recorded in 75.0% (21/28) of facilities: 4 public and 17 private (Table 1). Occupancy rates at the start of the study period were 95.1% and 87.7% in public and private NHs respectively, decreasing to 75.2% in public and 73.2% in private NHs by 22 May 2020. Eight NHs (38.1%) had ≥80% single rooms in line with regulatory standards [9]. There was no association between adherence to this standard and outbreak occurrence ( $\chi^2 = 1.37$ ,  $P = 0.24$ ).

### COVID-19 in NH residents

During the study period, 40.8% (710/1741) of residents in 21 NHs with outbreaks had laboratory-confirmed COVID-19 and 3.1% (54/1741) clinically suspected COVID-19, giving a total prevalence of 43.9% (764/1741). Over a quarter of residents with laboratory-confirmed COVID-19 were asymptomatic (Table 2).

The case-fatality rate (CFR) was 25.8% (183/710) in those with laboratory-confirmed COVID-19. When clinically suspected cases were included, overall CFR was 27.6% (211/764) reflecting almost three-quarters (70.3%; 211/300) of deaths recorded in these NHs. Across 18 NHs with COVID-19-related deaths, the median proportion of total residents (as per occupancy 29 February 2020) who died as result of confirmed/suspected COVID-19 was 15.0% (range 13.1–19.4%). Non-COVID-19 mortality was similar in outbreak-affected and unaffected NHs (5.1% [89/1741] versus 4.0% [12/300]  $\chi^2 = 0.71$ ,  $P = 0.40$ ).

Comparisons of resident outcomes between public and private NHs are biased by low numbers of public NHs included (5/28, 17.9%). However, there were significantly more residents with confirmed/suspected COVID-19 in 4 public (106/157; 67.5%) versus 17 private (620/1,500; 41.3%) ‘outbreak’ NHs ( $\chi^2 = 39.6$ ;  $P < 0.001$ ). Similarly, case fatality attributable to COVID-19 was significantly higher in public NHs (35/157; 22.3% versus 168/1,500; 11.2%;  $\chi^2 = 16.2$ ;  $P < 0.001$ ).

In 11 NHs (11/21, 52.4%) with a first confirmed COVID-19 case ‘early’ in the course of the pandemic, 45.4% of residents developed confirmed/suspected infection, compared with 42.1% in NH with a ‘late’ first case. NHs with ‘early’ outbreaks had a higher number of deaths expressed as a proportion of total residents but similar CFR for residents with confirmed/suspected COVID-19 as NHs with ‘late’ outbreaks (Table 3).

By 29 February 2020, 55.8% (396/710) of residents with laboratory-confirmed COVID-19 had recovered. A lower proportion had recovered in NHs with ‘early’ outbreaks compared with NHs with ‘late’ outbreaks. A greater proportion of residents remained in isolation in the ‘early’ versus ‘late’ group (Table 3). Six NHs (6/21, 28.6%) had no residents with confirmed/suspected COVID-19 in isolation at the end of the study period; two (18.1%; 2/11) in the ‘early’ and four (40.0%; 4/10) in the ‘late’ outbreak group.

In 10 ‘COVID-19 outbreak’ NHs reporting total staffing levels, the median proportion of residents with confirmed/suspected COVID-19 was 43.7% (IQR 34.6–53.4%) overall. Two had a staff/resident ratios <1, six of 1–2 and two with >2 staff members per resident. NHs with staff/resident ratios of <1, 1–2 and >2 had a median of 46.7%

**Table 2.** SARS-CoV-2 infection in NH residents

	Confirmed	Suspected	Total
COVID-19 infection (% total residents)	40.8% (710/1,741)	3.1% (54/1,741)	43.9% (764/1,741)
Asymptomatic (% confirmed COVID-19)	27.2% (193/710)	N/A	27.2% (193/710)
Case fatality	25.8% (183/710)	3.7% (28/764)	27.6% (211/764)

**Table 3.** Residents and Staff outcomes with SARS-CoV-2 infection in NHs with early versus later pandemic outbreaks

	Early outbreak (<28 days)	Late outbreak (≥28 days)	
Total residents confirmed/suspected COVID-19 infection	45.4% (425/936)	42.1% (339/805)	$\chi^2 = 2.16, P = 0.14$
Confirmed/suspected COVID-19 deaths (% total residents)	13.5% (126/936)	10.6% (85/805)	$\chi^2 = 3.42, P = 0.06$
CFR	29.7% (126/425)	25.1% (85/393)	$\chi^2 = 1.14, P = 0.29$
Residents recovered from COVID-19	37.4% (159/425)	61.7% (209/339)	$\chi^2 = 56.9, P < 0.001$
Residents remaining in isolation	32.9% (140/425)	13.3% (45/339)	$\chi^2 = 15.2, P < 0.001$
Total staff members confirmed COVID-19 in 10 'outbreak' NH where total staffing reported (n, %)	33.6% (236/703)	28.9% (159/524)	$\chi^2 = 1.43, P = 0.23$
Asymptomatic staff members confirmed in 10 'outbreak' NH where total staffing reported	21.6% (51/236)	28.9% (46/159)	$\chi^2 = 2.75, P = 0.10$

(IQR 33.0–60.5%), 48.5% (IQR 36.3–53.4%) and 40.3% (IQR 39.4–41.3%) of residents with confirmed/suspected COVID-19, respectively. NHs with staff/resident ratios of <1, 1–2 and >2 had median CFR of 52.0% (IQR 45.3–59%), 24.8% (IQR 22.5–28.1%) and 10.9% (IQR 9.5–15.6%), respectively.

### COVID-19 in NH staff

Twelve NHs (42.9%, 12/28) reported information relative to total staffing (all grades) with a total of 1,392 working across these sites. Over a quarter (29.0%, 403/1,392) had confirmed/suspected COVID-19. Almost a quarter of those confirmed were asymptomatic (24.7%, 99/398).

In total, 10 of these 12 NHs (83.3%, 10/12) met outbreak criteria (one had no staff/residents with COVID-19, another two staff but no residents infected). In those NHs, 32.2% (395/1227) of staff had confirmed/suspected COVID-19. Approximately a quarter were asymptomatic (24.6%; 97/395). The median proportion of staff with COVID-19 per outbreak site was 31.1%; (IQR 23.2–40.6%), with 19.6% (IQR 11.8–52.3%) asymptomatic. There was a significant correlation between the proportion of staff with symptomatic COVID-19 and number of residents with confirmed/suspected COVID-19 (Spearman's rho = 0.81,  $P < 0.001$ ) but not between the proportion of asymptomatic staff and number of residents with confirmed/suspected COVID-19 (Spearman's rho = 0.18,  $P = 0.61$ ).

Total staffing was reported in six NHs (6/10, 703 staff) with 'early' and four (4/10, 524 staff) with 'late' outbreaks. Approximately one-third of staff in 'early outbreak' NHs (33.3%; 236/703,) and 30.3% (159/524) in 'late outbreak' NHs had confirmed/suspected COVID-19. Less than a quarter of staff (21.6%; 51/236) in 'early outbreak' NHs were asymptomatic, compared with 28.9% (46/159) in those with 'late' outbreaks, though this difference was not statistically significant ( $\chi^2 = 2.75, P = 0.10$ ) (Table 3).

### Discussion

This large epidemiological study of NHs, residents and staff demonstrates the disproportionate impact of COVID-19 on this part of the health sector. Within 21 NH outbreak clusters in this report, 43.9% of residents had COVID-19 over the 12-week period (83 days). Additionally, 29.0% of staff had COVID-19 in 10 'outbreak' NHs reporting total staffing. Mass point-prevalence and contact-tracing testing revealed asymptomatic/presymptomatic infection in 27.2% of residents and 24.7% of staff with COVID-19. Overall staffing ratios appeared to impact on CFRs across sites.

The CFR due to suspected/confirmed COVID-19 in residents was 26.7%, in contrast to the overall Irish national CFR (as of 6 June 2020) of 5.6%, almost half of which are deaths attributable to NH residents. This bias in the recording of national case fatality has led some commentators to suggest NH-related mortality should be examined separate to other community deaths [10]. NH residents have increased co-morbidities and frailty. Much of the increased mortality risk is associated with these factors. Usual annualised mortality rate of residents is estimated at 31.8% [11] typically equating to an expected rate of 7.2% over 83 days. In the 83 days of this study, the mortality rate was 15.3%, overall and 17.2% in 'COVID-19-outbreak' NHs, more than double the normal expected rate. With regards international comparisons on NH COVID-19 infection rates and case fatality, results are consistent with a report on 89 residents from a US facility [12], with an infection rate of 64% and CFR of 26%, and a series from 394 residents in four UK NHs with an infection rate of 40% and CFR of 26% [13]. In the UK series, 43% of residents and 4% of staff were asymptomatic.

This is the first report to investigate the effect of outbreak timing and the potential impact of concurrent mass testing on outcomes. Earlier in the pandemic, testing was on the basis of symptoms. There were significant challenges

accessing timely testing, personal protective equipment availability and clinical knowledge regarding potential 'atypical' and asymptomatic presentation of COVID-19 in NHs. When comparing outcomes for NHs with 'early' versus 'late' outbreaks, while there were similar rates of infection and CFR among residents, greater proportions of asymptomatic staff were identified as a result of mass testing in NHs with later outbreaks. It is possible that some asymptomatic staff carriers in 'early' outbreak NHs had undetectable viral loads by the time of testing but had unwittingly propagated the spread of infection within NHs at early stages of the pandemic when testing was performed on the basis of symptoms. This potentially resulted in 'late' outbreak NHs having greater success in controlling outbreaks in a timely fashion, as evidenced by fewer people in isolation at the end of the study period. Current evidence suggests that asymptomatic carriage is as virulent as symptomatic carriage, highlighting the importance of mass testing [14]. In NHs with 'early' outbreaks, asymptomatic infected individuals were only identified when mass testing was performed, by which time the outbreak was well established.

Public NHs appeared to have been impacted disproportionately severely relative to private NHs, although we must be cautious interpreting this finding as five small public facilities returned outcomes (four with outbreaks). Nonetheless, there were substantially higher infection and CFRs in public facilities. This may be explained by the complex case mix in public NHs, with frailer residents who have higher medical and social care needs requiring greater amounts of close contact care [15].

While all COVID-19 outbreaks in this series were active at the end of the study period, by 6 August 2020 all were resolved, indicating success of systematic mass testing, in combination with other factors including reduced community transmission. The proportion of asymptomatic individuals identified during COVID-19 mass testing and the subsequent reduction in numbers of cases suggest regular testing in NH settings is appropriate. To complement the testing programme, NH staff have been trained to perform COVID-19 testing; testing kits supplied to all NHs and protocols implemented with local laboratories, with a 48-hour turnaround time. Systematic mass testing of all staff/residents occurs (unless known positive within 3 months) within 24 hours, in any NH with a new case.

There are limitations to this study. Despite the sample size, it represents 5% of Irish NHs and 8% with COVID-19 clusters. In total, 38.8% (17/45) of NHs did not respond within the timeframe and were excluded. Eleven 'outbreak' NHs (52.4%, 11/21) did not provide total staffing information. Information, including COVID-19-related deaths, was self-reported, increasing risk of bias, although senior NH medical/nursing staff were best placed to give accurate information. We did not have information on the nature and severity of symptoms that would be of interest in light of reports of 'atypical' symptoms in this cohort.

## Conclusion

This study demonstrates the substantial impact of COVID-19 on NH residents and staff, supporting evidence that has emerged during the pandemic to date. Proportions of asymptomatic staff/residents and increasing knowledge of 'atypical' COVID-19 presentations support systematic mass testing in NH settings. The ability to test, trace and isolate asymptomatic residents/staff in a timely manner is an essential part of outbreak eradication and recovery in this setting.

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