

**Fig. 1.** COVID-19 cases and deaths in long-term services and supports (LTSS) settings. ABI, Acquired Brain Injury Waiver; AL, assisted living; CHCP, CT Home Care Program; NH, nursing home; PCA, Personal Care Assistance Waiver.

Assistance Waiver (PCA) (<age 65), and Acquired Brain Injury Waiver (ABI) through its Critical Incident Reporting System. The Department of Social Services created new classification codes at the pandemic's onset to track COVID-related incidents, which are required to be entered into the system within 48 hours of an incident. Reports come from participants, family members, providers, and hospital and NH social workers. The Department of Public Health requires NHs and ALs to report data on COVID-19 cases and deaths daily, which the Department of Public Health reports weekly on the State's COVID-19 data portal.<sup>2</sup>

## Results

Both positive cases and deaths from COVID-19 were substantially higher in NH and AL than in any Medicaid HCBS program (Figure 1). During the 5-month study period, more than one-third (37%) of NH residents and 14% of AL residents were COVID-positive, compared with the reported 2% to 3% in each HCBS program. Likewise, the percentage of NH (11%) and AL (5%) residents who died from COVID-19 was considerably higher than the HCBS population (CHCP and Personal Care Assistance Waiver < 1%; Acquired Brain Injury Waiver = 0%). Death rates among the subgroup of COVID-positive cases were more comparable across settings, ranging from 25% to 39% in CHCP, NH, AL, and PCA, with no deaths among ABI participants (Figure 1).

In addition to the low incidence of positive cases and deaths for people receiving long-term services in home and community settings, COVID-related hospital and NH admission rates were also quite low in all 3 HCBS programs. Fewer than 3% in any program were hospitalized and fewer than 1% transferred to NHs. However, the small subset of COVID-positive HCBS participants did experience a substantial number of hospital and NH admissions. Between 60% and 68% of positive cases in the 3 HCBS programs were admitted to a hospital, and 17% to 30% were admitted to an NH during the study period. Comparable data were not available for persons living in congregate (NH and AL) settings. Data on deaths and hospital and NH admissions are not mutually exclusive.

## Discussion

All persons in Medicaid HCBS programs are at risk of institutionalization or meet NH level of care and thus have comparable medical vulnerability to NH residents and perhaps more than some AL residents. Nevertheless, their COVID-19 positivity rate during the first 5 months of the pandemic in Connecticut was considerably

lower than residents of either congregate setting. Among COVID-positive cases, death rates were more comparable across settings, and the small percentage of COVID-positive HCBS program participants also had relatively high rates of COVID-related hospital and NH admissions. The main distinction between groups was their living situation. It is likely that living in the community, vs a congregate setting, accounts for the significantly lower infection rates. These figures bear close monitoring for the HCBS population because if trends move upward, any policy response will be challenged by the decentralized location of these community-dwelling vulnerable adults.

One study limitation is that testing protocols differed among the settings. Mandatory 100% testing began in May for all NH and AL residents. HCBS participants did not have mandatory testing. Thus, COVID-19 infection rates may be somewhat underreported because of asymptomatic cases or cases not otherwise diagnosed as COVID-19, but they are still markedly lower than the NH or AL rates.

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## References

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## Temporal Associations between Community Incidence of COVID-19 and Nursing Home Outbreaks in Ontario, Canada



### Background

Nursing homes have borne the brunt of the COVID-19 pandemic, with residents of these homes incurring extreme morbidity and

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**Fig. 1.** Temporal Relationship between Community Incidence of COVID-19 and Outbreaks in Ontario's 623 Nursing Homes (April 8–July 16, 2020). All active COVID-19 community cases (cumulative cases less resolved cases and deaths) and COVID-19 nursing home outbreaks in the Province of Ontario were calculated during the period from March 1 to April 8, 2020, after which we evaluated the temporal relationship between cases and outbreaks from April 8 to July 16, 2020. Results are displayed for the entire Province of Ontario and its 5 provincial health regions. The reported lag times indicate the number of days most correlated between active COVID-19 community cases and nursing home outbreaks.

mortality.<sup>1</sup> The risk of nursing home COVID-19 outbreaks is strongly associated with the rate of infection in the communities surrounding homes, with infected health care workers being important and unknowing vectors for transmission into homes.<sup>2–4</sup> The temporal relationship between rising rates of community COVID-19 infection and the risk threshold for subsequent nursing home COVID-19 outbreaks is not well defined.

### Objective

Evaluate and quantify the temporal relationship between community incidence of COVID-19 and subsequent risk of COVID-19 outbreaks in nursing homes in Ontario, Canada.

### Methods and Findings

This population-based cohort study included all laboratory-confirmed COVID-19 cases in the Province of Ontario, Canada (population >14 million), between March 1, 2020 (start of community transmission of COVID-19), and July 16, 2020 (no new nursing home outbreak for >7-day period). We obtained data for this study from the Ontario Ministry of Health as part of the province's emergency "modeling table," including deidentified line level data from the integrated Public Health Information System on all reported COVID-19 cases for both community and nursing home dwelling Ontario residents. We also obtained data on COVID-19 outbreaks from the province's Long-Term Care Inspections Branch COVID-19 case tracking tool. In Ontario, a nursing home COVID-19 outbreak is defined as either 1 resident or staff case and is declared over when there are no news cases within a 14-day period. All

statistical analyses were completed in SAS Statistical Software and Python. The study was approved by the Research Ethics Board of the University of Toronto.

There was a total of 37,274 COVID-19 cases reported over this time period, of which 5545 (14.8%) were reported among residents of 343 cumulative nursing home outbreaks. We assigned all nursing homes to one of Ontario's 5 administrative health regions (West, Central, East, North, and Toronto). We then evaluated the temporal relationship between trends in the number of active community COVID-19 cases (cumulative cases less resolved cases and deaths) in each geographic region and the number of nursing home outbreaks (Figure 1). Active cases were used because they are better reflective of the risk of infection in the population. We calculated Pearson correlation coefficients ( $r$ ) between the number of nursing home outbreaks and daily active community cases of COVID-19 in the days (1-50) preceding outbreaks, and ranked coefficients by their descending values. The day with highest  $r$  value was chosen as the "lag day" indicator. The average lag time between community cases and nursing home outbreaks was 23 days for Ontario overall, with substantial variability across geographic regions ranging from 11 to 43 days (Table 1). The longest lag was observed in the North Region, which has low population density and reported a substantially lower cumulative COVID-19 incidence in nursing home residents (0.3%) compared with the provincial average (7.5%) over this time period.

We next used logistic regression to model the probability of a nursing home outbreak, with the independent variable being active community COVID-19 cases, as above, in the preceding days before an outbreak. We determined thresholds of community incidence of COVID-19 associated with a 75% probability of observing a nursing

**Table 1**  
 Characteristics of Ontario's 623 Nursing Homes and Lag Times Between Community Incidence of COVID-19 and Nursing Home Outbreaks (March 1–July 16, 2020)

Geographic Region	Population Density per Square Kilometer*	Number of Nursing Homes	Number of Nursing Home Residents	Cumulative COVID-19 Cases in Residents	Threshold of Daily Active COVID-19 Community Cases per 100,000 Population <sup>†</sup> Resulting in a 75% Probability of a Future Nursing Home Outbreak		
					5 d	10 d	15 d
Central	294.4	123	17,315	2273	2.93	4.02	5.84
East	64.7	165	20,327	1936	1.88	5.53	6.38
North <sup>‡</sup>	1.0	63	6495	17	—	—	—
Toronto	6412.6	36	5695	739	3.52	9.63	13.58
West	94.9	236	25,844	716	1.83	3.07	1.64
Ontario	14.8	623	75,676	5681	2.30	3.65	3.93

\*Source: Ontario Ministry of Finance, based on 2016 Canadian Census.

<sup>†</sup>Daily active COVID-19 community cases per 100,000 population. All active COVID-19 community cases (cumulative cases less resolved cases and deaths) and COVID-19 nursing home outbreaks in the Province of Ontario were calculated during the period from March 1 to April 8, 2020, after which we conducted logistic regression on all active cases and nursing home outbreaks from April 8 to July 16, 2020.

<sup>‡</sup>Threshold calculations for the North Region were suppressed because of the small numbers of reported cases and small population size.

home outbreak 5, 10, and 15 days into the future (Table 1). For the province overall, when daily active COVID-19 community cases are 2.30 per 100,000 population, there is a 75% probability of a nursing home outbreak occurring 5 days later.

## Discussion

Across Canada's most populous province of Ontario, increased community COVID-19 transmission portended a 23-day lagged rise in the number of nursing homes experiencing COVID-19 outbreaks. Our findings also establish thresholds for community infections at which outbreaks in nursing homes first occur. This is a useful early warning indicator when establishing surveillance systems, and the lag days estimate provides a time window during which nursing homes should rapidly mobilize occupational health and infection prevention and control processes to both prevent and mitigate COVID-19 outbreaks.

Our analytic approach reinforces the importance of disaggregating community and nursing home populations in models of COVID-19 and may also be applicable to other congregate care settings, including assisted living facilities.<sup>5,6</sup> Our findings are also highly relevant to jurisdictions like the United States that are implementing phased approaches to reopening nursing homes based on COVID-19 case status in the community.<sup>7,8</sup>

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