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Brief Report

Impact of a Public Policy Restricting Staff Mobility Between Nursing Homes in Ontario, Canada During the COVID-19 Pandemic



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A B S T R A C T

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Objectives: To assess changes in the mobility of staff between nursing homes in Ontario, Canada, before and after enactment of public policy restricting staff from working at multiple homes.

Design: Pre-post observational study.

Setting and Participants: 623 nursing homes in Ontario, Canada, between March 2020 and June 2020.

Methods: We used GPS location data from mobile devices to approximate connectivity between all 623 nursing homes in Ontario during the 7 weeks before (March 1–April 21) and after (April 22–June 13) the policy restricting staff movement was implemented. We constructed a network diagram visualizing connectivity between nursing homes in Ontario and calculated the number of homes that had a connection with another nursing home and the average number of connections per home in each period. We calculated the relative difference in these mobility metrics between the 2 time periods and compared within-home changes using McNemar test and the Wilcoxon rank-sum test.

Results: In the period preceding restrictions, 266 (42.7%) nursing homes had a connection with at least 1 other home, compared with 79 (12.7%) homes during the period after restrictions, a drop of 70.3% ($P < .001$). Including all homes, the average number of connections in the before period was 3.90 compared to 0.77 in the after period, a drop of 80.3% ($P < .001$). In both periods, mobility between nursing homes was higher in homes located in larger communities, those with higher bed counts, and those part of a large chain.

Conclusions and Implications: Mobility between nursing homes in Ontario fell sharply after an emergency order by the Ontario government limiting long-term care staff to a single home, though some mobility persisted. Reducing this residual mobility should be a focus of efforts to reduce risk within the long-term care sector during the COVID-19 pandemic.

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Worldwide, residents of nursing homes have been disproportionately affected by the COVID-19 pandemic.¹ In Canada, nearly 80% of all COVID-19 deaths have occurred among nursing home residents, the highest known proportion among developed countries.^{2,3} Residents of nursing homes are at disproportionately increased risk of both COVID-19 infection and poor COVID-19 outcomes, as a result of congregate living, advanced age, frailty, and multimorbidity.⁴

Early in the pandemic, health care workers were identified as important and unknowing vectors for importation of COVID-19 into nursing homes, with movement of staff between nursing homes and other health care settings a key contributor to the spread of COVID-19.^{5–7} Staff in nursing homes are frequently employed on a part-time or casual basis, requiring individuals to work in multiple homes or health care settings to earn a living wage.^{8,9}

When COVID-19 outbreaks intensified in nursing homes during the first months of the pandemic, numerous jurisdictions enacted policies to limit the movement of staff between multiple homes.^{10–12} On April 22, 2020, Canada's most populous province of Ontario implemented an order that prevented staff from working in more than 1 home. Recognizing that existing staffing shortages were exacerbated by the COVID-19 pandemic,¹³ the order did not apply to temporary agency workers or other contract staff, in order to ensure nursing homes had staff available to work on an emergency basis.^{14,15} We used anonymized mobile GPS location data to examine the impact of this order on mobility between nursing homes.

Methods

Setting and Study Design

We conducted a pre-post observational study of mobility between nursing homes in Canada's most populous province of Ontario (population approximately 15 million residents). Medical and personal care in nursing homes is covered by Ontario's universal and publicly funded health insurance plan, with residents responsible for an accommodation copayment. Currently, there are more than 70,000 residents in 623 nursing homes in Ontario.¹⁶

Data Sources

We obtained all data for this study as part of the COVID-19 Ontario Census Modelling Table. The Modelling Table is sponsored by the Ontario Ministry of Health, Ontario Health, and Public Health Ontario and is an ad hoc and voluntary group of senior decision makers and scientists tasked with creating credible consensus estimates of the impact of COVID-19. We used anonymized, population-aggregated, near-real-time, mobile device GPS location data provided by Veraset (Veraset, San Francisco, CA), a data-as-a-service vendor. Veraset aggregates location data across several thousand apps on both Apple and Android platforms after the user has consented to use of their anonymized data, and has been previously used in research.^{7,17} Data on nursing home characteristics and COVID-19 outbreaks were obtained from the Ontario Ministries of Health and Long-Term Care. The study was approved by the Research Ethics Board of University of Toronto.

Emergency Order

On April 15, 2020, the Government of Ontario announced an emergency order restricting employees of nursing homes from working in more than 1 nursing home, congregate care, or health care setting within a 14-day period. The order came into effect on April 22, 2020, but did not apply to temporary agency staff or other contract staff (who are not employees of nursing homes), in order to ensure nursing homes had staff available to work on an emergency basis.¹⁸

Mobility Between Nursing Homes

We evaluated mobility between nursing homes in 2 time periods before and after implementation of the emergency order: March 1–April 21, 2020 (the “before” period), and April 22–June 13, 2020 (the “after” period). We used Statistics Canada's Open Database of Buildings to define home location and footprint.^{19,20} For homes where there was no entry in the database, we defaulted to a 50-m buffer around a home's latitude-longitude coordinates. A visit is defined as 2 GPS check-ins within a nursing home's boundary in 2 consecutive half-hour time blocks with a minimum total elapsed time of 30 minutes. This method selects visits that are likely to be staff entering homes rather than transient visits due to deliveries, etc. A connection between 2 homes was recorded if the same device had visits to 2 separate homes within 14 days. Of note, the Province of Ontario restricted visitors to nursing homes from March 14–June 18, 2020, with the exception of end-of-life compassionate visits, meaning that mobility devices captured within our study period would very likely be limited to residents and staff.

Connections between nursing homes have both a start home and an end home. To summarize the connectivity of a single home without double counting, we calculated mobility metrics for each nursing home based on the connections in which it was the end home; that is, a device entered the home after being detected in a different nursing home in the previous 14 days. For each home, we calculated whether there was any connection with another nursing home and the total count of connections with other homes.

Analysis

We constructed an undirected network connectivity diagrams for periods before and after restrictions were implemented. The network diagram features individual homes as nodes with connections between homes as edges. The number of connections between 2 homes is represented by the thickness of the edges. We identified homes in COVID-19 outbreak (≥ 1 resident or staff case) during any part of each period on the diagrams. For each of our network metrics, we calculated the average for the before and after periods, and the relative difference (expressed as a percentage) between the 2 time periods. We reported these measures overall and by home size (number of licensed beds), community size (population), for-profit status (for-profit, nonprofit, or municipal), and chain size [single home, small chain (2–19), or large chain (≥ 20)]. Homes owned by municipalities were not considered part of a chain. We performed within-home comparisons of the mobility metrics between the periods using McNemar test and the Wilcoxon signed-rank test. Analysis was done using R 4.0.0.^{21,22}

Results

We identified 5640 unique mobile devices that entered at least 1 of Ontario's 623 nursing homes in the 7 weeks before enactment of an emergency order restricting staff mobility between nursing homes (March 1–April 21, 2020) and 3792 unique devices that entered in the 7 weeks after enactment of the order (April 22–June 13, 2020). Prior to the emergency order, 266 (42.7%) nursing homes had a connection with at least 1 other nursing home, compared with 79 (12.7%) homes following the order, a drop of 70.3% ($P < .001$) (Figure 1 and Table 1). The average number of connections was 3.90 in the time period before the order and 0.77 in the time period following the order, corresponding to a drop of 80.3% ($P < .001$). Mobility between nursing homes was higher in homes located in larger communities, in those with higher bed counts, and those part of a large chain. During the after period, 72 (30.2%) of homes with ≥ 200 beds still had at least 1 connection compared with 65 (1.5%) of the homes with ≤ 20 beds, and

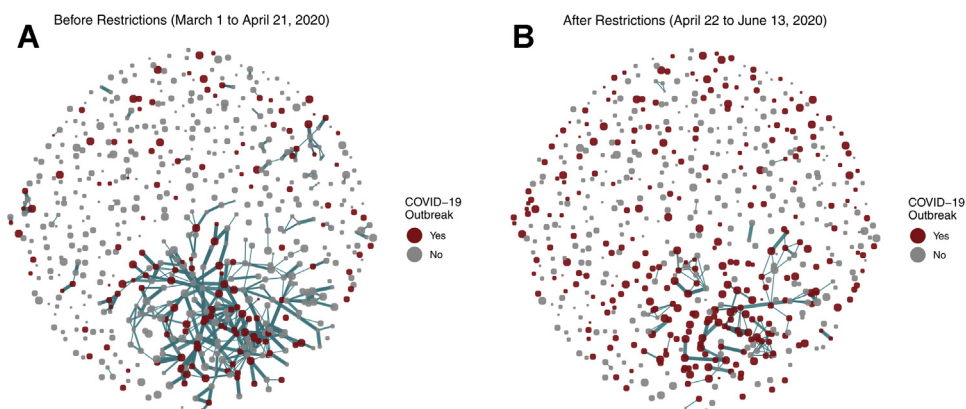


Fig. 1. Network connectivity diagrams (A) before and (B) after emergency order limiting staff to working at 1 nursing homes or health care setting.

145 (17.9%) of the large chain homes had a connection compared with 268 (9.3%) of the homes that were not part of a chain. There were 149 (23.9%) homes in outbreak at any point during the before period, and 292 (46.9%) homes in outbreak at any point during the after period.

Discussion

Mobility between nursing homes in the Province of Ontario dropped sharply after implementation of an emergency order restricting staff to work a single home. The number of nursing homes with any connection to another home fell by 70.3%, whereas the total number of connections dropped by 80.3%. Despite the sharp drop, 12.7% of all Ontario nursing homes had connections following enactment of the emergency order.

Staff mobility between nursing homes has been identified as an important vector for importation of COVID-19 into and spread between homes, and many jurisdictions have therefore restricted or limited workers from working in multiple health care settings. Ontario's emergency order came into force 3½ weeks after the first reported COVID-19 outbreak in a nursing home (March 29–April 22, 2020), at which point nearly 150 homes had experienced an outbreak.⁷ Other Canadian provinces like British Columbia responded somewhat faster, limiting mobility in just under 3 weeks after their

first reported outbreak (March 7–March 26, 2020),²³ at which point only 9 homes were in outbreak.²⁴ There are a number of factors that impact risk of COVID-19 outbreaks, with mobility of staff between homes being only one of them. However, given the robust drop in mobility we observed in our study, and other research linking higher staff mobility to increased COVID-19 incidence in nursing homes, delays in limiting mobility may have resulted in additional cases and deaths among nursing home residents and staff.^{7,25}

Our findings provide importance evidence about the degree to which connectivity between nursing homes is affected by single-site work orders, which is relevant for both short- and long-term pandemic planning. Although home-to-home mobility dropped significantly following the emergency order, the ongoing connectivity within Ontario's nursing homes merits serious consideration, especially as decision makers, and the nursing home sector grapple with the intensifying second wave of the COVID-19 pandemic. The residual connectivity may be due to Ontario exempting temporary agency workers and contract staff from the ban on working at more than 1 home or health care setting. This connectivity may also represent movement of individuals not covered by the order such as physicians who work at multiple homes. Although homes with large outbreaks may need to bring in extra staff, residual mobility remains a potential vector for the importation of COVID-19 into nursing homes not

Table 1
Mobility Between Ontario Nursing Homes Before (March 1–April 21, 2020) and After (April 22–June 13, 2020) Implementation of an Emergency Order Limiting Staff to Working at 1 Nursing Home or Health Care Setting

	n	% Homes With a Connection				Average No. of Connections per Home			
		Before	After	% Difference	<i>P</i> [*]	Before	After	% Difference	<i>P</i> [†]
Overall	623	42.7	12.7	−70.3	<.001	3.90	0.77	−80.3	<.001
Profit status									
For-profit	360	43.1	14.7	−65.9	<.001	3.94	0.94	−76.1	<.001
Not-for-profit	162	46.3	11.1	−76.0	<.001	4.02	0.50	−87.6	<.001
Municipal	101	35.6	7.9	−77.8	<.001	3.47	0.60	−82.7	<.001
Chain type									
Large (≥20)	145	50.3	17.9	−64.4	<.001	5.16	1.50	−70.9	<.001
Small (2-19)	210	44.3	13.3	−70.0	<.001	3.95	0.58	−85.3	<.001
Single home	268	37.3	9.3	−75.1	<.001	3.15	0.53	−83.2	<.001
Home size									
≥200 beds	76	67.1	30.2	−55.0	<.001	8.08	2.58	−68.1	<.001
100-199 beds	201	52.0	15.3	−70.6	<.001	5.23	0.91	−82.6	<.001
51-100 beds	281	27.8	6.0	−78.4	<.001	1.53	0.13	−91.5	<.001
≤50 beds	65	20.0	1.5	−92.5	<.001	0.47	0.03	−93.6	<.001
Community size (population)									
≥500,000	255	65.9	21.6	−67.2	<.001	7.56	1.65	−78.2	<.001
100,00-499,999	225	32.4	8.0	−75.3	<.001	1.83	0.24	−86.9	<.001
<10,000 (rural)	143	17.5	3.5	−80.0	<.001	0.53	0.06	−88.7	<.001

*McNemar test.

†Wilcoxon rank-sum test.

experiencing an outbreak, and closing the loophole on the emergency order could reduce risk in the sector during successive waves of the pandemic. Doing so would require addressing chronic staffing shortages, by accelerating the training of nursing home workers and by promoting retention in the field by ensuring all workers have fair and full-time pay with benefits and a career ladder to support their advancement.²⁶

Limitations

The pre-post design used in this study does not permit the examination of time trends in mobility, and data limitations did not allow for use of a time series analysis. However, the emergency order is the only plausible explanation for such a sharp drop in mobility as there were no other relevant national or provincial policies that could be expected to significantly impact mobility, and it is highly unlikely that an unrelated secular trend would result in an 80% drop. We also did not have data from other jurisdictions with which to compare our findings.

The mobility location data acquired from Veraset relies on GPS check-ins from several mobile phone applications. As such, individuals who do not use these applications or do not consent to sharing their data will not be captured. Although this will underestimate absolute measures of mobility, the relative differences calculated between the periods are robust as the sample is the same during both periods. Furthermore, a dearth in geospatial footprint data per facility limited the spatial accuracy in detectability of devices by a generalized 50-m buffer although this sampling error was consistent across all facilities. Finally, we were not able to assess the temporal association between staff mobility and COVID-19 outbreaks in nursing homes as this would require longitudinal mobility data on a granular level.

Conclusions and Implications

The emergency order by the Ontario government limiting nursing home staff to a single home sharply reduced mobility between nursing homes. The residual mobility (20%) between nursing homes remains a potential vector for the importation of COVID-19 into nursing homes, and further reduction may reduce risk within the nursing home sector during the COVID-19 pandemic.

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