

SYNOPSIS

Review of Two PHO Studies Examining Crowding and Rates of Respiratory Infections in Ontario Long-Term Care Homes

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Article citations:

Brown KA, Jones A, Daneman N, Chan AK, Schwartz KL, Garber GE, et al. Association between nursing home crowding and COVID-19 infection and mortality in Ontario, Canada. *JAMA Intern Med.* 2021;181(2):229-36. Available from: <https://doi.org/10.1001/jamainternmed.2020.6466>

Leece P, Whelan M, Costa AP, Daneman N, Johnstone J, McGeer A, et al. Association between nursing home crowding and outbreak-associated respiratory infection and death prior to the COVID-19 pandemic between 2014 and 2019 in Ontario, Canada. *medRxiv* 22277066 [Preprint]. 2022 July 7 [cited 2022 Aug 18]. Available from: <https://doi.org/10.1101/2022.07.06.22277066>

One-minute Summary

- We provide a synopsis of two PHO studies that examined how crowding in long-term care homes (LTCHs) affected resident risk of respiratory infections and deaths in Ontario.
- For severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), Brown et al. (2021) performed a population-based retrospective cohort study of more than 78,000 residents across more than 600 LTCHs in Ontario, Canada from Mar 29 through May 20, 2020.¹
- For other respiratory infections (i.e., non SARS-CoV-2 coronaviruses, influenza A/B viruses, human metapneumovirus, parainfluenza virus, respiratory syncytial virus [RSV], rhinovirus/enterovirus), Leece et al. (2022) (preprint) performed a retrospective cohort study of LTCH residents (in 588 LTCHs) in Ontario, Canada from over a five-year period prior to the Coronavirus Disease 2019 (COVID-19) pandemic from Sept 2014 through Aug 2019.²
- The risk of respiratory virus outbreaks and death from respiratory infection was higher in high crowding LTCHs (≥ 2 residents per room and bathroom), compared to low crowding LTCHs (< 2 residents per room and bathroom):
 - **SARS-CoV-2 Study:** More crowded homes had higher SARS-CoV-2-infection incidence (adjusted relative risk [aRR]: 1.7; 95% CI: 1.10–2.72) and mortality incidence (aRR: 1.7; 95% CI: 0.99–2.87).¹
 - **Non-SARS-CoV-2 Study:** More crowded homes had higher outbreak-associated respiratory infection incidence (aRR: 1.9; 95% CI: 1.64–2.18) and mortality incidence (aRR: 2.3; 95% CI: 1.84–2.84). The pattern of higher crowding index being associated with higher infection and mortality incidence was consistent across all of the respiratory pathogens examined, with the largest burden observed for influenza A, B, and RSV.²

- Respiratory infections, deaths and crowding in Ontario LTCHs:
 - **SARS-CoV-2 Study:** Overall, 6.6% (5,218/78,607) of residents developed COVID-19 and 1.8% (1,452/78,607) died of COVID-19. Fifty percent (308/618) of homes had a high crowding index (≥ 2). Incidence of SARS-CoV-2 infection in high crowding index homes was 9.7% vs 4.5% in low crowding index homes ($P < 0.001$), while COVID-19 mortality was 2.7% vs 1.3%, respectively ($P < 0.001$).¹
 - **Non-SARS-CoV-2 Study:** Among included LTCHs ($N=588$), there were 4,921 outbreaks involving 64,829 cases of respiratory infection and 1,969 deaths. Survey-based information on crowding was used to obtain a validated crowding index – 42.7% (251/588) of homes had a high crowding index (≥ 2). Incidence of respiratory infections in high crowding index homes was 24.2 per 100 residents per year vs 13.5 in low crowding index homes ($P < 0.001$), while respiratory infection associated mortality was 0.7 per 100 residents per year vs 0.4, respectively ($P < 0.001$).²
- Room capacity and infection incidence, simulations for Ontario LTCHs:
 - **SARS-CoV-2 Study:** Simulations suggested that converting all 4-bed rooms to 2-bed rooms would have averted 998 COVID-19 cases (19.1%) and 263 deaths (18.1%) during the first wave of the pandemic.¹ Currently, LTCH Directive 3 caps occupancy in 3–4-bed rooms in Ontario is at 2 residents per room.³
 - **Non-SARS-CoV-2 Study:** Simulations suggested that a cap on the capacity of rooms at 2-beds would have reduced infections over the 5-year period from 64,829 to 53,650 (95% CI: 50,571–57,425, reduction of 11,179, 95% CI: 7,404–14,258).² This study suggests that if 3–4-bed rooms are reverted to pre-pandemic occupancy levels, over the next 5-years we can potentially expect 11,179 additional non-SARS-CoV-2 respiratory virus infections and 416 additional respiratory virus associated deaths in LTCHs in Ontario.
- The study authors concluded that residents of crowded LTCHs experience more respiratory infections and mortality due to SARS-CoV-2 and other respiratory viruses.

Additional Information

- **SARS-CoV-2 Study:**¹
 - The primary outcomes were the cumulative incidence of confirmed COVID-19 cases per 100 LTCH residents and the COVID-19-associated deaths per 100 LTCH residents.
 - The authors defined the LTCH crowding index as the mean number of residents per room and bathroom across an entire home according to the following equation:

$$N_{\text{residents}} \div (\frac{1}{2}N_{\text{bedrooms}} + \frac{1}{2}N_{\text{bathrooms}}).$$
 - Laboratory confirmation of SARS-CoV-2 infection required a positive nucleic acid amplification test result (e.g., real-time polymerase chain reaction or nucleic acid sequencing) on at least 1 genome target.

- The authors examined five characteristics of LTCHs, including (1) type of ownership (private for-profit, private nonprofit, or municipal); (2) size (<100, ≥100 beds); (3) ratio of full-time–equivalent staff to beds; (4) proportion of 1-bed, 2-bed, and 4-bed rooms; and (5) design standard met (pre-1999 vs 1999 or later).
 - From these five LTCH characteristics, the authors noted that crowded LTCHs were more likely operated by private for-profit owners and had lower staffing ratios.
- The median proportion of female residents was 69.2% (IQR: 64.6–73.7), with 55.3% (IQR: 48.7–61.0) of patients ≥85 years of age.
- **Non-SARS-CoV-2 Study:²**
 - Respiratory infection outbreaks in Ontario are defined as either two cases of acute respiratory infection (new or worsening cough or shortness of breath) within 48 hours in a LTCH with an epidemiologic link (e.g., unit or floor), including one laboratory-confirmed case, or three cases regardless of laboratory confirmation.
 - The authors included data on LTCH ownership (private for-profit entity, private non-profit, or owned by a municipality), size (<100 beds, ≥100 beds), health region (N=6: East, Central-East, Toronto, Central-West, South-West, and North).
 - The median proportion of female residents was 68.6% (IQR: 64.2–73.3), with a median age of 83.5 years (IQR: 82.2–85.1).
- Study limitations reported by authors:
 - The LTCH crowding index and the 1999 design standard were strongly associated, and as such, other design features introduced by the new standard may have played a role in lowering COVID-19 incidence. These features include larger area per room, improved ventilation systems and improved resident areas (e.g., smaller, self-contained units with less than 40 beds that facilitate cohorting).
 - The author’s examined crowding at the LTCH level; therefore, they were not able to identify which specific residents occupied single, double, or quadruple-occupancy rooms.¹
 - Characteristics of LTCH residents were determined from Aug 2019 data for the SARS-CoV-2 study (i.e., characteristics of residents may have slightly varied as the study was conducted from Mar 29 to May 20, 2020).¹
 - The non-SARS-CoV-2 respiratory pathogen study used data based on standardized outbreak surveillance procedures; therefore, the authors may have missed some outbreaks and/or cases that led to total outbreak size errors or misattribution of the causative pathogen (only the first four outbreak cases were tested in accordance with provincial guidance).²

PHO Reviewer's Comments

- Another study from Barcelona, Spain (Mar–June 2020), Torres et al. 2022 used a similar approach to measure crowding in LTCHs, based on the number of occupants per room. The authors calculated crowding as the ratio of residents at the beginning of the period by number of rooms; categorized according to tertiles into high (T3), medium (T2) and low crowding (T1). They reported that nursing homes with a high level of crowding had increased COVID-19 incidence (aRR: 1.4; 95% CI: 1.28–1.45) and mortality incidence (aRR: 1.5; 95% CI: 1.34–1.66).⁴
- Due to the congregate nature of LTCHs, residents are often impacted by outbreaks of respiratory infections. Residents are more likely to develop severe disease due to their advanced age, comorbidities and a high degree of frailty. Therefore, crowding and the degree of crowding should be taken into consideration when developing policies and LTCH design standards to minimize risks to residents. Decreasing crowding in LTCHs is an important patient safety target for preventing respiratory infections and deaths.

References

1. Brown KA, Jones A, Daneman N, Chan AK, Schwartz KL, Garber GE, et al. Association between nursing home crowding and COVID-19 infection and mortality in Ontario, Canada. *JAMA Intern Med.* 2021;181(2):229-36. Available from: <https://doi.org/10.1001/jamainternmed.2020.6466>
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Note:

The articles summarized in this synopsis were published by PHO authors.

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