


# Short-Stay Admissions Associated With Large COVID-19 Outbreaks in Maryland Nursing Homes

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## Abstract

At the beginning of the COVID-19 pandemic, some nursing homes (NHs) in Maryland suffered larger outbreaks than others. This study examined how facility characteristics influenced outbreak size. We conducted a retrospective analysis of secondary data from Maryland NHs to identify characteristics associated with large outbreaks, defined as when total resident cases exceeded 10% of licensed beds, from January 1, 2020, through July 1, 2020. Our dataset was unique in its inclusion of short-stay residents as a measure of resident type and family satisfaction as a measure of quality. Facility characteristics were collected prior to 2020. Like other studies, we found that large outbreaks were more likely to occur in counties with high cumulative incidence of COVID-19, and in NHs with more licensed beds or fewer daily certified nursing assistant (CNA) hours. We also found that NHs with a greater proportion of short-stay residents were more likely to have large outbreaks, even after adjustment for other facility characteristics. Lower family satisfaction was not significantly associated with large outbreaks after adjusting for CNA hours. Understanding the characteristics of NHs with large COVID-19 outbreaks can guide facility restructuring to prevent the spread of respiratory infections in future pandemics.

## Keywords

COVID-19, nursing homes, epidemiology, short-stay admissions

## Introduction

Nursing home residents represent a disproportionately high percentage of deaths from coronavirus disease 2019 (COVID-19). COVID-19 outbreaks often occur in nursing homes (NHs) after introduction of the virus from an index NH staff member who is infected in the community often from a household member (Kim et al., 2020). This index staff member can spread it to other staff particularly in break rooms during meals. Staff can also spread it to residents particularly when they interact with residents for long periods of time (e.g., acting as a “sitter”). Once COVID-19 gets into the resident population, it amplifies quickly as many residents are unable wear masks consistently. Previously described risk factors for COVID-19 in NHs include larger facility size and occupancy, lower ratings and quality metrics, lower staffing, and proportion of residents that were Black (Abrams et al.,

2020; Li et al., 2020; Unruh et al., 2020; White et al., 2020). The purpose of this study was to assess NH factors that determined the size of COVID-19 outbreaks in Maryland during the early stage of the pandemic. Our analysis is unique

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in that we compared a set of nursing homes under the same health directives by outbreak size and had unique facility data on proportion of short-stay residents, and family satisfaction with nursing home care. Neither proportion of short-stay residents nor family satisfaction has been previously examined. Family satisfaction is similar to patient satisfaction, which is an important and commonly used indicator for measuring healthcare quality (Abrams et al., 2020; Brown et al., 2020; Bui et al., 2020; Chatterjee et al., 2020; Figueroa et al., 2020; Harrington et al., 2020; He et al., 2020; Institute of Medicine, 2001; Li et al., 2020; Sun et al., 2020; Unruh et al., 2020).

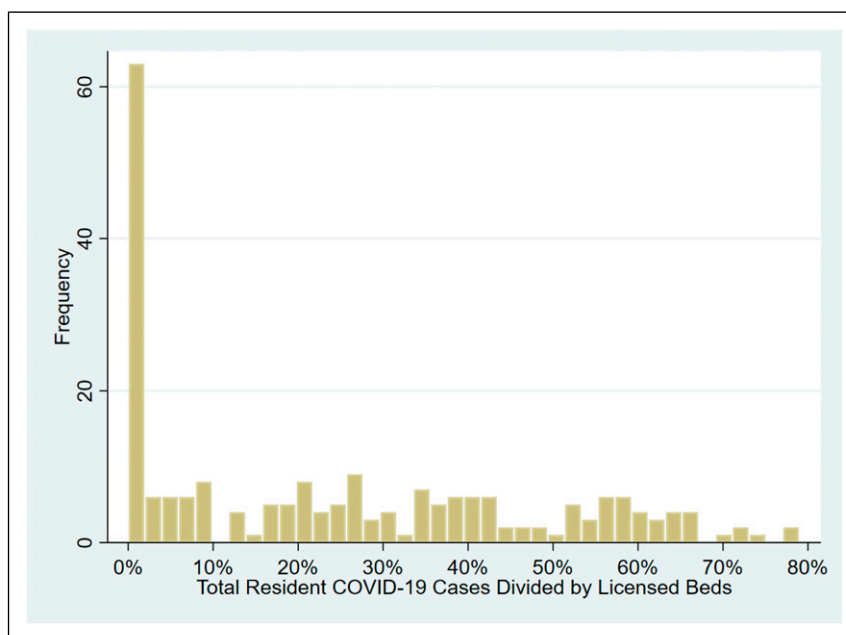
## Methods

This is a secondary data analysis relating facility factors to size of COVID-19 outbreak in Maryland NHs. To evaluate management of the COVID-19 outbreaks, NHs were divided into two comparison groups: those with cumulative resident cases totaling up to 10% of licensed beds versus those with cumulative resident cases exceeding 10% of beds from January 1 to July 1, 2020, based on the left skewed distribution of cases (Figure 1).

The sample included all Maryland NHs with Medicare and/or Medicaid Certification that had complete data for all covariates ( $n = 216$ ). Weekly COVID-19 case counts for NH residents were obtained from the Maryland Department of Health (Maryland Department of Health and Mental Hygiene, 2020). County-level cumulative incidence of COVID-19 through July 1, 2020, was obtained from the Johns Hopkins Coronavirus Resource Center (Johns Hopkins Coronavirus

Resource Center, 2020). COVID-19 cases in the respective county NHs were then subtracted from these totals for this analysis. NH-level resident and facility characteristics for quarter 4, 2019 (Oct-Dec), were from the Center for Medicaid and Medicare Services (CMS) CASPER and the Maryland Health Care Commission (MHCC). Variables were categorized for ease of interpretation. The distribution of the variable or previously established cut points were used to categorize the variables. Short-stay residence was defined as an episode of care at the facility of < 100 days. Facilities were categorized into  $\geq 50\%$  vs. < 50% of residents were short-stay based on the right-skewed distribution of the data. Family satisfaction was examined in relation to outbreak size, comparing NHs on the question: “family would recommend facility to others” (< 80% vs.  $\geq 80\%$  would recommend, cut at the sample mean). Staffing data were calculated as hours per resident day (HPRD) using CMS Payroll Based Journal data, with adequate staffing defined as staffing at the 75<sup>th</sup> percentile or higher, for all facilities in the sample (Needleman et al., 2002; Trinkoff et al., 2013). Institutional review board approval was obtained for this study.

Descriptive statistics were reported, beginning with the unadjusted association between all independent variables and the primary outcome and outbreak size, using t-test for continuous variables and chi-square or Fisher’s exact tests for categorical variables, as appropriate. In addition, NHs were compared by COVID-19 outbreak size in relation to the facility characteristics using multivariable regression techniques. We used a theoretically driven logit model based on what is known about COVID-19 outbreaks in nursing homes from the medical literature and actual experience managing outbreaks in



**Figure 1.** Histogram of total resident COVID-19 cases divided by licensed beds for Maryland nursing homes from January 1, 2020, through July 1, 2020.

nursing homes. Independent variable selection used forward forced entry. We began with county-level cumulative incidence (to control for the likelihood of introduction into the facility), followed by nursing home size (a known risk factor), proportion of short-stay residents, and our quality measure of

family satisfaction (our unique variables). We then added staffing, to evaluate its impact on the previous factors, along with other significant variables from Table 1. For model diagnostics and fit, we reviewed receiver operating characteristic (ROC) curves and Hosmer–Lemeshow goodness-of-fit tests

**Table 1.** Nursing Homes With Large Outbreaks: Total Resident COVID-19 Cases Greater Than 10% Of Licensed Beds Through July 1, 2020, as Compared to Those Without.

	Total Resident COVID-19 Cases Greater than 10% of Licensed Beds				
	No (N = 89)	% or SD	Yes (N = 127)	% or SD	p-value
<i>Resident Characteristics at Facility level</i>					
Age in years (Mean/SD)	77.4	8.1	75.4	7.5	0.07
Proportion of residents with dementia (Mean/SD)	35.5	13.4	32.5	13.9	0.12
Proportion of residents who are ambulatory (Mean/SD)	31.2	11.2	30.5	10.5	0.61
Proportion of male residents					
Less than 40%	52	58.4	55	44.3	0.03
Greater than or equal to 40%	37	41.6	72	56.7	
Proportion of Black residents					
Less than 28%	60	67.4	55	43.3	0.0005
Greater than or equal to 28%	29	32.6	72	56.7	
Proportion of short-stay residents					
Less than 50%	27	30.3	18	14.2	0.004
Greater than or equal to 50%	62	69.7	109	85.8	
<i>Facility Characteristics</i>					
Total licensed beds					
Small (< 100)	41	46.1	26	20.5	0.0002
Medium (100–140)	27	30.3	46	36.2	
Large (> 140)	21	23.6	55	43.3	
Ownership					
Non-profit and government	26	29.2	27	21.3	0.18
For-profit	63	70.8	100	78.7	
Chain					
Yes	41	46.1	75	59.1	0.06
No	48	53.9	52	40.9	
Alzheimer's unit					
Yes	28	31.5	43	33.9	0.71
No	61	68.5	84	66.1	
CMS star ratings—quality					
1-star	0	0.0	0	0.0	0.04
2-star	11	12.5	6	4.8	
3-star	16	18.2	23	18.3	
4-star	36	40.9	41	32.5	
5-star	25	28.4	56	44.4	
Certified nursing assistants HPRD					
HPRD above 75 <sup>th</sup> percentile	32	36.0	23	18.1	0.003
HPRD below 75 <sup>th</sup> percentile	57	64.0	104	81.9	
More than 80% of families would recommend NH					
Yes	58	65.2	59	46.5	0.007
No	31	34.8	68	53.5	
Nursing home county-level cumulative incidence of COVID-19					
Low	22	24.7	6	4.7	< 0.0001
Moderate	21	23.6	17	13.4	
High	46	51.7	104	81.9	

(Hosmer et al., 2013; Meurer & Tolles, 2017; Zhang, 2016). Our sensitivity analyses included additional regression analyses defining our primary outcome of COVID-19 outbreaks as an ordinal variable using tertiles (low, moderate, and high) and were compared to the results of our original model. Analyses were performed with Stata 15.1 (Stata Corp, College Station, TX) and SAS 9.4 (SAS Institute, Inc Cary, NC).

## Results

Ninety-five percent (216/227) of Maryland NHs were included in the analysis with 6 NHs excluded for missing nursing staffing hours, four for missing family satisfaction data, and one for missing data on resident age and gender. Descriptive analyses found associations between several resident and facility characteristics and a large COVID-19 outbreak (Table 1). NHs with a higher proportion of residents that were male ( $p = 0.03$ ), Black ( $p = 0.0005$ ), and short-stay ( $p = 0.004$ ) were significantly more likely to have large outbreaks. NH size was associated with COVID-19 outbreak size ( $p = 0.0002$ ), with larger NHs (> 140 beds) almost twice as likely to have a large outbreak as small NHs (< 100 beds), 72% versus 39%, respectively. Higher CMS quality star ratings were associated with having a large outbreak ( $p = 0.04$ ); 44% of facilities with large outbreaks had five stars compared to 28% with small outbreaks.

Our initial model included county incidence, facility size, proportion of short-stay residents, and proportion of families who would recommend the facility, with a subsequent model adding CNA staffing (Table 2). We also assessed race (OR: 1.55, 95% CI: 0.76–3.15), gender (OR: 1.07, 95% CI: 0.55–2.08) and CMS star rating (OR: 1.68, 95% CI: 0.84–3.35) but did not include them in the final models because they were not significant and did not change the other odds ratios. Factors related to a large outbreak were higher county incidence ( $p < 0.0001$ ), larger facilities ( $p = 0.007$ ), higher proportion of short-stay residents ( $p = 0.035$ ), and lower CNA staffing-HPRD < 75<sup>th</sup> percentile ( $p = 0.009$ ) in both models, whereas family satisfaction was no longer significant after adjustment for CNA staffing. Both models demonstrated fair discrimination with area

under the ROC curve above 0.74. Hosmer-Lemeshow tests indicated goodness of fit for both models with  $p$ -values above 0.6. Similar associations were found in our sensitivity analyses using an ordinal dependent variable (low, moderate, and high level of COVID-19 outbreak) (Data not shown).

## Discussion

In summary, our analysis found that nursing homes (1) in counties with a high COVID-19 cumulative incidence, (2) with more licensed beds, (3) with lower CNA staffing hours, and (4) with a higher proportion of short-stay residents were more likely to have a large outbreak early in the pandemic. After adjusting for these factors, race, gender, and CMS star quality rating were no longer associated with a large outbreak.

We are the first to report that facilities with a greater proportion of short-stay residents also had large outbreaks. Data on proportion of short-stay residents describes the typical resident population pre-pandemic and estimates the proportion of short-stay residents during the first 2–3 months of our study period, since most short-stay admissions stopped during March 2020 for the remainder of our study period. Short-stay residents are typically present for 2–3 weeks for rehabilitation after an acute illness at an acute care hospital. They require more care than long-stay residents. They also have more visitors. Our novel finding could reflect greater opportunities for introduction of COVID-19 from these short-stay residents or their visitors during the early stages of the pandemic. Due to higher acuity, short-stay residents also have higher staffing complements, that is, larger numbers of staff with the potential to introduce infections, as compared with long-stay residents. Separating short-stay and long-stay residents into distinct facilities could be a potential way to reduce the risk of COVID-19 and other infections being introduced into a facility or to contain the outbreak away from older long-stay residents.

Several other analyses have examined Medicare and Medicaid status as risk factors for COVID-19 outbreaks. Short-stay residents are often, but not always, covered by Medicare as opposed to Medicaid. Unruh et al., (2020) who

**Table 2.** Logistic Regression Models to Predict Maryland Nursing Homes With Cumulative Resident COVID-19 Cases Totaling > 10% of Licensed Beds, (N = 216 Facilities).

Variable	Model 1		Model 2	
	OR	95% CI	OR	95% CI
County-level COVID-19 incidence (high vs. moderate/low)	3.9	2.04–7.48	4.38	2.24–8.56
NH size				
Medium NH 100–140 bed versus small < 100 beds	2.01	0.95–4.26	1.84	0.86–3.93
Large NH > 140 versus small < 100 beds	2.85	1.33–6.08	2.72	1.26–5.89
Proportion of short-stay residents (50% or greater vs. <50%)	2.4	1.14–5.04	2.27	1.07–4.84
Less than 80% of families would recommend facility	1.67	0.90–3.11	1.3	0.67–2.54
Certified nursing assistants HPRD below 75 <sup>th</sup> percentile			2.33	1.10–4.95

examined NH COVID-19 deaths in three states, did not find an association with the percentage of residents on Medicare, but they did not focus, as we have, on outbreak size (Unruh et al., 2020). Other analyses investigated the impact of proportion of residents on Medicaid, which is used primarily by long-stay residents, with mixed results. Li et al. found that the proportion of residents covered by Medicaid increased the risk of large COVID-19 outbreaks, whereas Abrams et al. did not (Abrams et al., 2020; Li et al., 2020).

Like other analyses, we found that NHs in counties with a high cumulative incidence of COVID-19, more licensed beds, and fewer CNA staffing hours were more likely to have a large outbreak early in the pandemic (Abrams et al., 2020; Figueroa et al., 2020; Harrington et al., 2020; Sun et al., 2020; Unruh et al., 2020; White et al., 2020). Since staff are likely to live in the county in which they work, county incidence represents the risk that staff would be infected in their community and introduce it to the facility. Nursing homes with more licensed beds have larger staffing complements as they are needed to care for larger numbers of residents; thus, the risk of introduction is increased. Facilities with lower CNA staffing hours also had larger outbreaks. This may be a surrogate measure of overall lower quality of care or could mean that the limited staff did not have sufficient time for adequate infection prevention measures. Interestingly, the odds ratio for lower family satisfaction with the facility decreased when lower CNA staffing hours was added suggesting that staffing and family satisfaction are correlated.

## Conclusion

Our results newly highlight the potential importance of short-stay residential care in nursing home outbreaks during the COVID-19 pandemic, along with larger facility size and lower staffing as other have shown. This suggests consideration of nursing home re-structuring in preventing the spread of infections in the future. Separating long- and short-stay residents and keeping nursing homes small, or introducing care pods within larger homes, could prevent infections through fewer new residents, lower resident exposure to different staff members, and fewer visitors to introduce infections. Understanding the characteristics of nursing homes associated with large outbreaks can help us to better prepare for future pandemics.

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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## Ethical Approval

This study obtained approval from the University of Maryland Baltimore Institutional Review Board (IRB), protocol HP-91635.

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