Title
Characteristics of U.S. Nursing Homes with COVID-19 Cases.

Permalink
https://escholarship.org/uc/item/4j41836d

Journal
Journal of the American Geriatrics Society, 68(8)

ISSN
0002-8614

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Publication Date
2020-08-01

DOI
10.1111/jgs.16661

Peer reviewed
Abstract

**Background:** COVID-19 has been documented in a large share of nursing homes throughout the United States. This has led to high rates of mortality for residents. In order to understand how to prevent and mitigate future outbreaks, it is imperative that we understand which nursing homes are more likely to experience COVID-19 cases.

**Objective:** To examine the characteristics of nursing homes with documented COVID-19 cases in 30 states reporting individual facilities affected.

**Design and setting:** We constructed a database of nursing homes with verified COVID-19 cases as of May 11, 2020 via correspondence with and publicly available reports from state
departments of health. We linked this information to nursing home characteristics and used regression analysis to examine association between these characteristics and the likelihood of having a documented COVID-19 case.

Results: Of 9,395 nursing homes in our sample, 2,949 (31.4%) had a documented COVID-19 case. Larger facility size, urban location, greater percentage of African American residents, non-chain status, and state were significantly (p<0.05) related to increased probability of having a COVID-19 case. Five-star rating, prior infection violation, Medicaid dependency, and ownership were not significantly related.

Conclusions: COVID-19 cases in nursing homes are related to facility location and size and not traditional quality metrics such as star rating and prior infection control citations.
Introduction. COVID-19 has been documented in many US nursing homes leading to a high number of deaths among residents.[1] As of May 21, 2020, at least 35,000 deaths were reported from nursing homes or other long-term care facilities in the US.[2] These deaths represent 42% of deaths due to COVID-19 in the 38 states that are reporting this information. Because of the major health risks associated with COVID-19 in nursing homes, we sought to examine the characteristics of nursing homes with documented COVID-19 cases in 30 states reporting individual facilities affected.

Methods. We constructed a database of nursing homes with verified COVID-19 cases as of May 11, 2020 via correspondence with and publicly available reports from state departments of health. We linked these data to Nursing Home Compare from CMS, Long-term Care: Facts on Care in the US, and the Area Resource File to identify characteristics of nursing homes with COVID-19 cases.[3] We examined size (<50 beds, 50-150 beds, more than 150 beds), ownership (for-profit, nonprofit, government), chain membership, high Medicaid share (>85%), high percentage of African American residents (>25%), urban location, CMS overall five-star rating, prior infection violation, and state.

We used logistic regression to estimate the odds ratio of each characteristic on the likelihood of having a documented COVID-19 case. We used linear regression from a subsample of 21 states reporting case counts to estimate the relationship between facilities' characteristics and outbreak size, as a share of beds. Robust standard errors were calculated.

Results. Results are shown in Table 1. Of 9,395 nursing homes in our sample, 2,949 (31.4%) had a documented COVID-19 case. Among facilities with a positive COVID-19 case, the average
number of cases was 19.8. New Jersey (88.6%) and Massachusetts (78.0%) had the greatest share of affected facilities.

Larger facility size, urban location, greater percentage of African American residents, non-chain status, and state were significantly (p<0.05) related to probability of having a COVID-19 case. Five-star rating, prior infection violation, Medicaid dependency, and ownership were not significantly related. Outbreak size was significantly associated with facility size, for-profit status, and state, but not with other studied characteristics. Outbreak size ranged from 1-256 cases. (Figure 1)

**Discussion.** Our findings suggest that nursing home COVID-19 outbreaks are more related to facility size and location than traditional quality metrics such as star rating and prior infection control citation, reflecting the unique infection control needs of COVID-19. Our finding that facilities with a high percentage of African American residents are more likely to have COVID-19 cases echoes disparities in the pandemic at large and indicates a critical health disparity to be addressed in the response to COVID-19 nursing home outbreaks.[4]

State-by-state differences may reflect the evolving epidemiology of COVID-19 in each area and state-level variation in testing and reporting. These data nationally are limited by current tracking and reporting capacity, as well as the lack of a national system for reporting nursing home COVID-19 cases.[5] Widespread variation in reporting format, case definitions, and update frequency may present a barrier to further longitudinal and national analyses. State grouping of staff and resident cases may limit the study of policies related to infections and infectivity among staff.[6] New York State only identified the names of the 86 facilities that had at least five COVID-19 related fatalities whereas state officials have acknowledged over 300
New York facilities have at least one case.[7] Similarly, Delaware only provided names of facilities with a COVID-19 fatality. Washington, Maryland, and Minnesota restricted provision of data on facilities below an undisclosed size (Washington) or 10 beds, while other states (Colorado, Delaware, Kentucky, Massachusetts, North Carolina, Rhode Island, Tennessee, Vermont) did not include facilities with single cases or below a certain case count.

Although the federal government will soon begin reporting national nursing home data on COVID-19 cases and deaths, facilities are not required to report cases and fatalities that occurred prior to May. Thus, given this optional reporting for March and April, the federal data will largely miss the important early period in which COVID-19 emerged in US nursing homes. By documenting COVID-19 cases in 30 states through mid-May, our data provides an important complement to the national data.

The negative relationship between outbreak and facility size indicates that while smaller facilities are less likely to have outbreaks, outbreaks at small facilities affect more patients-per-bed. This may reflect a number of features of small facilities, including higher patient turnover and the possibility that isolating COVID-positive residents is more challenging for small facilities. However, interpretation is limited by the need for richer data covering larger samples, case tracking for facilities over time, and greater detail on case characteristics.

The rapid evolution and mortality of nursing home outbreaks of COVID-19 reflect the need for continued community-facility contact restrictions, increased testing of residents and staff, and heightened infection control including increased access to personal protective equipment for staff.[8, 9] As the COVID-19 crisis continues, nursing homes are in critical need of these resources to protect their vulnerable populations.
Acknowledgments

Financial Disclosures: Lacey Loomer reported doing contract work for the American Health Care Association. Ashvin Gandhi reported that he has received funding from the National Institute on Aging through Grant Number T32-AG000186 to the National Bureau of Economic Research, the National Institute of Health Care Management, the Harvard Institute for Quantitative Social Science, the Harvard Lab for Economic Applications and Policy, the UCLA Ziman Center for Real Estate, the UCLA Fink Center for Finance & Investment, and the UCLA Morrison Center for Marketing and Data Analytics. David Grabowski reported that he receives research support from grants from the National Institute on Aging; the Agency for Healthcare Research & Quality; the Arnold Foundation; and the Warren Alpert Foundation; serving as a paid consultant to Vivacitas; serving on the Scientific Advisory Committee for naviHealth; and receiving fees from the Medicare Payment Advisory Commission, Compass Lexecon, Analysis Group, the Research Triangle Institute, and Abt Associates.

Conflicts of Interest: None

Author Contributions: All authors made substantial contributions to conception and design, and/or acquisition of data, and/or analysis and interpretation of data; participated in drafting the article or revising it critically for important intellectual content; and gave final approval of the version to be submitted.

Sponsor’s Role: No sponsor.
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Figure 1 – Frequency distribution of number of COVID-19 cases in 2,575 with one or more cases
Table 1: Characteristics of Nursing Homes with reported cases of COVID-19

| Nursing Home Characteristics | Nursing Homes Without COVID-19 | Nursing Homes With COVID-19 | Probability of any case | Outbreak size |
|-----------------------------|--------------------------------|-----------------------------|-------------------------|---------------|
|                             | n=6,446 (68.6%) | n=2,949 (31.4%) | n=9,395 | n=2,575 |
| Size                        | No. (%) | No. (%) | Odds Ratio | Percentage Point Change |
| Small (<50 Beds)            | 869 (86.9%) | 131 (13.1%) | Reference | Reference |
| Medium (50–150 Beds)        | 4777 (70.9%) | 1960 (29.1%) | 2.63*** | -10.80*** |
| Large (>150 Beds)           | 800 (48.3%) | 858 (51.7%) | 6.52*** | -15.88*** |
| Ownership                   |          |          |            |               |
| For-Profit                  | 4651 (67.6%) | 2227 (32.4%) | 1.07 | 1.88* |
| Non-profit                  | 1534 (70.4%) | 644 (29.6%) | Reference | Reference |
| Government                  | 261 (77.0%) | 78 (23.0%) | 0.84 | -2.58 |
| Non-Chain                   | 2779 (67.9%) | 1312 (32.1%) | Reference | Reference |
| Chain                       | 3667 (69.1%) | 1637 (30.9%) | 0.89* | 1.39 |
| Resident characteristics    |          |          |            |               |
| Low Medicaid share          | 5827 (69.0%) | 2623 (31.0%) | Reference | Reference |
| High Medicaid share         | 619 (65.5%) | 326 (34.5%) | 0.97 | -0.79 |
| Low Black resident share    | 5570 (71.7%) | 2201 (28.3%) | Reference | Reference |
| High Black resident share   | 876 (53.9%) | 748 (46.1%) | 2.05*** | 1.44 |
| Rural                       | 2001 (89.7%) | 229 (10.3%) | Reference | Reference |
| Urban                       | 4445 (62.0%) | 2720 (37.9%) | 3.22*** | 1.28 |
| Overall Five-Star Rating    |          |          |            |               |
| 1                           | 1109 (69.5%) | 486 (30.5%) | Reference | Reference |
| 2                           | 1259 (66.9%) | 622 (33.1%) | 1.07 | 0.20 |
| 3                           | 1162 (67.6%) | 557 (32.4%) | 1.23* | 0.34 |
| 4                           | 1394 (69.8%) | 602 (30.2%) | 1.07 | -0.09 |
| 5                           | 1522 (69.1%) | 682 (30.9%) | 1.18 | 1.07 |
| No Infection Violation      |          |          |            |               |
| 3614 (69.5%) | 1584 (30.5%) | Reference | Reference |
| Prior Infection Violation   | 2832 (67.5%) | 1365 (32.5%) | 0.99 | -0.58 |
| State                       |          |          |            |               |
| CA                          | 802 (69.3%) | 356 (30.7%) | 0.51*** | Reference |
| CO                          | 133 (66.5%) | 67 (33.5%) | 0.81 | 19.65*** |
| CT                          | 68 (31.9%) | 145 (68.1%) | 2.62*** | 13.54*** |
| DE                          | 29 (65.9%) | 15 (34.1%) | 0.54 | N/A |
| FL                          | 385 (58.3%) | 275 (41.7%) | 0.73 | -4.51*** |
| GA                          | 132 (38.9%) | 207 (61.1%) | 1.98*** | 3.53 |
| IA                          | 383 (93.4%) | 27 (6.6%) | 0.19*** | 24.61*** |
| IL                          | 446 (64.2%) | 249 (35.8%) | 0.67* | 4.86*** |
| KY                          | 258 (96.3%) | 10 (3.7%) | 0.07*** | N/A |
| LA                          | 240 (89.5%) | 28 (10.5%) | 0.10*** | N/A |
| MA                          | 81 (22.0%) | 288 (78.0%) | 4.36*** | 9.06*** |
| MD                          | 79 (36.1%) | 140 (63.9%) | 1.57* | 10.28*** |
| ME                          | 89 (96.7%) | 3 (3.3%) | 0.08*** | N/A |
| MI                          | 270 (66.3%) | 137 (33.7%) | 0.69 | 4.80*** |
| MN                          | 278 (79.7%) | 71 (20.3%) | 0.54** | N/A |
| NC                          | 355 (88.5%) | 46 (11.5%) | 0.14*** | 14.06*** |
| ND                          | 57 (73.1%) | 21 (26.9%) | 1.32 | -7.31*** |
| NJ                          | 39 (11.4%) | 303 (88.6%) | 7.16*** | 28.37*** |
| NM                          | 50 (79.4%) | 13 (20.6%) | 0.55 | N/A |
| NV                          | 26 (53.1%) | 23 (46.9%) | 1.30 | 8.80 |
| NY                          | 512 (85.6%) | 86 (14.4%) | 0.10*** | N/A |

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| State | Cases (Overall %) | Outbreak Size | Note |
|-------|------------------|---------------|------|
| OH    | 712 (80.9%)      | 168 (19.1%)   | 0.33*** 3.59 |
| OK    | 233 (84.1%)      | 44 (15.9%)    | 0.37*** 7.25 |
| OR    | 112 (91.1%)      | 11 (8.9%)     | 0.15*** N/A |
| RI    | 37 (50.0%)       | 37 (50.0%)    | 1.13 15.01*** |
| SC    | 129 (72.9%)      | 48 (27.1%)    | 0.40*** -1.77 |
| TN    | 265 (91.1%)      | 26 (8.9%)     | 0.12*** 3.00 |
| VT    | 29 (87.9%)       | 4 (12.1%)     | 0.43 18.88 |
| WA    | 119 (60.1%)      | 79 (39.9%)    | 0.46** 2.10 |
| WV    | 98 (81.7%)       | 22 (18.3%)    | Reference N/A |

Notes: * p < 0.05, ** p < 0.01, *** p < 0.001; N/A: State does not report case counts. Outbreak size is the number of reported cases divided by the number of beds, multiplied by 100. Data were collected through May 11, 2020.