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Severe Staffing and Personal Protective Equipment Shortages Faced by Nursing Homes during the COVID-19 Pandemic

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Abstract

The COVID-19 pandemic continues to devastate U.S. nursing homes. Adequate personal protective equipment (PPE) and staffing are critical to protect nursing home residents and staff during future COVID-19 outbreaks. Despite the importance of these basic measures, little national data is available about the state of nursing homes with respect to these resources. This paper presents results from a new national database containing 94% of U.S. nursing homes. We find that more than 1 in 5 nursing homes report a severe shortage of PPE and any shortage of staff. Rates of both staff and PPE shortages did not meaningfully improve from May to July of 2020. Facilities with COVID-19 cases among residents and staff, as well as those serving more Medicaid recipients and with lower quality scores, were more likely to report shortages. Policies aimed at providing resources to obtain additional direct care staff and PPE to these vulnerable nursing homes, particularly in areas with rising community COVID-19 case rates, are needed to reduce the national COVID-19 death toll.

Introduction

COVID-19 has devastated nursing homes, both globally and in the US. By the end of July 2020, over 60,000 deaths had occurred in US nursing homes and other long-term care facilities, accounting for nearly half of all COVID-related fatalities nationwide.[1] Many staff have also contracted COVID, with over 760 staff deaths from the virus as of July 26, 2020.[2] Efforts to stem the virus are also taking a huge toll on residents. Nursing homes endured weeks of a federally-mandated all-out lockdown with no visitation, communal dining or activities allowed as of March in most facilities. Only recently have these restrictions begun to be relaxed and only on a limited basis in certain states. Similar difficulties have been reported for nursing homes in Europe.

Although our knowledge of COVID-19 is still evolving, strict infection control is considered a fundamental component of ensuring the safety of residents and staff in nursing homes. The standard of care for infection control in nursing homes is illustrated by a set of “core practices” endorsed by the Centers for Disease Control and Protection (CDC), including adequate access to personal protective equipment (PPE) and staffing.[3]

The CDC suggests that nursing homes must “provide supplies necessary to adhere to recommended infection prevention and control practices.”[3] Adequate access to PPE includes

supplies like masks, gowns, goggles, gloves, and hand sanitizer. Many nursing homes have reported shortages of PPE, which has led to the use of lower-grade equipment or reuse of equipment across COVID and non-COVID patients.[4,5] In response to this shortage, the federal government promised to provide two weeks' supply of PPE to all US nursing homes back in May.[5] However, many nursing homes reported that they did not receive adequate PPE through this initiative.[5]

The CDC has also called for nursing homes to "develop (or review existing) plans to mitigate staffing shortages from illness or absenteeism."[3] Many nursing homes struggled with staffing prior to COVID-19,[6] and shortages have reportedly been magnified because many staff are unable or unwilling to work in these conditions.[7]

It is widely accepted that the key practices above outlined by the CDC can prevent or mitigate the spread of COVID-19 in nursing homes. However, there has been little national evidence about the state of these practices in nursing homes due to the lack of data. As part of the recent federal COVID nursing home data, the Centers for Medicare and Medicaid Services (CMS) has begun collecting data from nearly every nursing home in the country regarding COVID and its impact on residents and staff. This paper reports some of the first results from these federal data by describing nursing home access to PPE and staffing and examining the facility characteristics associated with shortages in these areas.

Study Data and Methods

Data Sources

The primary data for this study was the Centers for Medicare and Medicaid services (CMS) COVID-19 Nursing Home Database. This publicly available file provides information submitted by nursing homes to the CDC's National Healthcare Safety Network COVID-19 Long Term Care Facility Module about the impact of COVID-19 on staff and residents, as well as shortages of staff, personal protective equipment, and testing.[2] We used data from 2 four-week reporting periods: the first spanned 5/18/2020 – 6/14/2020, while the second spanned 6/24/20–7/19/20. In the early study window, 87% of nursing homes submitted data for all four reporting periods, while 94% of nursing homes submitted data for all four periods in the later window. For facilities with multiple submissions within a study period, we used the most recent data available.

Facility information was obtained from the 2017 Certification and Survey Provider Enhancement Reports (CASPER) system through the National Institute on Aging-funded LTCFocus.org website and the 2020 Nursing Home Compare Provider Information file.[8,9] County-level data on the 7-day average of new COVID-19 cases (per 100,000 population) were obtained from the publicly available New York Times Coronavirus (Covid-19) Data in the United States repository.[10]

Study Sample

Our primary study sample included all Medicare and Medicaid certified nursing homes in the US who submitted responses to staffing and PPE questions during at least one of the weekly reporting periods during the two study windows detailed above. Additionally, we

examined all Medicare and Medicaid-certified nursing homes in the U.S. to compare characteristics of facilities with and without submitted data.

Outcomes and Measures:

We examined shortages in two categories: staffing and PPE (including hand sanitizer, which is not strictly 'equipment,' but is key for proper infection control practices). These categories are based on the set of questions that CMS required nursing homes to submit answers for along with other COVID-19 data. Nursing homes were considered to have a shortage of staff if they reported a shortage (defined simply as "shortage" in survey questions) in any of the following staff categories: 1) nurses (registered nurses (RNs) and licensed practical nurses (LPNs), 2) clinical staff (physicians, physician assistants, and advanced practice nurses), 3) aides (certified nursing assistants, nurse aides, medication aide/technician), 4) other (including staff not involved in direct resident care like food or environmental service staff). Nursing homes were classified as having a shortage of PPE if they reported less than a 1-week supply of any of the following equipment types: 1) N95 masks, 2) surgical masks, 3) eye protection (face shields, goggles), 4) gowns, 5) gloves, and 6) alcohol-based hand sanitizer. For all outcomes, we used the most recently available data within the two 4-week study windows for each facility.

We defined our outcomes on staff or PPE shortage as having a shortage in any category because of the interdependence of the individual components for high quality care. Having a shortage of any type of staff affects every aspect of clinical care, whereas a shortage of any PPE element can break infection control protocols. We considered shortages in PPE to be "severe" because positive answers to these questions represent an extremely limited capacity to respond to a COVID-19 outbreak. On the other hand, the staff shortage questions were worded more generally and did not indicate magnitude.

The following nursing home characteristics were obtained from the Nursing Home Compare data: total bed size, profit-status, overall 5-star quality score (a composite measure of multiple quality, staffing and compliance indicators assessed annually by Medicare), and staffing related 5-star quality score (which provides information about facilities' staffing levels prior to the pandemic). CASPER data was used to obtain information on the percent of facility revenue that comes from Medicaid (categorized into quartiles among all nursing homes), the percent of residents who are non-white race (categorized into quartiles), and whether the facility is part of a chain. Additionally, we included the incidence of new COVID-19 cases (measured as a 7-day average of new cases per 100,000 population) in the county where a facility is located for the 7-day period ending 6/14/2020 for the first study window or 7/19/2020 for the second. New case rates were categorized into quartiles. We also captured whether the facility reported any confirmed or suspected COVID-19 cases among residents or staff by the end of the relevant study window, as reported by facilities in the CMS Nursing Home COVID-19 data.

Statistical Analysis

We estimated the national rate of staff and PPE shortages, as well as the national rate of specific shortage types, across the two study windows. We examined variation in any staff

and PPE shortages at these two points in time using bivariate comparisons and multivariate modeling. Specifically, we estimated linear probability models for each outcome that included the facility characteristics described above and state-level fixed effects to capture variation in state policies and responses. For all variables, we included categories for missing values so that only facilities with missing outcome data for PPE or staff shortages were excluded from multivariate analyses. Separate models were estimated for each time period. All models used robust standard errors clustered at the county level. Finally, we examined geographic variation in the rate of overall shortages in the most recent time period by calculating county-level averages (weighted by facility bed size) and mapping the results. Refer to the Appendix for maps of shortage rates in the initial study window.[11]

Limitations

The CMS Nursing Home COVID-19 data is a novel database and may therefore be subject to measurement error. Early reports of the initial reporting period indicated errors existed in the death and case counts.[12] However, the shortage variables are plausibly less subject to such reporting errors as these variables are based on straightforward Yes/No questions asked of nursing homes. Furthermore, staff and PPE shortages are likely easier for nursing home administrators to track than COVID-19 death counts given the fact that deaths may often occur outside the nursing home and testing is not universal. To assess the internal validity of the shortage data, we calculated the number of facilities with inconsistent responses to the PPE questions- specifically, we examined the number that reported not having any of a particular PPE type *and* having a one-week supply of the same type, which is not possible. Fewer than 0.5% of facilities had this type of conflicting response, and these respondents were conservatively classified as not having a PPE shortage in our analyses. Although these checks are reassuring, the surveys are self-reported by nursing homes and it is still possible that facilities under-reported shortages, potentially to avoid undesired scrutiny.

This study is also limited by the wording of the shortage questions. For example, a one-week supply of PPE represents a severe shortage of supplies, but no additional questions are available to detect the magnitude of shortages. As such, PPE shortages should be viewed as a lower bound of clinically significant shortages at the time. On the other hand, staff shortage questions only asked about *any* shortage and did not quantify the extent of these deficits. Staff shortages are therefore subject to bias if respondents had systematic differences in their interpretation of the broad wording in the question. One other limitation is that the state of the COVID-19 pandemic moves very quickly. Therefore, the state of nursing homes in mid-July 2020 may not reflect shortages later in 2020. Nevertheless, this survey represents the largest and most recent data available about the state of nursing homes navigating the pandemic. Finally, our analysis only demonstrates associations between nursing home characteristics and the prevalence of shortages. Our results should be interpreted as descriptive, not causal.

Results

Of the 15,388 nursing homes identified in our data, 15,035 (98%) had submitted staff and PPE shortage data to the CDC database in at least one of the weekly reporting periods

during the later 6/24/20–7/19/20 study window (Appendix Exhibit A1).[11] Nursing homes without submitted data (n = 353) were more likely to be small, unaffiliated with a chain, have the highest and lowest quartiles Medicaid revenue share, the lowest overall and staffing 5-star quality score, have high proportions of non-white residents, and be located in a county with the highest quartile of new COVID-19 cases.

At the end of the first study window ending 6/14/2020, 20.7% of nursing homes with submitted data reported a severe PPE shortage with 1 week or less of available supply, with shortages of N95 masks and gowns being the most common type (13.4% and 12.6% of all nursing homes, respectively; Exhibit 1). A total of 20.8% of facilities reported a staff shortage, with 15.1%, 17.2%, and 9.2% indicating a shortage of nurses, nursing aides, and other staff, respectively.

Overall shortage rates were relatively unchanged at the conclusion of the second study window (7/19/20)- 19.1% and 21.9% percent of nursing homes reported shortages of PPE and staff, respectively. N-95 masks (14.4%) and gowns (10.9%) continued to be the most common types of PPE shortages, though gown shortages fell relative to the first study period. Nursing aides (18.5%), nurses (16.0%), and other (9.3%) continued to be the most common staff shortage categories.

In unadjusted comparisons, facilities reporting any PPE shortage in both study periods were more likely to be for profit, chain affiliated, and report COVID-19 cases among staff and residents (Exhibit 2). After adjustment, being for profit (8.1 [study period 1; P<0.001] and 8.3 [study period 2; P<0.001] percentage point [pp] increase relative to non-profit facilities)and having COVID-19 cases among residents (3.2 [P<0.001] and 3.1 [P<0.001] pp increase relative to facilities without) and staff (2.5 [P=0.003] and 2.3 pp [P=0.007] increase relative to facilities without) continued to be associated with higher rates of any PPE shortages. Regression estimates also indicated that facilities with the highest 5-star staffing scores were less likely (5.1 pp [P=0.002] decrease relative to 1 star facilities) to report a PPE shortage during the initial study window. Finally, being chain affiliated was associated with relative increase (1.7 pp [P=0.025]) in likelihood of reporting a PPE shortage in the most recent study period.

With respect to staffing, facilities that were government-owned, had higher Medicaid revenue shares, lower 5-star overall and staffing-specific quality scores, and with staff and resident COVID-19 cases were more likely to report shortages in both study periods in unadjusted analyses (Exhibit 3). After adjustment, government ownership (4.7 pp [study period 1; P=0.006] and 3.9 pp [study period 2; P=0.024] increase relative to non-profit facilities), having greater Medicaid revenue shares (e.g., 5.1 and 5.2 [P<0.001 for both] pp increase between facilities in the highest vs. lowest quartile), and having COVID cases among staff (1.9 [P=0.022] and 3.8 [P<0.001] pp increase relative to facilities without) continued to be significant predictors of a reported shortage in both time periods. In addition, there was a clear gradient across both general facility quality scores and scores specific to prior staffing levels, with higher-rated facilities being less likely to report a shortage. Facilities with an overall 5-star score were 6.4 (study period 1; P<0.001) and 7.5 (study period 2; P<0.001) pp less likely to report a shortage relative to 1-star facilities;

nursing homes with a 5-star staffing score were 5.7 (P=0.001) and 5.4 (P=0.002) pp less likely.

Some differences were noted between the two study periods. Larger facilities (i.e., 200+ beds) were less likely to report a staff shortage (−4.1 pp [P=0.033] relative to facilities with 50 or fewer beds) during the initial study period. This difference was no longer significant during the later round of data collection at the 95% significance level. Being part of a chain was associated with a lower likelihood of a staff shortage in the second study period (−2.5pp; P=0.002), while having COVID-19 cases among residents was associated with a greater likelihood (2.2 pp [P=0.005]) in the first.

There was considerable variation across counties reporting PPE (Exhibit 4) and staff (Exhibit 5) shortages during the 6/24/20–7/19/20 reporting period. For example, in 25% of counties with data, 32% of nursing homes reported less than a one week supply of at least one PPE category. In 10% of counties, 66% of nursing homes reported such a shortage. PPE shortages were distributed throughout the country, but clusters of high shortage rates were notable in northern New England, Iowa, Alabama, North Carolina, West Virginia and Tennessee. 25% of counties had at least 44% of nursing homes reporting a staff shortage; 12% of counties had 75% of more of their nursing homes operating short staffed. High rates of staff shortages were clustered in portions of the south and Midwest, especially Louisiana, Alabama, eastern Texas and Georgia. Geographic shortage patterns were similar in the earlier study period (Appendix Exhibit A4 and A5).[11]

DISCUSSION

Using the most comprehensive survey of nursing homes during the COVID-19 pandemic to date, we found that over 1 in 5 facilities faced a staff shortage or severe shortage of PPE in early July 2020. Despite a slight decrease in facilities with any PPE shortage driven by higher availability of gowns, overall PPE and staff shortages have not meaningfully improved since late May 2020. In many counties, the majority of facilities faced shortages of staff or PPE. PPE shortages were magnified among nursing homes with COVID-19 cases among staff or residents and those with low quality scores. Staff shortages were greater in facilities with COVID-19 cases, particularly among staff, those serving a high proportion of disadvantaged patients on Medicaid, and those with lower quality scores, including pre-pandemic staffing scores. Given the disproportionate burden of morbidity and mortality faced by nursing home residents, the magnitude of these shortfalls poses a major threat to public health, especially in areas with the highest proportions of nursing homes with severe shortages, many of which experienced surges in COVID-19 activity in July and August 2020.

These results provide a detailed view of the specific challenges faced by nursing homes during the height of pandemic in many areas nationwide. For example, PPE shortages were most pronounced for N95 masks and gowns, while staff shortages were most commonly reported for nurses and nursing aides. Overall shortages were also more common among facilities with COVID-19 cases among staff or residents. It is predictable that facilities with active COVID-19 cases would be more likely to experience shortages, because those

facilities are likely the ones using PPE at the highest rates and with sick staff who have to quarantine. However, this association highlights the importance of pandemic preparedness for nursing homes in areas of the country facing a second surge of COVID-19 in late June and July 2020. Many of these areas, such as South Carolina, Georgia and Alabama had a high concentration of counties where the majority of nursing homes faced shortages even before the second surge of COVID-19 began in late June.

For-profit nursing homes reported substantially higher rates of PPE shortages than other facilities, but not staffing shortages. This is especially concerning given that the vast majority of nursing homes in the US are for-profit and a substantial literature from before the pandemic documenting lower quality of care at for-profit nursing homes compared to non-profit facilities.[13–15] Our results are not able to speak to a specific mechanism that might drive this association. However, it is plausible that for-profit facilities had a stronger financial disincentive than others to make large investments in PPE given the uncertainty of how the pandemic might evolve in the US.

It is also notable that the most prominent staff shortages were for nurses and nursing aides as opposed to clinicians or other staff. Shortages in these staff were common prior to COVID-19, but the pandemic is straining an already over-stretched workforce with low pay and demanding work environments. This point is supported by the finding that homes with lower staffing quality scores before the pandemic were more likely to report current shortages. Nurses and nursing aides are on the front line of care delivery, with daily, or even hourly, contact with residents. These shortages could have a major impact not just on the ability of nursing homes to adhere to standard infection control protocols, but also their capacity to provide necessary ongoing care not directly related to COVID-19.

It is concerning, although not unexpected, that more disadvantaged or lower quality nursing homes, such as those with a higher percent of revenue from Medicaid or those with lower star ratings, have worse staff shortages. These are facilities whose profit margins will be necessarily lower due to the underpayment of Medicaid for nursing home costs. While nursing homes across the spectrum of quality and patient mix reported shortages, we observed a fairly stark disparity, with 29% of 1-star nursing homes reporting a shortage vs. 16% of 5-star nursing homes. This disparity illustrates that policies to address shortages will need to account for the heavier burden among nursing homes serving more disadvantaged populations. Without more policy attention and additional investment, nursing homes serving disadvantaged populations may struggle to meet even the most basic needs of their residents, regardless of COVID-19 status.

Although the most effective way to prevent COVID-19 outbreaks within nursing homes may be to reduce the community prevalence coronavirus infections, there are a number of nursing home-specific policy implications from our results. First, too many nursing homes lack a minimally sufficient supply of PPE to adequately protect themselves from COVID-19. This shortage has now persisted over a period of almost two months. Given that nearly half of all deaths from COVID-19 in the US come from nursing home residents, this must be a policy priority if policymakers intend to save as many lives as possible. Second, as in most crises, the most vulnerable nursing homes are at the highest risk for shortages that put the health of

their residents and staff at risk. Although there is no quick fix for the complex problems faced by nursing homes with more disadvantaged populations, additional targeted financial support for direct patient care and supplies, coupled with appropriate oversight to ensure that funds are used for intended purposes, as a part of future stimulus packages could help prevent COVID-19 from being both a financial as well as clinical crisis for these facilities. Third, there is clearly substantial geographic heterogeneity in the shortages faced by nursing homes. Some states such as Alabama need to prioritize their nursing homes' resilience for outbreaks more than others, particularly as the geographic distribution of COVID-19 hot spots continues to evolve. Fourth, these data are extremely valuable and Medicare should continue its commitment to gathering information on nursing homes' available resources and disseminating it publicly. However, as facilities improve their data reporting capacity, Medicare should also update their survey questions to reflect the current realities of the pandemic. The current set of questions reflects an extreme of scarcity that may not apply for long and misses other important factors like the degree of staff shortages or testing turnaround time.

In conclusion, many nursing homes in the US are poorly prepared to prevent and manage COVID-19 outbreaks given a lack of essential PPE and staff. Despite intense policy attention and mounting mortality, the shortages have not meaningfully improved from May to July of 2020. Unless these shortages are prioritized by policymakers, long-term care residents will continue to be at a great disadvantage in the pandemic.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

References

1. Kaiser Family Foundation. COVID-19: Metrics by State. State Data and Policy Actions to Address Coronavirus Web site. https://www.kff.org/health-costs/issue-brief/state-data-and-policy-actions-to-address-coronavirus/?utm_source=web&utm_medium=trending&utm_campaign=covid-19. Published 2020 Accessed July 1, 2020.
2. Centers for Medicare & Medicaid Services. COVID-19 Nursing Home Data. https://data.cms.gov/stories/s/COVID-19-Nursing-Home-Data/bkwz-xpvg/. Published 2020 Accessed June 18, 2020.
3. Centers for Disease Control and Prevention. Nursing Homes & Long-Term Care Facilities. Coronavirus Disease 2019 Web site. https://www.cdc.gov/coronavirus/2019-ncov/hcp/long-term-care.html. Published 2020 Accessed July 1, 2020.
4. Whoriskey P, Cenziper D, Englund W, Jacob J. Hundreds of nursing homes ran short on staff, protective gear as more than 30,000 residents died during pandemic. The Washington Post[Serial on the Internet]. 2020, 6 4; [Cited 2020 Aug 9] available from https://www.washingtonpost.com/business/2020/06/04/nursing-homes-coronavirus-deaths/.
5. Rau J Federal Help Falters As Nursing Homes Run Short Of Protective Equipment. Kaiser Health News.[Serial on the Internet] 2020, 6 11; [cited 2020 Aug 9] available from: https://khn.org/news/federal-help-falters-as-nursing-homes-run-short-of-protective-equipment/.
6. Geng F, Stevenson DG, Grabowski DC. Daily nursing home staffing levels highly variable, often below CMS expectations. Health Aff (Millwood),. 2019;38(7):1095–1100. [PubMed: 31260368]
7. Ornstein C, Sanders T. Nursing Homes Violated Basic Health Standards, Allowing the Coronavirus to Explode. ProPublica [serial on the Internet]. 2020 4 24; [cited 2020 Aug 9] Available from: https://www.propublica.org/article/nursing-homes-violated-basic-health-standards-allowing-the-coronavirus-to-explode.

8. Centers for Medicare & Medicaid Services. Provider Info. Nursing Home Compare Data Web site. https://data.medicare.gov/Nursing-Home-Compare/Provider-Info/4pq5-n9py. Published 2020 Accessed June 9, 2020.

9. Brown School of Public Health. LTCFocus. http://ltcfocus.org/. Published 2020 Accessed June 9, 2020.

10. The New Yok Times. Coronavirus (Covid-19) Data in the United States. https://github.com/nytimes/covid-19-data. Published 2020 Accessed June 25, 2020.

11. To access the Appendix, click on the Details tab of the article online. In.

12. Clark C Nursing Homes Shocked at 'Insanely Wrong' CMS Data on COVID-19. Medpage Today[Serial on the Internet]. 2020 6 9; [cited 2020 Aug 9] available from https://www.medpagetoday.com/infectiousdisease/covid19/86967:.

13. Comondore VR, Devereaux P, Zhou Q,Stone SB, Busse JW, Ravindran NC. et al. Quality of care in for-profit and not-for-profit nursing homes: systematic review and meta-analysis. BMJ . 2009;339:b2732. [PubMed: 19654184]

14. Ronald LA, McGregor MJ, Harrington C, Pollock A, Lexchin J. Observational evidence of for-profit delivery and inferior nursing home care: when is there enough evidence for policy change? PLoS Medicine. 2016;13(4):e1001995. [PubMed: 27093442]

15. Grabowski DC, Feng Z, Hirth R, Rahman M, Mor V. Effect of nursing home ownership on the quality of post-acute care: An instrumental variables approach. J Health Econ. 2013;32(1):12–21. [PubMed: 23202253]

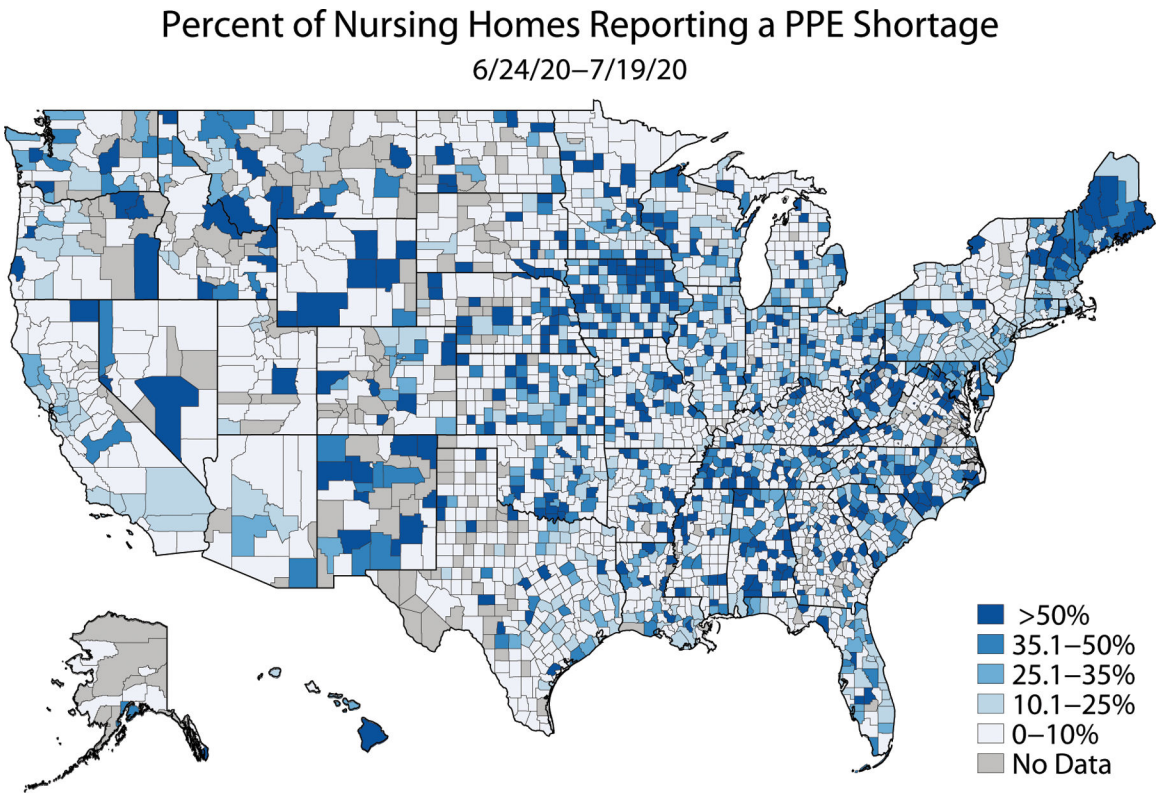

Exhibit 4:

Geographic Distribution of Nursing Home Personal Protective Equipment Shortages

Source- Author's calculations using CMS COVID-19 Nursing Home Data.

Notes- County shortage rates reflect the percent of facilities within the counted reported a shortage, weighted by facility bed size.

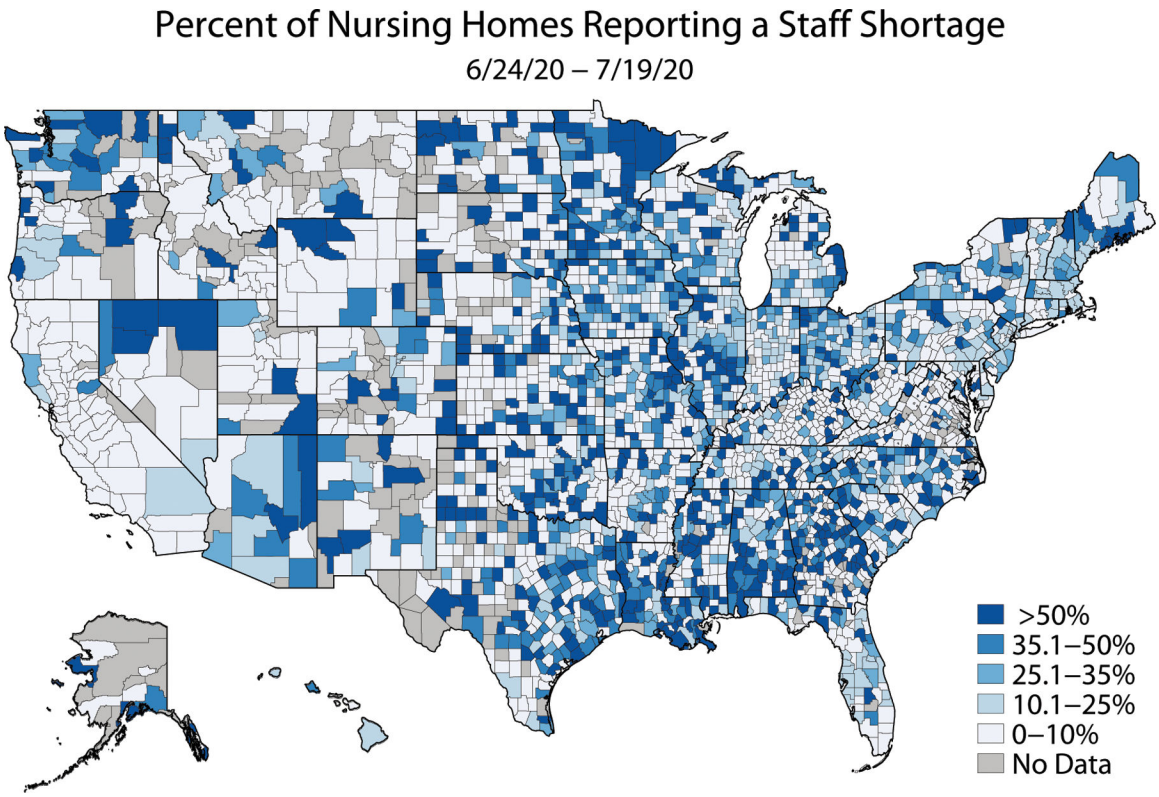

Exhibit 5:

Geographic Distribution of Nursing Home Staff Shortages

Source- Author's calculations using CMS COVID-19 Nursing Home Data.

Notes- County shortage rates reflect the percent of facilities within the counted reported a shortage, weighted by facility bed size.

Exhibit 1

National Rates of Personal Protective and Staff Shortages

	Data Reporting Period: 5/18/20 – 6/14/20	Data Reporting Period: 6/24/20 −7/19/20
Shortage Type	**Percent (95% Confidence Interval)**	**Percent (95% Confidence Interval)**
Any Personal Protective Equipment Shortage (N = 14,509 (a) and 15,036(b))	20.7	19.1
	(20.0, 21.4)	*(18.4, 19.7)*
N95 masks	13.4	14.4
	(12.9, 14.0)	*(13.9, 15.0)*
Surgical masks	6.1	8.3
	(5.7, 6.5)	*(7.9, 8.8)*
Eye protection	5.8	7.8
	(5.4, 6.2)	*(7.4, 8.2)*
Gowns	12.6	10.9
	(12.1, 13.2)	*(10.4, 11.4)*
Gloves	3.7	4.2
	(3.4, 4.0)	*(3.9, 4.6)*
Hand sanitizer	4.9	4.3
	(4.6, 5.3)	*(4.0, 4.7)*
Any Staff Shortage (N = 14,519(a) and 15,042 (b))	20.8	21.9
	(20.1, 21.5)	*(21.3, 22.6)*
Nurses	15.1	16.0
	(14.5, 15.7)	*(15.4, 16.6)*
Clinical staff	2.7	2.6
	(2.5, 3.0)	*(2.4, 2.9)*
Nursing Aides	17.2	18.5
	(16.6, 17.9)	*(17.9, 19.1)*
Other	9.2	9.3
	(8.8, 9.7)	*(8.9, 9.8)*

Source- Author's calculations using CMS COVID-19 Nursing Home Data.

NOTES: (a) For Reporting Period: 5/18/20–6/14/20, (b) For Reporting Period: 6/24/20–7/19/20

Exhibit 2:

Personal Protective Equipment Shortages by Facility Characteristics

Facility Characteristic	Data Reporting Period: 5/18/20–6/14/20		Data Reporting Period: 6/24/20–7/19/20	
	Unadjusted %	Adjusted Difference (percent points)	Unadjusted %	Adjusted Difference (percent points)
Profit Status				
Non-Profit	15.6	Ref	14.3	Ref
Government Owned	14.0	0.3	13.6	1.8
For Profit	23.0	8.1***	21.1	8.3***
Bed Size				
1–50 Beds	20.1	Ref	18.7	Ref
51–100	21.0	−0.9	19.4	−0.1
101–150	20.7	−0.5	19.3	0.9
151–200	20.7	−1.2	18.6	0.3
200+	20.0	−0.9	17.0	0.4
Part of Chain				
No	18.9	Ref	17.0	Ref
Yes	21.9	1	20.7	1.7**
% Revenue from Medicaid (quartiles)				
1 (lowest)	18.3	Ref	17.8	Ref
2	21.9	1.7	20.0	1.3
3	21.7	1.1	19.7	1.0
4 (Highest)	20.7	0.3	19.0	1.0
% of Residents who are non-white (quartiles)				
1 (lowest)	20.9	Ref	21.0	Ref
2	21.1	0.7	19.1	−1.5
3	19.7	0.0	18.6	−1.6
4 (Highest)	21.4	1.3	18.2	−2.0
5-star Overall Quality Score				
1	20.1	Ref	18.4	Ref
2	21.7	0.8	19.1	0.0
3	21.1	0.5	19.3	0.4
4	21.2	0.7	19.8	1.2
5	19.6	0.9	18.8	1.7
5-star Staffing Score				
1 (lowest)	17.9	Ref	15.4	Ref
2	20.3	−1	18.1	0.1
3	22.6	−0.1	21.3	1.7
4	23.0	0.4	21.4	1.3
5	16.4	−5.1***	16.3	−2.6
County COVID-19 New Case Rate				
1 (lowest)	21.6	Ref	20.2	Ref

Facility Characteristic		Data Reporting Period: 5/18/20–6/14/20		Data Reporting Period: 6/24/20–7/19/20	
		Unadjusted %	Adjusted Difference (percent points)	Unadjusted %	Adjusted Difference (percent points)
	2	21.0	0.2	19.5	−0.4
	3	19.5	−0.3	18.7	−0.8
	4 (Highest)	20.6	−0.5	17.7	0.3
Any COVID-19+ Residents					
	No	18.4	Ref	16.9	Ref
	Yes	22.7	3.2***	20.2	3.1***
Any COVID-19+ staff					
	No	18.5	Ref	16.9	Ref
	Yes	21.9	2.5***	19.6	2.3***

Source- Author's calculations using CMS COVID-19 Nursing Home Data.

Notes- Adjusted differences were calculated using linear regression models that included all characteristics listed in Exhibit 2 in addition to state fixed effects. Missing information for any of the facility characteristics was captured with a missing category not reported here. Refer to Appendix Exhibit A2 for full regression results.

** P≤0.05;

*** P≤0.01

Exhibit 3

Staff Shortages by Facility Characteristics

Facility Characteristic	Data Reporting Period: 5/18/20–6/14/20		Data Reporting Period: 6/24/20–7/19/20	
	Unadjusted %	Adjusted Difference (percent points)	Unadjusted %	Adjusted Difference (percent points)
Profit Status				
Non-Profit	19.4	Ref	19.6	Ref
Government Owned	24.5	4.7***	25.5	3.9**
For Profit	20.9	0.8	22.4	1.000
Bed Size				
1–50 Beds	19.9	Ref	19.6	Ref
51–100	20.7	−0.9	22.3	−0.2
101–150	20.9	−1.7	23.0	−1
151–200	21.1	−2.6	21.3	−2.1
200+	22.4	−4.1**	20.5	−3.4
Part of Chain				
No	21.3	Ref	22.4	Ref
Yes	20.7	−1.4	21.9	−2.5***
% Revenue from Medicaid (quartiles)				
1 (lowest)	17.2	Ref	17.8	Ref
2	20.0	0.9	22.1	2.1**
3	22.1	3.1***	22.9	2.8***
4 (Highest)	24.5	5.2***	25.5	5.1***
% of Residents who are non-white (quartiles)				
1 (lowest)	21.3	Ref	21.7	Ref
2	20.9	0.2	22.3	0.5
3	21.1	0.6	22.5	−0.5
4 (Highest)	21.3	1.1	22.9	0.3
5-star Overall Quality Score				
1	27.1	Ref	28.9	Ref
2	23.5	−1.9	24.9	−1.9
3	20.3	−4.8***	21.8	−4.6***
4	19.1	−5.4***	20.2	−5.6***
5	16.3	−6.4***	16.3	−7.5***
5-star Staffing Score				
1 (lowest)	27.2	Ref	29.5	Ref
2	21.9	−2.3	23.1	−2
3	19.7	−2.3	20.4	−2.4
4	19.3	−2.8	20.3	−2.5
5	17.0	−5.7***	17.2	−5.4***

Facility Characteristic	Data Reporting Period: 5/18/20–6/14/20		Data Reporting Period: 6/24/20–7/19/20	
	Unadjusted %	Adjusted Difference (percent points)	Unadjusted %	Adjusted Difference (percent points)
County COVID-19 New Case Rate				
1 (lowest)	22.6	Ref	20.1	Ref
2	20.5	−1.0	21.1	−1.5
3	19.9	−2.1**	23.1	1.0
4 (Highest)	20.1	−1.0	23.4	0.8
Any COVID-19+ Residents				
No	19.4	Ref	21.1	Ref
Yes	22.0	2.2***	22.4	1.2
Any COVID-19+ staff				
No	19.0	Ref	19.5	Ref
Yes	21.9	1.9**	22.5	3.8***

Source- Author's calculations using CMS COVID-19 Nursing Home Data.

Notes- Adjusted differences were calculated using linear regression models that included all characteristics listed in Exhibit 3 in addition to state fixed effects. Missing information for any of the facility characteristics was captured with a missing category not reported here. Refer to Appendix Exhibit A3 for full regression results.

** P≤0.05;

*** P≤0.01