Nursing Home Use as a Risk Factor for COVID-19 Mortality: Implications for Racial Disparities

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Abstract: We assessed differences in nursing home utilization and quality by race and their relation to the large racial disparities in COVID-19 mortality among older adults in 2020 and early 2021. The age-adjusted pre-pandemic rate of nursing home use was 66% higher among Black people and 35% lower among Hispanic people relative to White people 55 and older. Nursing home use was a modest contributor to racial disparities in COVID-19 mortality for Black people only, accounting for about 10% of excess deaths. We did not find evidence that excess deaths among Black and Hispanic people were related to lower baseline nursing home quality for these populations. Compared to racial disparities in COVID-19 mortality in the overall 55 and over population, differences in COVID-19 mortality by race were notably smaller among nursing home residents. Overall, risks unrelated to the nursing home setting were the predominant driver of excess deaths for Black people and particularly for Hispanic people during 2020 and early 2021, while White people appear to have been far more protected from COVID-19 outside of nursing homes.

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has resulted in the deaths of more than 700,000 Americans.[1] COVID-19 has hit communities of color especially hard, and age-adjusted COVID-19 mortality rates among Black and Hispanic people are double or more than those of White people (see **Exhibit 1;** throughout this article, Black and White refer to non-Hispanic people who identify with that race alone, but we drop the non-Hispanic modifier for ease of exposition).[2-4] Considerable researcher and media attention has been devoted to identifying the sources of the disproportionate toll of COVID-19 mortality in Black and Hispanic populations, including analyses of differences in risk factors for exposure to COVID-19—such as occupation or household composition and crowding—and risk factors for severe disease and mortality conditional on infection—such as diabetes, hypertension, and obesity.[5-9] The high COVID-19 death rates among nursing home residents have also been widely noted.[10] Nursing home residents accounted for about a third of all COVID-19 deaths before vaccines became available (and this is likely an underestimate), and we estimate more than 10 percent of all nursing home residents died of COVID-19 pre-vaccine.

Discussions of racial disparities in COVID-19 mortality have typically not considered the role of nursing homes, despite residence in a nursing home being a clear risk factor. And arguably, nursing home residence is more important for COVID-19 mortality than risks associated with occupational exposure that have received ample attention. This may be in part due to a lack of data on nursing home use by race. In this paper, we show how nursing home residence—an important risk factor for COVID-19 infection and mortality—varied by race at the start of the pandemic. We then discuss racial differences in baseline (pre-pandemic) nursing home quality and nursing home COVID-19 management measures, and how COVID-19 death rates varied over the course of the pandemic depending on the racial composition of residents. Finally, we discuss the implications of these findings for understanding racial mortality gaps.

We focus our analysis on the period through mid-February 2021, before COVID-19 vaccines were widely available in nursing homes, though future work should study the post-vaccine period. We focus on White, Black, and Hispanic people because several data sources we use are less consistently reported for other non-White populations; and we limit our analysis of both COVID-19 mortality and nursing home utilization to people 55 and over, who account for

93% percent of COVID-19 deaths during our study period and 95% percent of nursing home residents.

Age-adjusted nursing home use rates for Black people 55 and older are significantly higher, and rates for Hispanic people significantly lower, than for White people. Back-of the-envelope calculations suggest that differential nursing home use explains about 10 percent of the Black-White gap in age-adjusted COVID-19 mortality. Although facilities disproportionately serving White residents were of higher quality according to pre-COVID measures, COVID-19 management and cumulative mortality were fairly similar across facilities serving Black, Hispanic, and White residents. We find a strong state-level correlation between race-specific age-adjusted nursing home use and age-adjusted COVID-19 mortality, suggesting that differences in nursing home use explain some of the considerable cross-state variation in COVID-19 mortality.

Methods

Data Sources

Our analyses rely on several sources of administrative data on the characteristics of the US population overall and nursing home residents specifically. First, population estimates by age, race, and county for 2019 were obtained from Census Bureau. Second, the National Center for Health Statistics (NCHS) of the CDC provides COVID-19 death counts as well as prior all-cause and cause-specific death counts by age, race and state. Deaths were reported to NCHS with a lag that varied by state, introducing some under-reporting and measurement error. Third, nursing home-week level COVID-19 death counts and COVID-19 management measures were obtained from the CDC's National Healthcare Safety Network (NHSN) dataset. Data became available beginning May 24, 2020 and are still being updated weekly. Nursing homes had the option of reporting COVID-19 deaths prior to May 24 in the first week, and most facilities appear to have done so. Fourth, nursing home quality measures for the period prior to COVID-19 were obtained from the CMS care compare website, including 5-star summary ratings. Fifth, some nursing home organizational characteristics were taken from Certification and Survey Provider Enhanced Reports (CASPER) database, a collection of annual nursing home surveys. Sixth, we obtained the pre-pandemic census of nursing home residents using the Minimum Data Set (MDS), individual-level data on nursing home residents collected by CMS.

For all data sources that are reported by race, we used the estimates of people who are not Hispanic and identify with each race alone and the estimates of the Hispanic population to create mutually exclusive groups. We used COVID-19 death data for the overall population and nursing home residents reported as of mid-February, 2021. The data are described in more detail in **Appendix Exhibit 1.**

Age-Adjusted Cumulative COVID-19 Mortality Rates by Race/Ethnicity and State

Combining the NCHS data and aggregated population estimates, we calculated age- and race-specific COVID-19 death rates, using deaths reported through February 13, 2021, in each state and age standardize using direct adjustment with the age distribution for the U.S. population (from the 2019 estimates) as the reference population. Thus, age-adjusted death rates are comparable across both race/ethnicity categories and states. In the state-level data, NCHS suppresses cells with death counts between 0 and 9; no cells are suppressed in the national totals. We calculated the age-adjusted death rates assuming suppressed cells are 1 or 9 to get the minimum and maximum possible age-adjusted death rate for each state and race/ethnicity group. If the ratio of those two values was more than 1.15, we considered the age-adjusted death rate missing for that state and race/ethnicity; otherwise, we used the minimum value. We used the same approach to calculate all-cause and pneumonia/influenza-specific death rates in 2019. However, due to a significant amount of data suppression for pneumonia/influenza

deaths, we instead opted to use age-adjusted death rates averaged over 2018 and 2019 available from CDC wonder data tables (https://wonder.cdc.gov) which were less suppressed and available for more states. Notably, our estimates of 2019 death rates were highly consistent with those from CDC wonder for that year alone for the states with sufficient NHCS data.

Pre-Pandemic Age-Adjusted Nursing Home Use

Using the MDS, we constructed a census of nursing home residents to calculate resident counts by age and race for each facility. The census was based on individuals present in a nursing home on February 1, 2020. We aggregated to the national and state levels and calculated age-adjusted nursing home utilization rates for individuals 55 and older by race/ethnicity and state with the same direct adjustment procedure used for COVID-19 mortality. Nursing homes provide both post-acute and long-term care, and individuals receiving post-acute versus long-term care differ in important ways that are related to COVID-19 risk.[11] We therefore additionally calculated age-adjusted nursing home use rates separately for post-acute and long-term care.

Measures of pre-Pandemic Quality and COVID-19 Management in Nursing Homes

To measure pre-pandemic quality at the facility level, we classified facilities as having a low staffing level or a low inspection score if they scored one or two stars (out of five) in those categories on their February 2020 Care Compare report card. We captured how well-resourced a facility was based on the Medicaid bed share reported in CASPER, since Medicaid reimbursement rates are far lower than those of private payers.

We constructed COVID-19 related management measures using data reported in the NHSN dataset. We classified facilities as being short on PPE that week if they reported on the NHSN they did not have sufficient supplies of N95 masks, surgical masks, eye protection, gloves, gowns, or sanitizer. We classified facilities as being short staffed if they reported experiencing staffing shortages in any category (nursing staff, clinical staff, aides, or other staff); we classified facilities as short on testing supplies if they indicated they would not be able to obtain the supplies to test staff and residents in the coming week; we classified facilities as not having in-house testing supplies if they reported that they don't have a testing machine and/or enough supplies for the machine. For each of those variables, we created an indicator equal to one if they ever reported that (negative) outcome through February 14, 2021. We took the weighted average of each quality measure, weighting by the number of Black, Hispanic, or White residents prior to the pandemic. Assuming there were not systematic changes in the racial composition of facilities during the pandemic, these can be interpreted as the quality or COVID-19 management measures for the facility of the average Black, Hispanic, or White resident, respectively. We also show the time pattern of these measures. The questions about PPE and staffing shortages were asked starting in May, while the questions about testing supplies were asked starting in August 2020.

Nursing Home Death Rates by Racial Composition of Residents

To estimate the cumulative COVID-19 death rate for each facility, we calculated a weekly survival rate ((1 – COVID-19 deaths)/beds occupied) and multiplied by the survival rates for all earlier weeks to estimate a cumulative survival rate. We used all data reported from May 24, 2020 (the first week data were available) through February 14, 2021. The estimated COVID-19 mortality rate for each facility is 100,000 * (1 – cumulative survival). We calculated an alternative measure by dividing total cumulative COVID-19 deaths by the number of residents on February 1, 2020; this produces similar patterns of estimated cumulative mortality. To understand whether death rates varied systematically for facilities with different racial composition of residents, we calculated the weighted average facility-level cumulative death rate, weighted by the number of Black, Hispanic, or White residents in the pre-pandemic nursing home census. These can be interpreted as race-specific in-nursing home mortality rates under the assumption

(supported by other studies) that, *within facility,* COVID-19 deaths affected residents of different races similarly.[11]

Contribution of Exposure to Nursing Homes to COVID-19 Mortality Disparities

We assessed the contribution of differential exposure to nursing homes to racial disparities in COVID-19 mortality in the over 55 population by examining the state-level correlation between nursing home use disparities and COVID-19 mortality disparities. In addition, we calculated a back-of-the-envelope estimate of the contribution of nursing home exposure to COVID-19 mortality disparities. The back-of-the envelope estimate was as follows: (age-adjusted nursing home exposure for Black or Hispanic people – age-adjusted nursing home exposure for White people) * (risk of COVID-19 death in nursing homes – risk of COVID-19 death outside nursing homes) = excess deaths attributable to additional nursing home exposure among Black or Hispanic people compared to White people. In other words, the difference in nursing home use multiplied by the excess COVID-19 mortality rate in nursing homes is equal to the additional COVID-19 deaths attributable to additional nursing home exposure for Black or Hispanic people relative to White people (using our own estimated exposure rates).

We do not have national data on nursing home deaths by age, so we calculated the difference in age-adjusted mortality in and out of nursing homes in two steps. First, we calculated age-specific death rates for nursing home residents and non-residents combined (over age 55) using the NCHS data described above. To estimate the total mortality rate in nursing homes, we divided total COVID-19 deaths in the NHSN by the number of nursing home residents as of February 2020; we estimated the total death rate for non-nursing home residents by subtracting nursing home deaths from total deaths reported in NCHS data and dividing by the non-nursing home population 55 and older. We used indirect adjustment to calculate age-adjusted COVID-19 mortality risk for nursing home residents and non-residents; by this method, COVID-19 mortality risk for nursing home residents was almost 13 times that of non-residents of the same age, a difference of 3,750 per 100,000.

Results

Disparities in COVID-19 mortality by race were much larger than pre-pandemic mortality disparities from all causes or from influenza and pneumonia (**Exhibit 1**)**.** By mid-February 2021, Black people were 83% more likely to die from COVID-19 compared to White people, but prior to the pandemic, all-cause mortality was 13% higher for Black people. Even differences in influenza or pneumonia-related deaths, a measure somewhat comparable to COVID-19 mortality, were considerably smaller between Black and White people in 2018-19. Elevated mortality among Hispanic people was an especially large departure from pre-pandemic patterns, as Hispanic people were less likely than White people to die from any cause or influenza/pneumonia in 2018-19.

Pre-Pandemic Nursing Home Use by Race

As of February, 2020, age-adjusted nursing home use in the 55 and over population was 66% higher among Black people and 35% lower among Hispanic people relative to White people (**Exhibit 2**). Racial differences in post-acute and long-term nursing home use followed similar patterns, though notably Black people had particularly high rates of long-term nursing home use (71% higher than that of White people). Geographic variation in the availability and use of nursing homes could contribute to these findings. For example, Southern states have greater availability of nursing home beds; at the same time, a large share of the Black population and small share of the Hispanic population live in the South. However, this pattern of higher nursing home use among Black people and lower use among Hispanic people is present in almost all states (**Appendix Exhibits 2-3**).

Nursing Home Quality by Race before and after COVID-19

Nursing homes serving the average Black or Hispanic resident received lower quality ratings and had less financial resources compared to nursing homes serving the average White resident, according measures taken prior to COVID-19 (**Exhibit 3**). For example, 39% of White nursing home residents were in facilities with a low staffing rating compared to 55% of Black and 54% of Hispanic residents. On the other hand, we did not find large differences in COVID-19 management measures according to the (pre-pandemic) racial composition of residents. For example, the proportion of Black, White, and Hispanic residents in facilities reporting shortages of personal protective equipment (PPE) at least once between June, 2020 and February, 2021 was 61%, 63%, and 59%, respectively (note that this excludes the early weeks of the pandemic, when PPE shortages were severe). Interestingly, Hispanic nursing home residents were less likely to be in facilities that reported staffing shortages. Many of the COVID-19 management measures improved over time, but these trends did not differ substantially by the racial composition of residents (**Appendix Exhibit 4**).

Geographic Variation in Nursing Home Use and COVID-19 Mortality Rates

Across states, age-adjusted COVID-19 mortality (pre-vaccine) was positively correlated with age-adjusted nursing home use for all three racial groups, but this correlation was strongest for White people and weakest for Hispanic people (**Exhibit 4**)**.** For White people, 55% of state-level variation in COVID-19 mortality was explained by variation in nursing home use, compared to 31% for Black people and 29% for Hispanic people. These results indicate the importance of nursing home use as a risk factor for COVID-19 mortality for all individuals. But the fact that nursing home use explained more of the variation in COVID-19 deaths for White people suggests that White people were more protected outside of nursing homes relative to Black and Hispanic people.

Racial disparities in COVID-19 mortality at the state-level were also correlated with nursing home use (**Exhibit 5**). In Michigan, for instance, Black people were twice as likely to have resided in a nursing home pre-COVID-19 compared to their White counterparts, and Black people were 150% more likely to die of COVID-19 in this state. Although Hispanic people used nursing homes at lower rates, differences in COVID-19 mortality between Hispanic and White peopled widened as their nursing home residence rates converged. Across-state variation of nursing home use differentials may reflect racial differences in health risk that are correlated with both nursing home use and adverse health outcomes more generally. However, the correlation between nursing home exposure differences and mortality disparities before COVID-19 was far weaker (**Appendix Exhibits 5-6**).

COVID-19 Mortality in Nursing Homes

Cumulative COVID-19 mortality rates in nursing homes did not correlate strongly with the racial composition of residents (**Exhibit 6**). Earlier in the pandemic, COVID-19 mortality was higher in nursing homes with greater proportions of Black and Hispanic residents, but disparities narrowed over time as COVID-19 spread to areas with higher shares of White people. At the end of December, the cumulative COVID-19 mortality rate in the nursing home of the average Black resident was lower than that for nursing homes serving the average White or Hispanic resident, which were similar. By mid-February 2021, nursing homes with more White residents had the highest cumulative COVID-19 mortality rates, which ranged from 10.6% for the facility of the average Black resident to 12.2% for the average White resident. Generally, racial differences in COVID-19 mortality observed here in the nursing home setting are far smaller compared with those observed in overall 55 and over population (**Exhibit 1**). This is consistent with our findings shown in **Exhibit 3**, that nursing home use explained less of the variation in COVID-19 mortality for Black and Hispanic people.

Contribution of Nursing Home Use to Racial Disparities in COVID-19 Mortality
COVID-19 deaths among Black people and especially Hispanic people were predominantly driven by the non-nursing home population. Back-of-the-envelope calculations indicate that differences in nursing home use accounted for about 31 additional "expected" deaths per 100,000, or 10% of the Black-White pre-vaccine COVID-19 mortality differential (**Appendix Exhibit 7**). Nursing home use among Hispanic people was lower than among White people, so accounting for it would widen the already substantial mortality disparity by a modest amount (16 deaths per 100,000; 3.6%).

Discussion

Racial disparities in COVID-19 outcomes have been linked to differences in pre-existing chronic disease and structural factors affecting exposure, such as public transportation use, residential crowding, and occupation.[5-9] We extend this literature by illustrating variation in the use of nursing homes, one of the most important risk factors for COVID-19 mortality, by race. We found that the age-adjusted rate of nursing home use was 66% higher among Black people and 35% lower among Hispanic people relative to White people 55 or older. However, higher nursing home use among Black people only accounted for a modest amount, 10%, of the pre-vaccine overall Black-White COVID-19 mortality disparity. Thus, non-nursing home factors are the predominant driver of mortality disparities, particularly for Hispanic people who had lower nursing home use, higher COVID-19 mortality, and better baseline health (as evidenced by lower pre-pandemic death rates) relative to White people. We also found that about 30% of the across-state variation in pre-vaccine COVID-19 death rates for Black and Hispanic people was explained by nursing home use, compared to 55% for White people. Although, this analysis underscores the importance of nursing home use as a risk factor for COVID-19 mortality for White people and non-White people alike, it provides further evidence that non-nursing home factors were more important for non-White people.

Our analyses suggest that nursing home quality, an element of nursing home use, was not related to COVID-19 mortality disparities. Compared to disparities in COVID-19 mortality by race in the overall 55 and over population, differences in COVID-19 mortality rates were notably smaller between nursing homes serving the average Black, Hispanic, and White resident, even though facilities serving White residents were higher in quality according to pre-pandemic measures. Notably, facilities serving residents of all three racial groups reported similar levels of PPE and testing supply shortages throughout the study period (though we do not have data prior to May 2020, when shortages were likely more severe). By November 2020, cumulative COVID-19 mortality became highest in nursing homes disproportionately serving White residents relative to nursing homes disproportionately serving Black and Hispanic residents. Perhaps surprisingly, residents of predominately White facilities did not fare much better even though those communities were impacted much later in the pandemic when PPE and COVID-19 testing were more widely available. This may be due to a lack of federal oversight or related to the historic underfinancing of the nursing home system.[12-13] With more government attention or financial support, it is possible that nursing homes with months to prepare could have prevented COVID-19 outbreaks.

Prior studies provide limited evidence about how nursing home use varies by race, relying on older data, including the 65 and over population only (which is disproportionally White [**Appendix Exhibit 8**]), or failing to age-adjust utilization rates.[14-16] For these reasons, prior work has underestimated nursing home use among Black people. By contrast, our study uses recent data from all nursing home residents nationally and demonstrates that age-adjusted nursing home utilization is higher among Black people overall and compared to White people. Our finding of lower nursing home use by Hispanic individuals is consistent with prior work that uses

less comprehensive data.[14] Our results point to the importance of examining nursing home residence, and the impact of COVID-19 more broadly, for Black and Hispanic populations separately. Other studies of COVID-19 mortality in nursing homes have combined these groups due to data limitations.[17-18]

Higher nursing home use among Black Americans may reflect a differential need for this level of care, conditional on age. Poor access to other health care may be another explanation. For instance, higher quality post-acute care, which is received by Black Americans at lower rates, has been linked to lower long-term nursing home use.[19] In addition, higher nursing home use may reflect lower access to high-quality alternative forms of long-term services and supports in Black communities.[20] Regardless of cause, the variation in nursing home use by race we document has implications for policy beyond COVID-19. Scholars and advocates have recently called for large-scale reforms to the nursing home system, and our analysis demonstrates that policy changes may differentially impact Black Americans.[12-13]

Limitations

We do not have individual-level data on nursing home COVID-19 deaths, so we do not know whether there are racial disparities in mortality within facilities (instead we present differences between facilities for the average White, Hispanic, and Black resident). However, individual-level data for roughly 350 facilities suggest within-facility disparities were small.[11] In addition, we argue that individual-level data from Medicare, which will become widely available in the future, will still be subject to severe limitations. This is because Minimum Data Set resident assessments, while available for all nursing home residents, seldom capture acute diagnoses for long-stay residents. Gold-standard physician claims are readily available for Traditional Medicare beneficiaries only, and a significant fraction of nursing home residents are either enrolled in Medicare Advantage (MA) or are not enrolled in the Medicare program at all. Critically, a complicating factor for racial disparities analyses is that Hispanic and Black nursing home residents are about two times more likely than White residents to be aged under 65 (**Appendix Exhibit 8**).

In our analyses the racial composition of facilities is captured by the census on Feb 1, 2020 and remains constant over time. However, for many reasons, there was a decline in the census of most nursing homes over the course of the pandemic. For example, short-stay post-acute patients may have sought other types of post-hospital care like home health care, and it is likely that there were racial/ethnic differences in the ability of potential residents to avoid using a nursing home during COVID-19. If individuals who chose not to seek post-acute care in nursing homes were more likely to be White, then we may have underestimated how much of the Black-White COVID-19 mortality gap is explained by nursing home utilization, especially because pre-pandemic long-term nursing home use rates were even higher for Black people relative to White people. Another issue is that our calculations of mortality rates by race among nursing home residents likely understate death rates in facilities serving Black and Hispanic residents relative to those disproportionately serving White residents. This is because deaths prior to June 2020 were underreported, and areas most impacted by the pandemic at that time were disproportionately Black and Hispanic and because White residents are older on average, and these death rates are not age-adjusted.

Conclusion

Nursing home use is a leading risk factor for COVID-19 mortality, so understanding racial differences in exposure is critical to understanding broader patterns of COVID-19 mortality. We show that higher utilization among Black people explained only a modest amount of the Black-White disparity in COVID-19 mortality before vaccines were available, suggesting that non-nursing home factors were more important. This was even more true for Hispanic people, who

used nursing homes at lower rates than White people. Results showing that in-nursing home COVID-19 morality was not strongly correlated with the racial composition of residents, despite lower baseline nursing home quality for Black and Hispanic residents, also support the notion that while the nursing home setting was high-risk for COVID-19 mortality overall, it was less unequal compared to the community.

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Exhibits

Exhibit 1: Age-Adjusted COVID-19 Deaths Rates among People 55 and Older versus Prior Age-Adjusted Death Rates by Race

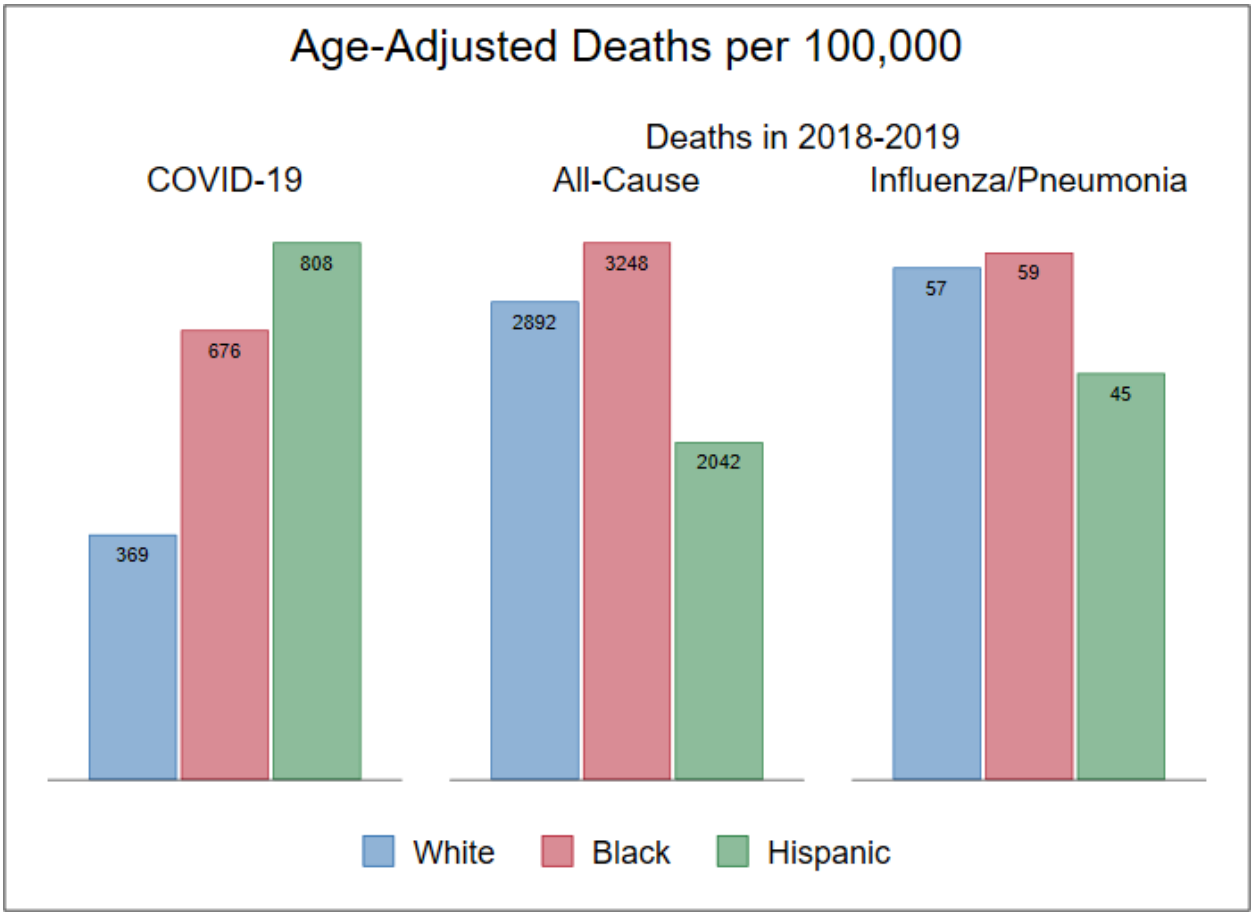


Exhibit 2: Age-Adjusted Pre-Pandemic Nursing Home Use among People 55 and Older by Race

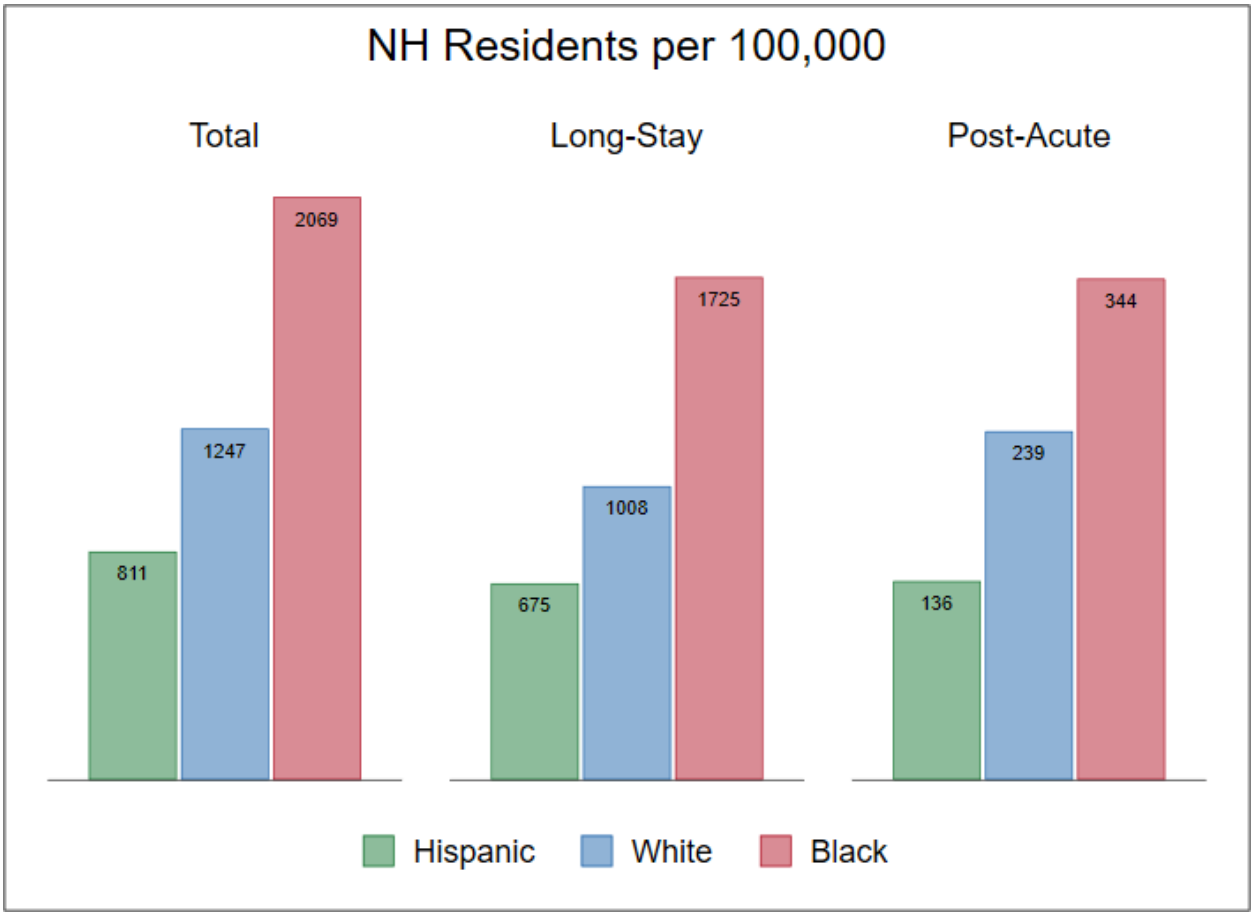
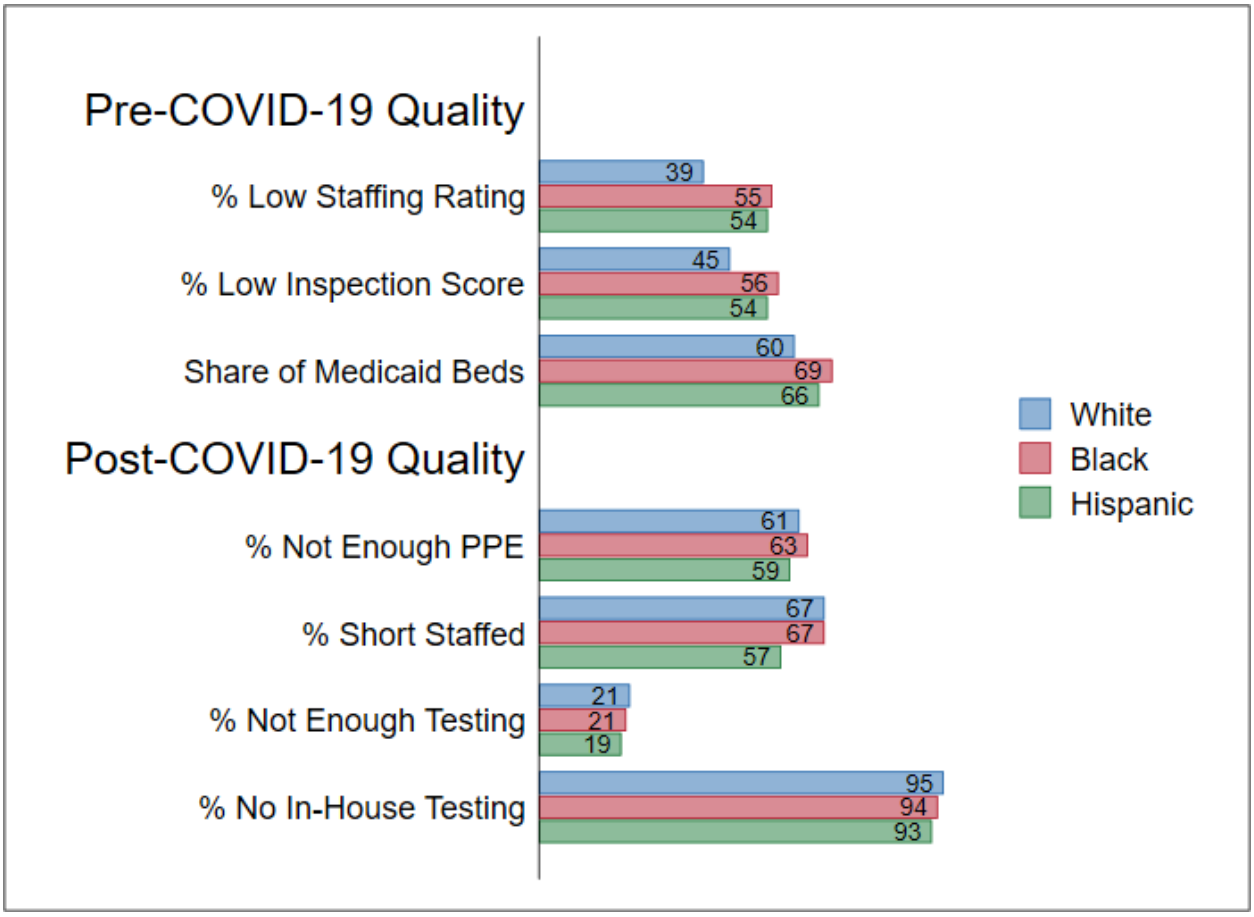


Exhibit 3: Average Nursing Home Quality Measures before and During the COVID-19 Pandemic Use by Race of Residents



Note: COVID-19 management measures in the manuscript are referred to here as Post-COVID-19 quality

Exhibit 4: Across-State Variation in COVID-19 Mortality Rates and Nursing Home Use by Race

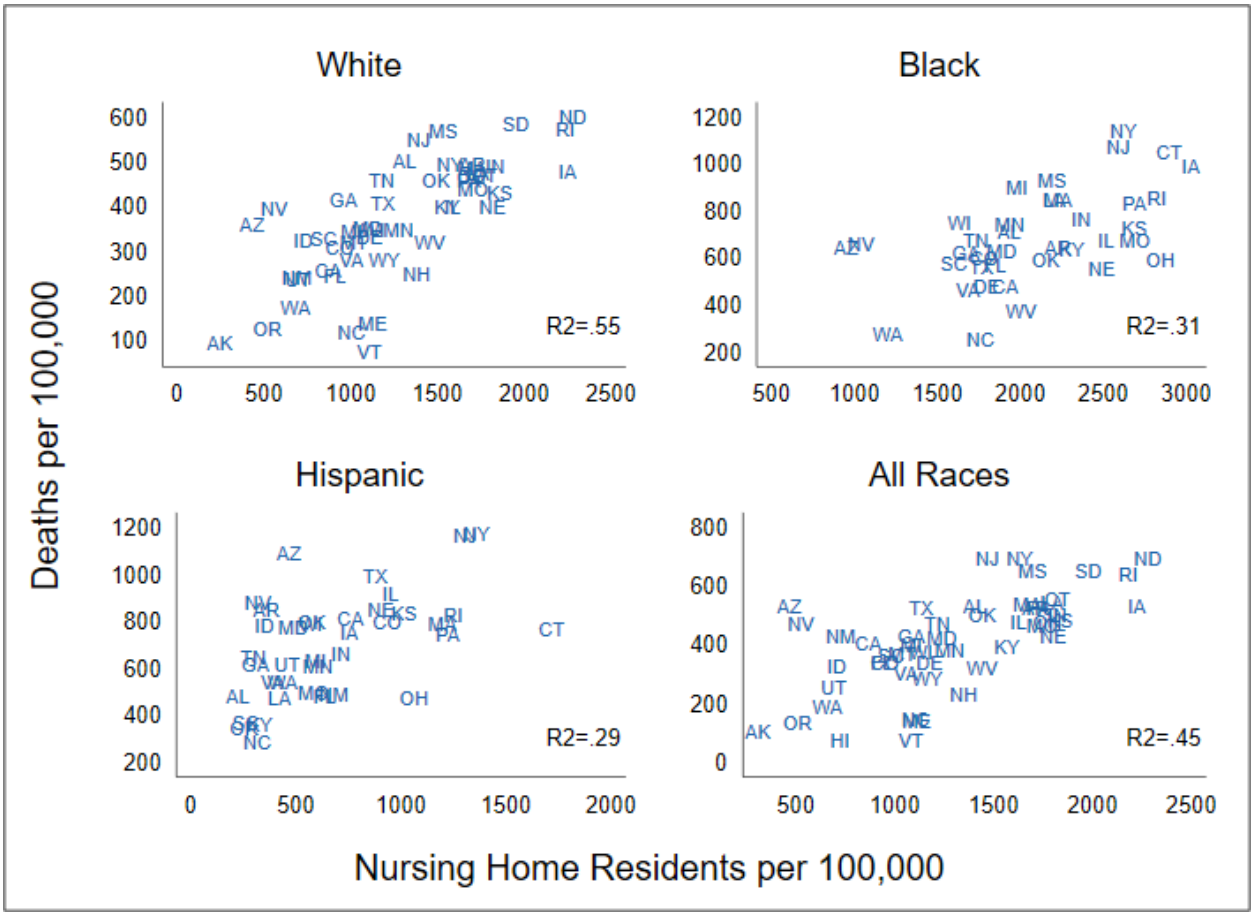


Exhibit 5: Relationship between Racial Disparities in COVID-19 Mortality and Racial Disparities in Nursing Home Use

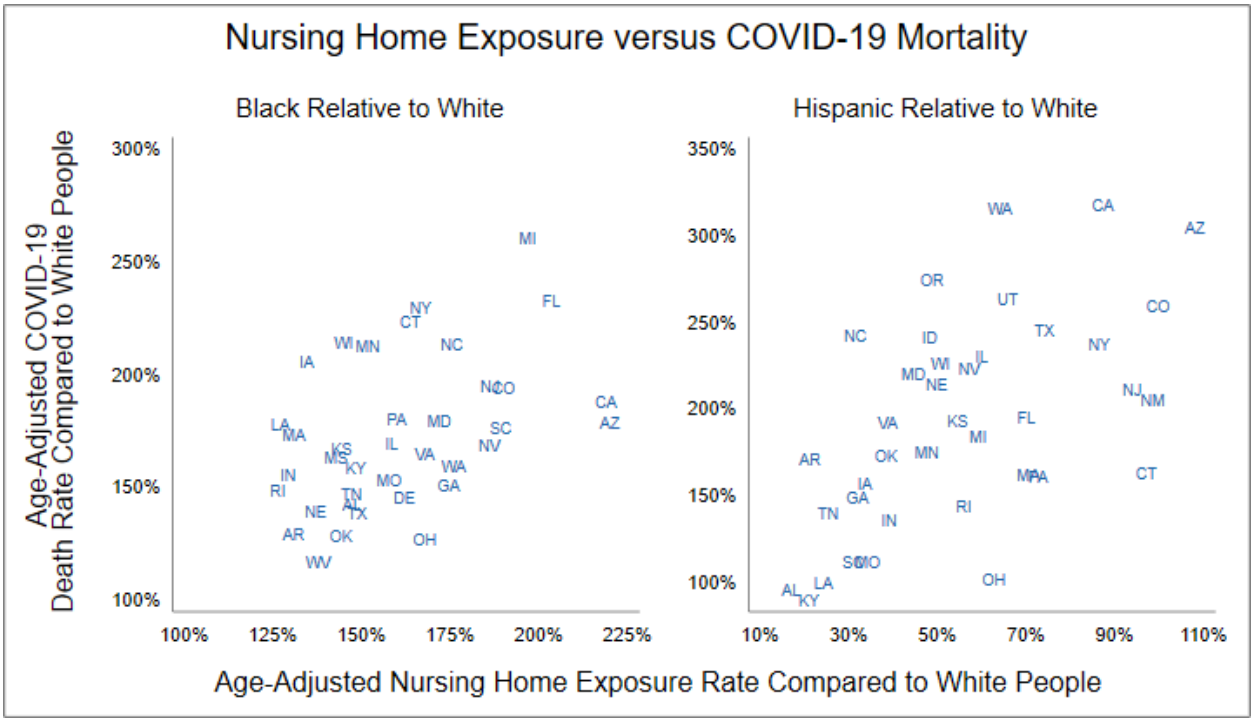
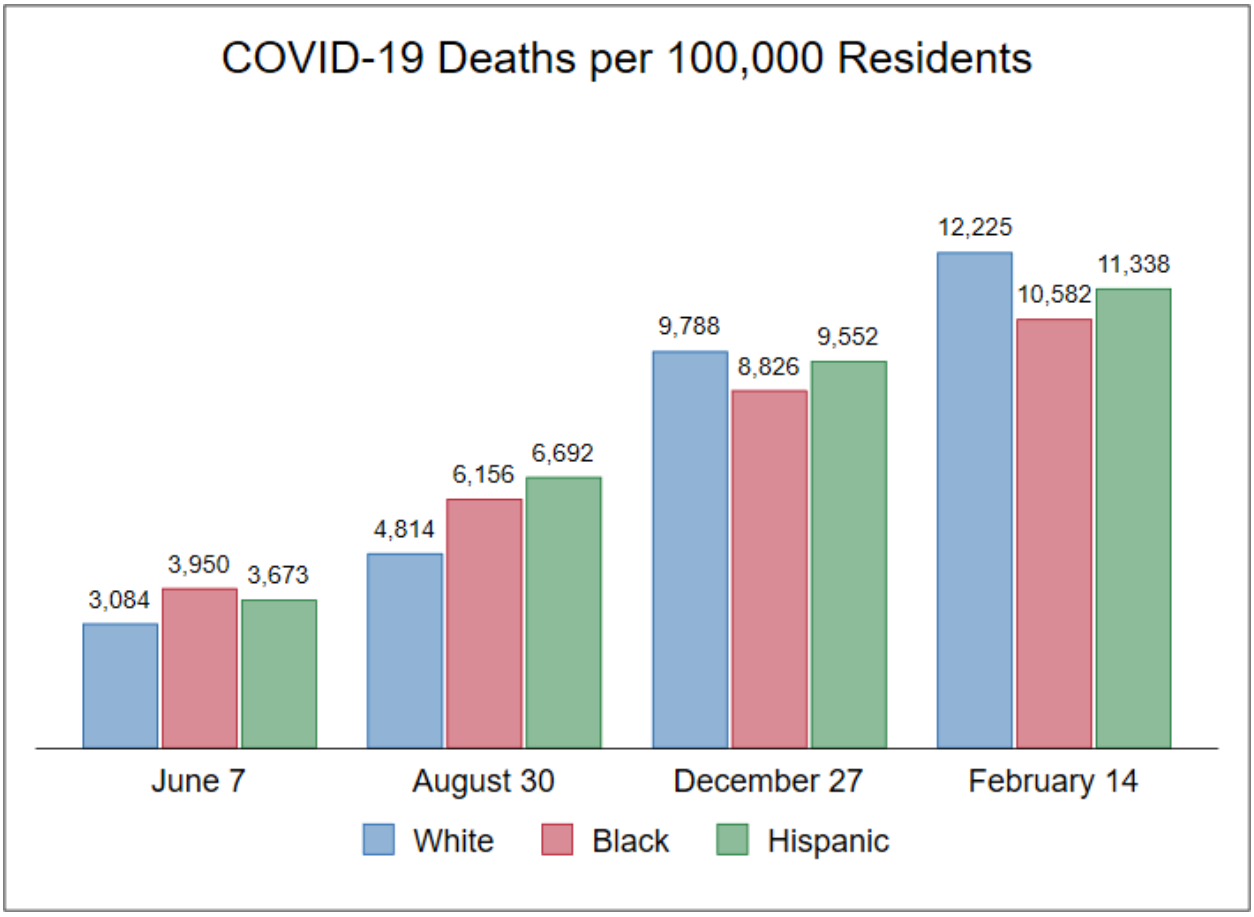


Exhibit 6: Trends in Estimated Cumulative COVID-19 Death Rate in Nursing Homes by Race of Residents



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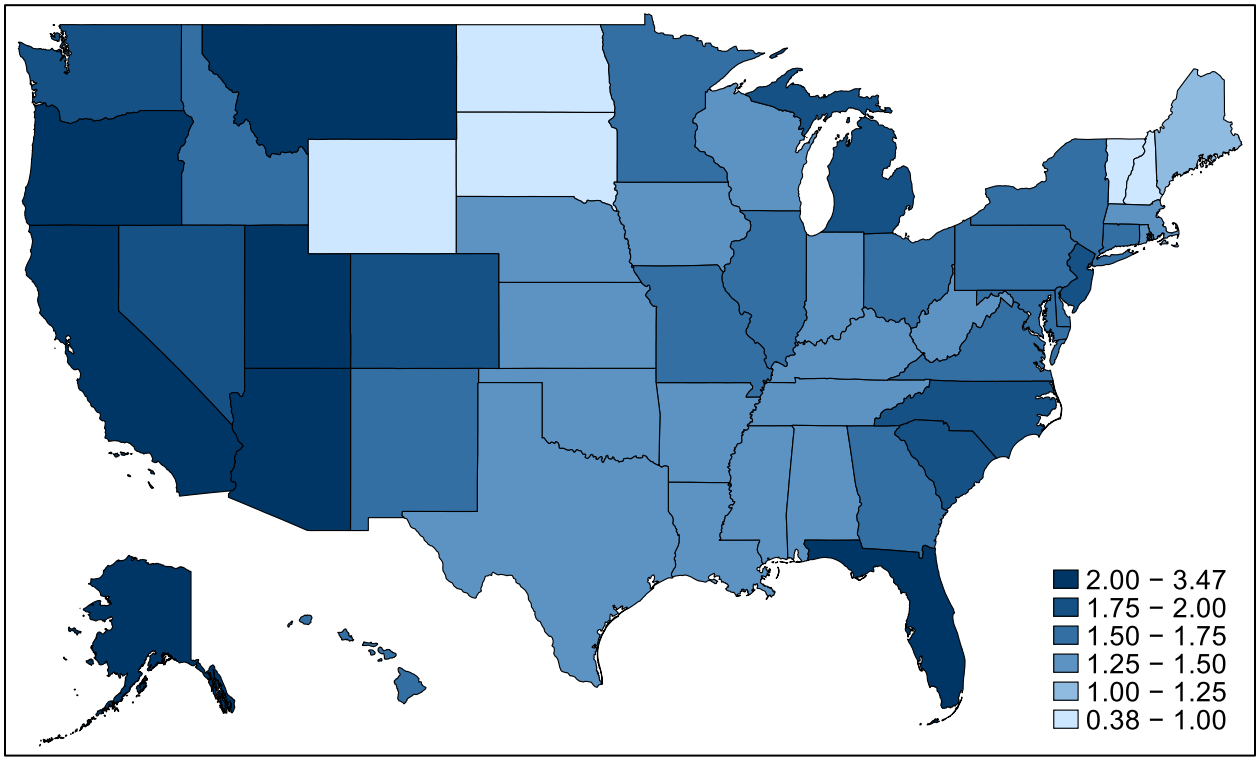
APPENDIX

1. Exhibit A1: Data Sources
2. Exhibit A2: Ratio of Age-Adjusted Nursing Home Use among Black People Relative to White People
3. Exhibit A3: Ratio of Age-Adjusted Nursing Home Use among Hispanic People Relative to White People
4. Exhibit A4: Trends in COVID-19 Nursing Home Quality Measures by Race/Ethnicity
5. Exhibit A5: Relationship of Differential Nursing Home Use and Differential Mortality from COVID-19 and All Causes for Black People Relative to White People
6. Exhibit A6: Relationship of Differential Nursing Home Use and Differential Mortality from COVID-19 and All Causes for Hispanic People Relative to White People
7. Exhibit A7: Contribution of Differential Nursing Home Use to COVID-19 Mortality Differences by Race
8. Exhibit A8: Age Distribution of Nursing Home Residents by Race

Exhibit A1: Data Sources

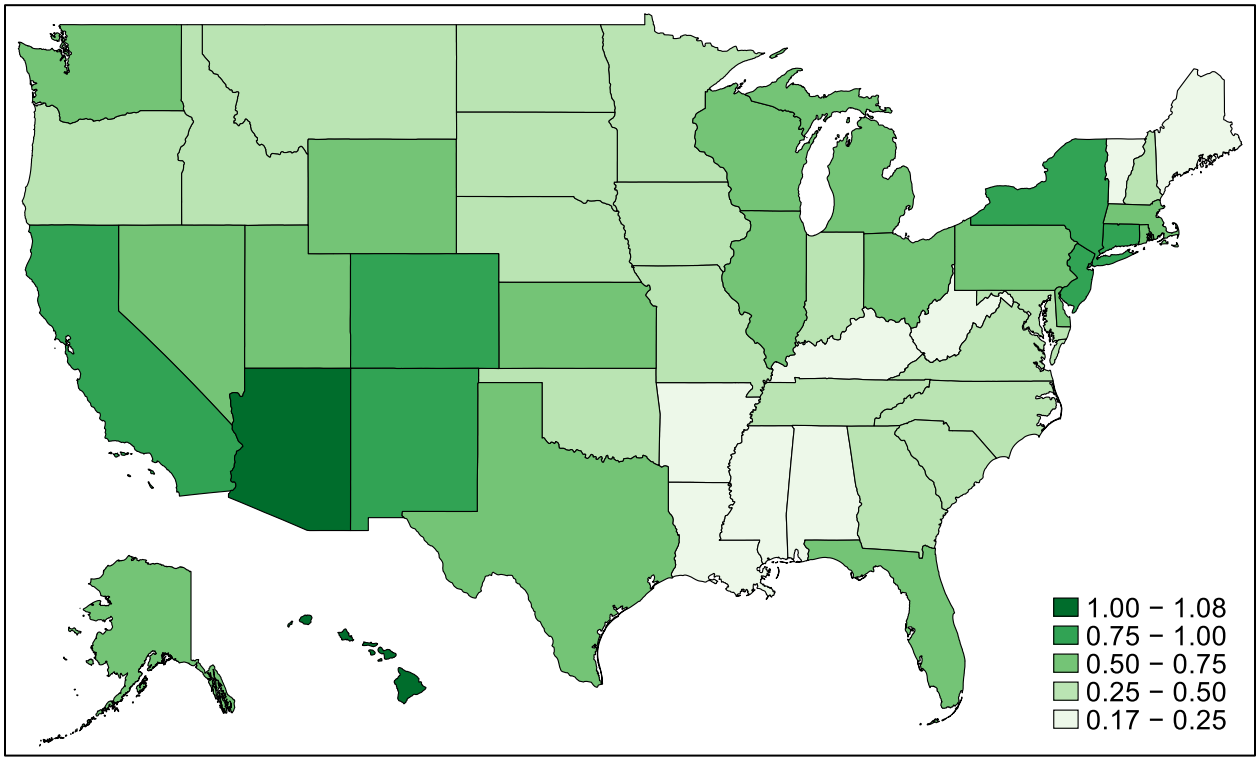
Data Source or Data Set	Description and Relevant Measures
U.S. Census Bureau	Population estimates by age, race, and county in 2019. These were aggregated to the state and national levels (see: https://www2.census.gov/programs-surveys/popest/technical-documentation/file-layouts/2010-2019/cc-est2019-alldata.pdf)
CDC National Center for Health Statistics	Cumulative COVID-19 death counts reported through February 13, 2021 by age, race, and state. These were combined with population estimates to calculated age-adjusted COVID-19 mortality rates at the state and national levels (see: https://data.cdc.gov/NCHS/Deaths-involving-coronavirus-disease-2019-COVID-19/ks3g-spdg)
CDC Wonder data tables	State-level age adjusted all-cause and pneumonia/influenza-specific death rates averaged over 2018-19 for the 55 and over population (see: https://wonder.cdc.gov)
CDC National Healthcare Safety Network (NHSN)/Nursing Home COVID-19 Public File	COVID-19 death counts in nursing homes and nursing home quality measures specific to COVID-19 (e.g., testing capacity and PPE levels). Data are available at the nursing home-week level starting May 24, 2020. Facilities had the option of reporting COVID-19 deaths prior to May 24, 2020 in the first week, and most facilities appear to have done so. We used all data reported through February 14, 2021
Minimum Data Set (MDS)	Nursing home resident assessments administered to all individuals admitted to Medicare- or Medicaid-certified nursing homes upon admission and in regular intervals thereafter until the resident is discharged. Discharge assessments capture deaths. Hundreds of data elements are captured by the MDS. For our main analysis we require age, race, and dates of admission and discharge. We used the admission and discharge rates to determine who was using a nursing home on February 1, 2020. This individual-level data was aggregated to the facility, state, and national levels
Care Compare report cards	Nursing home report cards publicly available at carecompare.gov. The report card data contain numerous measures of nursing home quality, including 5-star (Yelp-like) ratings. For our study we used the facility overall, staffing, and health inspection star-ratings
Certification and Survey Provider Enhanced Reports (CASPER).	Annual nursing home surveys that contain data on nursing home organizational and resident characteristics. For our study we used the payer mix data available from CASPER

Exhibit A2: Ratio of Age-Adjusted Nursing Home Use among Black People Relative to White People



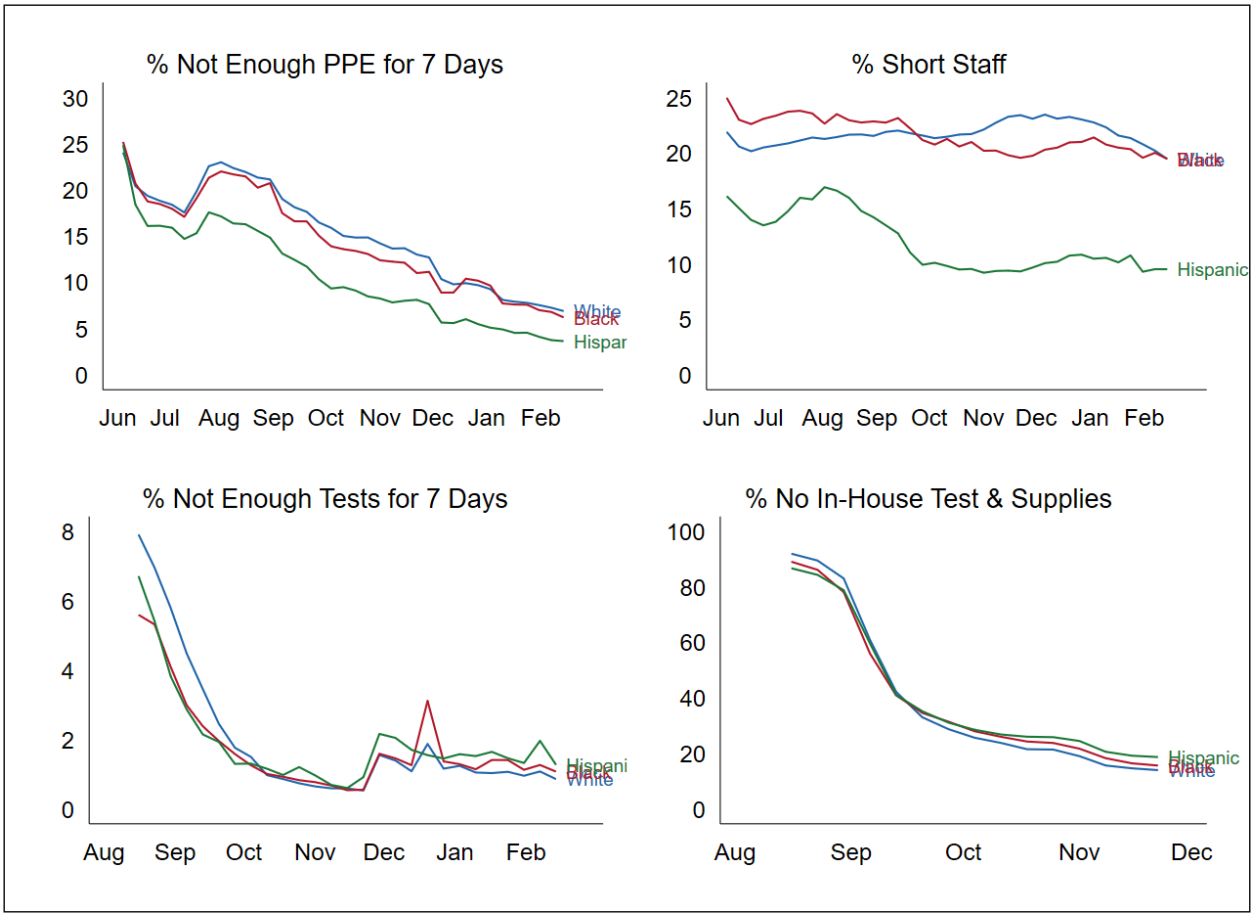
Notes: Nursing home use ratios were calculated using the nursing home resident census derived from 2020 Minimum Data Set assessments combined with U.S. Census Bureau population estimates for 2019.

Exhibit A3: Ratio of Age-Adjusted Nursing Home Use among Hispanic People Relative to White People



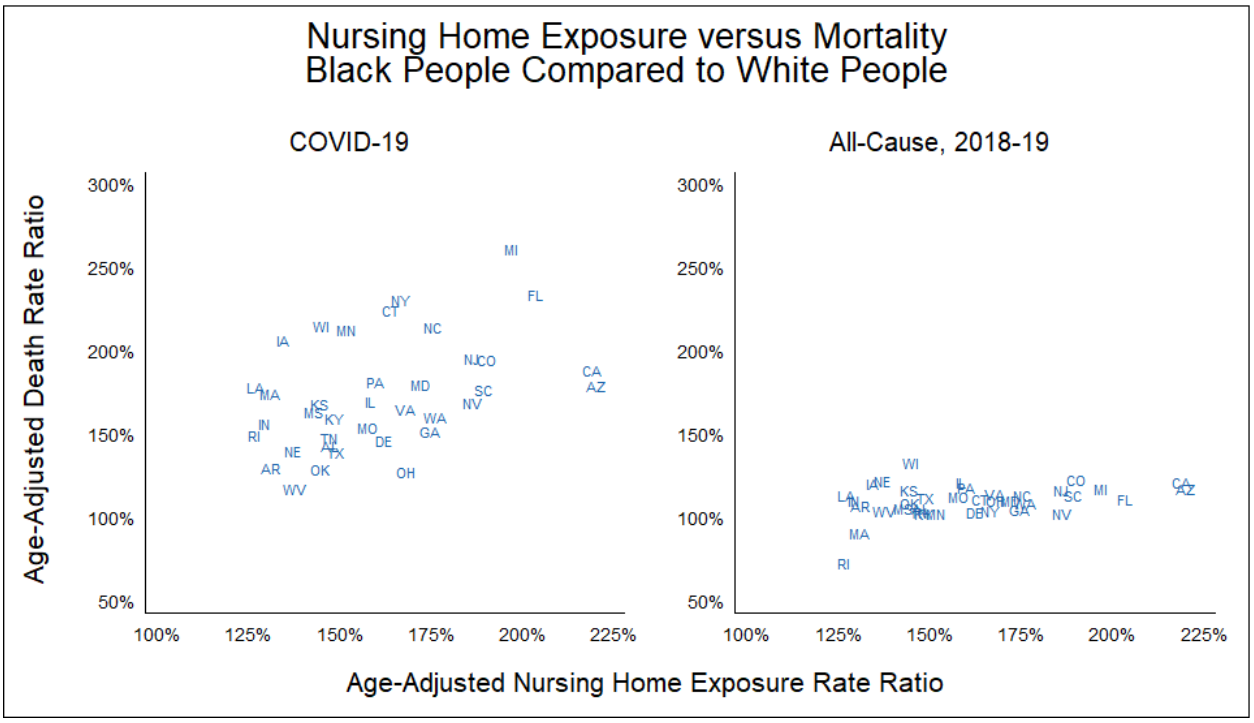
Notes: Nursing home use ratios were calculated using the nursing home resident census derived from 2020 Minimum Data Set assessments combined with U.S. Census Bureau population estimates for 2019.

Exhibit A4: Trends in COVID-19 Nursing Home Quality Measures by Race/Ethnicity



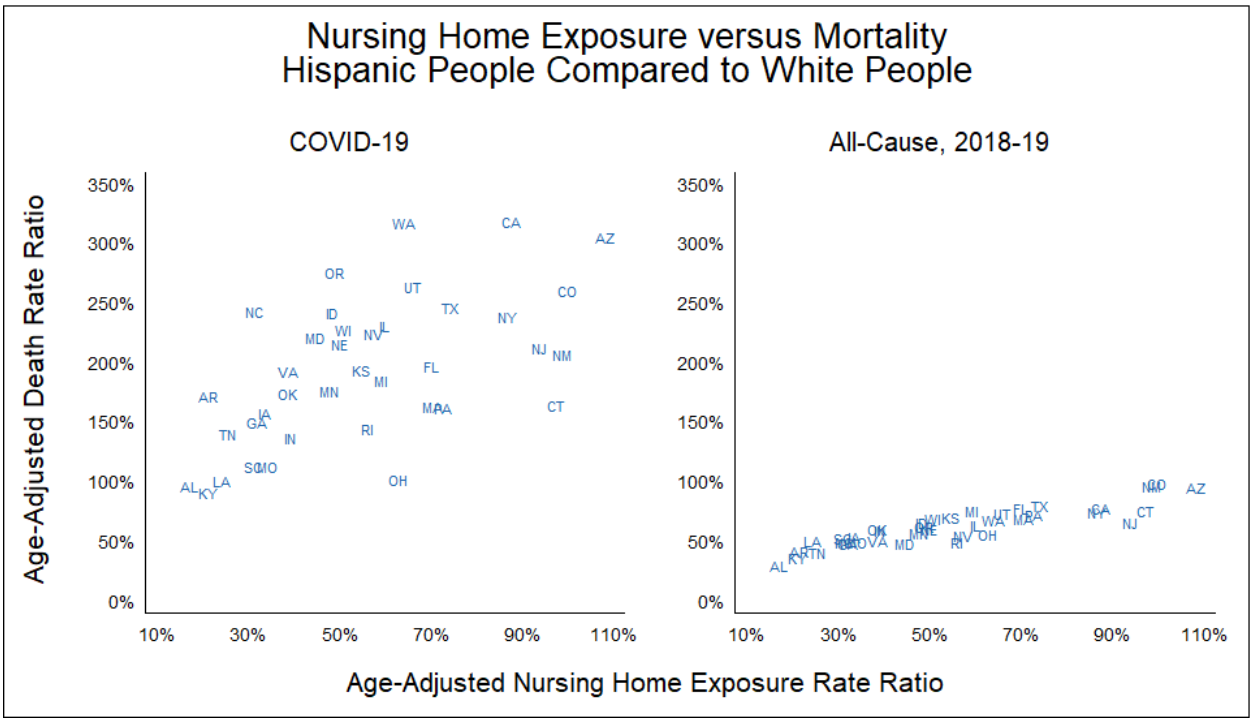
Notes: Point estimates reflect the proportion of Black, White, and Hispanic residents in a nursing home with a given quality measure, based on the nursing home resident census of February 1, 2020.

Exhibit A5: Relationship of Differential Nursing Home Use and Differential Mortality from COVID-19 and All Causes for Black People Relative to White People



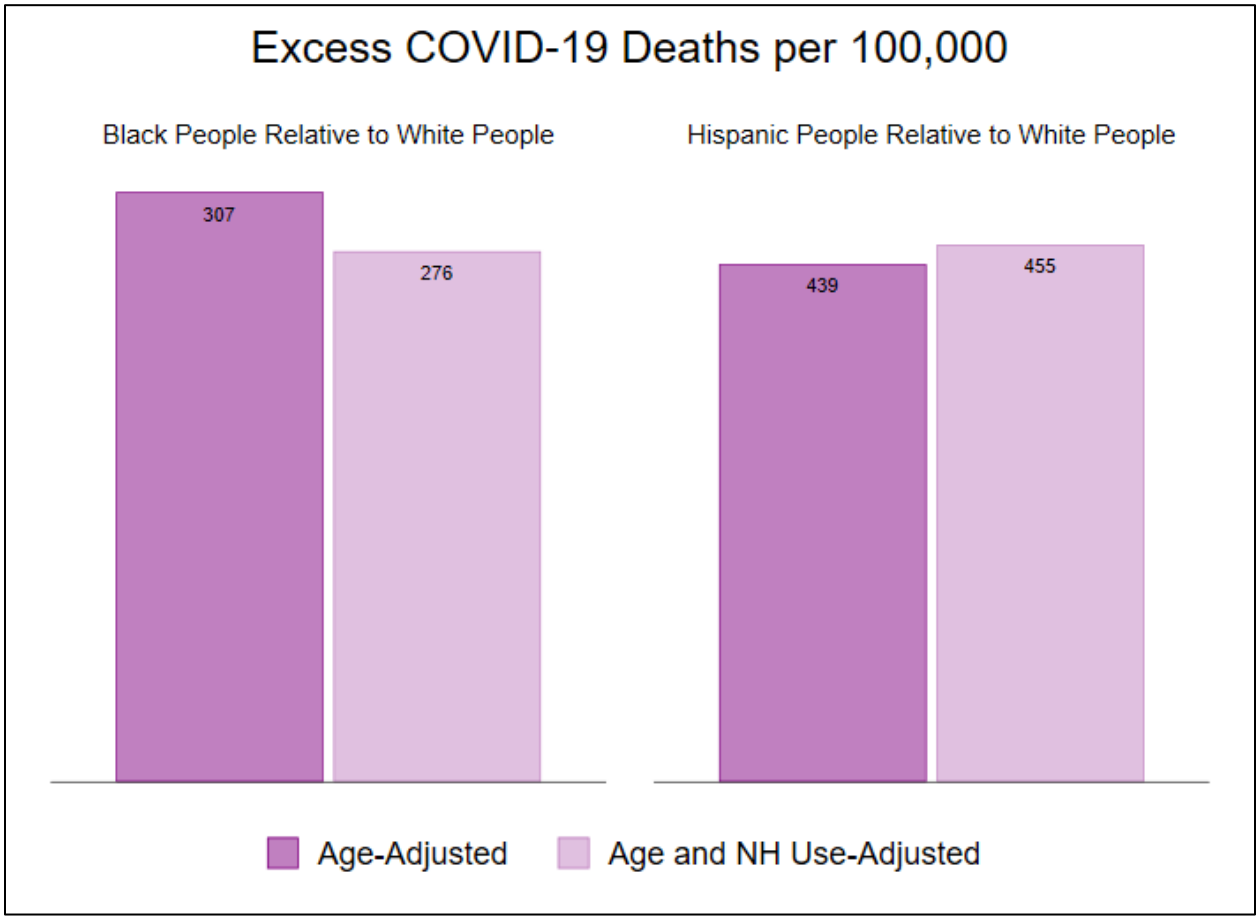
Notes: Nursing home use ratios were calculated using the nursing home resident census derived from 2020 Minimum Data Set assessments combined with U.S. Census Bureau population estimates for 2019.

Exhibit A6: Relationship of Differential Nursing Home Use and Differential Mortality from COVID-19 and All Causes for Hispanic People Relative to White People



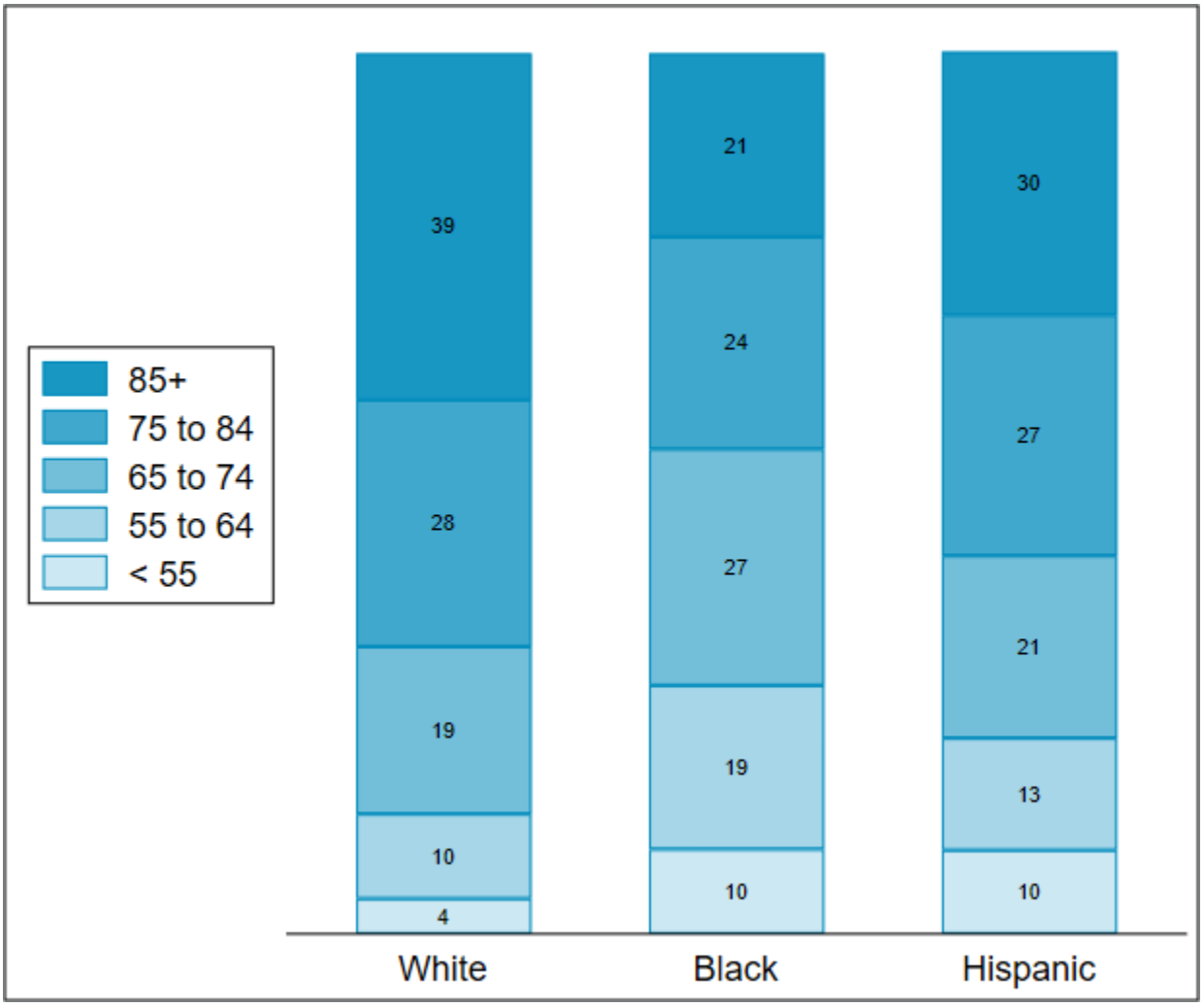
Notes: Nursing home use ratios were calculated using the nursing home resident census derived from 2020 Minimum Data Set assessments combined with U.S. Census Bureau population estimates for 2019.

Exhibit A7: Contribution of Differential Nursing Home Use to COVID-19 Mortality Differences by Race/Ethnicity



Notes: Excess is defined as the difference between Black or Hispanic COVID-19 deaths per 100,000 individuals aged 55 and up and deaths among White individuals aged 55 and up. The back of the envelope calculation of age and nursing home (NH) use-adjusted COVID-19 excess mortality is described in the supplemental methods.

Exhibit A8: Age Distribution of Nursing Home Residents by Race/Ethnicity



Note: Estimates are based on individuals present in a nursing home on February 1, 2020