Persistence of Racial Inequities in Receipt of Influenza Vaccination among Nursing Home Residents in the United States

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Summary: The persisting White-Black influenza vaccination gap among nursing home residents continues to occur at the facility level in states with at least 1% black nursing home residents, particularly in states with the most White-Black racial segregation.
Abstract

Background: We sought to determine if the racial differences in influenza vaccination among nursing home (NH) residents during the 2008-09 influenza season persisted in 2018-19.

Methods: We conducted a cross-sectional study of NHs certified by the U.S. Centers for Medicare & Medicaid Services during the 2018-19 influenza season in U.S. states with ≥ 1% black NH residents and a white-black gap in influenza vaccination of NH residents (N=2,233,392) of at least one percentage point (N=40 states). NH Residents during October 1, 2018 through March 31, 2019 aged ≥ 18 years and self-identified as black or white race were included. Residents’ influenza vaccination status (vaccinated, refused, and not offered) was assessed. Multilevel modeling was used to estimate facility-level vaccination status and inequities by state.

Results: The white-black gap in influenza vaccination was 9.9 percentage points. In adjusted analyses, racial inequities in vaccination were more prominent at the facility- than at the state-level. Black residents disproportionately lived in NHs with majority blacks, which generally had the lowest vaccination. Inequities were most concentrated in the Midwestern region, also the most segregated. Not being offered the vaccine was negligible by difference in absolute percentage points among whites (2.6%) and blacks (4.8%) whereas refusals were higher among black (28.7%) than white residents (21.0%).

Conclusions: The increase in the white-black vaccination gap among NH residents is occurring at the facility-level, in more states, especially those with the most segregation. Standing orders for vaccinations, previously reported to narrow the racial gap in vaccination among NH residents, should be considered.

Key words: influenza, vaccination, nursing homes
INTRODUCTION

Influenza disproportionately burdens the elderly,\(^1\) and those in the nursing homes are at increased risk of hospitalization and death.\(^2\) Since the 2005-06 influenza season, when the Centers for Medicare & Medicaid Services (CMS) first required that nursing home (NH) residents be offered the vaccine as a requirement for certification, vaccination coverage increased modestly.\(^3\) While the increase from 71.4% in 2005-06 to 73.0% in 2017-18 was positive, the gap between whites and blacks (W-B) increased from 7.1 to 9.5 percentage points.\(^3\) In 2008-09, the national W-B gap was 6.9 percentage points,\(^3\) and states with the highest overall vaccination coverage had the smallest W-B inequities.\(^4\) In states with 10 or greater percentage point inequities, differences were greater between NHs than within homes. Furthermore, coverage decreased for white and black residents as the proportion of black residents in the NH increased. In states with the greatest inequities, black residents disproportionately lived in homes with at least 50% black residents and homes with low vaccination coverage, resulting in state-level inequities. In addition, blacks were less frequently vaccinated than whites within the same facilities, though these differences were smaller than between facility differences.

It is unclear whether racial differences in influenza vaccination among NH residents continue to follow the same patterns. By 2030, 30% of the older adult population in the United States is expected to be racial and ethnic minorities, a trend likely to be mirrored in NHs,\(^5\) making it increasingly urgent to understand what drives these disparities and to design more effective interventions. If the W-B gap is increasing in care that is relatively easy to administer, such as the influenza vaccine, it could be a sentinel that the quality of other preventive or healthcare services may also be worsening in minority populations in NHs. For example, a study in
California reported increased COVID-19 cases and deaths in NHs of lower quality (2-star or lower ratings) and higher proportions of racial minorities.  

Therefore, the objective of this study was to determine if the pattern of inequities in influenza vaccination among NH residents reported during the 2008-09 season persisted in 2018-19.

METHODS

Study design

This was a cross-sectional study using Minimum Data Set (MDS) resident assessments from nursing facilities certified by CMS. Resident assessments are completed using medical records for all residents in CMS-certified facilities by nurses at admission, quarterly thereafter, when any significant change in condition occurs, and at discharge.

Study population and data source

We limited our analysis to the 40 states (39 states and the District of Columbia) that had at least 1% of NH residents with at least one assessment from October 1, 2018 through March 31, 2019 of black race. In addition, only states with a minimally significant inequity, defined as a W-B gap in influenza vaccination of at least one percentage point during the 2018-2019 influenza season, were included [Figure 1a]. In effect, the same states in the 2018-19 season were included in the 2008-09 study.

We obtained data from MDS resident assessments (version 3.0) completed from October 1, 2018 through March 31, 2019. The dates were selected to be consistent with our previous study, which used a prior version of the MDS (version 2.0). NH residents without a NH facility identifier were excluded.
Outcome Measure

The immunization supplement to the resident assessment instrument asks, “Did the resident receive the influenza vaccine in this facility for this year’s influenza season?” The next question asks, “If influenza vaccine was not received, state reason: 1) not in facility during this year’s flu season; 2) received outside of this facility; 3) not eligible-medical contraindication; 4) offered and declined; 5) not offered; and 6) inability to obtain vaccine.”

Most residents had data from more than one assessment for the 2018-19 influenza season. Vaccination status was determined using the same process as our previous study.

Vaccination coverage reported in this manuscript includes only white and black NH residents in the denominators.

Exposure measure

Race was the main exposure of interest. The MDS resident assessment instrument has a variable for each race/ethnicity allowing for multiple affirmative responses. Residents were classified as black if they reported black race, regardless of reporting another or Hispanic ethnicity; similarly, residents were classified as white if they reported white race, however if they also reported black race they were classified as black. For purposes of comparing our analyses with a previous study, we only report results for white and black NH residents. However, to report the actual proportion of residents in the state or in the nursing home, the denominator included all residents regardless of race. Thus, throughout the manuscript, the ‘proportion of blacks’ means the proportion out of all residents; ‘the proportion of blacks vaccinated’ is out of all black residents, and similarly for whites.
Covariates

We adjusted for two resident-level factors: gender and age. Additionally, we adjusted for two facility-level factors, the total number of residents in the NH and the proportion of black residents in the NH during the influenza season.

Segregation Measure

To assess segregation in NHs across states, we used the dissimilarity index and present it by state. While we could not assess segregation within a home, we could assess segregation across facilities within states. The index is formulated on the assumption that if there is no segregation, then members of a minority racial group would be distributed randomly throughout the various NHs in the state. The formula gives the proportion of black NH residents who would have to move to another NH to be randomly distributed in the state.

Statistical Analysis

To assess vaccination differences across states, we produced three unadjusted, state-level plots 1) inequity in vaccination among NH residents versus the proportion of NH residents vaccinated; 2) the proportion of NH residents vaccinated versus the proportion of black NH residents; and 3) the inequity in vaccination coverage among NH residents versus the proportion of black NH residents. Linear regression was used.

We also fit a three-level multilevel model with the 40 states as the third level, NHs as the second level and residents as the first level, to test for variability between states and to determine if region and the proportion of black residents in the state were associated with residents’ vaccination, after adjusting for other factors. The null hypothesis for the random effects was variance equal to zero (H0: σo2 = 0 and H02: σr2 = 0) at the facility-level (o2) and
(H₀: \( \sigma_o^2 = 0 \) and \( H_0: \sigma_r^2 = 0 \)) at the state level (3) where \( o= \) offered vaccine and \( r= \) refused vaccine, versus vaccinated.

To further assess whether a pattern persisted across states, we calculated the adjusted vaccination coverage for whites and blacks for each NH in a two-level multilevel model for each state. The outcome of each model was the resident-level vaccination status for whites and blacks in each NH. For each state, medians of vaccination status for whites and blacks are reported for each stratum of NHs by the proportion of black residents. Only residents self-identified as black/African American or white were included in the multilevel models, excluding 9.6% (n=215,144) of the study population self-identified as other than black/African American or white. For each state, we estimated the adjusted vaccination coverage across the strata of racially mixed NHs, by the distribution of black residents (0%, 0.1%-4.9%, 5.0%-19.9%, 20.0%-49.9%, and ≥ 50% black residents). States were grouped by the degree of inequity in each state (i.e., 1-4.9, 5.0-9.9, and ≥10 percentage points). Next, we examined adjusted probability of refusal and not being offered vaccine for whites and blacks.

Software and Ethics Approval

We used HLM v.8 software (Scientific Software International, Inc., Lincolnwood, IL) to conduct multilevel analyses for each of the 40 states. This was approved by the Brown University Institutional Review Board.

RESULTS

Our study population included 2,233,392 residents from 14,237 NHs in 40 states, 14.1% of whom self-reported black race (2.2% of the 14.1% also reported white race). Among NH residents in the 40 states, overall unadjusted vaccination coverage among white residents was...
76.2% and among black residents was 66.3%, a difference of 9.9 percentage points. Among the 40 states with W-B difference > 1 percentage point, vaccination coverage by quartiles was: 48.5% - 72.5%; 72.6% - 76.1%; 76.2% - 81.5%; and 81.6% - 87.8% [Figure 1a]. In Alaska, vaccination coverage among white NH residents was 3.0 percentage points lower than among black NH residents. An inequity of ≥ 10 percentage points existed in 14 states, inequity of 5.0-9.9 percentage points existed in 21 states, and inequity of 1-4.9 percentage points existed in 5 states. Inequities were concentrated in the Midwest [Figure 1b]. In the adjusted 3-level model, variability in being offered and refusing versus being vaccinated across facilities was statistically significant ($\sigma_o^2 = 2.49$ and $\sigma_i^2 = 0.54$ $p<0.001$, respectively); variability across states was also significant ($\sigma_o^2 = 0.18$ and $\sigma_i^2 = 0.11$ $p<0.001$, respectively) though to a lesser extent.

State-level Differences

In the adjusted 3-level model, the proportion of black NH residents in the state was not significantly associated with residents’ being offered the vaccine versus vaccinated ($p=0.42$) or between refusing the vaccine and being vaccinated ($p=0.44$). Similarly, in the unadjusted state-level analysis, no significant relationship was found between state-level vaccination coverage among NH residents and W-B inequity in vaccination ($\beta = 0.07$, $p=0.37$) [Figure 2], or between the proportion of black NH residents in states and W-B inequity in vaccination ($\beta = 0.05$, $p=0.24$) [Figure 3]. Additionally, no significant relationship was found between the proportion of black NH residents and vaccination coverage ($\beta = -0.11$, $p=0.23$) [Figure 4].
Adjusted Vaccination Status among States and Proportion of Black Residents in Facilities

In the strata with $\geq 10$ percentage points inequity, the median adjusted vaccination rate was highest in facilities with no blacks (range: 82.4% to 90.6%) and lowest among white and black residents in facilities with $\geq 50\%$ blacks (range for whites, 43.2% - 81.5%; for blacks: 40.8% - 77.8%) [Table 1]. Compared to states with $\geq 10$ percentage point inequities, in states with vaccination inequities 5.0-9.9 percentage points vaccination coverage was generally higher in facilities with $\geq 5\%$ black residents and the differences across strata by racial composition of the NH were less marked. Among states with inequity of 1-4.9 percentage points, differences in vaccination were negligible within strata; there was no dose-response relationship between vaccination coverage and racial composition in NHs.

When comparing adjusted differences of proportions of coverage for whites and blacks within each racially mixed NHs in the 40 states (n=11,326 NHs), differences were small (difference: median: 2.3 percentage points) [data not shown].

Compared with states where the W-B inequity was less than 10 percentage points, in states with $\geq 10$ percentage points inequity, blacks disproportionately lived in NHs with $\geq 50\%$ blacks (49.2%), compared with the other states (states with 5.0-9.9 percentage point inequity: 32.5%; states with 1-4.9 percentage point inequity: 27.0%) [data not shown].

The overall proportion of residents not offered the vaccine was 3%. Compared with being vaccinated, being offered the vaccine did not vary across the four regions in the 3-level model.
Nevertheless, facility median probabilities were highest in the states with ≥10 percentage point inequity among blacks and whites in the two strata of NHs with ≥20% blacks in NHs (20-49.9%: 1.2% - 1.3%; and ≥50%: 2.0% - 2.1% for whites and blacks, respectively).

**Vaccination Refusals**

Overall, black residents refused vaccine (28.7%) more frequently than white residents (21.0%). State median probabilities of refusing vaccine in states with ≥10 percentage point inequity ranged from 9.9% among whites in facilities with no blacks to 22.7% among blacks in facilities with ≥50% blacks. State median probabilities of refusing vaccine in states with 5-9.9 percentage point inequity ranged from 10.1% among whites in facilities with no blacks to 20.7% among blacks in facilities with ≥50% blacks; in states with ≥5% inequities, facility median refusals were 2-3 percentage points higher among black residents compared with whites in all strata of facilities. Compared with being vaccinated, refusing the vaccine was significantly higher in the western region compared with the Midwest in the 3-level model (p<0.01).

**Discussion**

The results of this national cross-sectional study suggest that in states with at least 1% black NH residents, racial inequities in receiving the influenza vaccine during the 2018-19 influenza season were mostly at the facility-level. Black residents disproportionately lived in NHs with 50% or more blacks, which generally had the lowest coverage. Additionally, inequities were most concentrated in the Midwestern region which was also the most segregated. Inequities across states with at least 1% black NH residents were not associated with vaccination or proportion black NH residents in the state. Moreover, vaccination (at the state as well as individual level) was not associated with proportion black NH residents in the
state. At the national level, it is important to note that of the ten states excluded from our study because they did not have at least 1% black NH residents, five had very high vaccination coverage (>82%); thus, nationally, state does play a vital role in racial differences in vaccination of NH residents, but among states with at least 1% black NH residents, racial inequities were mostly at the facility-level.

Consistent with the 2008-09 influenza season, the same 40 states with inequities had at least a one percentage point difference in 2018-19, with an increase in the unadjusted W-B gap from 8.1 to 9.9 percentage points. Comparing 2018-19 to 2008-09, 40.0% more states had ≥10 percentage point inequities, 23.5% more states had 5-9.9% inequities and the W-B median gap between facilities with no black residents and facilities with ≥50% black residents increased in all strata of states. Furthermore, a larger proportion of black NH residents lived in homes with ≥50% blacks in the 35 states with ≥5 percentage point inequities than previously. The proportion of residents not being offered the vaccine dropped dramatically since 2008-09, from as high as 24.1% among blacks in facilities with ≥50% black residents to 2.1% in 2018-19. Conversely, refusing the vaccine was reported more frequently among white and black residents in all states compared with 2008-09. Notably, four states with a large proportion (20.9% - 33.3%) of black NH residents had fewer than five facilities with no black residents during the 2018-19 influenza season.

Similar to the 2008-09 influenza season, differences were greater between NHs than within homes in states with ≥10 percentage point inequities. In the 2008-09 study, the patterns of racial differences in vaccination were primarily in the NHs rather than due to regional- or state-level characteristics. During that influenza season, the states with the greatest inequities
were also the states with the lowest vaccination coverage. In addition, they were the states with the greatest proportion of black NH residents in homes with ≥ 50% black residents. There was a dose-response decrease in vaccination coverage by racial composition of NHs. However, in the current study, inequities were larger, and larger in more states, but not primarily in the states with the lowest vaccination coverage as was the case in 2008-09. And, more black NH residents lived in homes with ≥ 50% black residents in all strata of states. While vaccination coverage varied significantly across the 40 states in the adjusted 3-level model, it varied to a larger extent between facilities. Region was not significantly associated with vaccination or being offered the vaccine, but was associated with refusing vaccine, more so in the western states than in the Midwest.

It is unknown if our results are due to a persisting two-tiered system of NH care, with racial composition differing by private versus public funding, a result of an increase in admissions to the NH from the hospital, an increase in post-acute stay residents, or some combination. It is also unknown if there has been a change in vaccination policies such as standing orders for vaccinations since 2004, when about 40% of U.S. NHs had such policies, since standing orders for vaccinations are associated with higher vaccination coverage and lower racial inequities. However, it is noteworthy that the overall pattern of inequities in 2018-19 is similar to 2008-09, though in the previous season not being offered the vaccine was quite high in facilities with ≥ 50% blacks (24.1%) whereas now the difference is due to refusals in that strata (22.7%). One intervention study found that NHs that adopted a policy to document residents’ refusal of influenza vaccine resulted in 10% or greater increase in vaccination.

Although the Advisory Committee for Immunization Practices recommends annual influenza vaccination for all NH residents, CMS requires that all certified NHs offer vaccination to
all residents, and Medicare funds vaccination, influenza vaccination coverage among NH residents at the U.S. national level decreased from 77.5% in the 2008-09 influenza season to 73.1% in the 2018-19 season, below the Healthy People 2020 goal of 90%. In spite of suboptimal vaccination and persistent racial inequities, influenza immunization of NH residents is no longer a health indicator in Healthy People 2030.

A limitation of this study is that reporting of race and ethnicity changed since our 2008-09 study which could excessively increase the proportion of black residents if self-identification was more likely when given more than one choice of race and/or ethnicity. However, the proportion of black NH residents in all US states was 11.5% in 2008-09, compared with 14.1% in the 40 states with >1% black NH residents in 2018-19. An increase of 2.6 percentage points is reasonable given the increase in racial minorities among the aging population. A strength of our study is that we examined each state separately, holding state constant, controlling for state-specific variability in access to healthcare and accounting for variability between NHs in each state using multilevel models.

In conclusion, the increase in the W-B influenza vaccination gap among NH residents is likely occurring at the facility-level, in states with the most W-B racial segregation. Increased racial inequities in receiving the influenza vaccine suggests that interventions to increase vaccination while narrowing racial differences, such as standing orders for vaccinations, should be considered.
NOTES

Contributors

BHB, SG, and ARZ conceived and designed the study. BHB, RRB, EB, and ARZ drafted the manuscript. JO obtained the data. All authors revised the manuscript for important intellectual content and contributed to the literature search. BHB conducted statistical analyses. RvA, AC, and ARZ provided administrative, technical, and material support.

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Declaration of interests

RvA and AC are employees of the pharmaceutical company, Sanofi Pasteur, that produces vaccines. ARZ reports conflicts with vaccine manufacturer, Sanofi, related to grants. SG reports conflicts with vaccine manufacturers related to grants, consulting and speaking engagements: Sanofi, Seqirus, Pfizer. SG also consults with other pharmaceutical companies such as Longevorin, Janssen, and Merck. SG has grants with Sunovion and Essity. JS reports grants from Sanofi Pasteur, outside the submitted work. PM reports Pilot grant funding under NIH grant P20GM125507 from Rhode Island Hospital, Faculty research award from Brown University, Interagency Personnel Agreement under VA grant IIR 17-231 from Providence Veterans Administration, Collaborator on 5UH3AG049619 from National Institutes of Health, and Collaborator on HHSA290201500002I from Agency for Healthcare Research and Quality, outside the submitted work. All other authors declare no competing interests.
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Figure 1. (A) Inequities in influenza vaccination among white and black nursing home residents by state, United States, 2018-2019. (B) State influenza vaccination coverage among nursing home residents, 2018-2019. (C) Dissimilarity index or the proportion of black nursing home residents who would have to move to another facility to be randomly distributed in the state. White indicates the state has < 1% black residents (ID, MT, WY, ND, SD, ME, VT, NH) or < 1 percentage point White-Black vaccination gap (AK, UT).

Figure 2. Inequity in influenza vaccination among nursing home residents by proportion nursing home residents vaccinated in the state, 2018-2019 season. Dashed lines indicate 95% confidence interval.

Figure 3. Inequity in influenza vaccination among nursing home residents by proportion of black nursing home residents in the state, 2018-2019 season. Dashed lines indicate 95% confidence interval.

Figure 4. Proportion of nursing home residents vaccinated in the state by proportion of black nursing home residents in the state, 2018-2019 season. Dashed lines indicate 95% confidence interval.
Table 1. Adjusted Probability Vaccination Status, Stratified by % Black Residents in Facility, by State—Minimum Data Set, United States, 2018 - 2019

| Reporting area | W-B gap | % Black Residents in State | 0% Blacks | 0.1% -4.9% Blacks | 5-19.9% Blacks | 20-49.9% Blacks | >50% Blacks |
|----------------|---------|-----------------------------|-----------|------------------|---------------|----------------|-------------|
|                |         |                             | White     | White            | Black         | White          | Black        |
| **States with ≥10 percentage point influenza vaccination inequity** |         |                             |           |                  |               |                |             |
| Illinois       | 20.6    | 17.2                         | 85.9      | 79.3             | 75.3          | 70.2           | 64.9         | 68.6        | 63.2        | 48.8        | 42.9        |
| Michigan       | 17.7    | 17.0                         | 85.8      | 78.8             | 73.9          | 72.1           | 67.8         | 56.9        | 51.4        | 43.2        | 40.8        |
| Kansas         | 17.6    | 6.2                          | 89.5      | 86.8             | 83.1          | 68.1           | 60.6         | 49.7        | 46.1        | -           | -           |
| District of Columbia | 15.7 | 77.8                      | -         | -                | -             | -              | -            | -           | -           | -           | -           |
| Minnesota      | 14.7    | 3.4                          | 88.9      | 82.6             | 76.2          | 73.9           | 66.3         | 78.6        | 71.7        | -           | -           |
| Indiana        | 13.7    | 8.2                          | 83.2      | 80.7             | 76.9          | 68.2           | 62.6         | 61.1        | 54.6        | -           | -           |
| Missouri       | 13.6    | 11.5                         | 85.9      | 84.4             | 80.9          | 84.0           | 80.4         | 74.4        | 69.9        | -           | -           |
| Ohio           | 12.0    | 13.8                         | 82.4      | 78.0             | 73.6          | 70.5           | 65.2         | 61.8        | 55.6        | -           | -           |
| Maryland       | 12.0    | 35.0                         | 90.5      | 84.2             | 84.6          | 85.6           | 84.5         | 77.1        | 76.4        | -           | -           |
| Pennsylvania   | 10.6    | 11.0                         | 87.0      | 80.2             | 76.9          | 72.8           | 69.2         | 71.7        | 67.8        | -           | -           |
| Wisconsin      | 10.6    | 4.6                          | 86.3      | 81.0             | 77.3          | 66.9           | 61.8         | 66.1        | 61.1        | -           | -           |
| Iowa           | 10.2    | 1.8                          | 90.6      | 85.4             | 83.8          | 80.8           | 77.4         | 71.3        | 65.5        | -           | -           |
| Alabama        | 10.2    | 25.4                         | 88.6      | 78.0             | 73.8          | 69.7           | 64.3         | 71.3        | 65.5        | -           | -           |
| Nebraska       | 10.0    | 3.6                          | 90.3      | 86.2             | 84.0          | 87.7           | 85.1         | 74.6        | 71.1        | -           | -           |
| **Median**     | 11.3    |                             | 87.0      | 81.0             | 76.9          | 72.1           | 66.3         | 70.0        | 64.4        | -           | -           |
| **States with 5-9.9 percentage point influenza vaccination inequity** |         |                             |           |                  |               |                |             |
| Georgia        | 9.5     | 33.1                         | 80.1      | 78.0             | 74.7          | 80.8           | 77.8         | 71.5        | 68.6        | 72.5        | 67.8        |
| Kentucky       | 9.1     | 7.7                          | 83.9      | 75.6             | 71.4          | 78.8           | 75.0         | 83.8        | 80.6        | -           | -           |
| New York       | 9.1     | 17.8                         | 92.4      | 84.3             | 82.2          | 71.4           | 68.6         | 72.5        | 69.2        | 77.5        | 75.0        |
| New Jersey     | 8.2     | 16.4                         | 92.7      | 78.0             | 75.9          | 75.3           | 73.3         | 68.0        | 65.4        | 76.9        | 74.6        |
| North Carolina | 8.0     | 24.0                         | 87.6      | 86.8             | 85.3          | 78.1           | 75.4         | 64.8        | 61.8        | 66.9        | 67.3        |
| Tennessee      | 7.8     | 14.1                         | 82.6      | 80.4             | 78.1          | 79.0           | 77.5         | 83.4        | 81.6        | 63.2        | 60.8        |
| Rhode Island   | 7.7     | 4.3                          | 90.9      | 83.5             | 82.3          | 79.2           | 77.3         | -           | -           | -           | -           |
| Reporting area | W-B gap | % Black Residents in State | 0% Blacks | 0.1% - 4.9% Blacks | 5-19.9% Blacks | 20-49.9% Blacks | >50% Blacks |
|----------------|---------|---------------------------|-----------|-------------------|----------------|----------------|-------------|
| Oregon         | 7.5     | 2.1                       | 76.7      | 78.5              | 74.6           | 75.2           | 70.2        | -           | -           |
| West Virginia  | 7.5     | 3.5                       | 85.8      | 83.8              | 79.3           | 79.0           | 74.7        | -           | -           |
| Virginia       | 7.3     | 22.6                      | 90.9      | 84.1              | 80.0           | 80.8           | 76.4        | 72.4        | 68.5        |
| Louisiana      | 7.3     | 30.5                      | -         | 86.6              | 84.1           | 80.9           | 77.5        | 79.1        | 75.3        |
| aware          | 6.9     | 20.9                      | -         | 92.9              | 90.5           | 85.8           | 81.4        | 83.8        | 78.0        |
| Massachusets   | 6.8     | 5.7                       | 86.8      | 81.0              | 78.6           | 78.0           | 75.1        | 75.9        | 73.2        |
| Connecticut    | 6.7     | 9.6                       | 90.9      | 84.0              | 81.9           | 77.3           | 75.2        | 82.2        | 79.9        |
| Oklahoma       | 6.4     | 7.1                       | 89.4      | 88.2              | 85.5           | 85.1           | 82.1        | 80.7        | 76.4        |
| Mississippi    | 6.0     | 33.3                      | -         | 76.5              | 73.6           | 84.6           | 82.7        | 84.4        | 82.1        |
| Arizona        | 5.8     | 4.2                       | 69.1      | 60.2              | 61.4           | 78.4           | 79.3        | -           | -           |
| California     | 5.6     | 10.1                      | 88.6      | 74.5              | 70.9           | 72.2           | 68.4        | 69.4        | 65.4        |
| Texas          | 5.3     | 12.9                      | 83.1      | 77.7              | 76.2           | 73.6           | 71.9        | 69.8        | 68.1        |
| Florida        | 5.1     | 13.7                      | 89.0      | 57.1              | 55.7           | 50.2           | 49.4        | 46.8        | 45.3        |
| Nevada         | 5.0     | 10.7                      | 70.9      | 58.3              | 60.2           | 50.4           | 52.1        | 39.9        | 41.3        |
| Median         |         |                           | 87.2      | 80.4              | 78.1           | 78.4           | 75.2        | 72.5        | 69.2        |

Vaccinated

|          | White | White | Black | White | Black | White | Black | White | Black |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Oregon   | 67.7  | 78.5  | 74.6  | 75.2  | 70.2  | -     | -     | -     | -     |
| West Virginia | 85.8 | 83.8  | 79.3  | 79.0  | 74.7  | -     | -     | -     | -     |
| Virginia | 90.9  | 84.1  | 80.0  | 80.8  | 76.4  | 72.4  | 68.5  | 71.2  | 67.5  |
| Louisiana | 69.5  | 84.1  | 80.0  | 76.4  | 72.4  | 68.5  | 71.2  | 67.5  | 65.1  |
| aware    | 92.9  | 90.5  | 85.8  | 81.4  | 83.8  | 78.0  | -     | -     | -     |
| Massachusets | 86.8 | 81.0  | 78.6  | 78.0  | 75.1  | 75.9  | 73.2  | 85.1  | 83.0  |
| Connecticut | 90.9 | 84.0  | 81.9  | 77.3  | 75.2  | 82.2  | 79.9  | -     | -     |
| Oklahoma  | 89.4  | 88.2  | 85.5  | 85.1  | 82.1  | 80.7  | 76.4  | -     | -     |
| Mississippi | -    | 76.5  | 73.6  | 84.6  | 82.7  | 84.4  | 82.1  | 70.7  | 67.4  |
| Arizona  | 69.1  | 60.2  | 61.4  | 78.4  | 79.3  | -     | -     | -     | -     |
| California | 88.6 | 74.5  | 70.9  | 72.2  | 68.4  | 69.4  | 65.4  | 71.2  | 67.4  |
| Texas    | 83.1  | 77.7  | 76.2  | 73.6  | 71.9  | 69.8  | 68.1  | 51.4  | 49.4  |
| Florida  | 89.0  | 57.1  | 55.7  | 50.2  | 49.4  | 46.8  | 45.3  | 64.6  | 63.2  |
| Nevada   | 70.9  | 58.3  | 60.2  | 50.4  | 52.1  | 39.9  | 41.3  | -     | -     |
| Median   | 87.2  | 80.4  | 78.1  | 78.4  | 75.2  | 72.5  | 69.2  | 71.0  | 67.4  |
Facilities grouped by percent black residents

| Reporting area | W-B gap | % Black Residents in State | 0% Blacks | 0.1% - 4.9% Blacks | 5-19.9% Blacks | 20-49.9% Blacks | ≥50% Blacks |
|----------------|---------|---------------------------|-----------|-------------------|---------------|----------------|------------|
|                |         |                           | White     | White             | Black         | White          | Black       | White     | Black     |
| South Carolina | 4.7     | 28.4                      | -         | 85.0              | 84.7          | 87.2           | 87.0        | 78.5      | 78.2      | 69.6      | 69.1      |
| Washington     | 4.0     | 3.6                       | 80.8      | 75.6              | 72.8          | 78.4           | 75.9        | 73.5      | 70.8      | -         | -         |
| Colorado       | 3.7     | 4.4                       | 85.8      | 74.4              | 74.5          | 74.2           | 74.4        | 62.8      | 63.1      | -         | -         |
| Arkansas       | 3.6     | 13.0                      | 85.0      | 89.5              | 86.7          | 88.6           | 85.6        | 88.3      | 85.2      | 86.6      | 83.2      |
| New Mexico     | 3.2     | 2.1                       | 71.5      | 65.6              | 65.6          | 83.8           | 80.3        | -         | -         | -         | -         |
| Median         | 4.4     |                           | 82.9      | 75.6              | 74.5          | 83.8           | 80.3        | 76.0      | 74.5      | 78.1      | 76.2      |
| Overall Median | 13.6    |                           | 87.2      | 80.3              | 77.3          | 74.2           | 70.6        | 70.5      | 67.0      | 66.9      | 62.6      |

States with 1-4.9 percentage point influenza vaccination inequity

| Reporting area | W-B gap | % Black Residents in State | 0% Blacks | 0.1% - 4.9% Blacks | 5-19.9% Blacks | 20-49.9% Blacks | ≥50% Blacks |
|----------------|---------|---------------------------|-----------|-------------------|---------------|----------------|------------|
|                |         |                           | White     | White             | Black         | White          | Black       | White     | Black     |
| South Carolina | 4.7     | 28.4                      | -         | 85.0              | 84.7          | 87.2           | 87.0        | 78.5      | 78.2      | 69.6      | 69.1      |
| Washington     | 4.0     | 3.6                       | 80.8      | 75.6              | 72.8          | 78.4           | 75.9        | 73.5      | 70.8      | -         | -         |
| Colorado       | 3.7     | 4.4                       | 85.8      | 74.4              | 74.5          | 74.2           | 74.4        | 62.8      | 63.1      | -         | -         |
| Arkansas       | 3.6     | 13.0                      | 85.0      | 89.5              | 86.7          | 88.6           | 85.6        | 88.3      | 85.2      | 86.6      | 83.2      |
| New Mexico     | 3.2     | 2.1                       | 71.5      | 65.6              | 65.6          | 83.8           | 80.3        | -         | -         | -         | -         |
| Median         | 4.4     |                           | 82.9      | 75.6              | 74.5          | 83.8           | 80.3        | 76.0      | 74.5      | 78.1      | 76.2      |
| Overall Median | 13.6    |                           | 87.2      | 80.3              | 77.3          | 74.2           | 70.6        | 70.5      | 67.0      | 66.9      | 62.6      |
Facilities grouped by percent black residents

| Reporting area | W-B gap | % Black Residents in State | 0% Blacks | 0.1% -4.9% Blacks | 5-19.9% Blacks | 20-49.9% Blacks | ≥50% Blacks |
|----------------|---------|-----------------------------|-----------|------------------|---------------|----------------|------------|
|                |         |                             | White     | White            | Black         | White          | Black      | White     | Black     |

*Includes anyone who lived in a nursing home at least one day between October 1, 2018 and March 31, 2019
Results from multilevel models for each state including sex, age, race, total number residents in the facility during influenza season, and proportion black residents in the facility
Vaccination coverage in nursing homes with 0% blacks and ≥ 50% blacks is bolded to show the differences in the most disparate strata.
‘-‘ indicates strata with < 5 facilities.
Figure 1 B

Vaccination coverage (quartiles)
- 48.5-72.5%
- 72.6-76.1%
- 76.2-81.6%
- >=81.0

[] Prevalence in percent
White indicates states with <1% black residents or <1 ppt W-B gap
Figure 1C

Figure-1 C

Quartiles: Dissimilarity Index

White indicates states with <1% black residents or <1 ppt W-E gap
Figure 3

The figure illustrates the relationship between the proportion of Black nursing home residents in a state and an equity index. Each state is represented by a dot, with the state abbreviation indicated. The x-axis represents the proportion of Black nursing home residents in the state, and the y-axis represents the equity index (absolute percentage points). The states are plotted along these axes, with some showing a higher proportion of Black residents in states with lower equity indices, indicating a potential inequity in care or resources.
