Geographic Variation in Influenza Vaccination Disparities Between Hispanic and Non-Hispanic White US Nursing Home Residents

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Background. Disparities in influenza vaccination exist between Hispanic and non-Hispanic White US nursing home (NH) residents, but the geographic areas with the largest disparities remain unknown. We examined how these racial/ethnic disparities differ across states and hospital referral regions (HRRs).

Methods. This retrospective cohort study included >14 million short-stay and long-stay US NH resident-seasons over 7 influenza seasons from October 1, 2011, to March 31, 2018, where residents could contribute to 1 or more seasons. Residents were aged ≥65 years and enrolled in Medicare fee-for-service. We used the Medicare Beneficiary Summary File to ascertain race/ethnicity and Minimum Data Set assessments for influenza vaccination. We calculated age- and sex-standardized percentage point (pp) differences in the proportions vaccinated between non-Hispanic White and Hispanic (any race) resident-seasons. Positive pp differences were considered disparities, where the proportion of non-Hispanic White residents vaccinated was greater than the proportion of Hispanic residents vaccinated. States and HRRs with ≥100 resident-seasons per age-sex stratum per racial/ethnic group were included in analyses.

Results. Among 7,442,241 short-stay resident-seasons (94.1% non-Hispanic White, 5.9% Hispanic), the median standardized disparities in influenza vaccination were 4.3 pp (minimum, maximum: 0.3, 19.2; n = 22 states) and 2.8 pp (minimum, maximum: −3.6, 10.3; n = 49 HRRs). Among 6,758,616 long-stay resident-seasons (93.7% non-Hispanic White, 6.5% Hispanic), the median standardized differences were −0.1 pp (minimum, maximum: −4.1, 11.4; n = 18 states) and −1.8 pp (minimum, maximum: −6.5, 7.6; n = 34 HRRs).

Conclusions. Wide geographic variation in influenza vaccination disparities existed across US states and HRRs. Localized interventions targeted toward areas with high disparities may be a more effective strategy to promote health equity than one-size-fits-all national interventions.

Keywords. ethnic groups; health care disparities; influenza; nursing homes; vaccines.

Older adults are among the most at-risk for severe illness or complications due to influenza. They account for ~90% of influenza-related deaths [1] and between 50% and 70% of influenza-related hospitalizations in the United States [2, 3]. Older adults in nursing homes (NHs) are particularly susceptible to these complications [4]. To prevent disease caused by influenza viruses in NHs, regulations by the Centers for Medicare and Medicaid Services (CMS) require NHs to offer each resident influenza vaccination annually [5]. However, influenza vaccination coverage in NHs remains suboptimal [6]. Coverage is especially poor among racial/ethnic minorities, and disparities in influenza vaccination exist [7–9]. Disparities occur when there are differences between socially disadvantaged (ie, Black and Hispanic) and more socially advantaged (ie, White) racial/ethnic groups, such that influenza vaccination uptake favors the more socially advantaged racial/ethnic group [10]. Although most prior literature has examined influenza vaccination disparities among Black and White NH residents [7–9, 11–14], some evidence suggests that disparities in vaccination between Hispanic (regardless of race) and non-Hispanic White residents range between 3.4 and 12.7 percentage points [15]. As the Hispanic population is expected to
represent ~20% of older adults in the United States by 2050 [16], it is critical to mitigate existing racial/ethnic inequities in NH influenza vaccination now and prevent these disparities from widening in the future. To inform such mitigation strategies, including state and local policies, it is first necessary to understand how influenza vaccination coverage differs between Hispanic and non-Hispanic White NH residents, including the geographic regions where the largest disparities exist.

Prior studies have examined person-level (eg, age) and facility-level factors (eg, chain vs standalone facility) associated with influenza vaccination in NHs [14, 17, 18], as well as disparities in influenza vaccination between Hispanic and non-Hispanic White NH residents [7, 12, 15]. However, studies investigating racial/ethnic disparities were mainly conducted at the national level, leaving smaller-area geographic patterns of non-Hispanic White and Hispanic influenza vaccination disparities underexplored [7, 19]. To employ quality improvement interventions in an efficient and cost-effective manner, it is necessary to identify disparities at smaller geographic levels. Only then can interventions be targeted toward areas with the largest disparities rather than applying a one-size-fits-all, national-level intervention [20]. In addition, past studies have seldom examined short-stay (post–acute care) and long-stay (long-term care) NH residents separately. Length of stay is an important characteristic, as long-stay residents have distinct clinical features and care goals compared with short-stay residents [15]. Length of stay may also influence influenza vaccination receipt in NHs. For example, short-stay residents could prefer to receive preventative care services, such as influenza vaccination, from an established outpatient provider rather than NH providers during short-term post–acute care. One study even found that racial/ethnic disparities in influenza vaccination were greater among short-stay residents [15].

Our objectives were to examine crude influenza vaccination disparities between Hispanic and non-Hispanic White short-stay and long-stay NH residents across US states and territories and use the nonparametric g-formula to compare disparities in influenza vaccination between Hispanic and non-Hispanic White residents at the state and Hospital Referral Region (HRR) levels. HRRs extend beyond state boundaries, which may reflect the geographic patterns of NH utilization and serve as a practical geographic unit to implement interventions to reduce disparities [21]. We hypothesized that there would be wide variation in influenza vaccination disparities across states/HRRs and that disparities would be more dramatic among short-stay residents.

METHODS

Study Design and Data Sources
This retrospective cohort study included NH residents enrolled in Medicare fee-for-service between October 1, 2011, and March 31, 2018. We linked the Medicare Beneficiary Summary File (MBSF) to Minimum Data Set (MDS), version 3.0, Certification and Survey Provider Enhanced Reports, and Long-Term Care: Facts on Care in the US data.

Patient Consent
This study was approved by the Brown University Institutional Review Board. Informed consent was not required.

Study Population
The study population included Medicare fee-for-service beneficiaries aged ≥65 years residing in free-standing (ie, not hospital-based) US NHs with ≥1 MDS assessment between the 2011 and 2017 influenza seasons. The study period included 7 influenza seasons, each starting October 1 and ending March 31 of the following year. These dates were based on historical influenza activity, typical timing of influenza vaccination administrations by nursing homes, and previous studies [9, 11, 19, 22]. Short-stay residents were those with <100 days in the same NH, and long-stay residents were those with ≥100 consecutive days in any NH, with no more than 10 days outside of an NH. The index dates were defined as the date of NH admission for short-stay residents, 100th day of the NH stay for long-stay residents in their first influenza season, or October 1 for long-stay residents in subsequent influenza seasons. For residents with multiple NH stays during a single influenza season, only the first NH stay was included; however, residents could be represented across multiple seasons if they remained in an NH or had multiple intermittent episodes of short-term post–acute care. Resident-seasons with missing data on variables used in analyses were excluded (n = 24,804 [0.07%]), as well as those who identified as non-Hispanic Black, Asian/Pacific Islander, American Indian/Alaska Native, or other races.

Race and Ethnicity
The primary exposure was Hispanic ethnicity (regardless of race) vs non-Hispanic White race, which was ascertained from the MBSF using the validated Research Triangle Institute race/ethnicity variable [23, 24].

Influenza Vaccination and Racial/Ethnic Disparities
Receipt of influenza vaccination was ascertained from the MDS using previously published algorithms (sensitivity 85%, specificity 77%) [9, 18, 25]. Residents were considered vaccinated if any MDS assessment between October 1 and June 30 indicated that the resident received an influenza vaccination during the influenza season, either before or after facility entry. The resident was considered not vaccinated if any alternate answer was given across all MDS assessments (eg, offered and declined, ineligible). Differences in vaccination were estimated by subtracting the proportion of Hispanic residents vaccinated from
the proportion of non-Hispanic White residents vaccinated. Positive differences indicated the presence of a disparity, as influenza vaccination coverage would favor the more socially advantaged racial/ethnic group (non-Hispanic White) [10, 26].

**Covariates**
Age and sex were obtained from the MBSF. Residents’ ages were categorized according to their index date in each season (65–69, 70–74, 75–79, 80–84, and 85 years or older). Other covariates (eg, comorbidities) were not accounted for in our analyses because we hypothesized that these would be mediators on the causal pathway between race/ethnicity and influenza vaccination and controlling for them could potentially block some of the effects of race/ethnicity on vaccination and mask existing disparities [27, 28]. Masking disparities might make it difficult to identify geographic areas that could benefit most from interventions to improve equity in influenza vaccination.

**Statistical Analysis**
Analyses were conducted at the person-period or “resident-season” level. Resident-season level refers to measures, such as vaccination status, determined for each resident in each influenza season, which could vary between seasons. Resident-seasons were aggregated across 7 seasons to generate single summary measures. Analyses were conducted separately for short-stay and long-stay resident-seasons.

**National Estimates of Influenza Vaccination Disparities by State**
We calculated the proportion of non-Hispanic White and Hispanic resident-seasons vaccinated and compared crude percentage point (pp) differences in vaccination for resident-seasons in all 50 states, Washington DC, and Puerto Rico.

**Geospatial Analyses by State and HRR**
We conducted geospatial analyses based on 2 geographic units: states and HRRs. There are 306 HRRs in the United States that represent regional hospital catchment areas with a minimum population of 120 000 [29]. To avoid small cell size issues and obtain stable estimates, only geographic units (states or HRRs) with at least 100 resident-seasons per age-sex stratum per racial/ethnic group were included in geospatial analyses. We also considered county as a geographic unit of analysis, but the sample sizes in the majority of counties were too small to support sufficiently precise, valid estimates.

In our primary analysis, we calculated crude and standardized differences in influenza vaccination (referred to as “Geospatial, Crude” and “Geospatial, Age/Sex-Standardized” in the Results). To calculate age- and sex-standardized estimates of vaccination, we employed the nonparametric g-formula using a fully saturated linear regression model, including product terms between race/ethnicity and all other variables (age category, sex, and geographic unit) [30, 31]. We completed calculations of marginal quantities by using predicted probabilities summed to a weighted average reflecting the age and sex distribution in the overall observed study population [32]. We calculated 95% confidence limits (CLs) using the delta method [33]. Although the delta method does not account for within-person clustering, we expected that the influence of within-person correlation on the standard errors would be minimal. It is uncommon for individuals in the short-stay population to be represented across multiple influenza seasons as their stays are both infrequent and brief. Individuals in the long-stay population have a greater opportunity to be represented in >1 influenza season but rarely are due to their limited life expectancy. PP differences in vaccination were reported separately for each state/HRR included in geospatial analyses and were visualized using choropleth maps.

To examine how different approaches may impact the national estimate of influenza vaccination disparities, we also calculated (1) the crude racial/ethnic disparity at the national level among resident-seasons included in our geospatial analysis (“National, Crude”) and (2) age- and sex-standardized estimates at the national level, where our model included product terms between race/ethnicity and age category/sex, but not geographic unit (“National, Age/Sex-Standardized”). We compared these estimates with the median pp difference in influenza vaccination across geographic units from our primary analysis.

**RESULTS**

**National Study Cohort**
The final study cohort consisted of 7 442 241 (7 002 108 non-Hispanic White [94.1%] and 440 133 Hispanic [5.9%]) short-stay resident-seasons and 6 758 616 (6 335 373 non-Hispanic White [93.7%] and 423 243 Hispanic [6.5%]) long-stay resident-seasons (Supplementary Figure 1). In the short-stay population, the median (quartile 1, quartile 3) age was 82.1 (75.1, 88.0) years, and 61.4% were female residents (Table 1). The median (quartile 1, quartile 3) age was 85.3 (78.3, 90.7) years, and 71.0% were female residents in the long-stay population. Resident demographics were consistent across all influenza seasons (Supplementary Table 1).

**National Estimates of Influenza Vaccination and Differences by State**
Across all US states/territories, the crude pp difference in influenza vaccination between non-Hispanic White and Hispanic residents ranged from a difference of −5.8 to a disparity of 19.3 among short-stay resident-seasons (Supplementary Table 2) and a difference of −6.5 to a disparity of 11.4 among long-stay resident-seasons (Supplementary Table 3).

**Geospatial Analyses**
After restricting to geographic units with at least 100 resident-seasons per age-sex stratum per racial/ethnic group, geospatial analyses excluded 28 states and 257 HRRs for short-stay resident-seasons and 32 states and 272 HRRs for long-stay resident-
seasons. The state geospatial analysis included 5,529,330 short-stay and 4,292,197 long-stay resident seasons, while the HRR geospatial analysis included 2,259,937 short-stay and 4,146,308 long-stay resident seasons (Supplementary Figure 1). The distributions of age and sex were generally similar among resident-seasons included and excluded in our state and HRR analyses, but influenza vaccination was slightly higher among those excluded for both non-Hispanic White and Hispanic residents (Supplementary Table 4).

### State Geospatial Analysis Before and After Standardization

Among states included in geospatial analyses, the median crude disparity in vaccination (minimum, maximum) was 4.4 (0.4, 19.3) pp for short-stay resident-seasons (n = 22 states) and 0.4 (−4.0, 11.4) pp for long-stay resident-seasons (n = 18 states) (Table 2). After standardization, the median disparity among the short-stay population (minimum, maximum) was 4.3 (0.3, 19.2) pp, and the median difference in vaccination (minimum, maximum) was −0.1 (−4.1, 11.4) pp among long-stay resident-seasons (Table 2). States with the largest standardized disparities (largest positive values) were generally located in the South, Midwest, and Northeast regions, while states with the lowest standardized differences (smallest positive value for short-stay and largest negative value for long-stay populations) were concentrated in the West (Figure 1). Florida had the largest standardized disparity among short-stay and long-stay populations at 19.2 (95% CI, 18.9 to 19.6) and 11.4 (95% CI, 10.9 to 11.8) pp, respectively (Supplementary Tables 5 and 6). Oregon had the smallest standardized disparity (smallest positive value) for the short-stay population (0.3; 95% CL, −2.0 to 2.5), and California had the largest negative difference for the long-stay population (−4.1; 95% CI, −4.4 to −3.8) (Supplementary Tables 5 and 6). Overall, 22/22 (100%) states in geospatial analyses had standardized disparities for the short-stay-population, while 7/18 (39%) had standardized disparities for the long-stay population.

### HRR Geospatial Analysis Before and After Standardization

The median crude disparity in vaccination among HRRs included in geospatial analyses (minimum, maximum) was 3.1 (−3.4, 10.6) pp for short-stay resident-seasons (n = 49 HRRs), and the median crude difference (minimum, maximum) was −1.5 (−6.4, 7.4) pp among long-stay resident-seasons (n = 34 HRRs) (Table 2). After applying standardization, the median disparity among short-stay resident-seasons (minimum, maximum) was 2.8 (−3.6, 10.3) pp, and the median difference in vaccination (minimum, maximum) was −1.8 (−6.5, 7.6) pp among long-stay resident-seasons (Table 2). HRRs with the largest standardized disparities were concentrated around cities in the South and Northeast regions, while HRRs with the largest negative differences were concentrated in the West (Figure 2). The Harlingen, Texas, HRR had the largest standardized disparity among short-stay residents-seasons (10.3; 95% CI, 8.0 to 12.6), and Miami, Florida, had the largest standardized disparity among long-stay resident-seasons (7.6; 95% CI, 6.4 to 8.7) (Supplementary Tables 7 and 8). The HRRs with the largest negative differences included San Jose, California (−3.6; 95% CI, −4.4 to −2.5).

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### Table 1. Characteristics of Short-Stay (Post–Acute Care) and Long-Stay (Long-term Care) Nursing Home Residents, 2011–2018 Influenza Seasons

| Resident-Season-Level Characteristic | Short-Stay/Post–Acute Care n = 7,442,241 Resident-Seasons | Long-Stay/Long-term Care n = 6,758,616 Resident-Seasons |
|-------------------------------------|--------------------------------------------------------|-------------------------------------------------------|
|                                     | No. or Median | % or Q1, Q3 | No. or Median | % or Q1, Q3 |
| **Race/ethnicity, No. (%)**         |              |            |              |            |
| Non-Hispanic White                   | 7 002 108    | 94.1       | 6 335 373    | 93.7       |
| Hispanic                             | 440 133      | 5.9        | 423 243      | 6.5        |
| **Age, median (Q1, Q3), y**         | 82.1         | 75.1, 88.0 | 85.3         | 78.3, 90.7 |
| **Age group, No. (%)**              |              |            |              |            |
| 65–69 y                              | 804 525      | 10.8       | 479 182      | 7.1        |
| 70–74 y                              | 1 040 603    | 14.0       | 657 556      | 9.7        |
| 75–79 y                              | 1 264 878    | 17.0       | 884 143      | 13.1       |
| 80–84 y                              | 1 521 730    | 20.4       | 1 255 783    | 18.6       |
| 85+ y                                | 2 810 505    | 37.8       | 3 481 952    | 51.5       |
| **Sex, No. (%)**                     |              |            |              |            |
| Male                                 | 2 875 445    | 38.6       | 1 958 742    | 29.0       |
| Female                               | 4 566 796    | 61.4       | 4 799 874    | 71.0       |

Influenza seasons were defined as starting on October 1 of one year and ending on March 31 of the following year based on historical influenza activity from the Centers for Disease Control and Prevention. Vaccination status leveraged data through June 30 to allow sufficient time for vaccination status to be documented by nurses during resident assessments.

Abbreviations: Q1, quartile 1; Q3, quartile 3.

*a* Because a resident could be represented across multiple influenza seasons, we conducted our analyses at the “resident-season” (also commonly referred to as “person-period”) level, whereby each resident could contribute multiple influenza seasons to the study, each of which is a resident-season. Resident-season-level information refers to measures that could be ascertained for each person in each season and that could vary between seasons. Person-level characteristics stratified by season can be found in Supplementary Table 1.

*b* Age was assigned at index date, defined as the date of nursing home admission for short-stay residents, 100th day of nursing home stay for long-stay residents in their first influenza season, or October 1 for long-stay residents in subsequent influenza seasons.
Our nationally representative study demonstrated that there was wide geographic variation in influenza vaccination for both non-Hispanic White and Hispanic short-stay and long-stay NH residents from 2011 to 2018. Disparities were most pronounced among short-stay residents and at the state level, while negative differences in vaccination (indicating that a greater proportion of Hispanic residents were vaccinated) were more pronounced among long-stay residents and at the HRR level. Although the racial/ethnic group with the higher likelihood of influenza vaccination differed by geographic region, we found that all states and HRRs fell short of the national Healthy People 2020 vaccination target of 90% for NH residents, which was applicable during our study period [34]. Therefore, future quality improvement interventions aimed at increasing influenza vaccination in NHs nationally should focus on (1) reducing racial/ethnic disparities in geographic areas with the greatest disparities and (2) improving vaccine uptake in geographic areas where the proportion of NH residents vaccinated is lowest.

**DISCUSSION**

Our nationally representative study demonstrated that there was wide geographic variation in influenza vaccination for both non-Hispanic White and Hispanic short-stay and long-stay NH residents from 2011 to 2018. Disparities were most pronounced among short-stay residents and at the state level, while negative differences in vaccination (indicating that a greater proportion of Hispanic residents were vaccinated) were more pronounced among long-stay residents and at the HRR level. Although the racial/ethnic group with the higher likelihood of influenza vaccination differed by geographic region, we found that all states and HRRs fell short of the national Healthy People 2020 vaccination target of 90% for NH residents, which was applicable during our study period [34]. Therefore, future quality improvement interventions aimed at increasing influenza vaccination in NHs nationally should focus on (1) reducing racial/ethnic disparities in geographic areas with the greatest disparities and (2) improving vaccine uptake in geographic areas where the proportion of NH residents vaccinated is lowest.

**Table 2.** Crude and Standardized Incidence of and Differences in Influenza Vaccination Between Non-Hispanic White and Hispanic Short-Stay (Post-Acute Care) and Long-Stay (Long-term Care) Nursing Home Resident-Seasons, by State and Hospital Referral Region, 2011–2018 Influenza Seasons

| State | Crude | Age/Sex-Standardized<sup>b</sup> |
|-------|-------|----------------------------------|
|       | Non-Hispanic White Vaccination, % | Hispanic Vaccination, % | Percentage Point Difference<sup>a</sup> | Non-Hispanic White Vaccination, % | Hispanic Vaccination, % | Percentage Point Difference<sup>a</sup> |
| Short-stay (n = 22) | | | | | | |
| Mean | 63.3 | 58.2 | 5.2 | 63.3 | 58.3 | 5.0 |
| SD | 8.8 | 10.6 | 4.0 | 8.8 | 10.7 | 4.0 |
| Median | 66.4 | 62.1 | 4.4 | 66.4 | 62.3 | 4.3 |
| Q1, Q3 | 62.7, 69.6 | 56.1, 65.6 | 2.5, 7.2 | 62.7, 69.6 | 56.2, 65.7 | 2.4, 7.0 |
| Min, max | 40.4, 73.2 | 26.8, 67.8 | 0.4, 19.3 | 40.4, 73.2 | 26.8, 67.9 | 0.3, 19.2 |
| Long-stay (n = 18) | | | | | | |
| Mean | 79.4 | 78.7 | 0.7 | 79.4 | 78.9 | 0.5 |
| SD | 5.2 | 7.0 | 3.7 | 5.2 | 7.1 | 3.7 |
| Median | 80.0 | 80.9 | 0.4 | 78.0 | 81.0 | −0.1 |
| Q1, Q3 | 78.1, 83.8 | 76.7, 83.3 | −1.3, 1.5 | 78.1, 83.8 | 77.0, 83.6 | −1.5, 1.4 |
| Min, max | 64.8, 85.3 | 58.1, 86.1 | −4.0, 11.4 | 64.8, 85.2 | 58.1, 86.4 | −4.1, 11.4 |
| HRR | | | | | | |
| Short-stay (n = 49) | | | | | | |
| Mean | 59.7 | 56.2 | 3.6 | 59.7 | 56.3 | 3.4 |
| SD | 10.7 | 12.0 | 3.6 | 10.7 | 12.1 | 3.6 |
| Median | 62.3 | 60.7 | 3.1 | 62.2 | 60.8 | 2.8 |
| Q1, Q3 | 52.9, 68.6 | 49.9, 66.1 | 1.4, 6.3 | 52.8, 68.4 | 50.1, 66.2 | 1.3, 6.1 |
| Min, max | 28.9, 75.6 | 19.6, 74.0 | −3.4, 10.6 | 28.8, 75.5 | 19.6, 74.1 | −3.6, 10.3 |
| Long-stay (n = 34) | | | | | | |
| Mean | 78.1 | 79.1 | −1.1 | 78.0 | 79.3 | −1.3 |
| SD | 5.3 | 7.1 | 3.3 | 5.3 | 7.1 | 3.3 |
| Median | 79.0 | 81.2 | −1.5 | 78.9 | 81.5 | −1.8 |
| Q1, Q3 | 76.0, 81.4 | 77.8, 83.3 | −4.3, 1.4 | 76.0, 81.2 | 78.1, 83.6 | −4.9, 1.1 |
| Min, max | 58.2, 85.3 | 50.7, 87.0 | −6.4, 7.4 | 58.3, 85.2 | 50.7, 87.1 | −6.5, 7.6 |

Abbreviations: HRR, hospital referral region; max, maximum; min, minimum; Q1, quartile 1; Q3, quartile 3.

<sup>a</sup>Influenza seasons were defined as starting on October 1 of one year and ending on March 31 of the following year based on historical influenza activity from the Centers for Disease Control and Prevention. Vaccination status leveraged data through June 30 to allow sufficient time for vaccination status to be documented by nurses during resident assessments.

<sup>b</sup>Standardized estimates were calculated via the nonparametric g-formula using a fully saturated linear regression model. Calculations of marginal quantities were completed using predicted probabilities summed to a weighted average reflecting the age and sex distribution in the overall population.

<sup>c</sup>Percentage point differences were calculated as the proportion in Non-Hispanic White residents vaccinated minus the proportion in Hispanic residents vaccinated, such that positive differences indicate the presence of a disparity.
Our results were generally consistent with the published literature, which reported that non-Hispanic White NH residents were more likely to receive influenza vaccinations than Hispanic residents [7, 12, 14] and that influenza vaccination patterns among short- and long-stay NH residents overall (not specific to any racial/ethnic group) vary widely across the United States [19]. However, our findings reveal novel patterns of variation in influenza vaccination at the state and HRR levels. We also found that differences measured at the state level may mask more dramatic differences at smaller geographic units. For example, the standardized difference in influenza vaccination among short-stay resident-seasons in Texas was 7.8 pp at the state level but ranged from 1.3 to 10.3 pp at the HRR level. Understanding smaller area geographic differences in influenza vaccination is important to enable the development of localized interventions (ie, by counties or health departments) and prioritization of influenza immunization programs in areas where disparities are the greatest. Such an approach may prove to be more cost-effective than deploying broad interventions widely throughout larger geographic areas [20].

Employing quality improvement interventions where disparities are large and vaccine uptake is low may be a particularly effective approach to improve influenza vaccination in NHs. Our results highlighted short-stay residents as an important subgroup who may benefit most from future interventions as short-stay residents tended to have greater disparities and lower vaccine uptake compared with long-stay residents. Targeting quality improvement interventions toward NHs in geographic areas with the largest disparities is another important strategy to improve equity in influenza vaccination across racial/ethnic groups. Studies investigating the reasons for differences in influenza vaccination disparities by length of stay in the NH and across geographic areas are very limited. Therefore, qualitative research examining sources of variation in influenza vaccination disparities (ie, state/local policies, cultural differences, organizations involved in improving immunization rates and/or reducing racial/ethnic disparities) and characteristics that
lead certain geographic areas to have negative differences in vaccination is especially needed.

Several strategies may be beneficial in increasing vaccine uptake and reducing racial/ethnic disparities in NHs. Programs that include training sessions with immunization “champions” or improvement teams, improving access to vaccine resources through toolkits and informational workbooks, and designing and implementing immunization action plans have displayed positive results for improving immunization processes (eg, staff education, informing residents about risks and benefits of vaccination) and vaccine uptake [21, 35, 36]. In addition, I study found that NH influenza vaccination strategies such as standing orders, policies allowing verbal consent for vaccination, and routine review of the facility’s influenza vaccination rates both improved vaccine coverage and reduced racial disparities in influenza vaccination between White and Black NH residents [37]. However, future research examining if these strategies reduce racial/ethnic disparities between non-Hispanic White and Hispanic individuals is needed. Future research is also needed to better understand the complex interplay of factors related to offering and providing influenza vaccinations in NHs, including at the resident, NH, and other levels. Although CMS requires that each NH resident be offered an influenza vaccination, using a tailored approach may help to reduce vaccine hesitancy and improve vaccine uptake, especially since racial/ethnic groups tend to have differing beliefs that influence their acceptance of vaccinations [38, 39]. It may also be beneficial to examine if vaccines are offered differentially by racial/ethnic group, including when a resident’s preferred language is Spanish (eg, through on-site interpreters, discussing with family members instead of directly with the resident).

**Limitations**

Given our inclusion and exclusion criteria, these results may not generalize to younger Medicare beneficiaries (<65 years) or those with Medicare Advantage; states or HRRs that were excluded from geospatial analyses; or time periods after the 2017–2018 influenza season. Future research examining how
influenza vaccination and racial/ethnic disparities in NHs changed in the years following the start of the COVID-19 pandemic is needed [40]. Additionally, the framework that guided our analyses is likely incomplete. This is largely due to a lack of research exploring mechanisms that drive disparities among Hispanic and non-Hispanic White residents in NHs. To have a more complete understanding of these disparities and identify additional intervention points, future research should consider the complex factors that determine influenza vaccination in NHs (eg, staffing levels and residency occupancy), heterogeneity among Hispanic individuals (eg, differences by country of origin, acculturation), and more distal mechanisms before NH entry that may drive racial/ethnic disparities (eg, provider discrimination that may lead to dissatisfaction and lack of trust in the health care system) [41, 42].

CONCLUSIONS

We found wide geographic variation in influenza vaccination disparities for non-Hispanic White and Hispanic short-stay and long-stay NH residents across states and HRRs. Additionally, we found that differences at the state level may mask more dramatic differences at the HRR level. This information can be leveraged by policy-makers and researchers to target interventions aimed at simultaneously reducing racial/ethnic disparities in geographic areas with the greatest disparities and improving vaccination uptake in areas where the proportion of NH residents vaccinated is lowest.

Supplementary Data

Supplementary materials are available at Open Forum Infectious Diseases online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

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