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Original Study

Decomposing Racial and Ethnic Disparities in Nursing Home Influenza Vaccination

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A B S T R A C T

Objectives: Quantify how observable characteristics contribute to influenza vaccination disparities among White, Black, and Hispanic nursing home (NH) residents.
Design: Retrospective cohort.
Setting and Participants: Short- and long-stay U.S. NH residents aged ≥65 years.
Methods: We linked Minimum Data Set (MDS) and Medicare data to LTCFocUS and other facility data. We included residents with 6-month continuous enrollment in Medicare and an MDS assessment between October 1, 2013, and March 31, 2014. Residents were classified as short-stay (<100 days in NH) or long-stay (≥100 days in NH). We fit multivariable logistic regression models to assess the relationships between 27 resident and NH-level characteristics and receipt of influenza vaccination. Using nonlinear Oaxaca-Blinder decomposition, we decomposed the disparity in influenza vaccination between White versus Black and White versus Hispanic NH residents. Analyses were repeated separately for short- and long-stay residents.
Results: Our study included 630,373 short-stay and 1,029,593 long-stay residents. Proportions vaccinated against influenza included 67.2% of White, 55.1% of Black, and 54.5% of Hispanic individuals among short-stay residents and 84.2%, 76.7%, and 80.8%, respectively among long-stay residents. Across 4 comparisons, the crude disparity in influenza vaccination ranged from 3.4 to 12.7 percentage points. By equalizing 27 prespecified characteristics, these disparities could be reduced 37.7% to 59.2%. Living in a predominantly White facility and proxies for NH quality were important contributors across all analyses. Characteristics unmeasured in our data (eg, NH staff attitudes and beliefs) may have also contributed significantly to the disparity.
Conclusions and Implications: The racial/ethnic disparity in influenza vaccination was most dramatic among short-stay residents. Intervening on factors associated with NH quality would likely reduce these disparities; however, future qualitative research is essential to explore potential contributors that were

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unmeasured in our data and to understand the degree to which these factors contribute to the overall disparity in influenza vaccination.

Racial and ethnic disparities in influenza vaccination among older adults are well-documented, particularly in nursing home (NH) residents.[1–9] In the NH population, reported disparities between racial/ethnic minorities and White individuals range from 2 to 20 percentage points.[10] These disparities have persisted over time despite regulations that require NHs participating in Medicare or Medicaid programs to offer each resident influenza vaccination annually, as well as national goals to vaccinate 90% of adults in NHs.[11,12] Influenza vaccination is especially important for this population because residents have an increased risk of severe illness or complications from influenza.[13] It is therefore critical to improve vaccination rates nationally. Improvements are particularly needed among racial/ethnic minorities, for whom current disparities in influenza vaccination exist and for whom future disparities in the use of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) vaccines could exist.[14] To more effectively advance clinical practice and health policy through interventions, it is necessary to first understand how various characteristics contribute to or drive these disparities.

Contributing factors to racial/ethnic disparities in influenza vaccination among NH residents include facility-level characteristics (eg, increased minority composition of the NH, lack of vaccination-promoting policies, low NH personnel vaccination rates, profit status, location) and individual-level characteristics (eg, minorities refusing vaccination, resident frailty).[2–7] Although prior literature has estimated the relative effect of various characteristics on influenza vaccination, the contribution of those and other observable characteristics to the overall racial/ethnic disparity remains unclear. In addition, many of these studies focused on the White-Black disparity, excluding Hispanic residents. Reports on the disparity in influenza vaccination for Hispanic individuals living in NHs have been conflicting, thus the presence and sources of this potential disparity are incompletely answered questions.[9,15] Further, available literature has rarely distinguished between resident subpopulations based on length of stay. Categorizing residents as short- ($<$100 days in the NH) or long-stay ($\geq$100 days in the NH) may be appropriate, as short-stay residents likely have differing clinical characteristics and care goals than long-stay residents.[16]

Therefore, we aimed to identify the degree to which select observable characteristics drove influenza vaccination disparities between White non-Hispanic, Black non-Hispanic, and Hispanic short- and long-stay NH residents. Using the nonlinear Oaxaca-Blinder decomposition method, we calculated the contribution of these characteristics to racial/ethnic disparities in influenza vaccination so that we can move toward understanding their etiology, including potential intervention targets. We hypothesized that these prespecified characteristics would drive most of the disparity in influenza vaccination, although factors unmeasured in our data (eg, NH staff attitudes and beliefs) would also contribute significantly to the disparity.

Methods

Data Sources

We linked Minimum Data Set (MDS) version 3.0 assessments to Certification And Survey Provider Enhanced Reports system (CASPER) and LTCFocUS data using unique identifiers for all NH residents enrolled in Medicare. The Medicare Beneficiary Summary File includes information on beneficiary demographics, plan enrollment, and duration of enrollment.[17] The MDS is a government-mandated assessment for NHs certified by the Centers for Medicare and Medicaid Services that documents resident health information including demographics, clinical conditions, functional status, and cognitive status.[18] CASPER provides facility data collected by state survey agencies and includes factors such as primary payer, number of facility beds, and staffing.[19] LTCFocUS provides additional facility-level information, including all-cause rehospitalization rates and admissions per bed.[20] The validated residential history file algorithm was applied to the datasets to characterize residents' timing and location of health services utilization.[21] The study protocol received institutional review board approval. Due to the use of de-identified administrative data, informed consent was not required.

Study Design and Population

This was a retrospective cohort study derived from a national source population of more than 3 million Medicare beneficiaries residing in 15,683 NHs between October 1, 2013, and March 31, 2014. Eligible participants resided in a free-standing NH. Short-stay residents had a total stay of $<$100 days in the same NH, whereas long-stay residents had a total stay of $\geq$100 consecutive days and no more than 10 days outside of the facility. The date of NH entry and 100th day in the facility were considered index dates for short- and long-stay residents, respectively. Those included in the study population had 6 months of continuous enrollment in Medicare Part A before index, were age $\geq$65 years at index, and had at least 1 MDS assessment during the influenza season (October 1, 2013, to March 31, 2014). We excluded individuals with missing data on any covariate used in modeling and residents of hospital-based NHs because these differ markedly from most NHs in their structure and resources.

Resident and Facility Characteristics

Demographic variables such as age, sex, and race/ethnicity as well as Medicare plan enrollment (eg, Medicare Advantage) were obtained from the Medicare Beneficiary Summary File. The Medicare Beneficiary Summary File includes 7 categories for race/ethnicity of the resident. We categorized residents into 4 race/ethnicity groups: non-Hispanic White, non-Hispanic Black, Hispanic, and other races. Only results for White, Black, and Hispanic residents were reported.

Facility-level variables were obtained from CASPER and LTCFocUS data. We selected characteristics a priori based on prior literature and subject matter knowledge.[2,22,23] We specifically chose factors likely to affect quality of care or have been associated with receipt of influenza vaccination in NHs. These variables included staffing resources, quality measures related to care processes, resident acuity, facility size and occupancy, payor mix, profit status, and location of the facility. We also collected information on the Herfindahl-Hirschman Index, a common measure of NH market concentration.[24] Because prior studies have suggested that NH quality and vaccination coverage may vary by the racial/ethnic composition of the NH's population,[6,25] using LTCFocUS data, we identified White predominant, Black predominant, and Hispanic predominant NHs based on the racial/ethnic group with the largest proportion among the 3 groups.

Receipt of Influenza Vaccination

Receipt of influenza vaccination was assessed in the MDS data using previously published algorithms.[26,27] In short, residents could have 1 of 2 vaccination outcomes: vaccinated or not vaccinated. Residents were considered vaccinated if any MDS assessment between October 1, 2013, through June 30, 2014, indicated the resident received influenza vaccination 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).

Statistical Methods

We calculated the proportion of White, Black, and Hispanic residents vaccinated in each racial/ethnic group (eg, proportion of Black individuals vaccinated among Black residents) and further stratified by White, Black, and Hispanic predominant NHs. Multivariable logistic regression models were fit to quantify the associations between influenza vaccination and 27 resident- and facility-level covariates.

To examine the degree to which the 27 resident and facility factors drove influenza vaccination disparities between White versus Black (White-Black) and White versus Hispanic (White-Hispanic) NH residents, we used the nonlinear Oaxaca-Blinder decomposition. Our approach used a first-order Taylor expansion to decompose the nonlinear outcome of vaccination[28] and implemented a variation that prevents reference category selection from affecting characteristic estimates.[29] Four separate analyses were performed to decompose the White-Black short-stay, White-Hispanic short-stay, White-Black long-stay, and White-Hispanic long-stay disparities. We reported 2 main outputs from the Oaxaca-Blinder decomposition, the characteristic estimate and coefficient estimate.[30,31] The characteristic estimate is the disparity due to the variation in observable characteristics across racial/ethnical groups, which would indicate the expected effect on the disparity if Black or Hispanic individuals were equal to White individuals on the distributions of the prespecified covariates.[32] This is often referred to as the "explained variation" because it describes the disparity that may be attributable to the characteristics included in the model. For each comparison, we disaggregated the characteristic estimate into the 27 prespecified resident- and facility-level characteristics. The coefficient estimate derives from the difference in the magnitude of the association that each characteristic has with vaccination (eg, the difference in Medicare Advantage enrollment's association with vaccination between White and Black residents), and is often referred to as the "unexplained variation." The coefficient estimate represents the portion of the disparity that may be due to discrimination or other unmeasured sources. We only reported the coefficient estimate in aggregate because it is challenging to explain why coefficient estimates may differ across groups.

Data were analyzed using SAS version 9.4 (SAS Institute, Inc., Cary, NC), R version 4.0.1 (R Foundation for Statistical Computing, Vienna, Austria), and Stata version 16 (StataCorp LLC, College Station, TX).

Results

Study Cohort

The final study cohort consisted of 630,373 short-stay residents and 1,029,593 long-stay residents (Supplementary Figure 1). Of the short-stay residents, 546,416 (86.7%) were White, 55,758 (8.8%) were Black, and 10,377 (1.6%) were Hispanic. For long-stay residents, 856,184 (83.2%) were White, 125,189 (12.2%) were Black, and 19,986 (1.9%) were Hispanic. Compared with White individuals, a greater

Table 1
Characteristics for Short- and Long-stay NH Residents by Race/Ethnicity

Characteristic*	Short-stay (n = 630,373)			Long-stay (n = 1,029,593)		
	White (n = 546,416)	Black (n = 55,758)	Hispanic (n = 10,377)	White (n = 856,184)	Black (n = 125,189)	Hispanic (n = 19,986)
Resident factors						
Age	80.1 (8.0)	77.4 (7.8)	80.3 (8.1)	84.5 (8.5)	81.4 (8.9)	84.4 (7.9)
Female sex	367,142 (67.2)	35,861 (64.3)	6485 (62.5)	622,842 (72.7)	80,687 (64.5)	12,597 (63.0)
Medicare Advantage	177,793 (32.5)	23,243 (41.7)	5296 (51.0)	180,469 (21.1)	28,049 (22.4)	4600 (23.0)
Facility factors						
Predominantly White facility	530,717 (97.1)	39,631 (71.1)	6839 (65.9)	825,157 (96.4)	80,165 (64.0)	12,584 (63.0)
Predominantly Black facility	7787 (1.4)	15,006 (26.9)	584 (5.6)	18,402 (2.1)	42,374 (33.8)	1530 (7.7)
Predominantly Hispanic facility	7738 (1.4)	1038 (1.9)	2948 (28.4)	11,997 (1.4)	2335 (1.9)	5825 (29.1)
Occupancy rate	84.2 (12.8)	85.3 (12.0)	86.3 (11.9)	85.1 (12.3)	85.6 (12.2)	86.5 (12.2)
Number of beds	129.9 (70.0)	155.1 (89.4)	153.5 (103.2)	137.0 (82.7)	163.9 (96.6)	171.0 (120.3)
Urban	464,765 (85.1)	51,564 (92.5)	9995 (96.3)	622,211 (72.7)	107,389 (85.8)	18,290 (91.5)
Chain	324,274 (59.3)	33,317 (59.8)	5676 (54.7)	459,567 (53.7)	69,990 (55.9)	9892 (49.5)
For profit	394,360 (72.2)	44,017 (78.9)	8829 (85.1)	582,077 (68.0)	100,672 (80.4)	16,474 (82.4)
Medicare	24.3 (18.2)	21.8 (15.5)	22.6 (17.3)	13.9 (10.0)	13.4 (9.1)	14.2 (10.3)
Medicaid	47.7 (23.7)	56.5 (22.9)	55.6 (22.6)	61.2 (18.6)	71.0 (15.4)	69.2 (16.0)
Other payer	27.9 (16.6)	21.7 (14.6)	21.8 (14.5)	24.9 (16.5)	15.6 (11.8)	16.6 (13.0)
Admissions per bed	3.7 (2.9)	3.1 (2.3)	3.5 (2.7)	1.9 (1.2)	1.7 (1.0)	1.9 (1.1)
Acuity index	12.1 (1.5)	12.5 (1.4)	12.7 (1.6)	12.1 (1.3)	12.5 (1.4)	12.7 (1.4)
Hospitalizations per resident year	1.4 (1.4)	1.5 (1.2)	1.5 (1.1)	1.0 (0.66)	1.2 (0.58)	1.2 (0.56)
CNA to nurse ratio	1.8 (0.5)	1.8 (0.5)	1.8 (0.5)	2.0 (0.6)	1.9 (0.5)	2.0 (0.6)
RN to nurse ratio	0.4 (0.2)	0.3 (0.2)	0.4 (0.2)	0.3 (0.2)	0.3 (0.2)	0.3 (0.2)
RN HPRD	0.6 (0.4)	0.5 (0.4)	0.5 (0.4)	0.4 (0.3)	0.4 (0.3)	0.4 (0.3)
LPN HPRD	0.9 (0.4)	0.9 (0.4)	0.9 (0.4)	0.8 (0.3)	0.9 (0.3)	0.8 (0.3)
CNA HPRD	2.5 (0.6)	2.4 (0.6)	2.5 (0.6)	2.4 (0.6)	2.3 (0.5)	2.4 (0.6)
Total direct care HPRD†	3.9 (1.0)	3.8 (0.9)	3.9 (0.9)	3.6 (0.7)	3.5 (0.7)	3.6 (0.8)
Physician extender onsite	291,522 (53.4)	33,046 (59.3)	4642 (44.7)	408,530 (47.7)	68,679 (54.9)	8623 (43.1)
% Bedsores	6.9 (4.5)	8.2 (4.8)	8.4 (5.0)	5.9 (4.1)	7.3 (4.5)	7.4 (5.3)
% Antipsychotics	16.5 (9.7)	18.5 (10.8)	18.7 (11.3)	22.0 (12.2)	24.8 (13.7)	25.0 (14.3)
% Tube feeding	4.2 (4.8)	7.6 (6.3)	8.7 (7.5)	4.0 (4.6)	8.1 (6.2)	8.9 (7.7)
Herfindahl index	0.1 (0.2)	0.1 (0.2)	0.1 (0.1)	0.2 (0.2)	0.2 (0.2)	0.1 (0.2)

HPRD, Hours Per Resident Day; LPN, Licensed Practical Nurse.
*Characteristics reported as n (%) or Mean (SD).
†Sum of RN, LPN, and CNA hours per resident day.

proportion of Black and Hispanic individuals resided in urban and for-profit NHs as well as facilities with a greater number of beds, higher percentage of residents with bedsores, on antipsychotics, and requiring tube feeds (Table 1). A higher proportion of Black and Hispanic short-stay residents had Medicare Advantage than White residents.

Influenza Vaccination by Race/Ethnicity

Among short-stay residents, the proportion vaccinated against influenza was 67.2% for White, 55.1% for Black, and 54.5% for Hispanic residents across all NHs. Proportions vaccinated were 84.2%, 76.7%, and 80.8%, respectively among long-stay residents across all NHs (Supplementary Table 1). The crude White-Black and White-Hispanic disparity in influenza vaccination within all NHs ranged from 3.4 to 12.7 percentage points and was most dramatic among short-stay residents (Supplementary Table 2). Proportions vaccinated and crude disparities differed by racial/ethnic composition of the facility.

Variables Associated With Vaccination

Multiple characteristics were associated with increased or decreased likelihood of influenza vaccination (Supplementary Table 3). For short-stay residents across all racial/ethnic groups, for-profit facilities, facilities with a greater proportion of Medicare as primary payer, Medicare Advantage, higher acuity index, hospitalizations per resident year, percent residents on an antipsychotic, and Certified Nursing Assistant (CNA) hours per resident day were significantly associated with decreased odds of vaccination. Higher Registered Nurse (RN)/nurse ratios, RN hours per resident day, and total direct care hours per resident day were associated with increased odds of vaccination.

Among long-stay residents for all racial/ethnic groups, chain and for-profit facilities, greater proportion of residents with Medicare as primary payer, higher admissions per bed, hospitalizations per resident year, percent residents with bedsores or on an antipsychotic, and CNA hours per resident day were significantly associated with decreased odds of vaccination. Increased age, higher Herfindahl-Hirschman Index, RN hours per resident day, and total direct care hours per resident day were associated with increased odds of vaccination.

Nonlinear Oaxaca-Blinder Decomposition Results

The White-Black and White-Hispanic influenza vaccination disparity for short- and long-stay residents were decomposed into differences due to characteristics and remaining unexplained variation due to coefficients (Supplementary Table 4). Differences in measured characteristics explained 42.2% of the racial/ethnic disparity for White-Black short-stay, 46.9% for White-Hispanic short-stay, 37.7% for White-Black long-stay, and 59.2% for White-Hispanic long-stay residents, indicating that if the prespecified characteristics were equal between White and minority residents, the disparity in influenza vaccination would be reduced by 37.7% to 59.2% across comparisons.

Table 2
Decomposition Analysis of the Racial/Ethnic Disparity in Influenza Vaccination Among White Versus Black Short-stay Nursing Home Residents

Characteristic	Coefficient	Standard Error	z	$P>\|z\|$	95% Confidence Interval		Contribution to Disparity (%)
Aggregate estimates							
Characteristic estimate	0.0600	0.0015	40.3600	<.001	0.0571	0.0629	42.23
Coefficient estimate	0.0820	0.0068	12.1100	<.001	0.0688	0.0953	57.77
Subaggregate characteristic estimates							
Resident factors							
Age*	0.0077	0.0002	34.7100	<.001	0.0073	0.0082	5.46
Female sex	0.0000	0.0000	0.4300	.67	−0.0001	0.0001	0.01
Medicare Advantage	0.0024	0.0001	18.5500	<.001	0.0021	0.0026	1.68
Facility factors							
Predominantly White facility	0.0196	0.0007	28.1300	<.001	0.0182	0.0209	13.78
Predominantly Black facility	−0.0031	0.0010	−3.1500	.002	−0.0050	−0.0012	−2.19
Predominantly Hispanic facility	0.0004	0.0000	22.6000	<.001	0.0004	0.0004	0.27
Urban	0.0012	0.0002	7.5400	<.001	0.0009	0.0015	0.84
Chain	0.0001	0.0000	9.9400	<.001	0.0000	0.0001	0.04
For profit	0.0052	0.0001	46.7400	<.001	0.0050	0.0054	3.68
Medicaid ≥ median	−0.0003	0.0001	−2.1800	.029	−0.0005	0.0000	−0.20
Medicare ≥ median	−0.0001	0.0000	−2.1800	.029	−0.0001	0.0000	−0.05
Total beds ≥ 150	−0.0010	0.0002	−5.4900	<.001	−0.0014	−0.0007	−0.73
Herfindahl index ≥ median	0.0028	0.0002	16.0000	<.001	0.0024	0.0031	1.94
Admissions per bed ≥ median	−0.0012	0.0001	−9.8100	<.001	−0.0014	−0.0009	−0.83
Percent occupancy ≥ 85th percentile	−0.0003	0.0000	−15.0200	<.001	−0.0003	−0.0002	−0.19
Acuity index ≥ median	0.0045	0.0002	22.3100	<.001	0.0041	0.0049	3.19
Hospitalizations per resident year*	0.0010	0.0001	13.0800	<.001	0.0008	0.0011	0.68
% Tube feeding*	0.0102	0.0005	20.1500	<.001	0.0092	0.0112	7.16
% Bedsores*	0.0025	0.0002	12.4800	<.001	0.0021	0.0029	1.76
% Antipsychotic use*	0.0030	0.0002	19.0100	<.001	0.0027	0.0033	2.10
CNA/Nurse ratio ≥ median	−0.0011	0.0001	−16.4100	<.001	−0.0013	−0.0010	−0.80
RN/Nurse ratio ≥ median	0.0044	0.0002	27.4300	<.001	0.0041	0.0047	3.11
RN HPRD ≥ 0.75	0.0010	0.0001	7.6600	<.001	0.0007	0.0012	0.69
LPN HPRD ≥ 0.55	0.0001	0.0001	0.7400	.46	−0.0002	0.0003	0.07
CNA HPRD ≥ 2.8	−0.0012	0.0001	−8.6100	<.001	−0.0015	−0.0010	−0.88
Total direct care HPRD*,†	0.0018	0.0001	13.5200	<.001	0.0016	0.0021	1.29
Physician extender onsite	0.0005	0.0001	6.3800	<.001	0.0003	0.0007	0.35

Note. The characteristic estimate reports how much the disparity would be reduced (eg, positive numbers) if the average characteristics for minority residents were equal to White residents.

HPRD, Hours Per Resident Day; LPN, Licensed Practical Nurse.

*Characteristic is continuous.

†Sum of RN, LPN, and CNA hours per resident day.

Coefficient estimates contributed 40.8% to 62.3% to the disparity across comparisons, suggesting that a significant portion of the racial/ethnic disparities is not explained by the measured characteristics in our models.

Characteristic estimates were disaggregated to determine each variable's contribution to the disparity for White-Black short-stay (Table 2), White-Hispanic short-stay (Table 3), White-Black long-stay (Table 4), and White-Hispanic long-stay residents (Table 5). Living in a predominantly White facility and tube feeding were among the greatest contributors to the explained portion of the disparities for all analyses. Positive and negative contributors varied across analyses (Tables 2–5). Characteristics with a negative impact contributed further to the disparity. For example, in the White-Hispanic long-stay decomposition, the racial/ethnic disparity in influenza vaccination would be expected to decrease by 3.02% (shown as +3.02) by equalizing the proportion of White and Hispanic residents living in urban facilities, whereas the disparity would be expected to increase (worsen) by 1.18% (shown as −1.18) if the proportion of residents living in chain facilities were equalized.

Discussion

In this retrospective study, we used nonlinear Oaxaca-Blinder decomposition to explore potential sources of racial/ethnic disparities in influenza vaccination among older short- and long-stay NH residents. Our results suggest that equalizing 27 observable characteristics would reduce the disparity in influenza vaccination by 37.7% to 59.2% depending on the racial/ethnic comparison. Applying these relative reductions to the respective crude disparity within all NHs (Supplementary Table 2), the absolute disparity would be expected to decrease by 2.01 to 5.96 percentage points across comparisons. Although we hypothesized that the prespecified characteristics would account for most of the disparity, we found that equalizing the measured characteristics would reduce >50% of the disparity only for the White-Hispanic long-stay comparison. The coefficient estimates, or portion unexplained by the measured characteristics, accounted for a majority of the disparity for the other 3 comparisons.

Our analyses concord with published literature suggesting that measurable characteristics such as facility profit status and racial/ethnic composition contribute to disparities in influenza vaccination among NH residents.[9,10] Interestingly, tube feeding was an important positive contributor across all comparisons. Prior studies have demonstrated that racial and ethnic minorities are more likely to be tube fed compared with White individuals,[33–35] although the association between tube feeding and influenza vaccination disparities is less clear. Tube feeding may be a proxy for other things, such as poor resident health status, goals of care that favor life-prolonging measures, or NH quality of care. Feeding tubes are not recommended over careful hand feeding, such as in older adults with advanced dementia,[36] although hand feeding may require more NH staff time and resources.[37] Lower quality facilities may not have the resources to allocate to hand feeding and may favor tube feeding instead. Intervening on facility resources or other factors to improve NH care quality may result in reduced influenza vaccination disparities if assumptions

Table 3
Decomposition Analysis of the Racial/Ethnic Disparity in Influenza Vaccination Among White Versus Hispanic Short-stay Nursing Home Residents

Characteristic	Coefficient	Standard Error	z	$P>\|z\|$	95% Confidence Interval		Contribution to Disparity (%)
Aggregate estimates							
Characteristic estimates	0.0979	0.0016	61.2400	<.001	0.0948	0.1010	46.91
Coefficient estimates	0.1108	0.0143	7.7700	<.001	0.0828	0.1387	53.09
Subaggregate characteristic estimates							
Resident factors							
Age*	−0.0006	0.0000	−34.9100	<.001	−0.0006	−0.0006	−0.29
Female sex	0.0000	0.0001	0.4300	.67	−0.0001	0.0002	0.01
Medicare Advantage	0.0050	0.0003	18.5900	<.001	0.0045	0.0055	2.39
Facility factors							
Predominantly White facility	0.0241	0.0008	28.7800	<.001	0.0225	0.0258	11.57
Predominantly Black facility	−0.0005	0.0002	−3.1300	.002	−0.0009	−0.0002	−0.25
Predominantly Hispanic facility	0.0243	0.0011	22.0300	<.001	0.0221	0.0264	11.63
Urban	0.0019	0.0002	7.5400	<.001	0.0014	0.0023	0.89
Chain	−0.0007	0.0001	−9.9500	<0.001	−0.0008	−0.0005	−0.32
For profit	0.0103	0.0002	47.2300	<.001	0.0098	0.0107	4.91
Medicaid ≥ median	−0.0003	0.0001	−2.1800	.029	−0.0005	0.0000	−0.12
Medicare ≥ median	−0.0001	0.0000	−2.1800	.029	−0.0002	0.0000	−0.04
Total beds ≥ 150	−0.0008	0.0001	−5.4900	<.001	−0.0011	−0.0005	−0.38
Herfindahl index ≥ median	0.0058	0.0004	15.9900	<.001	0.0051	0.0066	2.80
Admissions per bed ≥ median	−0.0003	0.0000	−9.7800	<.001	−0.0003	−0.0002	−0.13
Percent occupancy ≥ 85th percentile	−0.0013	0.0001	−15.0300	<.001	−0.0015	−0.0012	−0.64
Acuity index ≥ median	0.0064	0.0003	22.3100	<.001	0.0058	0.0069	3.04
Hospitalizations per resident year*	0.0009	0.0001	13.0800	<.001	0.0008	0.0011	0.44
% Tube feeding*	0.0138	0.0007	20.2500	<.001	0.0124	0.0151	6.60
% Bedsores*	0.0030	0.0002	12.4800	<.001	0.0026	0.0035	1.45
% Antipsychotic use*	0.0034	0.0002	19.0700	<.001	0.0031	0.0038	1.63
CNA/Nurse ratio ≥ median	0.0011	0.0001	16.4300	<.001	0.0010	0.0013	0.55
RN/Nurse ratio ≥ median	0.0020	0.0001	27.4800	<.001	0.0018	0.0021	0.95
RN HPRD ≥ 0.75	0.0007	0.0001	7.6600	<.001	0.0005	0.0009	0.33
LPN HPRD ≥ 0.55	0.0000	0.0000	0.7400	.46	0.0000	0.0001	0.01
CNA HPRD ≥ 2.8	0.0000	0.0000	8.6200	<.001	0.0000	0.0000	0.01
Total direct care HPRD*,†	0.0005	0.0000	13.5400	<.001	0.0004	0.0006	0.24
Physician extender onsite	−0.0008	0.0001	−6.3800	<.001	−0.0010	−0.0005	−0.36

Note. The characteristic estimate reports how much the disparity would be reduced (eg, positive numbers) if the average characteristics for minority residents were equal to White residents.

HPRD, Hours Per Resident Day; LPN, Licensed Practical Nurse.

*Characteristic is continuous.

†Sum of RN, LPN, and CNA hours per resident day.

about the relationship between tube feeding, resources, quality of care, and vaccination are correct.

The portion of the disparity attributable to coefficient estimates highlights the need for future qualitative research to understand the degree to which factors unmeasured in our data contribute to the overall disparity in influenza vaccination. These factors could include facility policies and procedures, such as centralized tracking systems for facility-wide vaccination or resources allocated interpreter services,[3] NH staff beliefs about influenza vaccination, or race/ethnicity of providers. Organizational culture may influence tube feeding and NH quality,[38] and therefore may play a role in the racial/ethnic disparity in influenza vaccination. Cultural competence may lead to improved quality of care and patient safety, and has compelled government agencies to develop National Standards for Culturally and Linguistically Appropriate Services (CLAS).[39,40] Because the most effective interventions to improve cultural competency remain unclear,[41] examining the extent to which NHs incorporate CLAS standards into their organizations and barriers to applying these standards may be important next steps to inform effective health care policies that promote equitable healthcare for all NH residents. Finally, the contribution of structural racism to the disparity in influenza vaccination should be a focus of future qualitative research, as prior quantitative measures of racism have been difficult to operationalize on a large scale or may not be applicable to the NH setting.[42]

Additional results varied slightly by resident length of stay. For short-stay residents, patient-level insurance coverage (Medicare Advantage) contributed more to the disparity than facility-level Medicare and Medicaid coverage. Prior literature has decomposed the racial/ethnic disparity in influenza vaccination among community-dwelling older adults and also found insurance coverage to be an important contributor; however, Medicare Advantage (versus no Medicare Advantage insurance) worsened the disparity.[43] Although residents of NHs may be expected to have the same access to health care providers within the same facility regardless of insurance, future research could be conducted to understand how differences in insurance type may affect receipt of preventative services, such as influenza vaccination, within the NH setting. Among long-stay residents, higher admissions per bed (for the White-Black disparity) and percent occupancy (for the White-Hispanic disparity) were negative contributors and may highlight the need for policies and procedures to ensure consistent care regardless of facility capacity.

The findings of our study should be interpreted in light of several limitations. By limiting our study population to those ≥65 years of age, our results may not generalize to younger NH residents. It is also unclear if our data generalizes well to the period after the SARS-CoV-2 pandemic began and other events that may have spurred changes to the health care system, but studies suggest disparities have continued to persist in NHs as late as 2018–2019.[14]

In addition, a methodologic challenge of Oaxaca-Blinder decomposition is that analyses were limited to our prespecified characteristics. Causally interpreting these results may be questionable if important covariates have been excluded from the models and confounding (of characteristics that might serve as potential intervention targets to reduce the disparity) remains.[44] Additional observable

Table 4
Decomposition Analysis of the Racial/Ethnic Disparity in Influenza Vaccination Among White Versus Black Long-stay Nursing Home Residents

Characteristic	Coefficient	Standard Error	z	$P>\|z\|$	95% Confidence Interval		Contribution to Disparity (%)
Aggregate estimates							
Characteristic estimate	0.0367	0.0010	35.4500	<.001	0.0346	0.0387	37.73
Coefficient estimate	0.0605	0.0041	14.8800	<.001	0.0526	0.0685	62.27
Subaggregate characteristic estimates							
Resident factors							
Age*	0.0054	0.0002	32.3900	<.001	0.0051	0.0057	5.56
Female sex	−0.0001	0.0001	−0.7300	.47	−0.0002	0.0001	−0.06
Medicare Advantage	0.0001	0.0000	4.0800	<.001	0.0000	0.0001	0.06
Facility factors							
Predominantly White facility	0.0058	0.0005	11.9800	<.001	0.0049	0.0068	6.02
Predominantly Black facility	0.0028	0.0006	4.2700	<.001	0.0015	0.0040	2.86
Predominantly Hispanic facility	0.0000	0.0000	4.1200	<.001	0.0000	0.0001	0.04
Urban	0.0013	0.0002	8.0800	<.001	0.0010	0.0016	1.33
Chain	0.0004	0.0000	18.8500	<.001	0.0003	0.0004	0.40
For profit	0.0048	0.0001	35.0800	<.001	0.0045	0.0051	4.94
Medicaid ≥ median	−0.0004	0.0001	−3.4500	.001	−0.0006	−0.0002	−0.43
Medicare ≥ median	0.0000	0.0000	−3.4500	.001	−0.0001	0.0000	−0.03
Total beds ≥ 150	0.0003	0.0001	2.4400	.015	0.0001	0.0006	0.34
Herfindahl index ≥ median	0.0029	0.0002	15.2200	<.001	0.0026	0.0033	3.02
Admissions per bed ≥ median	−0.0016	0.0001	−27.0000	<.001	−0.0018	−0.0015	−1.68
Percent occupancy ≥ 85th percentile	0.0001	0.0000	11.4100	<.001	0.0000	0.0001	0.05
Acuity index ≥ median	0.0001	0.0001	0.9500	.34	−0.0001	0.0004	0.15
Hospitalizations per resident year*	0.0022	0.0001	19.3300	<.001	0.0019	0.0024	2.23
% Tube feeding*	0.0076	0.0004	18.9000	<.001	0.0068	0.0083	7.77
% Bedsores*	0.0024	0.0001	16.8300	<.001	0.0021	0.0027	2.50
% Antipsychotic use*	0.0015	0.0001	13.1500	<.001	0.0013	0.0017	1.52
CNA/Nurse ratio ≥ median	−0.0001	0.0000	−2.5200	.012	−0.0002	0.0000	−0.11
RN/Nurse ratio ≥ median	0.0009	0.0001	7.1600	<.001	0.0007	0.0012	0.94
RN HPRD ≥ 0.75	0.0003	0.0001	5.6500	<.001	0.0002	0.0005	0.35
LPN HPRD ≥ 0.55	−0.0002	0.0001	−2.1300	.033	−0.0004	0.0000	−0.22
CNA HPRD ≥ 2.8	−0.0004	0.0001	−5.7400	<.001	−0.0006	−0.0003	−0.43
Total direct care HPRD*,†	0.0004	0.0001	6.4700	<.001	0.0003	0.0005	0.42
Physician extender onsite	0.0002	0.0001	3.0800	.002	0.0001	0.0003	0.20

Note. The characteristic estimate reports how much the disparity would be reduced (eg, positive numbers) if the average characteristics for minority residents were equal to White residents.

HPRD, Hours Per Resident Day; LPN, Licensed Practical Nurse.

*Characteristic is continuous.

†Sum of RN, LPN, and CNA hours per resident day.

Table 5
Decomposition Analysis of the Racial/Ethnic Disparity in Influenza Vaccination Among White Versus Hispanic Long-stay Nursing Home Residents

Characteristic	Coefficient	Standard Error	z	$P>\|z\|$	95% Confidence Interval		Contribution to Disparity (%)
Aggregate estimates							
Characteristic estimate	0.0365	0.0011	32.0000	<.001	0.0343	0.0387	59.23
Coefficient estimate	0.0251	0.0086	2.9100	.004	0.0082	0.0421	40.77
Subaggregate characteristic estimates							
Resident factors							
Age*	0.0001	0.0000	32.8500	<.001	0.0001	0.0001	0.21
Female sex	−0.0001	0.0001	−0.7300	.47	−0.0003	0.0001	−0.11
Medicare Advantage	0.0001	0.0000	4.0800	<.001	0.0000	0.0001	0.14
Facility factors							
Predominantly White facility	0.0061	0.0005	11.8000	<.001	0.0051	0.0071	9.85
Predominantly Black facility	0.0005	0.0001	4.3800	<.001	0.0003	0.0007	0.79
Predominantly Hispanic facility	0.0026	0.0006	4.0200	<.001	0.0013	0.0039	4.22
Urban	0.0019	0.0002	8.0800	<.001	0.0014	0.0023	3.02
Chain	−0.0007	0.0000	−18.8900	<.001	−0.0008	−0.0007	−1.18
For profit	0.0056	0.0002	34.9500	<.001	0.0053	0.0059	9.10
Medicaid ≥ median	−0.0003	0.0001	−3.4500	.001	−0.0005	−0.0001	−0.54
Medicare ≥ median	0.0000	0.0000	3.4500	.001	0.0000	0.0000	0.04
Total beds ≥ 150	0.0003	0.0001	2.4400	.015	0.0001	0.0005	0.49
Herfindahl index ≥ median	0.0050	0.0003	15.1800	<.001	0.0043	0.0056	8.06
Admissions per bed ≥ median	0.0005	0.0000	26.8500	<.001	0.0004	0.0005	0.75
Percent occupancy ≥ 85th percentile	−0.0007	0.0001	−11.4300	<.001	−0.0008	−0.0006	−1.13
Acuity index ≥ median	0.0002	0.0002	0.9500	.34	−0.0002	0.0005	0.27
Hospitalizations per resident year*	0.0018	0.0001	19.3100	<.001	0.0017	0.0020	2.99
% Tube feeding*	0.0091	0.0005	18.7700	<.001	0.0081	0.0100	14.75
% Bedsores*	0.0025	0.0002	16.7800	<.001	0.0022	0.0028	4.12
% Antipsychotic use*	0.0015	0.0001	13.0900	<.001	0.0013	0.0018	2.51
CNA/Nurse ratio ≥ median	0.0002	0.0001	2.5200	.012	0.0000	0.0003	0.25
RN/Nurse ratio ≥ median	0.0002	0.0000	7.1600	<.001	0.0002	0.0003	0.39
RN HPRD ≥ 0.75	0.0001	0.0000	5.6500	<.001	0.0001	0.0002	0.19
LPN HPRD ≥ 0.55	0.0000	0.0000	−2.1300	.033	0.0000	0.0000	−0.03
CNA HPRD ≥ 2.8	0.0000	0.0000	−5.7400	<.001	0.0000	0.0000	−0.05
Total direct care HPRD*,†	0.0002	0.0000	6.4700	<.001	0.0001	0.0003	0.34
Physician extender onsite	−0.0001	0.0000	−3.0800	.002	−0.0002	0.0000	−0.20

Note. The characteristic estimate reports how much the disparity would be reduced (eg, positive numbers) if the average characteristics for minority residents were equal to White residents.
HPRD, Hours Per Resident Day; LPN, Licensed Practical Nurse.
*Characteristic is continuous.
†Sum of RN, LPN, and CNA hours per resident day.

characteristics, such as comorbid conditions, may affect the racial/ethnic disparity in influenza vaccination. Due to the nature of our data, we could not ascertain certain potentially important variables such as facility policies and procedures, NH resident or family member attitudes toward vaccination (including if short-stay residents preferred to be vaccinated in the community setting after NH discharge), health care personnel vaccination rates, or measures of NH staff bias or structural racism. Despite these limitations, to our knowledge, this is the first study using the Oaxaca-Blinder method to decompose racial/ethnic disparities in influenza vaccination among older short- and long-stay residents in NHs.

Conclusion and Implications

Our results report that racial/ethnic disparities in influenza vaccination were most dramatic among short-stay residents and highlight the need for intervention in this subpopulation. Low vaccination coverage in this group may affect all NH residents if ambulatory short-stay residents are able to move freely around the facility, potentially exposing other residents to respiratory illnesses. Measures associated with NH quality of care were important positive contributors to the disparity in influenza vaccination. Qualitative research is necessary to document sources of disparity that are unmeasured in secondary data sources, because the disparity due to unmeasured factors was significant in our analyses. Tracking vaccination rates in NHs to detect and intervene locally on racial/ethnic differences may mitigate disparities until more detailed qualitative data are available to inform improvements to health care policy.

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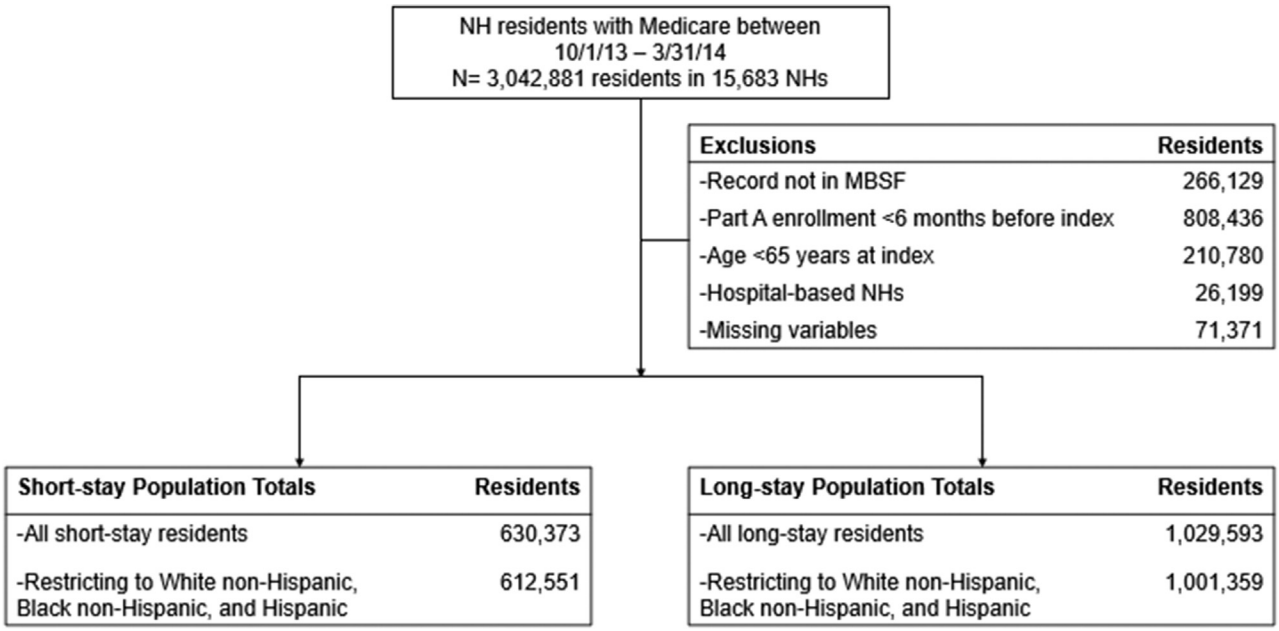

Supplementary Fig. 1. Flow diagram of the study population for short- and long-stay NH residents. MBSF, Medicare Beneficiary Summary File.

Supplementary Table 1
Proportions Vaccinated Against Influenza for Short- and Long-stay White, Black, and Hispanic NH Residents Based on Facility Racial/Ethnic Composition*

Racial/Ethnic Group	Short-stay (n = 630,373)				Long-stay (n = 1,029,593)			
	All NHs (N = 630,373)	White Predominant (n = 593,247)	Black Predominant (n = 24,060)	Hispanic Predominant (n = 12,680)	All NHs (N = 1,029,593)	White Predominant (n = 941,510)	Black Predominant (n = 64,166)	Hispanic Predominant (n = 21,951)
White	367,349 (67.2)	359,621 (67.8)	4338 (55.7)	3274 (42.3)	721,132 (84.2)	696,979 (84.5)	14,360 (78.0)	9242 (77.0)
Black	30,695 (55.1)	22,694 (57.3)	7465 (49.7)	496 (47.8)	96,034 (76.7)	62,261 (77.7)	31,670 (74.7)	1840 (78.8)
Hispanic	5654 (54.5)	4127 (60.3)	344 (58.9)	1178 (40.0)	16,144 (80.8)	10,321 (82.0)	1263 (82.5)	4520 (77.6)

Note: Proportions reported as n (%).

*Proportion vaccinated was calculated by dividing the number of residents vaccinated within a racial/ethnic group at a particular type of facility by the total number of residents in that racial/ethnic group at that type of facility. For example, the proportion vaccinated for Black residents at Black predominant facilities was calculated using the number of Black residents vaccinated in Black predominant facilities divided by the total number of Black residents in Black predominant NHs. Overall, each type of facility had specific racial/ethnic numerators and denominators given the distribution of residents.

Supplementary Table 2
Crude Estimates of the Racial/Ethnic Disparity in Influenza Vaccination Within Facilities, Based on NH Racial/Ethnic Composition*

Disparity	Short-stay (n = 630,373)				Long-stay (n = 1,029,593)			
	All NHs (N = 630,373)	White Predominant (n = 593,247)	Black Predominant (n = 24,060)	Hispanic Predominant (n = 12,680)	All NHs (N = 1,029,593)	White Predominant (n = 941,510)	Black Predominant (n = 64,166)	Hispanic Predominant (n = 21,951)
White-Black	12.1	10.5	6.0	−5.5	7.5	6.8	3.3	−1.8
White-Hispanic	12.7	7.5	−3.2	2.3	3.4	2.5	−4.5	−0.6

Note: Represents percentage points.

*Crude estimates for White-Black and White-Hispanic disparities were calculated by taking a difference in proportions from Supplementary Table 1. For example, the crude White-Black disparity in All NHs was calculated by subtracting the proportion of Blacks vaccinated in All NHs from the proportion of Whites vaccinated in All NHs.

Supplementary Table 3
Multivariable Logistic Models Estimating Odds of Influenza Vaccination for White, Black, and Hispanic Short- and Long-stay NH Residents

Characteristic	Short-stay Residents			Long-stay Residents		
	White n = 546,416	Black n = 55,758	Hispanic n = 10,377	White n = 856,184	Black n = 125,189	Hispanic n = 19,986
Resident factors						
Age*	**1.013 (1.012–1.014)**	**1.004 (1.002–1.006)**	1.002 (0.997–1.007)	**1.012 (1.012–1.013)**	**1.010 (1.009–1.012)**	**1.007 (1.002–1.012)**
Female sex	1.003 (0.991–1.015)	*0.915 (0.883–0.948)*	0.956 (0.880–1.039)	0.997 (0.983–1.010)	*0.910 (0.884–0.936)*	*0.910 (0.842–0.983)*
Medicare Advantage	*0.880 (0.869–0.891)*	*0.872 (0.842–0.903)*	*0.859 (0.791–0.933)*	*0.958 (0.944–0.972)*	*0.920 (0.891–0.950)*	0.922 (0.845–1.006)
Facility factors						
Predominantly White facility	0.913 (0.664–1.255)	1.316 (0.852–2.032)	0.337 (0.039–2.912)	*0.767 (0.604–0.975)*	0.778 (0.576–1.051)	0.851 (0.375–1.930)
Predominantly Black facility	*0.690 (0.500–0.951)*	1.038 (0.672–1.604)	0.305 (0.035–2.646)	*0.635 (0.498–0.808)*	*0.690 (0.511–0.932)*	0.783 (0.342–1.795)
Predominantly Hispanic facility	*0.442 (0.320–0.609)*	0.960 (0.611–1.507)	0.164 (0.019–1.420)	*0.633 (0.497–0.808)*	0.792 (0.577–1.087)	0.685 (0.302–1.556)
Urban	*0.930 (0.913–0.948)*	0.952 (0.887–1.022)	1.185 (0.943–1.488)	*0.932 (0.916–0.947)*	*0.809 (0.770–0.849)*	1.034 (0.873–1.225)
Chain	*0.940 (0.928–0.952)*	*0.933 (0.898–0.969)*	1.052 (0.962–1.150)	*0.890 (0.879–0.902)*	*0.923 (0.897–0.951)*	*0.774 (0.716–0.837)*
For profit	*0.717 (0.707–0.727)*	*0.769 (0.735–0.805)*	*0.784 (0.696–0.883)*	*0.770 (0.759–0.782)*	*0.778 (0.749–0.808)*	*0.871 (0.783–0.968)*
Medicaid ≥ median	0.993 (0.978–1.008)	**1.084 (1.035–1.137)**	**1.357 (1.212–1.519)**	1.006 (0.992–1.020)	**1.113 (1.076–1.152)**	**1.167 (1.070–1.272)**
Medicare ≥ median	*0.909 (0.896–0.923)*	*0.948 (0.906–0.993)*	*0.868 (0.780–0.966)*	*0.897 (0.884–0.910)*	*0.896 (0.867–0.925)*	*0.886 (0.810–0.970)*
Total beds ≥ 150	**1.037 (1.023–1.052)**	1.006 (0.969–1.044)	0.921 (0.840–1.011)	*0.983 (0.970–0.996)*	1.016 (0.987–1.045)	*0.915 (0.846–0.990)*
Herfindahl index ≥ median	**1.116 (1.102–1.131)**	**1.112 (1.070–1.156)**	1.096 (0.992–1.210)	**1.123 (1.107–1.139)**	**1.166 (1.126–1.208)**	**1.122 (1.004–1.255)**
Admissions per bed ≥ median	*0.961 (0.945–0.976)*	1.030 (0.981–1.082)	*0.894 (0.801–0.997)*	*0.860 (0.847–0.873)*	*0.861 (0.832–0.892)*	*0.723 (0.657–0.796)*
Percent occupancy ≥ 85th percentile	**1.141 (1.122–1.161)**	1.037 (0.988–1.089)	**1.147 (1.029–1.278)**	**1.108 (1.089–1.128)**	**1.170 (1.124–1.218)**	1.082 (0.984–1.190)
Acuity index ≥ median	*0.874 (0.863–0.884)*	*0.924 (0.890–0.959)*	*0.853 (0.777–0.936)*	0.999 (0.987–1.012)	**1.057 (1.026–1.089)**	0.945 (0.868–1.028)
Hospitalizations per resident year*	*0.974 (0.970–0.978)*	*0.974 (0.958–0.990)*	*0.936 (0.896–0.978)*	*0.929 (0.921–0.937)*	*0.877 (0.856–0.899)*	*0.788 (0.731–0.848)*
% Tube feeding*	*0.987 (0.986–0.988)*	*0.991 (0.988–0.994)*	1.005 (0.999–1.012)	*0.987 (0.986–0.988)*	*0.996 (0.994–0.999)*	1.000 (0.995–1.006)
% Bedsores*	*0.992 (0.991–0.993)*	*0.983 (0.980–0.987)*	0.993 (0.985–1.002)	*0.989 (0.987–0.990)*	*0.987 (0.984–0.990)*	*0.991 (0.984–0.998)*
% Antipsychotic use*	*0.993 (0.992–0.994)*	*0.994 (0.992–0.996)*	*0.987 (0.983–0.991)*	*0.996 (0.996–0.997)*	*0.998 (0.997–0.999)*	*0.995 (0.992–0.997)*
CNA/Nurse ratio ≥ median	*0.894 (0.883–0.906)*	*0.951 (0.915–0.988)*	1.089 (0.992–1.196)	*0.983 (0.970–0.995)*	1.000 (0.971–1.030)	*0.921 (0.849–0.999)*
RN/Nurse ratio ≥ median	**1.220 (1.202–1.237)**	**1.278 (1.224–1.335)**	**1.171 (1.057–1.296)**	**1.049 (1.035–1.063)**	**1.183 (1.146–1.222)**	1.084 (0.995–1.180)
RN HPRD ≥ 0.75	**1.080 (1.060–1.101)**	**1.075 (1.013–1.141)**	**1.341 (1.171–1.536)**	**1.071 (1.048–1.096)**	**1.129 (1.064–1.199)**	**1.177 (1.013–1.366)**
LPN HPRD ≥ 0.55	0.993 (0.975–1.011)	1.003 (0.942–1.068)	*0.872 (0.761–0.998)*	**1.024 (1.005–1.044)**	1.030 (0.978–1.084)	0.915 (0.811–1.033)
CNA HPRD ≥ 2.8	*0.922 (0.904–0.939)*	*0.873 (0.820–0.930)*	*0.717 (0.628–0.819)*	*0.937 (0.917–0.958)*	*0.833 (0.789–0.880)*	*0.618 (0.544–0.701)*
Total direct care HPRD*,†	**1.068 (1.058–1.078)**	**1.031 (1.003–1.061)**	**1.141 (1.064–1.224)**	**1.040 (1.028–1.052)**	**1.086 (1.057–1.116)**	**1.087 (1.011–1.169)**
Physician extender onsite	*0.964 (0.953–0.975)*	*0.957 (0.924–0.991)*	1.013 (0.932–1.100)	*0.981 (0.969–0.993)*	**1.029 (1.001–1.057)**	0.947 (0.878–1.020)

Reported as Odds Ratio (95% Confidence Interval). Bold shading indicates significantly increased odds of vaccination and italic shading indicates significantly decreased odds of vaccination.
HPRD, Hours Per Resident Day; LPN, Licensed Practical Nurse.

*Characteristic is continuous.

†Sum of RN, LPN, and CNA hours per resident day.

Supplementary Table 4
Overview of the Decomposition Analysis of the Disparity in Influenza Vaccination Among White Versus Black and White Versus Hispanic Short- and Long-stay NH Residents

Influenza Vaccination Disparity	Coefficient	Standard Error	z	$P>\|z\|$	95% Confidence Interval		Contribution to Disparity (%)
White-Black disparity, Short-stay residents							
Characteristic estimate	0.0600	0.0015	40.3600	<.001	0.0571	0.0629	42.23
Coefficient estimate	0.0820	0.0068	12.1100	<.001	0.0688	0.0953	57.77
Total	0.1420	0.0066	21.6100	<.001	0.1291	0.1549	100.00
White-Hispanic disparity, Short-stay residents							
Characteristic estimate	0.0979	0.0016	61.2400	<.001	0.0948	0.1010	46.91
Coefficient estimate	0.1108	0.0143	7.7700	<.001	0.0828	0.1387	53.09
Total	0.2087	0.0142	14.7400	<.001	0.1809	0.2364	100.00
White-Black disparity, Long-stay residents							
Characteristic estimate	0.0367	0.0010	35.4500	<.001	0.0346	0.0387	37.73
Coefficient estimate	0.0605	0.0041	14.8800	<.001	0.0526	0.0685	62.27
Total	0.0972	0.0039	25.0600	<.001	0.0896	0.1048	100.00
White-Hispanic disparity, Long-stay residents							
Characteristic estimate	0.0365	0.0011	32.0000	<.001	0.0343	0.0387	59.23
Coefficient estimate	0.0251	0.0086	2.9100	.004	0.0082	0.0421	40.77
Total	0.0616	0.0085	7.2200	<.001	0.0449	0.0783	100.00

Note. Reports the results of the decomposition analyses using all variables reported in Tables 2–5. The characteristic estimate identifies how much the disparity would be reduced (eg, positive numbers) if the average characteristics for minority residents were equal to White residents. The characteristic estimate refers to the variation explained by the measured characteristics and the coefficient estimate refers to the variation unexplained by the measured characteristics.