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RESEARCH ARTICLE

Racial/Ethnic Differences in Receipt of Influenza and Pneumococcal Vaccination among Long-Stay Nursing Home Residents

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Objective/Study Question. To examine racial/ethnic differences in influenza and pneumococcal vaccination receipt and nonreceipt among nursing home (NH) residents post implementation of federal vaccination policy.

Data Sources/Study Setting/Study Design/Data Collection/Extraction Methods. An analysis of a merged national cross-sectional dataset containing resident assessment, facility, and community data for years 2010–2013 was conducted. Logistic regressions omitting and including facility fixed effects were used to examine the influence of race and ethnicity (black, Hispanic, white) and black concentration on vaccination status across and within NHs.

Principle Findings. Vaccination receipt of 107,874 residents in 742 NHs was examined. Blacks were less likely than whites to receive influenza and pneumococcal vaccinations (OR = 0.75; OR = 0.81, respectively, p-values <.001). The likelihood of not being offered the influenza vaccination was greater for blacks (OR=1.25, $p = .004$) and the likelihood of not being offered the pneumococcal vaccination was greater for Hispanics (OR = 1.65, $p = .04$) compared to whites. Fixed effects showed that within the same NH, Hispanics were more likely to receive both vaccinations compared to whites (OR=1.22, $p = .004$ (influenza); OR=1.34, $p < .001$ (pneumococcal)). Facilities highly concentrated with blacks accounted for large proportions of differences seen in vaccination receipt.

Conclusions. Racial/ethnic differences remain despite policy changes. Focused strategies aimed at NH personnel and racially segregated NHs are critical to improving vaccination delivery and eliminating disparities in care.

Key Words. Vaccines, disparities, long-term care

Influenza and pneumococcal infections are the eighth leading cause of death in the United States (Centers for Disease Control and Prevention, 2014, 2015). Nearly half of these deaths occur among individuals who are 65 years of age and older and among the frail elderly residing in nursing homes (NHs)

(Centers for Disease Control and Prevention, 2015). Effective interventions for preventing influenza and pneumonia are influenza and pneumococcal vaccinations (Govaert et al. 1994; Loeb et al. 1999; Monto, Hornbuckle, and Ohmit 2001; Vila-Corcoles et al. 2010).

Because of the efficacy of these vaccinations, policies have been developed to encourage their use for vulnerable populations including residents living in NHs (Centers for Medicare & Medicaid Services, 2005; Kroger et al. 2011; U.S. Department of Health Human Services, 2013). Specifically, in 2005, the federal government issued requirements for all Centers for Medicare and Medicaid Services (CMS)-certified NHs to offer influenza and pneumococcal vaccinations to each resident and mandated the documentation status of these vaccinations (Centers for Medicare & Medicaid Services, 2005). Moreover, CMS reimburses NHs for the costs of both vaccinations and their administration. Facility-level interventions that have been found to improve vaccination receipt include standing orders, written and verbal consent, immunization tracking systems, and vaccination mandates for residents (McKibben et al. 2000; Immunization Action Coalition, 2008).

Healthy People 2020 set target goals of influenza and pneumococcal vaccinations at 90 percent or greater (Centers for Disease Control and Prevention, 2013; U.S. Department of Health and Human Services, 2013a). However, in 2013 only 79.3 percent of NH residents received the pneumococcal vaccination, and during the 2008–09 flu season, only 70 percent received the influenza vaccination (Bardenheier, Shefer, and Wortley 2011; U.S. Department of Health and Human Services, 2013a).

Racial/ethnic minority status (i.e., black race or Hispanic ethnicity) has been found to be a strong predictor of NH resident vaccination status (Lindley et al. 2006; Winston, Wortley, and Lees 2006). Previous researchers report racial/ethnic minority residents less likely to receive influenza and pneumococcal vaccinations because they are not offered the vaccinations or refuse them altogether, compared to whites (Bardenheier et al. 2010, 2011a,b; Bardenheier et al. 2013; Cai et al. 2011). Using data from the 1995 to 2004 National Nursing Home Surveys (NNHS) and 1999 to

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2009 Minimum Data Sets (MDS), the difference in receipt of the influenza vaccination between racial and ethnic minorities ranged from 2 to 20 percent (Bardenheier et al. 2004, 2010, 2011a,b, 2013; Marsteller et al. 2006; Li and Mukamel 2010; Cai et al. 2011; Strully 2011; Luo et al. 2014) and 6 to 15 percent for the pneumococcal vaccination (Bardenheier et al. 2004, 2005a,b; Marsteller et al. 2008; Li and Mukamel 2010; Luo et al. 2014); specifically, in the most current reports available, there was a 7 percent difference in influenza vaccination receipt between blacks and whites in the 2008–2009 influenza season and 7 percent difference between Hispanics and whites in the 2005–2006 influenza season (Cai et al. 2011; Bardenheier et al. 2012). The difference in pneumococcal vaccination receipt was approximately 14 percent between blacks and whites in 2004 and 15 percent between Hispanics and whites in 2000 (Bardenheier et al. 2004; Li and Mukamel 2010; Luo et al. 2014).

Minority mistrust of health care providers and treatment as well as inadequate patient education by providers may explain a portion of the racial/ethnic differences in vaccination receipt (Cai et al. 2011). The largest difference in vaccination receipt has been found, however, among residents in facilities that serve a high minority population (often defined as >50 percent black residents) (Bardenheier et al. 2011a,b, 2012; Cai et al. 2011; Strully 2011). These NHs are primarily compensated by Medicaid and are known to have fewer resources, lower staffing, and poorer quality of care (Mor et al. 2004; Cai, Mukamel, and Temkin-Greener 2010; Fennell et al. 2010).

The primary aims of this study were to describe and compare current influenza and pneumococcal vaccination receipt rates and reasons for nonreceipt (i.e., not offered vs. offered and refused) between racial/ethnic minority and white NH residents and characterize differences in influenza and pneumococcal vaccination receipt and nonreceipt across and within NH facilities.

METHODS

This retrospective study analyzed a merged, national, cross-sectional dataset from three sources, which were cleaned and linked as part of a larger study (R01 NR013687). The unit of analysis was the resident. All data were de-identified prior to analyses. The Institutional Review Board at the Columbia University Medical Center approved the methods of this study.

Data Sources

Minimum Data Sets

MDS version 3.0 is the latest version of MDS. Data from October 2010 to December 2013 were available for use and include NH resident assessment data. All CMS-certified NHs are required to collect these resident assessment data upon admission as well as quarterly, annually, and whenever there is a significant change in resident status (Institute of Medicine 2001). The data provide individual resident characteristics including race/ethnicity and vaccination administration and when applicable reasons for not receiving vaccinations. The data are completed and/or approved by a licensed health care professional employed by the NH. Researchers have found that the MDS is a valid and reliable tool for NH resident assessments (Frederiksen, Tariot, and De Jonghe 1996; Morris et al. 1997). Percent agreement and kappa for the influenza and pneumococcal vaccination items on the MDS 3.0 are high (range of 0.978–0.994 agreement) (Saliba and Buchanan 2008).

To account for multiple assessments from one resident, analyses were limited to the last nonadmission assessment completed during the influenza season. While the influenza season varies from year to year depending on the span of the previous year's outbreaks, the majority of disease occurs from October through May; therefore, the influenza season was defined as October 1 through May 31 (Centers for Medicare & Medicaid Services 2015). Using data obtained from the nonadmission MDS 3.0 assessments allowed for the exclusion of those who were short-stay (<101 days) and have been found to be less likely to receive vaccinations (U.S. Department of Health and Human Services 2013b).

Unlike influenza, pneumococcal vaccinations can be administered at any time of the year. Therefore, for pneumococcal vaccination receipt, data were retrieved from the last nonadmission MDS 3.0 assessment performed for each resident for each year of full data (i.e., 2011–2013).

Online Survey, Certification and Reporting/Certification and Survey Provider Enhanced Reporting

The Online Survey, Certification and Reporting (OSCAR)/Certification and Survey Provider Enhanced Reporting (CASPER) system is a federal administrative database containing aggregated resident characteristics, survey deficiencies, and facility-level data. Data are collected annually as part of the NH CMS certification and recertification process. The 2010–2013 facility-level

data (e.g., staffing and ownership status) were used to develop control variables.

Area Health Resource Files

The Area Health Resource Files (AHRF) dataset contain over 50 sources of primarily county-level health data resources including the number of health facilities, environmental and population characteristics, and economic and expenditures data (Health Resources and Services Administration). These data provide information on characteristics of the community in which the NHs were located. The 2010–2013 AHRF data were used to develop community-level control variables that may contribute to health disparities.

Study Sample

A 5 percent random sample of free-standing NHs was selected. Residents in these NHs included non-Hispanic white, non-Hispanic black (hereafter referred to as white and black), and Hispanic NH residents age 65 and older who had a nonadmission MDS assessment during the study years. Hospital-affiliated NHs were excluded because these facilities have different populations and resources, which do not make them generalizable to the vast majority of free-standing NHs. Asians, American Indian/Alaskan Natives, and/or Native Hawaiian/Pacific Islanders were not included because these groups represent a combined total of 2.3 percent of the entire NH resident population (Centers for Medicare Medicaid Services, 2012), too small for making meaningful comparisons.

Variables

Conceptual Framework

A systematic review was primarily used to guide variable selection (Travers et al. 2017). The Strategic Framework for Improving Racial and Ethnic Minority Health and Eliminating Racial and Ethnic Health Disparities (the Strategic Framework) was used to frame the organization of these variables and our conceptualization of racial/ethnic vaccination disparities (U.S. Department of Health and Human Services 2008). This Framework posits that disparities based on racial and ethnic minority status are proliferated by a variety of contributing factors and mitigated through appropriate delivery of strategies and practices leading to the prevention of poor outcomes and improved minority health. An overview of each variable is provided below. A

full operational description of the variables included in this study and the data source in which they were derived are listed in Appendix SA2 and organized by the Strategic Framework.

Outcomes: Vaccination Status

The strategies and practices of primary interest were influenza and pneumococcal vaccination administration. For influenza, the MDS asks, "Did the resident receive the influenza vaccine in this facility for this year's influenza season?" For pneumococcal, "Is the resident's pneumococcal vaccination up to date?" Vaccination receipt for both influenza and pneumococcal vaccination was operationalized as vaccination received and vaccination not received and was a dichotomous dependent variable.

A secondary outcome was developed for reason for nonreceipt for both the influenza and pneumococcal vaccination (i.e., a dichotomous variable [offered and refused or offered and received]). Similar to Nursing Home Compare, this variable excluded those who appropriately did not receive the vaccination (i.e., not in the facility during the current year's flu season, received outside of the facility, not eligible medically contraindicated, and inability for facility to obtain vaccination due to declared shortage) (National Quality Measures Clearinghouse 2015a,b).

Independent Variables

Racial/ethnic minority status operationalized as white, black, or Hispanic was the primary independent variable of interest. The white racial group served as the comparator group.

NH concentration of black residents was a secondary independent variable of interest that was examined in sensitivity analyses. Similar to previous researchers, this variable was created with six categories to reflect the percentage of blacks in a facility so that the lower and higher categories were proportional (0 percent to 4.9 percent, 5.0 percent to 19.9 percent, 20.0 percent to 49.9 percent, 50 percent to 79.9 percent, 80 percent to 94.9 percent, and 95 percent to 100 percent) (Bardenheier et al. 2011a,b, 2012, 2013; Cai et al. 2011).

Confounders

Consistent with the conceptual framework and literature, other contributing factors may influence vaccination status. Resident characteristics derived from

the last MDS 3.0 assessment that were controlled for included age, gender, and assessment of dementia, asthma, respiratory failure, and behavior (i.e., a positive assessment for any of the following behaviors: verbal behavior, physical behavior, risk to injure self, interferes with care, interferes with participation, risk to injure others, intrudes on privacy of others, disrupts care or living environment, rejects care, wanders, or other) (Yoshikawa and Mylotte 2002; Bardenheier et al. 2005a,b; El-Solh, Niederman, and Drinka 2010; Haviland et al. 2011; Dwyer et al. 2013).

Facility characteristics derived from OSCAR/CASPER that were controlled for included bed count, percent occupancy, staffing (i.e., certified nursing assistant [CNA], licensed practical nurse [LPN]/licensed vocational nurse [LVN], and registered nurse [RN] hours per resident per day [HRD]), ownership (i.e., for-profit, government, and nonprofit), setting (i.e., metropolitan, rural, and nonmetropolitan with urban population), and percent of residents who use Medicaid as their source of payment (Mor et al. 2004; Cai et al. 2011; Bardenheier et al. 2012, 2013; Davis et al. 2014).

Community characteristics derived from AHRF data that were controlled for included percent poverty in the county (i.e., categorized by quartiles), number of federally qualified health centers in the county (i.e., categorized by quintiles), and NH market competition (i.e., county Herfindahl index defined as the number of beds, compared to the total number of NH beds in the county and categorized by quintiles).

Data Analyses

Prior to conducting all analyses, descriptive statistics of each variable were computed and distributions examined to ensure statistical assumptions were met (e.g., normal distribution and adequate cell size [>5]). Bivariate analyses were performed to determine differences in resident/facility/community characteristics and vaccination status by race/ethnicity. T-tests and chi-square tests were used for continuous and categorical variables, respectively.

Logistic regression was used to examine the influence of race/ethnicity and black concentration on vaccination status. Four logistic regression specifications consisted of (1) a model including only race/ethnicity indicators, (2) a model including race/ethnicity indicators and facility fixed effects, (3) a model including race/ethnicity indicators and a full set of resident, facility, and community characteristics, and (4) Model 3 described above with facility fixed effects. The first model characterizes the overall difference in vaccination rates

by race/ethnicity. The second identifies the racial/ethnic differences within facilities. The third and fourth specifications show the differences by race/ethnicity overall and within facility, respectively, after controlling for other resident, facility, and community characteristics. Because individual residents in a community may not be independent, Huber–White robust standard errors were used with clustering at the community level (Williams 2000).

Sensitivity analyses were performed to determine the robustness of the results and consider alternative explanations for differences in vaccination receipt. First, models were estimated using state fixed effects as opposed to facility fixed effects. Second, because some NHs had no variation in the outcome and/or had observations that were missing data for some of the covariates and therefore dropped out of the fixed-effects and/or adjusted models, all models were re-estimated using only the observations that were common to all four models. This allowed us to examine the robustness of the results and the relative findings across the models using identical data. Third, to determine the impact of black concentration, two adjusted logit models (with and without fixed effects) were estimated that included the interaction term race/ethnicity and black concentration, and an adjusted logit model without fixed effects and without an indicator variable for black concentration was also specified. Last, two adjusted logit models (with and without fixed effects) were estimated and included a Hispanic concentration variable to determine the role Hispanic concentration played in vaccination disparities.

To characterize racial and ethnic differences in the probability of not being offered the vaccinations, we used a similar approach and estimated the same four specifications as described above. We modified the fixed-effects specifications for these models to include an indicator for small NHs (fewer than 125 observations). As many of these small NHs had 0 observations in which vaccinations were not offered, we grouped them as "small NHs" to avoid having them drop out of the estimation samples. Similar sensitivity analyses were also conducted. Variables with a p-value $<.05$ were considered associated with the outcomes of interest. All analyses were performed using *STATA* version 13 (College Station, TX, USA).

RESULTS

The final sample consisted of 107,874 unique residents in 742 NH facilities across the nation. Resident, facility, and county characteristics varied by minority status (all p-values $<.0001$, see Table 1). White residents made up

Table 1: Descriptives of Unique Residents in Nursing Homes between October 2010 and 2013 by Race/Ethnicity

	White (n = 90,451) % (n)	*Black (n = 12,647) % (n)*	*Hispanic (n = 4,776) % (n)*	*p-value*
Resident characteristics				
Gender				
Male	29.5 (26,715)	37.4 (4,726)	40.0 (1,911)	<.0001
Female	70.5 (63,736)	62.6 (7,921)	60.0 (2,865)	
Age				
65–74	14.2 (12,857)	28.6 (3,614)	23.6 (1,125)	<.0001
75–84	30.5 (27,619)	34.7 (4,385)	38.9 (1,859)	
85+	55.3 (49,975)	36.8 (4,648)	37.5 (1,792)	
Behavior	46.1 (20,587)	42.0 (2,367)	45.5 (976)	<.0001
Dementia	48.9 (44,254)	49.4 (6,243)	52.4 (2,503)	<.0001
Asthma	22.3 (20,127)	18.7 (2,363)	20.9 (999)	<.0001
Respiratory failure	1.6 (1,420)	3.2 (408)	2.2 (104)	<.0001
Facility characteristics				
Setting				
Metropolitan	76.41 (69,111)	89.0 (11,260)	95.6 (4,565)	<.0001
Rural	4.0 (3,604)	1.7 (219)	0.8 (38)	
Nonmetropolitan with urban population	19.6 (17,736)	9.2 (1,168)	3.6 (173)	
Bed count				
<100	31.6 (28,620)	18.7 (2,360)	21.8 (1,043)	<.0001
100–199	51.7 (46,730)	56.3 (7,117)	41.1 (1,965)	
200+	16.7 (15,101)	25.1 (3,170)	37.0 (1,768)	
Ownership				
For-profit	62.1 (56,158)	82.2 (10,395)	85.4 (4,079)	<.0001
Government	6.2 (5,565)	2.8 (354)	3.4 (161)	
Non profit	31.8 (28,728)	15.0 (1,898)	11.2 (536)	
Black concentration				
<5.0%	63.1 (57,050)	6.0 (760)	38.6 (1,841)	<.0001
5.0–19.9%	27.3 (24,688)	24.0 (3,040)	36.8 (1,757)	
20.0–49.9%	7.4 (6,725)	30.6 (3,866)	18.7 (892)	
50.0–79.9%	2.1 (1,873)	28.7 (3,632)	5.4 (257)	
80.0–94.9%	0.1 (112)	7.5 (942)	0.6 (28)	
95.0–100%	0.0 (3)	3.2 (407)	0.0 (1)	
Chain	52.7 (47,671)	57.9 (7,323)	38.1 (1,821)	<.0001
Occupancy				
<80%	26.5 (23,952)	23.8 (3,006)	24.0 (1,147)	<.0001
80–90%	25.0 (22,622)	28.0 (3,539)	24.1 (1,153)	
90–93%	24.1 (21,780)	24.5 (3,099)	35.3 (1,687)	
94–100%	24.4 (22,097)	23.7 (3,003)	16.5 (789)	

Continued

Table 1: *Continued*

	White (n = 90,451) % (n)	*Black (n = 12,647) % (n)*	*Hispanic (n = 4,776) % (n)*	*p-value*
CNA HRD				
0–2.01	17.6 (15,897)	29.6 (3,749)	25.8 (1,231)	<.0001
2.01–2.259	19.4 (17,516)	26.5 (3,352)	14.6 (698)	
2.26–2.519	20.8 (18,807)	16.4 (2,078)	16.6 (793)	
2.52–2.859	20.9 (18,898)	15.0 (1,891)	19.2 (917)	
2.86–5.10	21.4 (19,333)	12.5 (1,577)	23.8 (1,137)	
LPN/LVN HRD				
0–0.569	21.5 (19,480)	12.5 (1,582)	19.8 (946)	<.0001
0.57–0.729	17.9 (16,218)	19.4 (2,448)	25.9 (1,238)	
0.73–0.869	19.7 (17,795)	19.2 (2,426)	15.6 (746)	
0.87–1.039	21.3 (19,268)	22.5 (2,844)	12.8 (613)	
1.04–2.05	19.6 (17,690)	26.5 (3,347)	25.8 (1,233)	
RN HRD				
0–0.43	16.1 (14,551)	26.1 (3,298)	34.8 (1,664)	<.0001
0.43–0.569	20.3 (18,366)	25.6 (3,239)	22.6 (1,078)	
0.57–0.679	19.9 (18,011)	18.2 (2,300)	14.6 (699)	
0.68–0.839	20.5 (18,571)	16.0 (2,018)	11.5 (547)	
0.84–2.47	23.2 (20,952)	14.2 (1,792)	16.5 (788)	
Percent Medicaid				
Community characteristics				
Percent in poverty				
≤11.9%	29.0 (18,278)	11.8 (1,052)	9.5 (308)	<.0001
12–15.2%	26.5 (16,700)	11.9 (1,056)	14.3 (465)	
15.3–18.8%	24.7 (15,549)	31.4 (2,795)	27.1 (880)	
18.9–45.0%	19.7 (12,428)	44.9 (3,996)	49.1 (1,593)	
Federally qualified health centers				
0	24.4 (22,044)	6.8 (854)	4.8 (230)	<.0001
1–2	24.4 (22,067)	21.2 (2,682)	10.0 (475)	
3–5	19.8 (17,922)	17.1 (2,157)	8.7 (416)	
6–13	17.0 (15,402)	19.9 (2,512)	14.3 (682)	
14–40	14.4 (13,016)	35.1 (4,442)	62.3 (2,973)	
Market competition				
0.84–29.9	16.7 (15,067)	28.9 (3,654)	46.1 (2,202)	<.0001
30–59.9	21.1 (19,042)	24.3 (3,076)	16.9 (806)	
60–94.9	18.9 (17,062)	19.0 (2,403)	11.9 (566)	
95–149.9	22.6 (20,441)	15.7 (1,987)	12.5 (597)	
150–10,000	20.8 (18,839)	12.1 (1,527)	12.7 (605)	
Vaccination strategies				
Vaccinated for influenza	82.5 (91,382)	71.3 (11,372)	76.2 (4,178)	<.0001
Vaccinated for pneumococcal	82.9 (122,998)	75.2 (15,448)	74.6 (5,910)	<.0001

Continued

Table 1: *Continued*

	White (n = 90,451) % (n)	*Black (n = 12,647) % (n)*	*Hispanic (n = 4,776) % (n)*	*p-value*
Among those not vaccinated				
Influenza				
Vaccination refused	70.7 (13,397)	69.6 (3,096)	73.1 (889)	.050
Not offered	29.3 (5,542)	30.4 (1,355)	27.0 (328)	
Pneumococcal				
Vaccination refused	83.2 (19,958)	76.4 (4,185)	78.4 (1,421)	<.0001
Not offered	16.8 (4,037)	23.6 (1,291)	21.6 (392)	

CNA, certified nursing assistant; HRD, hours per resident per day; LPN/LVN, licensed practical nurse/licensed vocational nurse; RN, registered nurse.

83.8 percent (n = 90,451) of the population, blacks made up 11.7 percent (n = 12,647), and Hispanics made up 4.4 percent (n = 4,776). Compared to whites (29.5 percent), blacks and Hispanics were more likely to be male (37.4 percent and 40.0 percent, respectively) and younger than 85 years old. Residence in for-profit NHs was most likely among blacks (82.2 percent) and Hispanics (85.4 percent) compared to whites (62.1 percent). Blacks and Hispanics were also more likely to reside in NHs with a black concentration of >20 percent as well as reside in communities with high poverty, an increased number of federally qualified health centers, and more market competition. Black residents were in NHs with fewer CNA staffing HRD (<2 .26 HRD) compared to whites and Hispanics.

Overall, influenza vaccination receipt was 80.9 percent and pneumococcal was 81.2 percent. Among those who were not vaccinated, 70.6 percent of residents refused the influenza vaccination, while 29.4 percent were not offered. For pneumococcal, 81.7 percent of residents refused the vaccination and 18.3 percent were not offered.

Racial/Ethnic Differences of Vaccination Receipt—Bivariate Analysis

With the exception of no racial/ethnic differences in influenza vaccination refused/not offered (Table 1, p-value = .05), differences were also found in vaccination receipt rates and reasons for nonreceipt by race and ethnicity (all p-values <.0001). Blacks, when compared to whites, had an approximately 11 percent lower rate of influenza vaccination receipt, 1 percent lower rate of influenza vaccination refusals, and 1 percent higher rate of not being offered the influenza vaccination. Hispanics, when compared to whites, had an approximately 6 percent lower rate of influenza vaccination receipt, 2.5

percent higher rate of influenza vaccination refusals, and 2 percent lower rate of not being offered the influenza vaccination. For pneumococcal, blacks had an approximately 8 percent lower vaccination receipt rate, 7 percent lower refusal of vaccinations, and 7 percent higher rate of not being offered the vaccination compared to Whites; Hispanics had an approximately 8 percent lower rate of pneumococcal vaccination receipt, 5 percent lower rate of refusal of pneumococcal vaccinations, and 5 percent higher rate of not being offered the pneumococcal vaccination.

Differences in Vaccination Receipt—Multivariate Logit Analyses

When performing the multivariate analyses, the total number of NHs in the samples ranged from 738 in the models without fixed effects to 499 in the models with fixed effects. The fixed-effects sample excluded those NHs for which there was no variation in the outcomes.

Table 2 presents the results of the four models of influenza vaccination receipt. In all models, blacks were less likely to receive the vaccination

Table 2: Four Sets of Models Estimating the Effect of Race/Ethnicity and Black Concentration on Influenza Vaccination Receipt between October 2010 and 2013. The Final Regression Sample Included (1) 132,179 Observations, (2) 132,007 Observations, (3) 59,339 Observations, (4) 58,872 Observations

	Model 1 Unadjusted OR	*Model 2 Unadjusted Fixed Effects OR*	*Model 3 Adjusted OR*	*Model 4 Adjusted Fixed Effects OR*
Race/ethnicity				
White†	–	–	–	–
Black	0.53***	0.78***	0.75***	0.76***
Hispanic	0.68	1.18**	0.96	1.22**
Black concentration				
<5.0%†				
5.0–19.9%			0.87	0.26*
20.0–49.9%			0.83	0.15**
50.0–79.9%			0.60***	0.15***
80.0–94.9%			0.59*	0.10***
95.0–100%			0.29***	0.11**

†Referent group, *$p < .05$, **$p < .01$, ***$p < .001$.
Adjusted for resident— gender, age, behavior, dementia, asthma, respiratory failure; facility—setting, bed count, ownership, chain, occupancy, staffing HRD (CNA, LPN/LVN, RN), percent Medicaid; and community characteristics—percent in poverty, federally qualified health centers, market competition.
CNA, certified nursing assistant; HRD, hours per resident per day; LPN/LVN, licensed practical nurse/licensed vocational nurse; OR, odds ratio; RN, registered nurse.

compared to whites with odds ratios (ORs) ranging from 0.53 to 0.78 (all *p*-values <.001). Hispanics were more likely to receive the vaccination, compared to whites in models 2 and 4 (OR = 1.18, OR = 1.22, all *p*-values <.01, respectively). When including covariates (models 3 and 4), residents in facilities with a 50 percent or greater concentration of blacks were less likely to receive the vaccination compared to residents in facilities with <5 percent blacks (ORs = 0.29–0.60, all *p*-values <.05 [Model 3]).

Table 3 presents the results of the four models of pneumococcal vaccination receipt. Very similar patterns were seen for pneumococcal vaccination in regard to blacks being less likely to be vaccinated compared to whites in all models with ORs ranging from 0.54 to 0.89 (all *p*-values <.05). In Model 1, Hispanics were also less likely to be vaccinated compared to whites (OR = 0.61, $p < .05$); however, Hispanics were found to be more likely to be vaccinated in models 2 and 4 (OR = 1.17, OR = 1.34, respectively, all *p*-values <.001). Greater black concentration of residents in a facility was again

Table 3: Four Sets of Models Estimating the Effect of Race/Ethnicity and Black Concentration on Pneumococcal Vaccination Receipt Between 2011 and 2013. The Final Regression Sample Included (1) 177,772 Observations, (2) 176,759 Observations, (3) 56,963 Observations, (4) 55,729 Observations

	Model 1 Unadjusted OR	*Model 2 Unadjusted Fixed Effects OR*	*Model 3 Adjusted OR*	*Model 4 Adjusted Fixed Effects OR*
Race/ethnicity				
White†	–	–	–	–
Black	0.54***	0.89***	0.81***	0.85*
Hispanic	0.61*	1.17***	0.83	1.34***
Black concentration				
<5.0%†				
5.0–19.9%			0.75**	0.16**
20.0–49.9%			0.78	0.22***
50.0–79.9%			0.48***	2.55*
80.0–94.9%			0.50	0.36*
95.0–100%			0.20***	0.16***

†Referent group, *$p < .05$, **$p < .01$, ***$p < .001$.
Adjusted for resident—gender, age, behavior, dementia, asthma, respiratory failure; facility—setting, bed count, ownership, chain, occupancy, staffing HRD (CNA, LPN/LVN, RN), percent Medicaid; and community characteristics—percent in poverty, federally qualified health centers, market competition.
CNA, certified nursing assistant; HRD, hours per resident per day; LPN/LVN, licensed practical nurse/licensed vocational nurse; OR, odds ratio; RN, registered nurse.

associated with a decreased likelihood of vaccination receipt for residents (Model 3).

Differences in Not Being Offered Vaccinations—Multivariate Logit Analyses

Table 4 presents results of the influenza vaccination not offered models. In Model 1, blacks were more likely to not be offered the influenza vaccination when compared to whites (OR = 1.77, $p = .001$). This effect remained, but decreased when adding fixed effects and adjusting for resident, community, and facility characteristics across models 2–4. There were no disparities in not being offered the influenza vaccination among Hispanics.

Table 5 presents results of the pneumococcal vaccination not offered models. Blacks were more likely to not be offered the vaccination, compared to whites in only Model 1 (OR = 2.33, $p < .001$) and Model 2 (OR = 1.17, $p = .02$). Hispanics were more likely to not be offered the pneumococcal vaccination in Model 1 (OR = 1.89, $p = .04$) and Model 3 (OR = 1.65, $p = .04$).

Table 4: Four Sets of Models Estimating the Effect of Race/Ethnicity and Black Concentration on Influenza Vaccination Not Offered between October 2010 and 2013. The Final Regression Sample Included (1) 131,539 Observations, (2) 104,635 Observations, (3) 59,050 Observations, (4) 44,744 Observations

	Model 1 Unadjusted OR	*Model 2 Unadjusted Fixed Effects OR*	*Model 3 Adjusted OR*	*Model 4 Adjusted Fixed Effects OR*
Race/ethnicity				
White†	–	–	–	–
Black	1.77**	1.28**	1.25**	1.27**
Hispanic	1.22	1.17	0.88	1.08
Black concentration				
<5.0%†			–	–
5.0–19.9%			1.17	1.50
20.0–49.9%			1.21	1.14
50.0–79.9%			2.14**	2.61**
80.0–94.9%			1.69	1.03
95.0–100%			7.35***	2.328E-06***

†Referent group, **$p < .01$, ***$p < .001$.
Adjusted for resident—gender, age, behavior, dementia, asthma, respiratory failure; facility—setting, bed count, ownership, chain, occupancy, staffing HRD (CNA, LPN/LVN, RN), percent Medicaid; and community characteristics—percent in poverty, federally qualified health centers, market competition.
CNA, certified nursing assistant; HRD, hours per resident per day; LPN/LVN, licensed practical nurse/licensed vocational nurse; OR, odds ratio; RN, registered nurse.

Table 5: Four Sets of Models Estimating the Effect of Race/Ethnicity and Black Concentration on Pneumococcal Vaccination Not Offered between 2011 and 2013. The Final Regression Sample Included (1) 175,640 Observations, (2) 120,657 Observations, (3) 56,386 Observations, (4) 32,481 Observations

	Model 1 Unadjusted OR	*Model 2 Unadjusted Fixed Effects OR*	*Model 3 Adjusted OR*	*Model 4 Adjusted Fixed Effects OR*
Race/ethnicity				
White†	–	–	–	–
Black	2.33***	1.17*	1.18	1.05
Hispanic	1.89*	1.00	1.65*	0.77
Black concentration				
<5.0%†				
5.0–19.9%			1.69*	1.18
20.0–49.9%			0.90	0.57
50.0–79.9%			3.17*	2.19
80.0–94.9%			1.55	3.472E-07***
95.0–100%			21.00***	4.334E-07***

†Referent group, *$p < .05$, ***$p < .001$.
Controlled for resident—gender, age, behavior, dementia, asthma, respiratory failure; facility—setting, bed count, ownership, chain, occupancy, staffing HRD (CNA, LPN/LVN, RN), percent Medicaid; and community characteristics—percent in poverty, federally qualified health centers, market competition.
CNA, certified nursing assistant; HRD, hours per resident per day; LPN/LVN, licensed practical nurse/licensed vocational nurse; OR, odds ratio; RN, registered nurse.

Sensitivity Analyses

The results were generally robust in the sensitivity analyses (see Appendix SA3). When state fixed-effects models were estimated, results were similar as in the facility fixed-effects analyses, except Hispanics were no longer more likely to receive either vaccination compared to whites but were more likely to not be offered the pneumococcal vaccination. With all outcomes, the results were robust when estimating the smaller but equal sample sizes. When examining the interaction of race/ethnicity and black concentration, Hispanics were more likely than whites to receive the influenza or pneumococcal vaccination in highly concentrated NHs. Additionally, the differences in not receiving both vaccinations and not being offered them among blacks were much greater when removing the black concentration variable. Adjusting for Hispanic concentration did not change the results.

DISCUSSION

This national study provides the first evidence on pneumococcal vaccination disparities after 2005 CMS policy mandating all NH residents be offered vaccinations. It also updates previous evidence on influenza vaccination disparities. AHRF data were used to control for community characteristics not previously considered.

It was found that no racial/ethnic group was meeting the national vaccination targets of 90 percent or greater between the years 2010 and 2013. Furthermore, racial/ethnic disparities persisted. Across facilities, blacks and Hispanics continue to receive both vaccinations less than whites and the likelihood of not being offered the influenza vaccination was greater for blacks and the likelihood of not being offered the pneumococcal vaccination was greater for Hispanics. Compared with reports prior to 2005, which found differences in vaccination receipt among both blacks and Hispanics compared to whites to be as much as 20 percent, the differences have decreased (Travers et al. 2017). However, in 2009 the differences in influenza vaccination receipt between blacks and whites were reported to be approximately 7 percent; in these data, the difference was 10 percent, suggesting that the effects of CMS policy may be diminishing and not be sufficient to close differences in long-term vaccination care (Cai et al. 2011; Bardenheier et al. 2012). Positively, a new finding was that blacks and Hispanics experienced either no difference in vaccination refusals compared to whites (influenza) or a lower percentage of vaccination refusals (pneumococcal). This may suggest progress on efforts directed toward educating black and Hispanic residents on the importance of both vaccinations.

Facility fixed effects allowed for the examination of unmeasured facility characteristics. The decreased likelihood of blacks receiving either vaccination declined but persisted in the fixed-effects models. These findings suggest that blacks are residing in poorer performing facilities compared to whites but remain less likely to receive either vaccination compared to whites when residing in the same facility. Factors reported in the past such as discrimination and bias among health care providers and cultural and personal beliefs may be contributing to these within-facility racial difference (Fiscella 2005). Similar results have been found previously and support the need for better understanding of health care provider vaccination practices related to potential biases (Cai et al. 2011).

Given the same resources within an NH, Hispanics were more likely to receive both vaccinations than whites. These results remained consistent in high black minority-concentrated NHs. The Hispanic minority group is

known to have better health outcomes than whites despite their lower socioeconomic status and decreased access to care; this notion has been referred to as the "Hispanic paradox" (Ribble and Keddie 2001). Findings related to Hispanics receiving better care compared to whites, however, are new and not explained in this paradox. Within states, Hispanics were similar to blacks with being less likely to receive both vaccinations. Further research is warranted to understand the characteristics of the Hispanic population and the NHs in which they reside.

Consistent with previous research, it was found that residents in high black concentration facilities were less likely to receive either vaccination (Marsteller et al. 2008; Li and Mukamel 2010). Blacks and Hispanics reside in these NHs in greater numbers than white residents, placing them at increased risk for disparities in care (Luo et al. 2014). When removing the black concentration variable from the analysis, the differences in vaccination receipt among blacks compared to whites increased, which implies that the NH system itself that many blacks reside in contributes greatly to the differences found. Highly black-concentrated NHs have been found to have inadequate resources, poorer quality of care, and increased attention to profitable interventions as opposed to quality improvement (Fennell, Miller, and Mor 2000; Harrington et al. 2001). This critical finding has important policy implications. Federal, state, and local governments must direct efforts toward high black concentration NHs to ensure that these facilities have the necessary resources (e.g., revenue, training, staffing, technology, leadership, and feedback) to encourage, enable, and empower health care providers to offer vaccinations and educate residents on the importance of their receipt. With appropriate support and efforts targeted toward more poorly performing facilities, it is possible to improve overall vaccinations and decrease racial and ethnic differences in care. For example, between the years 1999 and 2002, Quality Improvement Organizations (QIOs) set out to provide a variety of interventions aimed at improving influenza and pneumococcal vaccinations among a select group of NH facilities (Bardenheier et al. 2005a,b). NHs that received the intervention were compared to NHs that did not to determine whether vaccination improved in result. When QIOs promoted preprinted vaccine orders, contacted NH facilities to discuss improving immunization programs, and provided resource materials to improve immunization, the facilities were more likely to have at least a 10 percent-point increase in vaccination coverage, compared to those that did not receive these interventions. The same research team found that when QIOs provided NH

facilities with various resources (e.g., informational workbooks, samples of protocols and policies, patient education materials, and provider reminders), these sites were more likely to adopt recommended changes in their immunization protocols (McKibben et al. 2000). Interventions such as these deserve further attention and research on their effectiveness in resource-poor facilities.

Strengths and Limitations

This study has several strengths. First, no prior studies have used the MDS 3.0, the most reliable and valid NH resident assessment data available to date, to examine differences in influenza and pneumococcal vaccination receipt and nonreceipt by race/ethnicity. Second, this study is a large representative sample of all CMS-certified NHs in the United States and uses large administrative data, thereby increasing the generalizability of its findings. Third, several sensitivity analyses were performed to ensure the robustness of the final results.

Limitations must be considered as well. It is possible that important characteristics related to vaccination status, including length of stay, may contribute to vaccination status. This potential limitation was addressed by controlling for known confounders and omitting short-stay residents who are less likely to receive vaccinations. Additionally, the MDS pneumococcal variable asks about the vaccination being up-to-date. It is possible that some of the differences in this variable by race/ethnicity are related to poor record keeping and an inability to determine actual vaccination status. Differences have also been reported related to lack of documentation of these vaccinations (Marsteller et al. 2008; Li and Mukamel 2010). Nevertheless, this is still problematic. It is known that medical record data are subject to misclassification on race and ethnicity (Zingmond et al. 2015), which may be present in the MDS and be an inherent limitation in the data.

Last, caution is needed when comparing the results of this study to previous research. In this study, those who appropriately did not receive the vaccination, for example, received outside of the current facility, were excluded from the analysis. Other researchers and government entities have kept these observations in the analysis as not receiving the vaccination according to MDS definitions (U.S. Department of Health and Human Services, 2013a). As a result, these researchers and entities report lower vaccination receipt rates than those reported in this study.

CONCLUSION

Differences in racial and ethnic vaccination receipt and not offered among NH residents continue to exist. Although the gap has decreased since 2005 CMS policy, the current differences are still notable, indicating a health disparity based on racial and ethnic status continues. Current initiatives seem to lack the weight, specificity, consistency, and support needed to sustain a continued reduction in this disparity and meet target goals. From these findings, focused strategies to eliminate disparities in vaccinations among NH older adults may be developed. Prioritizing such strategies for NHs with a high concentration of black minority residents and health care professionals employed in these NHs is of critical importance. Redefining vaccination receipt and ensuring its consistency across platforms is also necessary to better quantify vaccination coverage and assess progress toward achieving target vaccination rates for all NH residents.

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Supporting Information

Additional supporting information may be found online in the supporting information tab for this article:

Appendix SA1: Author Matrix.

Appendix SA2: Variables with Operational Definitions Categorized by Domains from the Strategic Framework.

Appendix SA3: Sensitivity Analysis: State Fixed Effects.