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Racial/Ethnic Disparities in Influenza Vaccination of Chronically-ill U.S. Adults: The Mediating Role of Perceived Discrimination in Healthcare

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Abstract

BACKGROUND: Despite well-established programs, influenza vaccination rates in U.S. adults are well below federal benchmarks and exhibit well-documented, persistent racial and ethnic disparities. The causes of these disparities are multifactorial and complex, though perceived racial/ethnic discrimination in healthcare is one hypothesized mechanism.

OBJECTIVES: To assess the role of perceived discrimination in healthcare in mediating influenza vaccination disparities in chronically-ill U.S. adults (at high-risk for influenza-related complications).

RESEARCH DESIGN: We utilized 2011–2012 data from the Aligning Forces for Quality Consumer Survey on health and healthcare (n=8,127), nationally-representative of chronically-ill U.S. adults. Logistic regression marginal effects examined the relationship between race/ethnicity and influenza vaccination, both unadjusted and in multivariate models adjusted for determinants of health service use. We then used binary mediation analysis to calculate and test the significance of the percentage of this relationship mediated by perceived discrimination in healthcare.

RESULTS: Respondents reporting perceived discrimination in healthcare had half the uptake as those without discrimination (32% vs. 60%, p=0.009). The change in predicted probability of vaccination given perceived discrimination experiences (vs. none) was large but not significant in the fully-adjusted model (−0.185, 95% CI: −0.385, 0.014). Perceived discrimination significantly

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mediated 16% of the unadjusted association between race/ethnicity and influenza vaccination, though this dropped to 6% and lost statistical significance in multivariate models.

CONCLUSIONS: The causes of persistent racial/ethnic disparities are complex and a single explanation is unlikely to be sufficient. We suggest re-evaluation in a larger cohort as well as potential directions for future research.

Keywords

chronic disease; discrimination; health disparities; influenza; vaccinations

Introduction

Adults at highest risk for influenza-related complications and mortality include those aged 65+ years and those of any age with chronic illnesses, including asthma, chronic lung disease, heart disease, and diabetes.[1] Adult influenza vaccination rates in the U.S., however, remain well below federal benchmarks of optimal coverage, especially among high-risk adult populations;[2,3] e.g., the Healthy People 2020 target is 70% uptake,[4] though between 2004–2012 uptake among high-risk working-age adults peaked at 45.6%.[2] Influenza results in up to 200,000 hospitalizations, 49,000 deaths[5,6] and an estimated $87 billion in total economic burden to the U.S. each year.[7] Chronically-ill adults share a disproportionately large portion of this burden.[8]

Furthermore, influenza vaccination uptake in U.S. adults exhibits well-documented, persistent racial/ethnic disparities. These disparities remain after **adjusting** for many sociodemographic characteristics[9] and despite influenza vaccines' continued safety record,[10] increasing affordability and accessibility,[11] and strong evidence that influenza vaccination is the most effective means of preventing influenza and influenza-related outcomes in both general and chronically-ill adult populations.[2,12–17] For example, uptake for Blacks and Hispanics aged 65+ was at least 10 percentage points lower than Whites for most years of the previous two decades.[9,18] Similar disparities have been documented among working age adults,[2] including those with high-risk conditions.[3,19] Many conditions that increase the risk of severe influenza illness or death are more prevalent among racial/ethnic minorities (e.g., asthma, diabetes, HIV/AIDS, and hypertension),[20] making racial/ethnic disparities in influenza vaccination of even greater consequence, placing inequitably higher mortality on U.S. minority populations.[21]

The causes of racial/ethnic disparities in influenza vaccination are likely multifactorial and complex.[22] Potential explanations include circumstances pertaining to many minorities: lower healthcare access; greater distrust of physicians; potential unconscious racial bias in providers which may result in differential provision of vaccination; minorities may see providers who are generally less inclined to vaccinate; and resistant attitudes/beliefs towards influenza shots.[23,24] Research elucidating these mechanisms is limited.[21,22]

Broadly, racial discrimination and racism are thought to contribute to racial/ethnic disparities in health.[25] Measures of perceived discrimination have been used to examine pathways through which they can affect health. How perceived discrimination, as it is experienced in

daily life[26] and specifically within healthcare settings,[27] affects health disparities has received increasing empirical attention across multiple health outcomes. However, it is understudied as a mechanism potentially explaining racial/ethnic disparities in influenza vaccination in U.S. adults. The few studies that have examined this association report mixed results and are generalizable only to limited settings.[28–30]

This study examines the role of perceived racial/ethnic discrimination in healthcare as a mediator of the association between race/ethnicity and influenza vaccination. It addresses gaps in the literature by: (1) using a nationally-representative sample of high-risk, chronically-ill adults; and (2) applying mediation analysis to assess a potential mechanism (perceived discrimination) hypothesized to explain influenza vaccination disparities.

Methods

Data Source and Sample

Data come from the Consumer Survey (CS) of the Aligning Forces for Quality (AF4Q) initiative. AF4Q was a Robert Wood Johnson Foundation (RWJF) initiative to improve healthcare quality, reduce racial/ethnic health disparities, and provide models for national reform in 16 geographically, demographically, and economically diverse targeted communities representing 12.5 percent of the U.S. population.[31] The CS is part of an independent, scientific evaluation of AF4Q. Additional details about the AF4Q program and evaluation have been published elsewhere.[32,33] The CS uses random digit dial design to generate a representative sample of adults 18+ years living in AF4Q communities, as well as a national comparison sample of respondents not in AF4Q communities, with at least one of five chronic conditions – asthma, depression, diabetes, heart disease, and hypertension. Survey questions focus on patient engagement in and knowledge regarding their own health, skills and willingness to manage their health, ability to be an effective healthcare consumer in the context of physician visits, and other related topics.[33] Two rounds were administered – during the first year of AF4Q from (July 2007-August 2008), and from July 2011-November 2012 of new respondents and first-round respondents who agreed to be re-interviewed.[34] AF4Q evaluation research is reviewed and approved by the Pennsylvania State University Institutional Review Board, including all data analysis or use.

This study uses the 9,737 second round respondents. The overall response rate for this round was 39.7% (American Association of Public Opinion method) to 42.1% (Council of American Survey Research Organizations method). This was restricted to those in the original 15 study markets and national comparison sample so sample weights could be applied to obtain national representativeness (n=9,527). This was further restricted to those of non-Hispanic White, non-Hispanic Black, and Hispanic race/ethnicity, and not missing on influenza vaccination nor perceived discrimination in healthcare, equating to a total eligible analytic sample of 8,850.

Measures

Since the decision to receive an influenza vaccine is one to receive a preventive health service, Andersen's Behavioral Model of Health Services Use[35(fig1.1)] is employed to

conceptually-ground the selection of determinants of health services utilization as covariates. Andersen's Model identifies factors predisposing, enabling, and creating need for health services and how health services use is influenced by health behaviors and processes of medical care; it has been used extensively in studies across various healthcare sectors, and in the context of many outcomes.[35(pp3−10),36]

Influenza vaccination.—The outcome variable is self-reported receipt of the seasonal influenza vaccine within the previous 12 months (dichotomous), the same as used in the National Health Interview Survey.[37] Though subject to recall bias, the annual nature of influenza vaccination likely decreases such bias relative to other vaccines chronically-ill patients may receive.

Race/ethnicity.—Race/ethnicity, a pre-disposing factor of health services use, is the independent variable of interest. Respondents were asked, "What race or races do you consider yourself to be?" and selected all that apply: White (Caucasian); Black or African American; Asian; American Indian or Alaska Native; Native Hawaiian or Other Pacific Islander; Hispanic; or Other (specify). Less than 4% of respondents selected >1 race; in these cases were classified in a new "Multiracial" category. Respondents were also asked, "Are you of Hispanic or Latino origin or descent?" In the rare case that respondents indicated Hispanic race but not Hispanic ethnicity, they were reclassified as Hispanic ethnicity. These two variables were recoded to generate one mutually-exclusive race/ethnicity variable: non-Hispanic White (no other race indicated), non-Hispanic Black or African American (no other race indicated), or Hispanic (of any or multiple races).

Perceived discrimination in healthcare.—The mediating variable is self-reported perceived discrimination in healthcare, a process of care factor of health services use. Respondents were asked, "Do you think there was ever a time when you would have gotten better medical care if you had belonged to a different race or ethnic group?" This question has been used in the California Health Interview Survey and the Commonwealth Fund Health Care Quality Survey, and very similar valid and reliable measures have been used elsewhere.[27]...

Covariates.—Other covariates represent determinants of health services use from Andersen's Model and others relevant to influenza vaccination. This includes fifteen total measures. Six factors pre-dispose individuals to health services use: (1) *sex*; (2) *education*; (3) *age* (classified as 18–64 vs. 65 or older given the latter is a high-risk populations for influenza-related complications[8]); (4) *employment status*; (5) *Patient Activation Measure (PAM) stage*, a scale reflecting engagement in one's own health;[38,39] and (6) *AF4Q sample market*. Two factors are enabling conditions facilitating or impeding health services use: (7) *poverty status*; and (8) *health insurance status*. Two factors represent perceived or evaluated needs or conditions requiring health services use: (9) *self-rated health*; and (10) a *summative index of the total number of chronic illnesses the respondent has*. Five variables represent health behavior level factors (i.e., personal health practices, processes of medical care, and use of personal health services): (11) *tobacco smoking status*; (12) a *diet and exercise index* representing the number of recommended practices to which each individual conforms:

exercises regularly, and eats at least 5 servings of fruits or vegetables most days of the week; (13) *trust* the individual has in information from their doctor (not specific to vaccination); (14) *number of visits made to healthcare providers* to treat their conditions, previous 3 months; and (15) *rating of all care received* from all healthcare professionals, previous 12 months.

Statistical Analyses

To make all models comparable, analyses were restricted to respondents not missing any covariates. This "complete case analytic sample" contains 8,127 respondents; 723 respondents (8.17% of the eligible analytic sample) were considered missing. Missingness across the variables was low; the largest contributors were poverty (3.87% missing) and diet and exercise (1.32%); missingness in the remaining variables ranged from 0.01–0.64%. Missingness was not associated with influenza vaccination, discrimination, nor race/ethnicity. However, the 723 missing respondents were significantly more likely to be older, retired, and non-smokers.

We first calculated bivariate statistics to examine the association between influenza vaccination with all covariates individually using design-based F-tests for categorical variables and adjusted Wald tests for continuous and ordinal variables. We then conducted logistic regression of influenza vaccination onto race/ethnicity in several models to examine disparities. First, in unadujsted analyses, we regressed influenza vaccination onto race/ethnicity alone (Model 1) and then added in perceived discrimination in healthcare (Model 2) to see how it is associated with influenza vaccination and how it changes racial/ethnic disparities in influenza vaccination. Models 3 and 4 add to Models 1 and 2, respectively, all other determinants of health services use to generate multivariate results.

Lastly, we test for mediation. Mediation occurs when the effect of an independent variable (race/ethnicity) on a dependent variable (influenza vaccination) is transmitted by a mediating variable (perceived discrimination in healthcare). If path "a" is the effect of the independent variable on the mediator (the effect of race/ethnicity on perceived discrimination; i.e. racial/ethnic disparities in influenza vaccination), and path "b" is the effect of the mediator on the dependent variable **adjusting** for the independent variable (the effect of perceived discrimination on influenza vaccination status **adjusting** for race/ethnicity), the recommended way to assess mediation is by multiplying the regression coefficients of paths "a" and "b" together and testing if the a*b cross-product is significantly different from zero.[40–44] This process is sometimes referred to as the four-step process and the test as the Sobel test (e.g., see Baron & Kenny,[45] James & Brett,[46] and Judd & Kenny[47]). However, when analyzing mediation with a binary mediator and/or dependent variable ("binary mediation"), the aforementioned coefficients calculated via logistic regression are not always correct and require transformation; the recommended approach is a modified Sobel test that calculates a standardized a*b cross-product suitable for logistic regression.[40] We calculated the correct mediation coefficients as recommended above, the corresponding percentage of mediation occurring, and tested whether or not it was different from zero.[44,48] Using bootstrapping (500 repetitions) to obtain correct standard errors,[43,49,50] we calculated the percentage of the unadjusted (Model 1 vs. 2) and adjusted (Model 3 vs. 4) relationship between race/ethnicity

and influenza vaccination mediated by perceived discrimination in healthcare and tested if the mediation was statistically significant. All statistical analyses used Stata/SE 13.1 statistical software,[51] and Stata's *svy* commands to obtain nationally-representative estimates adjusting for complex survey design.

Results

Table 1 contains descriptive statistics of the complete case analytic sample of chronically-ill U.S. adults in 2011–2012 overall, and by influenza vaccination status, race/ethnicity, and experiences of perceived discrimination in healthcare. Overall, 58.2% of respondents reported receipt of the influenza vaccination within the previous 12 months and 7.3% reported ever experiencing a time when they perceived they would have gotten better medical care if they had belonged to a different race or ethnic group. Column 2 of Table 1 shows the unadjusted correlations of determinants of health services with influenza vaccination uptake. Uptake was significantly lower across several covariates, individuals: who ever experienced perceived discrimination in healthcare; without a four-year college degree; of working age; not retired; below the poverty line; without health insurance; currently smoking; and reporting less trust in information from their doctor.

Table 2 shows marginal changes in predicted probability of self-reported influenza vaccination associated with changes in covariates from logistic regression analyses. In Model 1, the predicted probability of vaccination was significantly lower among non-Hispanic Blacks relative to non-Hispanic Whites (−0.173, [95%CI: −0.332, −0.014]). In Model 2, having experienced perceived discrimination was significantly associated with lower predicted probability of influenza vaccination (−0.273 [−0.493, −0.052]); the racial/ethnic disparities were similar to Model 1 but lost statistical significance.

Results from Model 3 were nearly identical to Model 4 so only the latter is reported here. In Model 4, those experiencing perceived discrimination in healthcare had a large decrease in predicted probability of influenza vaccination (−0.185), though this was not statistically significant. Associated with higher predicted probability of influenza vaccination were obtaining a four-year college degree (0.146 [0.018, 0.273]), and not currently smoking (0.143 [0.033, 0.253]), and associated with lower predicted probability of vaccination was having less trust in information from one's doctor (−0.139 [−0.227, −0.050]). In both models, there were no statistically significant racial/ethnic disparities, though non-Hispanic Blacks had the lowest predicted probabilities of vaccination (−0.046 to −0.066 lower probability than predicted for non-Hispanic Whites).

Table 3 shows the results of the binary mediation analysis. In sum, perceived discrimination in healthcare significantly mediated 16.2% of the unadjusted relationship between influenza vaccination and race/ethnicity. **Adjusting** for determinants of health services, the amount of the relationship between influenza vaccination and race/ethnicity mediated by perceived discrimination in healthcare dropped to 6.0% and lost statistical significance.

Discussion

This study contributes to the very few examining the association of perceived discrimination in healthcare and influenza vaccination and to our knowledge is the only examining perceived discrimination as a mediator of racial/ethnic influenza vaccination disparities. The CDC reports estimates of influenza vaccination uptake among high-risk working-age adults (18–64) and those over 65. Among high-risk working-age adults, uptake was 46.7% in the 2010–2011 season and 45.2% in the 2011–2012 season, and for adults 65 and older, the comparable uptake was 66.6% and 64.9%, respectively.[52,53] Uptake in our sample, which spanned these two seasons, was slightly higher (53.1% in working age adults and 73.1% among those 65 and older). The unadjusted racial/ethnic disparities in uptake in our sample, though not statistically significant, are comparable to the magnitude noted over the previous two decades in U.S. adults.[2,3,9,18,19]

The three determinants that remained significantly associated with higher predicted probability of vaccination in the fully-adjusted model were attainment of a four-year college degree, not being a current smoker, and having greater trust in information provided by one's doctor. Higher levels of education are generally associated with increased uptake of influenza vaccination in the literature.[54] Tobacco smoking is linked to increased influenza severity, complications, and mortality,[55,56] suggesting smokers might have increased uptake via increased perceived vaccine need. However, in line with this study, smokers are generally less likely to be vaccinated, the reasons of which are not well understood[57] but may relate to influenza vaccines' reduced efficacy in smokers.[58–60] Last, a trustful physician-patient relationship is necessary for physicians to successfully recommend vaccines and distrust of doctors is frequently listed as a reason of vaccine hesitancy.[61] Because trust in one's physician and discrimination are conceptually related, we performed sensitivity analyses. The correlation between trust and discrimination was low (r=0.07) and upon re-running our main analyses removing the trust variable, none of our findings changed, suggesting that they function as two distinct constructs. That these three findings remained significant despite this study's power limitations (see below) suggests they may be the strongest factors associated with influenza vaccination in chronically-ill U.S. adults and warrant further investigation regarding their role in disparities.

This study has three limitations. The first relates to how the survey was sampled. The AF4Q CS is representative of 15 healthcare markets (~1/8th of chronically-ill US adults) with a national comparison sample representative of the remaining 7/8^{ths}. Though weights can be used to generate national-representativeness, it is not explicitly designed as a national probability sample, presenting design effect limitations. Design effect statistics (DEFF) from main analysis coefficients (Model 4) ranged from 4.6–37.4; corresponding root design effect statistics (DEFT) indicate standard errors are approximately 2–6 times larger than a corresponding simple random sample. While not ideal, it is not uncommon to have DEFF coefficients in this range, especially among cluster-sampled surveys[62] like the CS. The implication is the loss of statistical power in nationally-representative estimates. Further, CS response rates were relatively low, though in accordance with general declining trends in survey response rates.[63] This issue was previously examined and no significant differences were found in CS respondents' demographic characteristics nor prevalence of chronic

illnesses compared to corresponding years of the National Health Interview Survey,[63] a related survey with higher response rates. Moreover, other data sources studying racial/ethnic discrimination in healthcare cannot be used to provide reliable national estimates,[27] making this study a contribution despite design limitations. The second limitation relates to key variable categorization. There are differing measures of racial/ethnic discrimination in the literature. It is generally recommended that such measures ideally have both a setting and a timeframe.[28,64] Though our measure does not specify a timeframe, it does specify a setting (healthcare visits), allowing us to address our study aims. There are more nuanced measures in the literature[27] (e.g., asking about exact actions perceived to be discriminatory, or frequency/intensity of experiences), but since only 7.5% of respondents reported *ever* experiencing perceived discrimination in healthcare, it is to our benefit to have a broader capture. Moreover, two very similarly worded questions from other sources have been tested for reliability and validity in minority populations,[27] increasing confidence in our measure. Future studies should have a specific timeframe (typically, the past 1–2 years) and specific mechanisms of discrimination but therefore will likely need a sample quite larger than ours. Small sample size among races other than White and Black and among Hispanics prevented further stratification of the race/ethnicity variable, though our categorization allows us to make comparisons to national estimates.[2,3,9] We performed a sensitivity analysis to examine potential effects of ethnic heterogeneity by separating Hispanics into those of Mexican origin (largest Hispanic subgroup, also noted as using less preventive services compared to other Hispanics[65]) and Hispanics of other origin; our results did not change. The last limitation relates to temporality. Our results are associative and not causative given this study is cross-sectional. The CS has a sub-section of panel respondents but two factors made them impractical to utilize. First, race/ethnicity is not time-varying, preventing fixed effects analyses. Second, the prevalence of respondents ever experiencing discrimination is already small; any change in its prevalence in the few years since the prior round would provide insufficient variation to use other longitudinal methods. Further, the possibility of bidirectionality in our findings is very unlikely. Because race/ethnicity is a fixed characteristic, it can neither be caused by vaccination status nor discrimination. It is theoretically possible that a respondent could opt to not be vaccinated, causing their healthcare provider to treat them differently, causing the respondent to attribute this perceived difference in care to their race/ethnicity. However, Andersen's model suggests this scenario to be unlikely: pre-disposing factors (race/ethnicity) precede process of care factors (discrimination in healthcare), which precede health services utilization (vaccination).

Racial and ethnic disparities in healthcare exist broadly in the U.S. and have significant implications. They erode trust in health professionals, hinder the ability of disadvantaged racial/ethnic groups to advance economically and professionally, threaten public health efforts to improve the nation's health, worsen national healthcare expenditures, and generally tear at the nation's social fabric pertaining to perception of racial discrimination.[66] Racism and racial discrimination is thought to be one mechanism underlying persistent racial/ethnic disparities in health and shown to be associated with numerous health and health services outcomes, such as higher mortality, blood pressure, body mass index, weight gain, and mental health outcomes and worse levels of cancer screening, diabetes care, general care-seeking behavior, and unmet healthcare needs.[27] This study found that

experiences of perceived discrimination in healthcare significantly mediated 16% of unadjusted racial/ethnic disparities in influenza vaccination. Though this mediation dropped to 6% and loss statistical significance in fully-adjusted models, the magnitude of the adjusted association between discrimination and vaccination was larger than that of other significant findings. This suggests that lack of significance is likely due to the low prevalence of discrimination and that this effect may be significant in future, larger samples. Clearly the causes of influenza vaccination disparities are complex as they have remained for decades, and from this study, the role discrimination plays is not entirely clear. Nonetheless, the overemphasis on main-effect multivariate models in health disparities research and subsequent lack of focus on the processes contributing to these disparities is a limitation of the literature.[67] Though this study raises numerous questions for further research, understanding the mechanisms of persistent influenza vaccination disparities among chronically-ill adults is of particular importance since this population is at higher risk for influenza-related complications and because they have higher potential for gains.

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Table 1.

Sample Summary Statistics by Influenza Vaccination Status, Race/Ethnicity, and Experiences of Perceived Discrimination in Healthcare: AF4Q Consumer Survey, Chronically-ill U.S. Adults (2011–2012)

	Total	Outcome	Independent Variable of Interest			Moderator
Characteristic	**Complete case sample N = 8,127**	**Vaccinated, prev. 12 months N = 5,197**	**Non-Hispanic White race N = 5,505**	**Non-Hispanic Black race N = 2,112**	**Hispanic ethnicity N = 510**	**Discrimination, prev. 12 months N = 597**
Influenza vaccination (prev. 12 months)	58.2%	--	60.3%	43.0%	62.1%	32.4%
Race/ethnicity						
Non-Hispanic White	74.8%	77.5%	--	--	--	36.5%
Non-Hispanic Black	13.5%	9.9%	--	--	--	28.2%
Hispanic	11.8%	12.6%	--	--	--	35.4%
Perceived racial/ethnic discrimination in healthcare	7.3%	** 4.1%	3.6%	15.3%	21.9%	--
Female sex	56.6%	54.7%	53.3%	66.5%	65.7%	62.2%
Education: obtained 4-year college degree	24.7%	* 29.8%	29.7%	6.3%	14.0%	7.1%
Age (years)						
18-64	74.5%	*** 68.0%	71.0%	86.8%	83.2%	93.4%
65 and older	25.5%	*** 32.0%	29.0%	13.2%	16.8%	6.4%
Employment status						
Full-time (30+ hours/week)	39.9%	* 38.0%	41.5%	30.1%	40.8%	20.5%
Part-time (<30 hours/week)	11.4%	* 11.3%	13.2%	8.2%	4.2%	11.4%
Retired	21.2%	* 27.1%	23.4%	17.1%	12.0%	12.7%
Other	27.4%	* 23.6%	21.9%	44.5%	43.0%	55.4%
Patient Activation Measure stage, mean (SD)	3.2 (0.8)	3.2 (0.8)	3.2 (0.8)	3.1 (0.8)	3.1 (0.9)	2.8 (1.1)
Household income above federal poverty line	67.6%	* 73.2%	77.9%	30.2%	45.2%	28.4%
Currently insured	85.4%	* 90.3%	90.9%	69.3%	68.5%	57.6%
Self-rated health, mean (SD)	3.0 (1.0)	3.0 (1.0)	3.1 (1.0)	2.6 (0.8)	2.4 (0.9)	2.0 (1.2)
Number of chronic illnesses, mean (SD)	1.4 (0.9)	1.5 (0.9)	1.4 (0.9)	1.3 (0.8)	1.6 (0.8)	1.6 (0.8)
Current tobacco smoker	18.4%	*** 11.6%	15.7%	38.3%	12.5%	34.9%
Diet and exercise score, mean (SD)	1.3 (0.7)	1.3 (0.7)	1.2 (0.7)	1.3 (0.7)	1.5 (0.7)	1.1 (0.8)
Trust in physician score, mean (SD	1.3 (0.5)	* 1.3 (0.5)	1.3 (0.5)	1.3 (0.5)	1.4 (0.5)	1.4 (0.5)
Visits to providers, prev. 3 months, mean (SD)	1.1 (1.2)	1.1 (1.2)	1.0 (1.2)	1.4 (1.4)	1.4 (1.2)	2.1 (1.3)
Rating of all care, prev. 12 months, mean (SD)	8.1 (2.1)	8.3 (1.8)	8.0 (2.0)	8.7 (1.6)	7.6 (3.0)	5.5 (3.2)

Column percentages and means are weighted to be nationally-representative of chronically-ill U.S. adults. Due to missing values and rounding, numbers in the column percentages in this table may not add up to the total sample size. Sample size values (N) are unweighted to show actual number of respondents in cells. For the outcome column, bivariate statistical tests were conducted to detect, by influenza vaccination uptake, significant differences among group percentages (design-based F tests) and among means (adjusted Wald tests). In this column, *0.05>p≥0.01; **0.01>p≥0.001; ***p<0.001

Patient Activation Measure stage ranges from 1–4 where 4 indicates higher patient activation.

Self-rated health ranges from 1–5 where 5 indicates excellent health.

Number of chronic illnesses rages from 1–5 (asthma, depression, diabetes, heart disease, and/or hypertension).

Diet and exercise index ranges from 0–2 where higher scores indicate better exercise and diet practices.

Trust in physician score ranges from 1–3, where 1 is “a lot” and 3 is “not at all.”

Number of visits to healthcare providers in the previous 3 months to treat conditions is categorized as 0, 1, 2, 3, or 4+ times.

Rating of all care received from all healthcare professionals in the previous 12 months ranges from 0–10 where 10 is the best possible score.

Table 2.

Marginal Changes in Predicted Probability of Influenza Vaccination from Weighted, Logistic Regression Models: AF4Q Consumer Survey, Chronically-Ill US Adults (2011–2012)

Characteristic	Model 1 N = 8,127 ΔProb. (95% CI)	Model 2 N = 8,127 ΔPROB. (95% CI)	Model 3 N = 8,127 ΔPROB. (95% CI)	Model 4 N = 8,127 ΔPROB. (95% CI)
Race/ethnicity (ref: non-Hispanic White)				
Non-Hispanic Black	* −0.173 (−0.332, −0.014)	−0.142 (−0.308, 0.023)	−0.066 (−0.214, 0.081)	−0.046 (−0.194, 0.102)
Hispanic	0.018 (−0.167, 0.203)	0.070 (−0.082, 0.221)	0.087 (−0.064, 0.239)	0.112 (−0.031, 0.255)
Perceived racial/ethnic discrimination in healthcare	--	* −0.273 (−0.493, −0.052)	--	−0.185 (−0.385, 0.014)
Male sex (ref: female)	--	--	0.008 (−0.096, 0.112)	0.008 (−0.095, 0.111)
Education: obtained 4-year college degree	--	--	* 0.145 (0.017, 0.274)	* 0.146 (0.018, 0.273)
Aged 65 or older (ref: 18-64 years)	--	--	0.124 (−0.001, 0.248)	0.115 (−0.009, 0.240)
Employment status (ref: full-time: 30+ hours/week)				
Part-time (<30 hours/week)	--	--	0.058 (−0.104, 0.221)	0.065 (−0.093, 0.223)
Retired	--	--	0.084 (−0.066, 0.234)	0.093 (−0.055, 0.241)
Other	--	--	0.006 (−0.126, 0.139)	0.013 (−0.117, 0.144)
Patient Activation Measure stage	--	--	−0.040 (−0.110, 0.031)	−0.038 (−0.106, 0.030)
Household income above federal poverty line	--	--	0.046 (−0.076, 0.167)	0.041 (−0.079, 0.162)
Currently insured (ref: not)	--	--	0.137 (−0.028, 0.302)	0.128 (−0.030, 0.286)
Self-rated health	--	--	−0.034 (−0.094, 0.026)	−0.036 (−0.096, 0.024)
Number of chronic illnesses	--	--	0.031 (−0.037, 0.098)	0.033 (−0.033, 0.099)
Not a current tobacco smoker (ref: current smoker)	--	--	* 0.144 (0.032, 0.255)	* 0.143 (0.033, 0.253)
Diet and exercise score	--	--	−0.002 (−0.074, 0.071)	−0.003 (−0.073, 0.068)
Trust in physician score	--	--	** −0.137 (−0.228, −0.046)	** −0.139 (−0.227, −0.050)
Visits to providers, prev. 3 months	--	--	0.018 (−0.018, 0.053)	0.022 (−0.014, 0.058)
Rating of all care, prev. 12 months	--	--	0.025 (−0.003, 0.052)	0.019 (−0.008, 0.046)

Predicted probabilities are calculated using dy/dx marginal effects post-estimation commands following logistic regression models listed at the top of each column (**Models 1 and 2 are unadjusted logistic regression models without and with the mediator variable, respectively; Models 3 and 4 add to Models 1 and 2, respectively, all covariates and survey market**). Logistic regression models (and the resulting predicted probabilities) are weighted to be nationally-representative of chronically-ill U.S. adults adjusting for complex survey design. *0.05>p&≥0.01; **p<0.01

Patient Activation Measure stage ranges from 1-4 where 4 indicates higher patient activation.

Self-rated health ranges from 1-5 where 5 indicates excellent health.

Number of chronic illnesses rages from 1-5 (asthma, depression, diabetes, heart disease, and/or hypertension).

Diet and exercise index ranges from 0-2 where higher scores indicate better exercise and diet practices.

Trust in physician score ranges from 1-3, where 1 is “a lot” and 3 is “not at all.”

Number of visits to healthcare providers in the previous 3 months to treat conditions is categorized as 0, 1, 2, 3, or 4+ times.

Rating of all care received from all healthcare professionals in the previous 12 months ranges from 0-10 where 10 is the best possible score.

Table 3.

Binary mediation results for testing the mediation of racial/ethnic disparities in influenza vaccination by perceived discrimination in healthcare: AF4Q Consumer Survey, Chronically-Ill US Adults (2011–2012)

Binary mediation results	**Unadjusted for covariates N = 8,127**	**Adjusted for covariates N = 8,127**
a	0.3442	0.3368
b	−0.0567	−0.0145
a*b (indirect effect of X on Y)	−0.0195	−0.0049
95% confidence interval of a*b	(−0.0286, −0.0114)	(−0.0146, 0.0036)
Total effect of X on Y	−0.1203	−0.0808
Percent total effect mediated (percent indirect of total effect)	16.2%	6.0%

Results weighted to be nationally-representative of chronically-ill U.S. adults adjusting for complex survey design Results presented are transformed binary mediation coefficients a, b, a*b (the indirect effect; i.e., the mediation effect), the 95% confidence interval of a*b (to see if it is different from zero), and the percent indirect effect of the total effect (i.e., the percent of the relationship between race/ethnicity and influenza vaccination mediated by experiences of perceived discrimination in healthcare).