Determinants of healthcare provider recommendations for influenza vaccinations

Reginald Villacorta *, Neeraj Sood

Leonard D. Schaeffer Center for Health Policy and Economics, University of Southern California, Verna and Peter Dauterive Hall, 635 Downey Way, Los Angeles, CA 90089-3333, USA

ABSTRACT

Objective. Investigate determinants of receiving healthcare provider (HCP) recommendations for seasonal and H1N1 influenza vaccinations.

Methods. Using a United States national sample of adults 18 + from the National 2009 H1N1 Flu Survey, multivariate regression models estimated the likelihood of receiving a HCP recommendation. Covariates included demographics, socioeconomic status, and Advisory Committee on Immunization Practices (ACIP) priority groups.

Results. Adults age 55–64 and 65 + were more likely to report a HCP recommendation when compared to adults age 18–34 (OR: 1.483, 95%CI: 1.237–1.778 and OR: 1.738, 95%CI: 1.427–2.116, respectively). Chronically ill adults had 58.0% (95%CI: 1.414–1.765) higher odds of receiving a HCP recommendation than non-chronically ill adults. Patients visiting a doctor once and twice had 28.7% (95%CI: 0.618–0.821) and 17.1% (95%CI: 0.721–0.952) lower odds of receiving a HCP recommendation when compared to adults visiting their doctor at least four times. And, compared to Non-Hispanic Whites, Non-Hispanic Blacks had 28.4% (95%CI: 1.064–1.549) higher odds of receiving a recommendation.

Conclusions. ACIP priority groups experienced higher rates of recommendations compared to non-ACIP groups. Racial differences in HCP recommendations cannot explain racial disparities in flu vaccination rates.

© 2015 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Introduction

In the United States (US), influenza (i.e., the flu) infections result in >200,000 hospitalizations and 24,000 deaths on average (Groshkopf et al., 2013). Seasonal influenza vaccination is an important method for preventing the transmission of the influenza virus. Despite this recognition, gaps in vaccination coverage exist. Disparities in adult US influenza vaccination coverage exist between the elderly and non-elderly; populations at high-risk for influenza-related complications compared to otherwise; and, racial/ethnic minority groups compared to White, non-Hispanic groups (Lu et al., 2013; Centers for Disease Control and Prevention, 2011; Hebert et al., 2005; Fiscella, 2005; O'Malley & Forrest, 2006). For example, influenza vaccination coverage for Non-Hispanic Whites is approximately 10 percentage-points higher than Non-Hispanic Black and Hispanic adults (Lu et al., 2013; O'Malley & Forrest, 2006). And, White Medicare beneficiaries have a 1.52 higher odds of receiving an influenza vaccine in the past year than Black beneficiaries (O'Malley & Forrest, 2006).

Receipt of a physician recommendation for an influenza vaccination has been studied based on patient (Armstrong et al., 2001; Hemingway & Poehling, 2004; Lyn-Cook et al., 2007; Ding et al., 2011; Nichol et al., 1992; Gnanasekaran et al., 2006; Fiebach & Viscoli, 1991; Pandolfi

et al., 2012; Poehling et al., 2001; Mirza et al., 2008; Santibanez et al., 2010) or physician (Dominguez & Daum, 2005; Nichol & Zimmerman, 2001; Jessop et al., 2013; Levy et al., 2009) self-reports. These studies find a strong association between physician recommendation and the likelihood of obtaining an influenza vaccination for various patient groups. However, these studies predominantly focus on groups at high-risk for influenza-related complications (i.e., asthmatics, elderly adults) and racial/minority groups that have relatively low flu vaccine uptake. Therefore, there is limited generalizability to the general population.

Other studies demonstrate disparities in influenza vaccination rates for racial or ethnic minorities and those with lower socio-economic status (Takayama et al., 2012; Gu & Sood, 2011; Singleton et al., 2005; Annunziata et al., 2012). However, it is not known the extent to which these patient groups received flu vaccine recommendations from their provider. Examining the patient populations likely to report a physician recommendation can influence policy initiatives with the goal of reducing disparities in vaccination rates. Similar work related to factors associated with recommendations for human papillomavirus (HPV) vaccines were recently assessed from patient (Ylitalo et al., 2013) and provider (Vadaparampil et al., 2014) perspectives. These studies find disparities in HPV vaccine recommendations among racial/ethnic groups.

The first objective of this study is to investigate the association between healthcare provider recommendations for influenza vaccinations

* Corresponding author. Fax: +1 213 740 3460.
E-mail address: rvillaco@usc.edu (R. Villacorta).

and patient demographic, socioeconomic, and health access characteristics from a US population. The second objective is to determine whether Advisory Committee on Immunization Practices (ACIP) priority groups experienced flu vaccine recommendations from their healthcare provider at higher rates than non-ACIP priority groups.

Methods

Data source

Data came from the public-use National 2009 H1N1 Flu Survey (NHFS) by the Centers of Disease Control and Prevention (Department of Health & Human Servces (DHHS), 2012) and was reviewed by the National Center for Health Statistics Disclosure Review Board to protect participant privacy and data confidentiality. Households were identified from all 50 US states and the District of Columbia where both H1N1 and seasonal influenza vaccination coverage rates were evaluated, at national and state levels, for persons age ≥ 6 months. NHFS household interviews were conducted from October 2009 through June 2010. Interviews consisted of survey-respondent history of chronic conditions and respiratory illness; H1N1 and seasonal flu vaccination history; demographics and socioeconomic information; household characteristics; and, for adults, questions about knowledge, attitudes, and practices related to 2009 H1N1 and seasonal influenza. The reported Council of American Survey Research Organizations response rate range was 33.4% for landline telephones and 26.1% for cell phones (Department of Health & Human Servces (DHHS), 2012).

The NHFS is well suited to answer our research question because it is nationally representative, provides rates of reporting healthcare provider recommendations, and has rich information of respondent characteristics such as demographics, health care use, health status and beliefs about influenza vaccinations (Department of Health & Human Servces (DHHS), 2012).

Study population

This study focused on adult survey-respondents age 18 + that were interviewed from January through June 2010 and had visited a doctor's office, hospital, or clinic since August 2009 up to the interview date (Department of Health & Human Servces (DHHS), 2012). We focused on interviews conducted in January 2010 to June 2010 as the NFHS asked about doctor visits and other behaviors since August 2009. This means that using data from interviews conducted from October to December 2009 might not paint an accurate picture of provider recommendations or other behavior during the 2009–2010 flu season due to limited time between August 2009 and interview date and also because interviews in 2009 were conducted early in the 2009–2010 flu season. Restricting data to adults that visited a doctor's office, hospital, or clinic ensures that our primary outcome captures patients experiencing face-to-face flu vaccine recommendations that were likely tailored to the individual patient. Finally, we focused on adults because important respondent characteristics were only captured from adults (i.e., chronic medical condition status, work status, and opinions about the seasonal and H1N1 influenza vaccine).

Primary outcome measure

The primary outcome was adults' self-report of a doctor or other health professional personal recommendation for the H1N1 or seasonal flu vaccination since August 2009. Posted signs, newsletters, pamphlets, or television and radio ads were not considered a recommendation. Survey-respondents were given the following choices of HCP recommendations: (1) H1N1 flu vaccination; (2) seasonal flu vaccination; (3) both vaccinations; (4) neither vaccination; (5) don't know; and, (6) refused. Respondents reporting don't know and refused were grouped with neither vaccination response to create a four choice framework. These

respondents were less than 5% of the total respondents grouped into neither vaccination recommendation. For our primary outcome, respondents indicating they received a recommendation for H1N1 flu vaccination only, seasonal flu vaccination only, or both vaccinations were grouped together and defined as a dichotomous variable.

Explanatory variables

Prior studies have limited information on predictors of healthcare provider recommendations for influenza vaccines. Therefore, similar to work on recommendations for human papillomavirus vaccinations (Ylitalo et al., 2013), we utilize previously studied determinants of influenza vaccination to inform the variables in the adjusted models. This allows for a comprehensive comparison of differences in recommendation rates versus vaccination rates. For example, demographic characteristics such as males and non-White race are significantly associated with a lower likelihood of influenza vaccinations compared to females and White race groups, respectively. Further, compared to younger adults, older adults experience higher rates of influenza vaccinations (Takayama et al., 2012; Gu & Sood, 2011; Singleton et al., 2005; Annunziata et al., 2012; Centers for Disease Control and Prevention, 2009a; Centers for Disease Control and Prevention, 2009b). Similar to prior work, we also adjust for marital status, number of children, number of household adults, Metropolitan Statistical Area, and Census region of residence (Ding et al., 2011; Gu & Sood, 2011; Straits-Troster et al., 2006; Schneider et al., 2001; Lu et al., 2011; Mullahy, 1999; Egede & Zheng, 2003). Interview date was included in our multivariate analysis to adjust for any time varying events that could affect the primary outcome.

Socioeconomic characteristics such as adults with higher education, higher incomes, employment status, and home ownership status are more likely to receive an influenza vaccination (Takayama et al., 2012; Gu & Sood, 2011; Singleton et al., 2005; Annunziata et al., 2012; Nagata et al., 2011). Adults with health characteristics such as the presence of a chronic medical condition and poor health status are less likely to receive an influenza vaccination (Straits-Troster et al., 2006; Lu et al., 2011). We include similar variables in our multivariate analysis.

For this time period, the ACIP defined priority patient groups in the case of vaccination shortages or limitations. The NHFS captures these priority groups as healthcare workers, adults with chronic medical conditions, and adults 50 years or older (Department of Health & Human Servces (DHHS), 2012). These groups receive priority during vaccine shortages because, for example, chronically ill adults (i.e., asthmatics, diabetics) have higher likelihoods of receiving an influenza infection when compared to non-chronically ill adults (Takayama et al., 2012; Annunziata et al., 2012; Department of Health & Human Servces (DHHS), 2012).

We further adjust for access variables such as presence of health insurance and those who visit their doctor more frequently because these characteristics were associated with increased likelihood of influenza vaccinations (Takayama et al., 2012; Gu & Sood, 2011; Singleton et al., 2005; Annunziata et al., 2012). Lastly, negative beliefs and opinions about vaccine effectiveness (e.g., vaccine side effects) create significant barriers to vaccination that contribute to disparities in vaccination rates (Fiscella, 2005; O'Malley & Forrest, 2006; Armstrong et al., 2001; Santibanez et al., 2010; Singleton et al., 2005). Therefore, we examined whether HCP recommendations reach patients reporting similar barriers to vaccinations. In summary, these sample characteristics are grouped into demographic, socioeconomic, health, and access variables (Table 1A) and flu vaccine opinions (Table 1B).

Statistical analysis

Sample weights provided by the NHFS were used to account for the complex survey sampling design. These weighted estimates produce nationally representative estimates of persons vaccinated or having

Table 1A
Descriptive statistics of healthcare provider recommendations from the National 2009 H1N1 Flu Survey.

| | | | | Healthcare provider recommendation[a] | | |
| | | 95% Confidence interval | | | 95% Confidence interval | |
Variable	Weighted, %	Lower limit	Upper limit	Weighted, %	Lower limit	Upper limit
Demographic						
Age group						
18–34	26.2	25.1	27.4	36.2	33.6	38.8
35–44	16.5	15.5	17.5	37.3	34.2	40.4
45–54	20.1	19.2	21.1	35.2	32.6	37.8
55–64	16.6	15.8	17.4	47.1	44.7	49.6
65+	20.7	19.9	21.5	51.8	49.8	53.9
Race/ethnicity						
Hispanic	11.6	10.6	12.7	41.5	36.5	46.6
Non-Hispanic, Black only	12.6	11.7	13.5	43.0[b]	39.2	46.8
Non-Hispanic, White only	69.9	68.6	71.1	41.0	39.8	42.2
Non-Hispanic, other or multiple races	5.9	5.4	6.6	38.9	34.1	44.0
Gender						
Male	45.1	43.9	46.3	37.8	36.0	39.7
Female	54.9	53.7	56.1	44.0	42.5	45.5
Married						
Yes	52.7	51.5	53.9	42.9	41.3	44.5
No	41.5	40.3	42.7	39.8	38.0	41.6
Missing	5.8	5.2	6.5	35.5	30.3	41.1
Number of children						
0	64.4	63.2	65.6	41.8	40.5	43.2
1	14.6	13.7	15.5	40.5	37.2	44.0
2	12.3	11.5	13.2	37.5	34.0	41.2
3	7.8	7.1	8.6	43.1	38.0	48.3
Missing	1.0	0.7	1.3	40.1[c]	25.9	54.3
Number of people in household						
1	16.8	16.0	17.6	41.1	38.9	43.4
2	34.6	33.5	35.7	43.0	41.3	44.8
3	17.7	16.8	18.7	40.3	37.6	43.2
4	18.0	17.0	19.1	38.7	35.6	41.9
5	9.3	8.5	10.2	40.4	35.7	45.2
6	2.3	1.9	2.9	43.2[b]	32.8	53.7
7	1.2	0.9	1.7	42.8[d]	25.9	59.7
3-category MSA status						
MSA, principal city	31.9	30.8	33.2	41.0	38.7	43.3
MSA, not principal city	51.4	50.2	52.6	41.3	39.7	42.9
Non-MSA	16.6	15.9	17.4	41.3	39.0	43.6
Census region of residence[e]						
Region 1	19.0	18.4	19.6	47.2	44.5	49.9
Region 2	21.9	21.3	22.5	41.3	39.1	43.4
Region 3	37.2	36.5	38.0	39.4	37.6	41.2
Region 4	21.9	21.2	22.6	39.0	36.1	42.0
Interview date						
Jan-10	4.6	4.2	5.0	40.3	35.8	45.1
Feb-10	17.8	16.9	18.7	41.9	39.2	44.8
Mar-10	18.6	17.7	19.6	40.4	37.7	43.1
Apr-10	19.4	18.4	20.4	40.0	37.4	42.7
May-10	19.6	18.7	20.5	42.5	40.1	45.0
Jun-10	20.1	19.1	21.1	41.4	38.6	44.2
Socioeconomic						
Self-report education level						
<12 years	9.9	9.1	10.8	42.6	38.2	47.0
12 years	21.1	20.1	22.0	44.3	41.8	46.8
Some college	27.3	26.2	28.4	40.5	38.3	42.9
College graduate	35.9	34.9	37.1	40.5	38.8	42.3
Missing	5.8	5.2	6.4	34.9	29.7	40.5
Income poverty status						
Above poverty threshold, >=$75,000 income	26.5	25.4	27.5	39.6	37.5	41.7
Above poverty threshold, <$75,000 income	44.9	43.7	46.1	42.2	40.4	43.9
Below poverty threshold	11.8	10.9	12.7	44.1	40.1	48.2
Poverty status unknown	16.9	16.0	17.8	39.2	36.4	42.0
Work status						
Employed	50.4	49.2	51.6	37.8	36.1	39.4
Unemployed	6.5	5.9	7.2	37.6	32.4	43.1
Not in labor force	36.9	35.8	38.1	47.6	45.7	49.4
Don't know/Refused/Missing	6.2	6.2	5.5	34.9	30.0	40.3
Works in health care field						
No	86.2	85.3	87.0	40.9	39.7	42.2
Yes	11.2	10.4	12.0	44.9	41.2	48.7
Missing	2.6	2.3	3.1	34.7	28.2	41.8

Table 1A (continued)

| Variable | Weighted, % | 95% Confidence interval | | Healthcare provider recommendation[a] | | |
| | | Lower limit | Upper limit | Weighted, % | 95% Confidence interval | |
					Lower limit	Upper limit
Home rented or owned						
Home is owned	65.2	64.0	66.4	42.4	41.0	43.7
Home is rented or other arrangement	26.6	25.4	27.8	39.9	37.3	42.6
Don't know/Refused/Mising	8.2	7.5	9.0	36.4	32.2	40.7
HEALTH						
Chronic medical condition[f]						
No	66.6	65.5	67.7	36.1	34.6	37.5
Yes	30.3	29.3	31.4	53.2	51.1	55.2
Missing	3.0	2.7	3.5	34.9	29.2	41.1
Health status						
Sick with fever and cough or sore throat in past month						
No	92.6	91.9	93.2	40.9	39.7	42.1
Yes	5.5	5.0	6.1	49.1	44.0	54.3
Missing	1.9	1.6	2.3	32.9	25.5	41.2
Other people in house with fever and cough or sore throat						
No	81.6	80.5	82.6	41.1	39.8	42.3
Yes	16.7	15.7	17.7	42.6	39.3	46.1
Missing	1.8	1.5	2.1	33.5	25.6	42.5
Access						
Has health insurance coverage						
Yes	83.2	82.1	84.2	43.1	41.8	44.3
No	11.0	10.1	12.0	30.7	26.6	35.0
Don't know/Refused/Missing	5.8	5.2	6.5	34.8	29.6	40.4
Number of times seen doctor since August 2009						
>=4	28.8	27.7	29.9	48.8	46.6	51.0
3	14.7	13.8	15.6	44.4	41.1	47.7
2	27.1	26.0	28.2	39.6	37.4	41.9
1	27.8	26.7	28.8	33.2	31.2	35.3
Missing	1.7	1.5	2.0	40.8	33.7	48.3

[a] Healthcare provider recommendation was defined by grouping together respondents indicating they received a recommendation for H1N1 flu vaccination only, seasonal flu vaccination only, or both vaccinations as a dichotomous variable.

[b] 1 stratum omitted because it contains no subpopulation members.

[c] 4 strata omitted because it contains no subpopulation members.

[d] 10 strata omitted because it contains no subpopulation members.

[e] Region 1: CT, ME, MA, NH, VT, RI, NJ, NY, and PA; Region 2: IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, and SD; Region 3: DE, DC, FL, GA MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, and TX; Region 4: AZ, CO, ID, MT, NV, NM, UT, WY, AK, CA, HI, OR, and WA.

[f] This indicates whether the person has any of the following chronic medical conditions: asthma or another lung condition, diabetes, a heart condition, a kidney condition, sickle cell anemia or another anemia, a neurological or neuromuscular condition, a liver condition, or a weakened immune system caused by a chronic illness or by medicines taken for a chronic illness.

opinions about influenza vaccinations (Ylitalo et al., 2013; Department of Health & Human Servces (DHHS), 2012). We compare HCP recommendation rates with respondent characteristics to investigate associations between demographic, socioeconomic, health, access variables, and HCP recommendation. After adjusting for all variables presented in Tables 1A and 1B, multivariate logistic regression models examined significant determinants of HCP recommendations.

The 2009–2010 flu season was unique in providing both seasonal and H1N1 flu vaccinations, and there may be differences in HCP recommendations between these two vaccinations related to disease severity or infectiousness. Therefore, we conducted the following sensitivity analyses on the classification of HCP recommendations: defining the outcome as any seasonal (season flu vaccine only and both vaccinations) or any H1N1 (H1N1 flu vaccine only and both vaccinations) flu vaccine recommendations (Appendix A); relative risk ratios from a multinomial logit (MNL) model analyzing the polychotomous outcome of: no recommendation, receipt of H1N1 recommendation only, receipt of seasonal vaccination only, and receipt of both seasonal and H1N1 recommendations (Appendix B). To generalize our study to the prior literature, we estimated marginal effects where the primary outcome was HCP recommendation and compared them to marginal effects where the primary outcome was flu vaccinations (Appendix C). All analyses were conducted with Stata 11 (Stata Corp, College Station, TX).

Results

Unadjusted analyses of sample characteristics

Unadjusted analysis of the study population revealed older age was positively associated with receiving HCP recommendations (Table 1A). For example, 51.8% (95% CI: 49.8–53.9) of adults aged 65+ years received a HCP recommendation while 36.2% (95% CI: 33.6–38.8) of adults 18–34 years old received a HCP recommendation. The chronically ill and those with health insurance were more likely to report receiving HCP recommendation. For example, 43.1% (95% CI: 41.8–44.3) of insured adults received a HCP recommendation while 30.7% (95% CI: 26.6–35.0) of uninsured adults received a HCP recommendation. And, approximately one half (95%CI: 46.6–51.0) and a third (95%CI: 31.2–35.3) of patients with ≥4 and one doctor's visit received a HCP recommendation, respectively.

Table 1B reports the opinions about vaccine effectiveness, risk of getting sick with the flu without the vaccine, and worry about getting sick from the vaccine. First, the majority of our study sample considered the seasonal and H1N1 influenza vaccine as somewhat and very effective. These patient groups were more likely to have received a HCP recommendation. For example, 51.9% (95%CI: 50.0–53.9) of patients that considered the seasonal vaccine as very effective received a HCP recommendation compared to 26.9% (95%CI: 22.5–31.9) of patients that

Table 1B
Descriptive statistics of healthcare provider recommendations from the National 2009 H1N1 Flu Survey.

| Variable | Weighted, % | 95% Confidence interval | | Healthcare provider recommendation[a] | | |
| | | Lower limit | Upper limit | Weighted, % | 95% Confidence interval | |
					Lower limit	Upper limit
Opinions about flu vaccine						
Opinion: Effectiveness of H1N1 vaccine						
Very effective	30.3	29.2	31.5	49.9	47.6	52.2
Somewhat effective	44.2	43.0	45.4	39.5	37.8	41.2
Not very effective	7.1	6.5	7.8	32.1	28.3	36.2
Not at all effective	3.5	3.1	3.9	28.8	23.5	34.7
Don't know/Refused/Missing	14.9	14.1	15.7	35.8	33.1	38.7
Opinion: Risk of getting sick with H1N1 flu without vaccine						
Very high	6.9	6.3	7.7	60.9	55.6	66.0
Somewhat high	19.5	18.5	20.5	53.1	50.3	55.9
Somewhat low	35.9	34.8	37.0	39.8	37.9	41.8
Very low	32.9	31.9	34.1	31.8	29.9	33.6
Don't know/Refused/Missing	4.7	4.2	5.2	39.2	34.1	44.6
Opinion: Worry about getting sick from the H1N1 vaccine						
Very worried	9.7	8.9	10.5	46.1	41.7	50.6
Somewhat worried	22.7	21.7	23.8	46.6	44.0	49.2
Not very worried	33.6	32.5	34.8	39.5	37.6	41.5
Not at all worried	32.6	31.5	33.7	37.9	36.0	39.7
Don't know/Refused/Missing	1.3	1.1	1.7	39.2	34.1	44.6
Opinion: Effectiveness of seasonal vaccine						
Very effective	37.4	36.3	38.6	51.9	50.0	53.9
Somewhat effective	43.8	42.6	45.0	37.4	35.7	39.2
Not very effective	8.7	8.1	9.4	30.7	27.0	34.5
Not at all effective	4.7	4.2	5.3	26.9	22.5	31.9
Don't know/Refused/Missing	5.3	4.9	5.9	27.0	22.9	31.5
Opinion: Risk of getting sick with seasonal flu without vaccine						
Very high	12.2	11.3	13.1	56.1	52.1	60.0
Somewhat high	28.1	27.1	29.2	53.1	50.8	55.4
Somewhat low	33.4	32.3	34.5	35.0	33.2	36.9
Very low	22.6	21.6	23.7	27.7	25.5	30.0
Don't know/Refused/Missing	3.7	3.3	4.1	39.9	34.4	45.7
Opinion: Worry about getting sick from the seasonal vaccine						
Very worried	7.7	7.0	8.5	44.3	39.4	49.3
Somewhat worried	19.9	19.0	20.9	45.9	43.2	48.6
Not very worried	29.7	28.6	30.8	40.1	37.9	42.4
Not at all worried	40.9	39.8	42.2	39.5	37.8	41.1
Don't know/Refused/Missing	1.7	1.5	2.1	33.7	26.0	42.4

[a] Healthcare provider recommendation was defined by grouping together respondents indicating they received a recommendation for H1N1 flu vaccination only, seasonal flu vaccination only, or both vaccinations as a dichotomous variable.

considered the seasonal vaccine as not at all effective. Second, about two thirds of the study population thought that they had a "very low" or "somewhat low" risk of getting sick with flu without either vaccine. However, the perception of getting sick with the flu, without either vaccine, was positively associated with receiving a HCP recommendation. Lastly, the study population was not predominantly worried about getting sick from either the seasonal or H1N1 flu vaccine; where patients with high levels of worry were more likely to report having a HCP recommendation.

Adjusted analyses of HCP recommendations for flu vaccinations

The logistic regression model for the primary outcome of this study (Table 2) demonstrates that ACIP priority groups such as adults aged 55+ and those reporting a chronic medical condition were more likely to report a HCP recommendation compared to their non–ACIP counterparts. Compared to 18–34 year olds, adults 55–64 and 65+ were 48.3% (95%CI: 1.237–1.778, Table 2) and 73.8% (95%CI: 1.427–2.116, Table 2) more likely to receive a recommendation, respectively. Adults with a chronic medical condition were 58.0% (95%CI: 1.414–1.765, Table 2) more likely to report a recommendation versus adults with no chronic medical condition. And, healthcare workers, another ACIP priority group, were not significantly associated with a recommendation. Re–estimating the model (with and without race/ethnicity) in Table 2 by

only adjusting for significant variables in Tables 1A and 1B did not considerably alter the findings.

Patients with health insurance were more likely to receive a HCP recommendation compared to patients with no health insurance (OR: 1.448, 95%CI: 1.165–1.801, Table 2). Also, compared to adults visiting a doctor at least 4 times, patients visiting a doctor once were 28.7% less likely to receive a recommendation (OR: 0.713, 95%CI: 0.618–0.821, Table 2). Lastly, there were racial/ethnic differences in HCP recommendations; where Non-Hispanic Black only adults were more likely to receive a HCP recommendation when compared to Non-Hispanic White only adults (OR: 1.284, 95%CI: 1.064–1.549).

Sensitivity analyses of adjusted models

The sensitivity analysis of the primary outcome can be found in Appendices A–C. The results from these model specifications were similar to the Table 2 results with few exceptions. For example, the results for any H1N1 vaccine recommendation outcome suggest no differences in HCP recommendation rates between racial/minorities and Non-Hispanic, White adults (Model 2 — Appendix A). There were no significant correlations associated with H1N1 vaccine only recommendations and age, race/ethnicity, and frequency of doctor's visits (Model 1C — Appendix B). Combined, these results suggest that recipients of H1N1 flu vaccine recommendations were evenly distributed among age,

Table 2
Multivariate logistic regression for healthcare provider recommendations[a] from the National 2009 H1N1 Flu Survey.

Variable	Odds ratio	95% Confidence interval	
		Lower limit	Upper limit
Demographic			
Age group			
18–34	Reference		
35–44	1.001	0.828	1.211
45–54	0.952	0.798	1.136
55–64	1.483	1.237	1.778
65+	1.738	1.427	2.116
Race/ethnicity			
Hispanic	1.165	0.928	1.462
Non-Hispanic, Black only	1.284	1.064	1.549
Non-Hispanic, White only	Reference		
Non-Hispanic, other or multiple races	1.041	0.830	1.304
Gender			
Male	Reference		
Female	1.140	1.027	1.266
Married			
Yes	1.091	0.941	1.264
No	Reference		
Missing	1.302	0.622	2.724
Number of children			
0	Reference		
1	1.175	0.958	1.440
2	1.104	0.840	1.453
3	1.454	0.983	2.151
Missing	2.016	0.937	4.338
Number of people in household			
1	1.053	0.897	1.236
2	1.067	0.865	1.317
3	1.057	0.811	1.377
4	0.995	0.685	1.445
5	1.057	0.608	1.839
6	0.816	0.358	1.857
7	Reference		
3-category MSA status			
MSA, principal city	1.097	0.946	1.271
MSA, not principal city	1.060	0.933	1.205
Non-MSA	Reference		
Census region of residence[b]			
Region 1			
Region 2	0.752	0.648	0.872
Region 3	0.666	0.578	0.767
Region 4	0.662	0.559	0.784
Interview date			
Jan-10	Reference		
Feb-10	1.089	0.857	1.383
Mar-10	0.975	0.769	1.237
Apr-10	0.958	0.757	1.212
May-10	1.084	0.859	1.368
Jun-10	1.026	0.805	1.308
Socioeconomic			
Self-report education level			
<12 years	Reference		
12 years	1.180	0.946	1.473
Some college	1.092	0.870	1.370
College graduate	1.061	0.848	1.326
Missing	0.903	0.474	1.719
Income poverty status			
Above poverty threshold, >=$75,000 income	Reference		
Above poverty threshold, <$75,000 income	1.049	0.921	1.194
Below poverty threshold	1.065	0.841	1.348
Poverty status unknown	1.049	0.868	1.269
Work status			
Employed	Reference		
Unemployed	1.021	0.791	1.318
Not in labor force	1.066	0.935	1.216
Don't know/Refused/Missing	0.921	0.512	1.659
Works in health care field			
No	Reference		
Yes	1.101	0.931	1.301
Missing	1.193	0.620	2.298
Home rented or owned			
Home is owned	Reference		
Home is rented or other arrangement	0.940	0.812	1.089
Don't know/Refused/Missing	0.960	0.695	1.326

Table 2 (*continued*)

Variable	Odds ratio	95% Confidence interval	
		Lower limit	Upper limit
Health			
Chronic medical condition[c]			
No	Reference		
Yes	1.580	1.414	1.765
Missing	1.113	0.731	1.694
Health status			
Sick with fever and cough or sore throat in past month			
No	Reference		
Yes	1.115	0.882	1.408
Missing	0.867	0.399	1.886
Other people in house with fever and cough or sore throat			
No	Reference		
Yes	0.966	0.821	1.137
Missing	0.778	0.413	1.465
Access			
Has health insurance coverage			
Yes	1.448	1.165	1.801
No	Reference		
Don't know/Refused/Missing	1.154	0.522	2.548
Number of times seen doctor since August 2009			
>=4	Reference		
3	0.915	0.778	1.076
2	0.829	0.721	0.952
1	0.713	0.618	0.821
Missing	0.746	0.531	1.048

[a] The regression model controls for variables reported in Table 1B. The relationships between the Table 1B variables and recommendations can be found in the Appendix tables. The outcome for this model was defined by grouping together respondents indicating they received a recommendation for H1N1 flu vaccination only, seasonal flu vaccination only, or both vaccinations as a dichotomous variable.

[b] Region 1: CT, ME, MA, NH, VT, RI, NJ, NY, and PA; Region 2: IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, and SD; Region 3: DE, DC, FL, GA MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, and TX; Region 4: AZ, CO, ID, MT, NV, NM, UT, WY, AK, CA, HI, OR, and WA.

[c] This indicates whether the person has any of the following chronic medical conditions: asthma or another lung condition, diabetes, a heart condition, a kidney condition, sickle cell anemia or another anemia, a neurological or neuromuscular condition, a liver condition, or a weakened immune system caused by a chronic illness or by medicines taken for a chronic illness.

race/ethnicity, and frequency of doctor's visit when compared to seasonal flu vaccine recommendations.

The MNL model results (Appendix B) demonstrate that recommendation disparities in key variables (i.e., age, race/ethnicity, and chronic illness status) were driven by seasonal flu vaccine recommendations rather than H1N1 flu vaccine recommendations. For example, Table 2 demonstrates that adults age 65+ and Non-Hispanic Black groups were more likely to receive recommendations compared to adults age 18–34 years and Non-Hispanic Whites, respectively. From Model 1C — Appendix B, these disparities do not exist when the outcome is H1N1 vaccine only. A similar trend can be ascertained when comparing the MNL model results to any H1N1 flu vaccine (Model 2 — Appendix A), where receiving a recommendation for both seasonal and H1N1 flu vaccines does not contribute to disparities in recommendations for age and race/ethnicity groups.

Lastly, similar to previous research, a HCP recommendation was significantly associated with obtaining seasonal and H1N1 flu vaccinations (Model 2 — Appendix C). Furthermore, this analysis reveals patients with low levels of opinion about seasonal flu vaccine effectiveness were less likely to receive a recommendation and any vaccine when compared to patients with high levels of opinion about seasonal flu vaccine effectiveness (Models 1 and 2 — Appendix C). Patients with low risk perceptions of getting sick with seasonal flu without the vaccine experienced similar negative associations with recommendations and vaccinations.

Discussion

Previous research on healthcare provider recommendations for influenza vaccination considers its effect on vaccination uptake. By characterizing the patient groups reporting a HCP recommendation, our study provides two important findings about determinants of HCP recommendations for flu vaccines.

First, our study demonstrates that Non-Hispanic, Black adults (a racial/ethnic group typically less likely to obtain a flu vaccine) (Lu et al., 2013; Centers for Disease Control and Prevention, 2011; Hebert et al., 2005; Fiscella, 2005) were more likely to receive a recommendation compared to Non-Hispanic, White adults (Table 2). These findings suggest that disparities in HCP recommendation rates by race/ethnicity are not a likely explanation for disparities in flu vaccination rates by race/ethnicity. This naturally raises the question: Why do Non-Hispanic Black adults have lower vaccination rates despite receiving higher rates of HCP recommendations? One potential reason is that Non-Hispanic Black adults might be less receptive to advice from healthcare providers. For example, this demographic group may be resistant to vaccinations (Hebert et al., 2005) or more concerned about being experimented upon by physicians without consent (Fiscella, 2005). Another explanation might be that racial/ethnic minority groups experience healthcare discrimination that may influence interactions within the healthcare setting leading to low patient adherence (MacIntosh et al., 2013). Finally, other differences between racial/ethnic minority groups and Non-Hispanic Whites such as socio-economic status and trust in modern health care might explain the disparities in vaccination rates (O'Malley & Forrest, 2006). Future research should carefully evaluate the importance of each of the above explanations to identify potential interventions for improving vaccination rates among minority racial/ethnic groups.

Second, ACIP priority groups are more likely to receive recommendations compared to non-ACIP groups and recommendations can contribute, in large part, towards obtaining a flu vaccination.

For example, from Models 1 and 2 — Appendix C, our sample population has a 33.1% increased probability of obtaining flu vaccination given a vaccine recommendation from their provider. Chronically ill adults have a 4.9% higher chance of obtaining a flu vaccine compared to non-chronically ill adults. Moreover, chronically ill adults have a 10.9% higher chance of receiving a recommendation for flu vaccines compared to non-chronically ill adults. Taken together, receiving flu vaccine recommendations from providers explains 73.6% (i.e., 33.1% times 10.9% and divided by 4.9%) of the difference in flu vaccination rates between chronically ill and non-chronically ill adults.

The HealthyPeople 2020 influenza vaccination goals suggest that further research is needed to improve vaccination rates for all patient groups (HealthyPeople2020, 2013). This study demonstrates that certain patient groups did not experience flu vaccine recommendations from their provider during the 2009–2010 flu season. The National Vaccine Advisory Committee has recently outlined recommendations as a standard for providers (Bhatt et al., 2014; Fiore et al., 2009). This is a promising step towards ensuring that recommendations reach all patient groups. However, relevant recommendation policies should also consider how provider recommendations reach patients and how providers respond when patients voice resistance to vaccine recommendations (Opel et al., 2013).

There are several limitations to this study. First, it is likely that some doctor's visits were to non-primary care physicians or healthcare providers who are less likely to recommend seasonal and H1N1 flu vaccination. Ideally, we would like to distinguish between visits to primary care physicians versus other providers but we did not have data to make this distinction. Second, just like several other papers in this literature, we use self-reports to measure receipt of provider recommendation. Our findings might be biased due to measurement error if respondents misreport receipt of provider recommendations due to recall bias or other reasons. However, it is challenging to improve measurement of provider recommendations, as it is not feasible to observe doctor–patient interactions for a large representative sample of the US population. Finally, our findings show that patients who support flu vaccinations are likely to report a recommendation. However, this is an association and it is unclear whether provider recommendations change beliefs about flu vaccinations or whether patients predisposed to certain beliefs seek provider recommendations. Longitudinal studies that examine whether providers know about their patient's opinions prior to recommendations can further assess temporal differences in recommendation rates. And, future work may wish to discern how the provider delivered the recommendation (i.e., whether the recommendation was a face-to-face verbal communication).

There are limited studies in describing patient characteristics associated with influenza vaccine provider recommendations. Despite this limitation, we use prior work on patient characteristics associated with influenza vaccinations to inform our model adjustments. The advantage of this approach is that it considers prior relationships in vaccination status. However, it is possible that these relationships may not be relevant to a provider recommendation, which we demonstrate in our study. Thus, it is important that future research explores the relative associations of similar patient characteristics with provider recommendations for influenza vaccines.

Further, unique to the 2009–2010 flu season, the distinction between seasonal and H1N1 flu vaccinations may not be fully understood by survey-respondents. However, our sensitivity analyses related to this distinction suggest generally robust results (Appendices A–B). And, it is possible that respondents reporting don't know and refused, as a response to whether they received a recommendation, couldn't differentiate between recommendations of vaccinations. We re-estimated our primary analysis by excluding these respondent groups. When compared to Table 2, the findings did not significantly change (data available upon request). However, since the 2009–2010 flu season experienced the H1N1 flu pandemic, these findings may not generalize to other flu seasons. Although, these results are relevant to future influenza pandemics because policies related to ensuring influenza vaccination coverage will benefit from our study conclusions on HCP recommendations.

Conclusions

Healthcare provider recommendations for influenza vaccinations play an important role in improving vaccination rates, especially among ACIP priority groups. This study demonstrates that these priority groups were more likely to report healthcare provider recommendations for influenza vaccinations during the 2009–2010 flu season when compared to non-priority groups. Unlike similar studies in HPV vaccine recommendations, Non-Hispanic Blacks were more likely to receive recommendations compared to Non-Hispanic Whites.

Conflict of interest and financial disclosure statement

The authors have neither financial disclosures nor conflicts of interest to declare.

Appendix A. Sensitivity of logit model outcomes[a]

Recommendation	Any seasonal flu vaccine			Any H1N1 flu vaccine		
	Model 1			Model 2		
		95% Confidence interval			95% Confidence interval	
Variable	Odds ratio	Lower limit	Upper limit	Odds ratio	Lower limit	Upper limit
Demographic						
Age group						
18–34	Reference					
35–44	1.026	0.848	1.240	0.854	0.691	1.055
45–54	1.054	0.880	1.262	0.742	0.607	0.907
55–64	1.648	1.372	1.978	0.994	0.814	1.215
65 +	2.030	1.671	2.466	0.887	0.712	1.104
Race/ethnicity						
Hispanic	1.080	0.857	1.362	1.055	0.826	1.349
Non-Hispanic, Black Only	1.263	1.049	1.522	1.099	0.896	1.349

Appendix A (*continued*)

Recommendation	Any seasonal flu vaccine			Any H1N1 flu vaccine		
	Model 1			Model 2		
		95% Confidence interval			95% Confidence interval	
Variable	Odds ratio	Lower limit	Upper limit	Odds ratio	Lower limit	Upper limit
Race/ethnicity						
Non-Hispanic, White only	Reference					
Non-Hispanic, other or multiple races	1.018	0.807	1.285	0.833	0.651	1.066
Gender						
Male	Reference					
Female	1.140	1.027	1.266	1.061	0.943	1.194
Married						
Yes	1.045	0.906	1.206	1.131	0.955	1.340
No	Reference					
Missing	1.195	0.529	2.703	1.064	0.600	1.885
Number of children						
0	Reference					
1	1.153	0.939	1.414	1.250	0.996	1.569
2	1.094	0.825	1.451	1.224	0.908	1.651
3	1.279	0.853	1.919	1.497	0.966	2.318
Missing	1.934	0.868	4.306	1.533	0.617	3.809
Number of people in household						
1	Reference					
2	1.098	0.936	1.288	1.042	0.867	1.253
3	1.101	0.895	1.354	1.037	0.813	1.323
4	1.210	0.925	1.584	0.970	0.724	1.299
5	1.125	0.770	1.645	1.010	0.666	1.531
6	0.835	0.504	1.384	1.227	0.671	2.245
7	0.867	0.384	1.958	0.666	0.267	1.662
3-category Metropolitan Statistical Area (MSA) status	Reference					
MSA, principal city	1.140	0.985	1.320	1.101	0.932	1.299
MSA, not principal city	1.057	0.930	1.202	0.977	0.846	1.129
Non-MSA						
Census region of residence[b]						
Region 1	Reference					
Region 2	0.736	0.634	0.855	0.817	0.693	0.963
Region 3	0.662	0.574	0.764	0.729	0.624	0.851
Region 4	0.644	0.542	0.766	0.798	0.663	0.961
Interview date						
10-Jan	Reference					
10-Feb	1.002	0.792	1.267	1.059	0.818	1.372
10-Mar	0.948	0.749	1.199	0.929	0.722	1.195
10-Apr	0.948	0.751	1.198	0.921	0.717	1.183
10-May	1.006	0.799	1.267	1.118	0.873	1.431
10-Jun	0.959	0.755	1.219	1.025	0.790	1.329
Socioeconomic						
Self-report education level						
<12 years	Reference					
12 years	1.249	0.998	1.563	1.192	0.925	1.537
Some college	1.078	0.860	1.351	1.253	0.967	1.624
College graduate	1.094	0.875	1.369	1.249	0.965	1.616
Missing	0.936	0.465	1.884	2.196	1.151	4.190
Income poverty status						
Above poverty threshold, >=$75,000 income	Reference					
Above poverty threshold, <$75,000 income	1.001	0.879	1.140	0.982	0.851	1.133
Below poverty threshold	0.956	0.751	1.218	1.067	0.821	1.386
Poverty status unknown	1.047	0.864	1.269	0.988	0.800	1.220
Work status						
Employed	Reference					
Unemployed	0.893	0.701	1.137	1.093	0.823	1.452
Not in labor force	1.064	0.933	1.213	1.003	0.869	1.159
Don't know/Refused/Missing	1.033	0.556	1.918	0.552	0.303	1.006
Works in health care field						
No	Reference					
Yes	1.155	0.977	1.365	1.263	1.055	1.512
Missing	1.200	0.609	2.363	0.995	0.445	2.225
Home rented or owned						
Home is owned	Reference					
Home is rented or other arrangement	0.875	0.754	1.016	0.958	0.813	1.130
Don't know/Refused/Missing	0.893	0.643	1.241	1.118	0.789	1.583
Health						
Chronic medical condition[c]						
No	Reference					
Yes	1.620	1.449	1.811	1.607	1.423	1.814
Missing	1.201	0.792	1.821	0.897	0.548	1.468

Appendix A (*continued*)

Recommendation	Any seasonal flu vaccine			Any H1N1 flu vaccine		
	Model 1			Model 2		
		95% Confidence interval			95% Confidence interval	
Variable	Odds ratio	Lower limit	Upper limit	Odds ratio	Lower limit	Upper limit
Health status						
Sick with fever and cough or sore throat in past month						
No	Reference					
Yes	1.127	0.893	1.423	1.057	0.819	1.365
Missing	0.865	0.397	1.884	1.210	0.538	2.717
Other people in house with fever and cough or sore throat						
No	Reference					
Yes	0.888	0.755	1.044	0.948	0.797	1.127
Missing	0.706	0.357	1.395	0.684	0.308	1.517
Access						
Has health insurance coverage						
Yes	1.555	1.244	1.945	1.188	0.933	1.513
No	Reference					
Don't know/Refused/Missing	1.308	0.588	2.906	0.848	0.398	1.808
Number of times seen doctor since August 2009						
>=4	Reference					
3	0.906	0.770	1.066	0.944	0.792	1.125
2	0.845	0.735	0.970	0.878	0.753	1.025
1	0.694	0.603	0.799	0.797	0.680	0.935
Missing	0.770	0.547	1.085	0.724	0.502	1.045
Opinions about flu vaccine						
Opinion: Effectiveness of H1N1 vaccine						
Very effective	Reference					
Somewhat effective	0.963	0.845	1.098	0.608	0.531	0.696
Not very effective	1.065	0.847	1.340	0.449	0.346	0.582
Not at all effective	0.934	0.657	1.327	0.675	0.462	0.986
Don't know/Refused/Missing	0.964	0.809	1.150	0.498	0.403	0.615
Opinion: Risk of getting sick with H1N1 flu without vaccine						
Very high	Reference					
Somewhat high	0.879	0.684	1.131	0.692	0.541	0.885
Somewhat low	0.835	0.644	1.083	0.386	0.297	0.501
Very low	0.712	0.543	0.935	0.262	0.199	0.345
Don't know/Refused/Missing	0.875	0.598	1.279	0.459	0.314	0.670
Opinion: Worry about getting sick from the H1N1 vaccine						
Very worried	Reference					
Somewhat worried	1.052	0.824	1.344	1.093	0.847	1.411
Not very worried	0.962	0.751	1.233	0.738	0.570	0.956
Not at all worried	1.012	0.785	1.305	0.915	0.703	1.191
Don't know/Refused/Missing	1.027	0.500	2.108	1.038	0.515	2.092
Opinion: Effectiveness of seasonal vaccine						
Very effective	Reference					
Somewhat effective	0.709	0.626	0.802	0.951	0.827	1.094
Not very effective	0.603	0.483	0.753	1.113	0.872	1.421
Not at all effective	0.554	0.411	0.747	0.915	0.664	1.261
Don't know/Refused/Missing	0.416	0.303	0.571	0.926	0.655	1.310
Opinion: Risk of getting sick with seasonal flu without vaccine						
Very high	Reference					
Somewhat high	0.941	0.781	1.134	1.163	0.959	1.411
Somewhat low	0.539	0.441	0.659	0.945	0.764	1.168
Very low	0.421	0.333	0.532	1.003	0.781	1.289
Don't know/Refused/Missing	0.742	0.501	1.098	1.219	0.810	1.834
Opinion: Worry about getting sick from the seasonal vaccine						
Very worried	Reference					
Somewhat worried	1.247	0.948	1.639	1.082	0.809	1.446
Not very worried	1.096	0.830	1.446	1.184	0.883	1.589
Not at all worried	1.143	0.871	1.501	1.085	0.815	1.444
Don't know/Refused/Missing	1.377	0.676	2.806	1.157	0.585	2.290

[a] The outcome from Model 1 was defined by grouping together respondents indicating that they received a recommendation for a seasonal flu vaccination only or both seasonal and H1N1 vaccinations as dichotomous variable. Grouping together respondents indicating they received a recommendation for the H1N1 flu vaccination only or both seasonal and H1N1 vaccinations defined the dichotomous outcome from Model 2.

[b] Region 1: CT, ME, MA, NH, VT, RI, NJ, NY, and PA; Region 2: IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, and SD; Region 3: DE, DC, FL, GA MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, and TX; Region 4: AZ, CO, ID, MT, NV, NM, UT, WY, AK, CA, HI, OR, and WA.

[c] This indicates whether the person has any of the following chronic medical conditions: asthma or another lung condition, diabetes, a heart condition, a kidney condition, sickle cell anemia or another anemia, a neurological or neuromuscular condition, a liver condition, or a weakened immune system caused by chronic illness or by medicines taken for a chronic illness.

Appendix B. Multinomial logit model of healthcare provider recommendations[a]

Recommendation	Both seasonal and H1N1 flu vaccines			Seasonal flu vaccine only			H1N1 flu vaccine only		
	Model 1A			Model 1B			Model 1C		
	RRR	95% Confidence interval		RRR	95% Confidence interval		RRR	95% Confidence interval	
Variable	RRR	Lower limit	Upper limit	RRR	Lower limit	Upper limit	RRR	Lower limit	Upper limit
Demographic									
Age group									
18–34	Reference								
35–44	0.890	0.715	1.107	1.344	0.989	1.826	0.885	0.590	1.328
45–54	0.827	0.666	1.028	1.512	1.160	1.972	0.663	0.443	0.993
55–64	1.276	1.028	1.584	2.535	1.935	3.321	0.843	0.560	1.270
65 +	1.328	1.050	1.679	3.431	2.598	4.530	0.604	0.386	0.944
Race/ethnicity									
Hispanic	1.027	0.779	1.355	1.296	0.943	1.783	1.410	0.902	2.205
Non-Hispanic, Black Only	1.178	0.945	1.468	1.444	1.128	1.849	1.197	0.813	1.764
Non-Hispanic, White only	Reference								
Non-Hispanic, other or multiple races	0.838	0.642	1.095	1.383	0.988	1.936	1.077	0.646	1.796
Gender									
Male	Reference								
Female	1.103	0.971	1.253	1.202	1.044	1.384	1.106	0.865	1.416
Married									
Yes	1.102	0.926	1.312	0.979	0.808	1.187	1.199	0.829	1.734
No	Reference								
Missing	1.050	0.529	2.081	1.544	0.415	5.747	1.874	0.785	4.470
Number of children									
0	Reference								
1	1.269	0.997	1.615	1.010	0.750	1.362	1.171	0.707	1.940
2	1.223	0.879	1.702	0.875	0.583	1.314	1.191	0.713	1.990
3	1.440	0.878	2.361	1.212	0.701	2.094	1.807	0.899	3.629
Missing	1.783	0.588	5.405	2.464	1.041	5.829	2.149	0.645	7.161
Number of people in household									
1	Reference								
2	1.104	0.906	1.344	1.099	0.891	1.356	0.898	0.597	1.350
3	1.090	0.841	1.411	1.140	0.871	1.493	0.970	0.561	1.676
4	1.143	0.828	1.576	1.235	0.851	1.792	0.607	0.345	1.065
5	1.142	0.723	1.805	1.061	0.639	1.760	0.689	0.309	1.534
6	0.997	0.547	1.816	0.797	0.379	1.677	1.388	0.542	3.559
7	0.683	0.257	1.811	1.197	0.406	3.528	0.708	0.146	3.424
3-category Metropolitan Statistical Area (MSA) status									
MSA, principal city	1.182	0.987	1.415	1.056	0.876	1.273	0.899	0.620	1.302
MSA, not principal city	1.002	0.856	1.173	1.165	0.990	1.372	1.028	0.751	1.408
Non-MSA	Reference								
Census region of residence[b]									
Region 1	Reference								
Region 2	0.729	0.610	0.872	0.725	0.594	0.884	0.894	0.618	1.294
Region 3	0.640	0.540	0.757	0.672	0.556	0.812	0.802	0.554	1.162
Region 4	0.680	0.556	0.832	0.557	0.437	0.711	0.859	0.564	1.310
Interview date									
10-Jan	Reference								
10-Feb	1.000	0.761	1.314	1.065	0.765	1.482	1.466	0.760	2.826
10-Mar	0.904	0.689	1.186	1.021	0.737	1.415	1.100	0.583	2.076
10-Apr	0.908	0.693	1.191	1.005	0.727	1.389	0.992	0.528	1.861
10-May	1.055	0.808	1.377	1.004	0.729	1.381	1.467	0.788	2.730
10-Jun	0.966	0.732	1.275	1.010	0.724	1.409	1.345	0.711	2.544
Socioeconomic									
Self-report education level									
<12 years	Reference								
12 years	1.328	1.002	1.761	1.101	0.832	1.455	0.907	0.560	1.468
Some college	1.243	0.937	1.650	0.914	0.688	1.214	1.157	0.725	1.847
College graduate	1.282	0.966	1.702	0.869	0.657	1.150	0.953	0.569	1.599
Missing	2.005	0.957	4.199	0.255	0.081	0.796	0.723	0.225	2.320
Income poverty status									
Above poverty threshold, >=$75,000 income	Reference								
Above poverty threshold, <$75,000 income	0.963	0.828	1.120	1.127	0.939	1.353	1.270	0.885	1.824
Below poverty threshold	0.983	0.731	1.322	1.014	0.737	1.396	1.441	0.910	2.283
Poverty status unknown	1.014	0.806	1.276	1.133	0.874	1.467	1.028	0.614	1.721
Work status									
Employed	Reference								
Unemployed	0.945	0.709	1.261	0.919	0.648	1.305	1.446	0.883	2.366
Not in labor force	1.026	0.880	1.196	1.131	0.942	1.357	1.057	0.765	1.460
Don't know/Refused/Missing	0.642	0.318	1.297	1.680	0.768	3.677	0.513	0.175	1.506

Appendix B (*continued*)

Recommendation	Both seasonal and H1N1 flu vaccines			Seasonal flu vaccine only			H1N1 flu vaccine only		
	Model 1A			Model 1B			Model 1C		
		95% Confidence interval			95% Confidence interval			95% Confidence interval	
Variable	RRR	Lower limit	Upper limit	RRR	Lower limit	Upper limit	RRR	Lower limit	Upper limit
Works in health care field									
No	Reference								
Yes	1.303	1.082	1.571	0.841	0.641	1.103	0.906	0.571	1.437
Missing	1.091	0.432	2.751	1.653	0.781	3.496	1.008	0.265	3.841
Home rented or owned									
Home is owned	Reference								
Home is rented or other arrangement	0.876	0.730	1.051	0.934	0.769	1.135	1.218	0.875	1.697
Don't know/Refused/Missing	1.002	0.673	1.492	0.807	0.533	1.222	1.409	0.719	2.759
HEALTH									
Chronic medical condition[c]									
No	Reference								
Yes	1.862	1.628	2.129	1.372	1.187	1.586	1.204	0.930	1.558
Missing	1.033	0.601	1.773	1.357	0.802	2.297	0.614	0.202	1.861
Health status									
Sick with fever and cough or sore throat in past month									
No	Reference								
Yes	1.120	0.843	1.486	1.182	0.870	1.605	1.053	0.644	1.722
Missing	1.147	0.461	2.856	0.654	0.228	1.878	1.018	0.292	3.548
Other people in house with fever and cough or sore throat									
No	Reference								
Yes	0.865	0.717	1.044	0.994	0.785	1.258	1.279	0.919	1.779
Missing	0.572	0.224	1.458	0.957	0.438	2.091	1.312	0.538	3.194
ACCESS									
Has health insurance coverage									
Yes	1.400	1.074	1.825	1.888	1.356	2.628	1.122	0.765	1.647
No	Reference								
Don't know/Refused/Missing	1.027	0.461	2.288	1.870	0.536	6.523	0.855	0.207	3.537
Number of times seen doctor since August 2009									
>= 4	Reference								
3	0.908	0.748	1.101	0.903	0.733	1.111	1.005	0.682	1.482
2	0.843	0.713	0.997	0.811	0.672	0.978	0.832	0.592	1.171
1	0.702	0.593	0.832	0.665	0.549	0.806	0.888	0.626	1.260
Missing	0.688	0.457	1.036	0.838	0.535	1.313	0.660	0.314	1.386
OPINIONS ABOUT FLU VACCINE									
Opinion: Effectiveness of H1N1 vaccine									
Very effective	Reference								
Somewhat effective	0.687	0.591	0.799	1.548	1.292	1.854	0.591	0.439	0.795
Not very effective	0.575	0.437	0.757	2.202	1.596	3.039	0.365	0.200	0.665
Not at all effective	0.729	0.466	1.140	1.344	0.854	2.114	0.665	0.349	1.267
Don't know/Refused/Missing	0.600	0.481	0.750	1.659	1.326	2.076	0.421	0.235	0.754
Opinion: Risk of getting sick with H1N1 flu without vaccine									
Very high	Reference								
Somewhat high	0.754	0.574	0.991	1.199	0.738	1.949	0.571	0.370	0.881
Somewhat low	0.494	0.370	0.660	1.894	1.170	3.064	0.269	0.169	0.428
Very low	0.336	0.248	0.456	1.956	1.187	3.224	0.195	0.117	0.324
Don't know/Refused/Missing	0.608	0.394	0.938	1.509	0.845	2.694	0.179	0.090	0.357
Opinion: Worry about getting sick from the H1N1 vaccine									
Very worried	Reference								
Somewhat worried	1.059	0.803	1.397	1.177	0.810	1.711	1.362	0.828	2.242
Not very worried	0.749	0.564	0.995	1.453	1.000	2.110	0.994	0.598	1.653
Not at all worried	0.932	0.695	1.248	1.212	0.836	1.758	0.978	0.579	1.653
Don't know/Refused/Missing	0.918	0.395	2.133	1.520	0.632	3.658	2.649	0.892	7.869
Opinion: Effectiveness of seasonal vaccine									
Very effective	Reference								
Somewhat effective	0.795	0.684	0.923	0.634	0.536	0.750	1.233	0.882	1.724
Not very effective	0.848	0.648	1.111	0.382	0.266	0.548	1.494	0.927	2.408
Not at all effective	0.711	0.496	1.019	0.415	0.268	0.643	1.181	0.643	2.169
Don't know/Refused/Missing	0.608	0.407	0.908	0.275	0.183	0.413	1.485	0.745	2.960
Opinion: Risk of getting sick with seasonal flu without vaccine									
Very high	Reference								
Somewhat high	1.050	0.850	1.296	0.862	0.658	1.128	1.622	1.023	2.572

Appendix B (continued)

Recommendation	Both seasonal and H1N1 flu vaccines			Seasonal flu vaccine only			H1N1 flu vaccine only		
	Model 1A			Model 1B			Model 1C		
		95% Confidence interval			95% Confidence interval			95% Confidence interval	
Variable	RRR	Lower limit	Upper limit	RRR	Lower limit	Upper limit	RRR	Lower limit	Upper limit
Opinion: Risk of getting sick with seasonal flu without vaccine									
Somewhat low	0.664	0.528	0.835	0.448	0.332	0.605	1.847	1.142	2.988
Very low	0.618	0.472	0.810	0.296	0.213	0.411	2.232	1.267	3.930
Don't know/Refused/Missing	0.912	0.573	1.453	0.653	0.394	1.082	2.850	1.291	6.292
Opinion: Worry about getting sick from the seasonal vaccine									
Very worried	Reference								
Somewhat worried	1.223	0.889	1.681	1.199	0.816	1.762	0.757	0.413	1.388
Not very worried	1.178	0.849	1.636	1.014	0.691	1.488	1.124	0.639	1.979
Not at all worried	1.151	0.834	1.589	1.092	0.754	1.582	0.898	0.512	1.573
Don't know/Refused/Missing	1.371	0.651	2.889	1.332	0.466	3.809	0.634	0.159	2.524

Abbreviations: RRR, relative risk ratio.

[a] Model 1A, 1B, and 1C outcomes were binary variables equal to one when the respondent indicated that they received recommendations for both seasonal and H1N1 flu vaccinations, seasonal flu only vaccination, and H1N1 flu only vaccination, respectively. The comparator group for these models was whether the respondent replied with neither, don't know, and refused for whether they receive any seasonal and H1N1 flu vaccination recommendations. We conduct a multinomial probit model specification and, when compared to the multinomial logit model, there were no significant differences. Therefore, we maintain the presentation of findings using the logit model as described in the manuscript.

[b] Region 1: CT, ME, MA, NH, VT, RI, NJ, NY, and PA; Region 2: IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, and SD; Region 3: DE, DC, FL, GA MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, and TX; Region 4: AZ, CO, ID, MT, NV, NM, UT, WY, AK, CA, HI, OR, and WA.

[c] This indicates whether the person has any of the following chronic medical conditions: asthma or another lung condition, diabetes, a heart condition, a kidney condition, sickle cell anemia or another anemia, a neurological or neuromuscular condition, a liver condition, or a weakened immune system caused by a chronic illness or by medicines taken for a chronic illness.

Appendix C. Predicted probabilities for healthcare provider recommendations and flu vaccines[a]

Outcome	Any seasonal and H1N1 flu vaccine recommendation			Any seasonal and H1N1 flu vaccine		
	Model 1			Model 2		
		95% Confidence interval			95% Confidence interval	
Variable	dy/dx	Lower limit	Upper limit	dy/dx	Lower limit	Upper limit
Provider recommendation for seasonal and H1N1 flu vaccines						
Yes				0.33135	0.29945	0.36324
No				Reference		
Demographic						
Age group						
18–34	Reference					
35–44	0.00034	−0.04534	0.04601	−0.01681	−0.07072	0.03710
45–54	−0.01174	−0.05421	0.03073	0.08610	0.03679	0.13541
55–64	0.09474	0.05133	0.13815	0.18342	0.13019	0.23666
65+	0.13282	0.08566	0.17999	0.31243	0.25295	0.37192
Race/ethnicity						
Hispanic	0.03664	−0.01798	0.09127	−0.05534	−0.12232	0.01164
Non-Hispanic, Black Only	0.06010	0.01493	0.10527	−0.04546	−0.10057	0.00965
Non-Hispanic, White only	Reference					
Non-Hispanic, other or multiple races	0.00957	−0.04471	0.06385	0.03571	−0.03004	0.10147
Gender						
Male	Reference					
Female	0.03156	0.00642	0.05670	−0.00810	−0.03914	0.02294
Married						
Yes	0.02085	−0.01461	0.05631	0.01462	−0.02671	0.05594
No	Reference					
Missing	0.06338	−0.11412	0.24089	−0.00898	−0.22514	0.20718
Number of children						
0	Reference					
1	0.03867	−0.01034	0.08769	0.05012	−0.00609	0.10633
2	0.02387	−0.04201	0.08976	0.10915	0.03523	0.18307
3	0.09002	−0.00392	0.18396	0.13397	0.02337	0.24456
Missing	0.16854	−0.01563	0.35270	0.17772	0.01493	0.34050
Number of people in household						
1	Reference					
2	0.01242	−0.02615	0.05098	0.01481	−0.03402	0.06364
3	0.01567	−0.03487	0.06621	−0.02041	−0.08318	0.04235
4	0.01329	−0.05029	0.07686	−0.07087	−0.14665	0.00490
5	−0.00116	−0.09087	0.08855	−0.09581	−0.20018	0.00857
6	0.01344	−0.11952	0.14639	−0.15431	−0.31045	0.00183
7	−0.04890	−0.24650	0.14869	−0.26502	−0.53923	0.00920

(continued on next page)

Appendix C (continued)

Outcome	Any seasonal and H1N1 flu vaccine recommendation			Any seasonal and H1N1 flu vaccine		
	Model 1			Model 2		
		95% Confidence interval			95% Confidence interval	
Variable	dy/dx	Lower limit	Upper limit	dy/dx	Lower limit	Upper limit
3-category Metropolitan Statistical Area (MSA) status						
MSA, principal city	0.02221	−0.01330	0.05772	0.00385	−0.04084	0.04855
MSA, not principal city	0.01405	−0.01673	0.04484	0.00365	−0.03557	0.04287
Non-MSA	Reference					
Census region of residence[b]						
Region 1	Reference					
Region 2	−0.06862	−0.10446	−0.03278	0.01968	−0.02249	0.06185
Region 3	−0.09775	−0.13181	−0.06369	−0.00187	−0.04311	0.03938
Region 4	−0.09922	−0.13991	−0.05852	0.01730	−0.03212	0.06672
Interview date						
10-Jan	Reference					
10-Feb	0.02049	−0.03700	0.07799	0.04111	−0.03025	0.11246
10-Mar	−0.00602	−0.06306	0.05103	0.04239	−0.02836	0.11314
10-Apr	−0.01034	−0.06695	0.04628	0.07908	0.00912	0.14905
10-May	0.01946	−0.03644	0.07536	0.06865	0.00045	0.13685
10-Jun	0.00620	−0.05210	0.06451	0.06182	−0.00860	0.13223
Socioeconomic						
Self-report education level						
<12 years	Reference					
12 years	0.03987	−0.01342	0.09315	0.00759	−0.05984	0.07503
Some college	0.02114	−0.03347	0.07574	0.03750	−0.02862	0.10361
College graduate	0.01418	−0.03954	0.06789	0.07806	0.01141	0.14470
Missing	−0.02451	−0.17928	0.13027	−0.11259	−0.28792	0.06274
Income poverty status						
Above poverty threshold, >=$75,000 income	Reference					
Above poverty threshold, <$75,000 income	0.01144	−0.01970	0.04257	−0.03005	−0.06840	0.00830
Below poverty threshold	0.01511	−0.04150	0.07172	−0.06393	−0.13110	0.00324
Poverty status unknown	0.01155	−0.03413	0.05724	0.00246	−0.05352	0.05844
Work status						
Employed	Reference					
Unemployed	0.00497	−0.05637	0.06632	−0.02508	−0.10063	0.05047
Not in labor force	0.01539	−0.01616	0.04693	0.05328	0.01389	0.09267
Don't know/Refused/Missing	−0.01967	−0.16107	0.12173	0.10507	−0.05223	0.26238
Works in health care field						
No	Reference					
Yes	0.02311	−0.01707	0.06328	0.17220	0.12013	0.22428
Missing	0.04251	−0.11488	0.19990	0.09312	−0.09413	0.28037
Home rented or owned						
Home is owned	Reference					
Home is rented or other arrangement	−0.01477	−0.05001	0.02047	−0.03115	−0.07374	0.01145
Don't know/Refused/Missing	−0.00988	−0.08761	0.06786	−0.05016	−0.13514	0.03481
Health						
Chronic medical condition[c]						
No	Reference					
Yes	0.10994	0.08334	0.13655	0.04864	0.01486	0.08242
Missing	0.02572	−0.07522	0.12667	0.04613	−0.07002	0.16228
Health status						
Sick with fever and cough or sore throat in past month						
No	Reference					
Yes	0.02608	−0.03003	0.08220	−0.01470	−0.09947	0.07008
Missing	−0.03417	−0.22087	0.15253	−0.05916	−0.25769	0.13938
Other people in house with fever and cough or sore throat						
No	Reference					
Yes	−0.00830	−0.04736	0.03076	−0.04568	−0.09132	−0.00004
Missing	−0.06024	−0.21226	0.09178	0.02922	−0.12960	0.18803
Access						
Has health insurance coverage						
Yes	0.08904	0.03681	0.14128	0.18723	0.12396	0.25051
No	Reference					
Don't know/Refused/Missing	0.03434	−0.15614	0.22482	0.20069	0.00251	0.39888
Number of times seen doctor since August 2009						
>= 4	Reference					
3	−0.02145	−0.06046	0.01755	0.02907	−0.01895	0.07708
2	−0.04519	−0.07868	−0.01169	0.02852	−0.01487	0.07190
1	−0.08141	−0.11552	−0.04729	0.04367	0.00197	0.08537
Missing	−0.07048	−0.15227	0.01131	0.07388	−0.03279	0.18055

Appendix C (continued)

Outcome	Any seasonal and H1N1 flu vaccine recommendation			Any seasonal and H1N1 flu vaccine		
	Model 1			Model 2		
		95% Confidence interval			95% Confidence interval	
Variable	dy/dx	Lower limit	Upper limit	dy/dx	Lower limit	Upper limit
Opinions about flu vaccine						
Opinion: Effectiveness of H1N1 vaccine						
Very effective	Reference					
Somewhat effective	− 0.03212	− 0.06306	− 0.00118	− 0.06678	− 0.10655	− 0.02700
Not very effective	− 0.03226	− 0.08627	0.02175	− 0.10731	− 0.17428	− 0.04035
Not at all effective	− 0.03225	− 0.11214	0.04763	− 0.12163	− 0.22350	− 0.01975
Don't know/Refused/Missing	− 0.04416	− 0.08659	− 0.00174	− 0.07755	− 0.13356	− 0.02154
Opinion: Risk of getting sick with H1N1 flu without vaccine						
Very high	Reference					
Somewhat high	− 0.06746	− 0.13133	− 0.00360	0.03292	− 0.05443	0.12027
Somewhat low	− 0.11416	− 0.18007	− 0.04825	− 0.05388	− 0.14338	0.03563
Very low	− 0.16047	− 0.22879	− 0.09214	− 0.10685	− 0.19756	− 0.01615
Don't know/Refused/Missing	− 0.11684	− 0.20809	− 0.02560	− 0.00640	− 0.12354	0.11074
Opinion: Worry about getting sick from the H1N1 vaccine						
Very worried	Reference					
Somewhat worried	0.03136	− 0.02750	0.09021	− 0.00013	− 0.08014	0.07988
Not very worried	− 0.00356	− 0.06198	0.05487	− 0.00674	− 0.08659	0.07311
Not at all worried	0.00534	− 0.05438	0.06506	− 0.04521	− 0.12648	0.03607
Don't know/Refused/Missing	0.05160	− 0.12170	0.22490	− 0.20509	− 0.37048	− 0.03970
Opinion: Effectiveness of seasonal vaccine						
Very effective	Reference					
Somewhat effective	− 0.06609	− 0.09584	− 0.03635	− 0.20392	− 0.23941	− 0.16844
Not very effective	− 0.08841	− 0.13942	− 0.03741	− 0.39179	− 0.45387	− 0.32971
Not at all effective	− 0.12190	− 0.19122	− 0.05257	− 0.31560	− 0.41074	− 0.22046
Don't know/Refused/Missing	− 0.17230	− 0.24508	− 0.09952	− 0.19661	− 0.28753	− 0.10569
Opinion: Risk of getting sick with seasonal flu without vaccine						
Very high	Reference					
Somewhat high	0.01425	− 0.03117	0.05967	− 0.13962	− 0.20615	− 0.07309
Somewhat low	− 0.10085	− 0.14908	− 0.05262	− 0.36195	− 0.42959	− 0.29431
Very low	− 0.14228	− 0.19870	− 0.08586	− 0.50661	− 0.58244	− 0.43077
Don't know/Refused/Missing	− 0.01531	− 0.10887	0.07824	− 0.23195	− 0.36424	− 0.09965
Opinion: Worry about getting sick from the seasonal vaccine						
Very worried	Reference					
Somewhat worried	0.03264	− 0.03159	0.09687	0.09909	0.01578	0.18239
Not very worried	0.02599	− 0.03804	0.09002	0.14587	0.06351	0.22822
Not at all worried	0.02342	− 0.03921	0.08605	0.26570	0.18468	0.34671
Don't know/Refused/Missing	0.04705	− 0.12975	0.22385	0.20288	0.01409	0.39167

[a] The outcome for Model 1 was defined as a binary variable equal to one when the respondent indicated they received recommendations for H1N1 flu vaccination only, seasonal flu vaccination only, or both vaccinations. Model 2 outcome was defined as a binary variable equal to one when the respondent indicated they received the H1N1 flu vaccination only, seasonal flu vaccination only, or both vaccinations.

[b] Region 1: CT, ME, MA, NH, VT, RI, NJ, NY, and PA; Region 2: IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, and SD; Region 3: DE, DC, FL, GA MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, and TX; Region 4: AZ, CO, ID, MT, NV, NM, UT, WY, AK, CA, HI, OR, and WA.

[c] This indicates whether the person has any of the following chronic medical conditions: asthma or another lung condition, diabetes, a heart condition, a kidney condition, sickle cell anemia or another anemia, a neurological or neuromuscular condition, a liver condition, or a weakened immune system caused by a chronic illness or by medicines taken for a chronic illness.

References

Annunziata, K., Rak, A., Del Buono, H., et al., 2012. Vaccination rates among the general adult population and high-risk groups in the United States. PLoS ONE 7 (11), e50553.

Armstrong, K., Merlin, M., Schwartz, J.S., et al., 2001. Barriers to influenza immunization in a low-income urban population. Am. J. Prev. Med. 20 (1), 21–25.

Bhatt, A., Bridges, C., Donoghue, K., et al., 2014. Recommendations from the National Vaccine Advisory committee: standards for adult immunization practice. Public Health Rep. 129 (2), 115–123.

Centers for Disease Control and Prevention, 2009a. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices (ACIP), 2009. MMWR Recomm. Rep. 58 (RR08), 1–52.

Centers for Disease Control and Prevention, 2009b. Use of influenza A (H1N1) 2009 monovalent vaccine: recommendations of the Advisory Committee on Immunization Practices (ACIP), 2009. MMWR Recomm. Rep. 58 (RR10), 1–8.

Centers for Disease Control and Prevention, 2011. CDC health disparities and inequalities report — United States, 2011. Health-care access and preventive health services: influenza vaccination coverage — United States, 2000–2010. MMWR 60 (Suppl.), 38–42.

Ding, H., Santibanez, T.A., Jamieson, D.J., et al., 2011. Influenza vaccination coverage among pregnant women — National 2009 H1N1 Flu Survey (NHFS). Am. J. Obstet. Gynecol. 204 (6), S96–S106.

Dominguez, S.R., Daum, R.S., 2005. Physician knowledge and perspectives regarding influenza and influenza vaccination. Hum. Vaccin. 1 (2), 74–79.

Egede, L.E., Zheng, D., 2003. Racial/ethnic differences in adult vaccination among individuals with diabetes. Am. J. Public Health 93, 324–329.

Fiebach, N.H., Viscoli, C.M., 1991. Patient acceptance of influenza vaccination. Am. J. Med. 91 (4), 393–400.

Fiore, A.E., Shay, D.K., Broder, K., et al., 2009. Prevention and control of influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices (ACIP), 2009. MMWR Recomm. Rep. 58 (RR08), 1–52.

Fiscella, K., 2005. Commentary — anatomy of racial disparity in influenza vaccination. Health Serv. Res. 40 (2), 539–550.

Gnanasekaran, S.K., Finkelstein, J.A., Hohman, K., et al., 2006. Parental perspective on influenza vaccination among children with asthma. Public Health Rep. 121 (2), 181–188.

Groshkopf, L.A., Shay, D.K., Shimabukuro, T.T., et al., 2013. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices (ACIP) — United States, 2013–2014. MMWR 62 (RR07), 1–43.

Gu, Q., Sood, N., 2011. Do people taking flu vaccines need them the most? PLoS ONE 6 (12), e26347.

HealthyPeople2020, 2013. Immunization and infections diseases. http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=23.

Hebert, P.L., Frick, K.D., Kane, R.L., McBean, A.M., 2005. The causes of racial and ethnic differences in influenza vaccination rates among elderly Medicare beneficiaries. Health Serv. Res. 40 (2), 517–538.

Hemingway, C.O., Poehling, K.A., 2004. Change in recommendation affects influenza vaccinations among children 6 to 59 months of age. Pediatrics 114 (4), 948–952.

Jessop, A.B., Dumas, H., Moser, C.A., 2013. Delivering influenza vaccine to high-risk adults: subspecialty physician practices. Am. J. Med. Qual. 28, 232–237.

Levy, D.J., Ambrose, C.S., Oleka, N., Lewin, E.B., 2009. A survey of pediatricians' attitudes regarding influenza immunization in children. BMC Pediatr. 9 (8), 1–5.

Lu, P., Callahan, D.B., Ding, H., Euler, G.L., 2011. Influenza A (H1N1) 2009 monovalent vaccination among adults with asthma, U.S., 2010. Am. J. Prev. Med. 41 (6), 619–626.

Lu, P.J., Singleton, J.A., Euler, G.L., et al., 2013. Seasonal influenza vaccination coverage among adult populations in the United States, 2005–2011. Am. J. Epidemiol. 178 (9), 1478–1487.

Lyn-Cook, R., Halm, E.A., Wisnivesky, J.P., 2007. Determinants of adherence to influenza vaccination among inner-city adults with persistent asthma. Prim. Care Respir. J. 16 (4), 229–235 (Gen Pr Airways Group).

MacIntosh, T., Desai, M.M., Lewis, T.T., Jones, B.A., Nunez-Smith, M., 2013. Socially-assigned race, healthcare discrimination and preventive healthcare services. PLoS ONE 8 (5), 1–7.

Mirza, A., Subedar, A., Fowler, S.L., et al., 2008. Influenza vaccine: awareness and barriers to immunization in families of children with chronic medical conditions other than asthma. South. Med. J. 101 (11), 1101–1105.

Mullahy, J., 1999. It'll only hurt a second? Microeconomic determinants of who gets flu shots. Health Econ. 8, 9–24.

Nagata, J.M., Hernandez-Ramos, I., Kurup, A.S., Albrecht, D., Vivas-Torrealba, C., Franco-Paredes, C., 2011. Social determinants of health and seasonal influenza vaccination in adults ≥65 years: a systematic review of qualitative and quantitative data. BMC Public Health 13, 388.

Nichol, K.L., Zimmerman, R., 2001. Generalist and subspecialist physicians' knowledge, attitudes, and practices regarding influenza and pneumococcal vaccinations for elderly and other high-risk patients: a nationwide survey. Arch. Intern. Med. 161, 2702–2708.

Nichol, K.L., Lofgren, R.P., Gapinski, J., 1992. Influenza vaccination: knowledge, attitudes, and behavior among high-risk outpatients. Arch. Intern. Med. 152 (1), 106–110.

O'Malley, A.S., Forrest, C.B., 2006. Immunization disparities in older Americans: determinants and future research needs. Am. J. Prev. Med. 31 (2), 150–158.

Opel, D.J., Heritage, J., Taylor, J.A., et al., 2013. The architecture of provider–parent vaccine discussion at health supervision visits. Pediatrics 132 (6), 1037–1046.

Pandolfi, E., Marino, M.G., Carloni, E., et al., 2012. The effect of physician's recommendation on seasonal influenza immunization in children with chronic diseases. BMC Public Health 12 (1), 984.

Poehling, K.A., Speroff, T., Dittus, R.S., et al., 2001. Predictors of influenza virus vaccination status in hospitalized children. Pediatrics 108 (6), 1–6.

Santibanez, T.A., Mootrey, G.T., Euler, G.L., Janssen, A.P., 2010. Behavior and beliefs about influenza vaccine among adults aged 50–64 years. Am. J. Health Behav. 34 (1), 77–89.

Schneider, E.C., Cleary, P.D., Zaslavsky, A.M., Epstein, A.M., 2001. Racial disparity in influenza vaccination. Does managed care narrow the gap between African Americans and Whites? JAMA 286, 1455–1460.

Singleton, J., Santibanez, T., Wortley, P., 2005. Influenza and pneumococcal vaccination of adults aged ≥65 racial/ethnic differences. Am. J. Prev. Med. 29 (5), 412–420.

Straits-Troster, K.A., Kahwati, L.C., Kingsinger, L.S., Orelien, J., Burdick, M.B., Yevich, S.J., 2006. Racial/ethnic differences in influenza vaccination in the Veterans Affairs healthcare system. Am. J. Prev. Med. 31 (5), 375–382.

Takayama, M., Wetmore, C.M., Mokdad, A.H., 2012. Characteristics associated with the uptake of influenza vaccination among adults in the United States. Prev. Med. 54 (5), 358–362.

U.S. Department of Health and Human Servces (DHHS), 2012. National Center for Health Statistics. The National 2009 H1N1 Flu Survey, Hyattsville, MD: Centers for Disease Control and Prevention (Information about the NHFS is located at http://www.cdc.gov/nchs/nis/about_nis.htm#h1n1).

Vadaparampil, S.T., Malo, T.L., Kahn, J.A., et al., 2014. Physicians' human papillomavirus vaccine recommendations, 2009 and 2011. Am. J. Prev. Med. 46 (1), 80–84.

Ylitalo, K.R., Lee, H., Mehta, N.K., 2013. Health care provider recommendation, human papillomavirus vaccination, and race/ethnicity in the US National Immunization Survey. Am. J. Public Health 103 (1), 164–169.