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Uptake of influenza vaccination and missed opportunities among adults with high-risk conditions, United States, 2013

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Abstract

Background—Since 1960, the Advisory Committee on Immunization Practices (ACIP) has recommended influenza vaccination for adults with certain high-risk conditions because of increased risk for complications from influenza infection. We assessed national influenza vaccination among persons 18-64 years with high-risk conditions.

Methods—We analyzed data from the 2012 and 2013 National Health Interview Survey (NHIS). The Kaplan-Meier survival analysis procedure was used to estimate the cumulative proportion of influenza vaccination among adults 18-64 years with high-risk conditions. Potential missed opportunities for influenza vaccination were also evaluated. Multivariable logistic regression and predictive marginal analyses were conducted to identify factors independently associated with vaccination.

Results—Overall, 39.9 million adults 18-64 years (18.9%) had at least one high-risk condition. For adults 18-64 years with high-risk conditions, overall influenza vaccination coverage was 49.5%. Coverage among adults 50-64 years was significantly higher compared with those 18-49 years (59.3% vs. 39.0%; $p < 0.05$). Among adults 18-64 years, coverage was 46.2% for those with chronic lung diseases, 50.5% for those with heart disease, 58.0% for those with diabetes, 62.5% for those with renal disease, and 56.4% for those with cancer. Overall, 90.1% reported at least one visit to a health care setting where vaccination could have been provided. Among adults 18-64 years with high-risk conditions, older age, being female, Hispanic ethnicity or Asian race, having one or more physician visits, a regular physician for health care, health insurance, and having ever received pneumococcal vaccination were independently associated with a higher likelihood of influenza vaccination. Being widowed/divorced/separated or never married and not being employed were independently associated with a lower likelihood of influenza vaccination

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Conflict of Interest Statement:

All authors have no conflicts of interest to be stated.

Conclusions—Influenza vaccination coverage varies substantially by age and high-risk conditions but remains low. Approximately 50% of those with high-risk conditions remain unvaccinated. Healthcare providers should ensure they routinely assess influenza vaccination status, recommend and offer vaccines to those with high-risk conditions.

Keywords

influenza vaccine; vaccination; coverage; adults; high-risk conditions

Introduction

Persons with underlying health-risk conditions such as asthma, bronchitis, emphysema, chronic obstructive pulmonary disease (COPD), heart disease, renal disease, diabetes, and cancer are known to be at substantially increased risk for serious complications from influenza (1-3). Vaccination of persons with high-risk conditions is a key public health strategy in preventing influenza-related morbidity and mortality in the United States (2). Optimal use of vaccination strategies can not only reduce influenza-related morbidity and mortality but can also minimize missed work days due to illness (2). Persons with high-risk conditions were recommended for annual influenza vaccination by the Public Health Service as early as 1960 (4). Prior to 2010, the Advisory Committee on Immunization Practices (ACIP) recommended yearly vaccination for adults 50 years and adults 18-49 years with high-risk conditions (5). Since the 2010-11 season, the ACIP has recommended annual influenza vaccination for all adults (1, 2, 5).

Before *Healthy People 2020* influenza vaccination objectives were consolidated following the ACIP recommendation for universal vaccination of adults, the annual influenza vaccination target for adults 18-64 years with high-risk conditions was 90%. The current revised vaccination target for all adults 18 years is 70% (6); however, ACIP continues to emphasize that persons with high-risk conditions should be a focus of vaccination efforts (5). Despite the long-standing ACIP recommendations, vaccination levels among persons with medical conditions that increase risk for complications from influenza have remained suboptimal (7-11). To evaluate the impact of the current adult influenza vaccination program in the United States for persons with high-risk conditions, we assessed national influenza vaccination coverage and potential missed opportunities for vaccination among adults 18-64 years with underlying high-risk conditions using data from the National Health Interview Survey (NHIS). We also evaluated demographic and access-to-care factors associated with receipt of influenza vaccination to identify potential strategies to improve vaccination coverage.

Methods

We analyzed data from the 2012 and 2013 NHIS. NHIS is a probability based annual household survey conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention (12-13). The survey has four main modules: the household composition section, family core, sample adult core, and sample child core. In the sample adult core, one adult per sampled family was randomly selected and asked to complete the

sample adult questionnaire, including questions about receipt of influenza vaccination. In 2012 and 2013, the final response rates for the sample adult core were 61.2% for both years (12-13).

We defined high-risk persons as individuals who self-reported one or more of the following: ever being told by a physician they had diabetes, emphysema, COPD, coronary heart disease, angina, heart attack or other heart condition; being diagnosed with cancer in the past 12 months (excluding non-melanoma skin cancer) or ever being told by a physician they have lymphoma, leukemia or blood cancer; during the past 12 months, being told by a physician they have chronic bronchitis or weak or failing kidneys; or reporting an asthma episode or attack in the past 12 months. Poverty status was defined as a total family income of <\$23,492, and <23,624 for a family of four for 2012 and 2013, respectively, using poverty thresholds published by the U.S. Census Bureau (14).

SUDAAN (Software for the statistical analysis of correlated data, Research Triangle Institute, Research Triangle Park, NC, version 10.01) was used to calculate point estimates and 95% confidence intervals (CIs). In bivariate analyses, we assessed influenza vaccination among adults 18-64 years with high-risk conditions stratified by demographic and access-to-care variables. Chi-square and t-tests were used to determine differences between groups with statistical significance at $p < 0.05$. To better assess seasonal influenza vaccination coverage, we reported coverage restricted to individuals interviewed during August 2012 through June 2013, and vaccinated during July 2012 through May 2013 using the Kaplan-Meier survival analysis procedure. Multivariable logistic regression and predictive marginal models were used to generate adjusted prevalence ratios and identify variables independently associated with reported receipt of influenza vaccination in the past 12 months (15, 16). All variables used in the bivariate analysis were included in the full multivariable model. To assess potential missed opportunities for influenza vaccination among adults with high-risk conditions, we calculated the proportions of persons who reported not receiving influenza vaccination in the 2012-13 influenza season by selected health care access characteristics.

Results

Table 1 shows the baseline demographic characteristics of the study population.

The overall influenza vaccination coverage for the 2012-13 season among adults 18-64 years with high-risk conditions was 49.5%. Vaccination coverage for the 2012-13 season among adults with high-risk conditions was significantly lower among adults 18-49 years at 39.0% compared with 59.3% for adults 50-64 years (Table 2). Vaccination coverage for adults 18-64 years with high-risk conditions was 49.0% for non-Hispanic whites, 45.8% for non-Hispanic blacks, 49.4% for Hispanics, 65.9% for Asians, and 60.6% for those reporting other race (Table 2). Coverage was significantly higher among Asians compared with non-Hispanic whites ($p < 0.05$) (Table 2). Coverage for adults 18-64 years with high-risk conditions was significantly higher among adults with at least some college education, who were employed, and living at or above poverty level (Table 2) ($p < 0.05$). Additionally, coverage was significantly lower among adults who were never married, and those who were

born outside the United States and were in the United States less than 10 years (Table 2) ($p<0.05$).

Among adults 18-64 years with high-risk conditions, vaccination coverage was higher for those who had any physician contacts during the past year compared with those with none, and increased with higher numbers of physician contacts. There was almost a 40 percentage-point difference in proportion vaccinated between those who had no physician contacts and those who had 10 or more physician contacts in the past year (Table 2). Persons who had been hospitalized in the past year were significantly more likely to have received influenza vaccination than those who were not. There was a 38 percentage-point difference in vaccination coverage between those who had a regular physician for health care and those who did not have one. Coverage was significantly higher ($p<0.05$) among adults with health insurance (55.1%) compared with those without health insurance (23.9%) and among adults who had ever received pneumococcal vaccination (73.4%) compared with those who had not (38.7%) ($p<0.05$ for both comparisons) (Table 2). Vaccination coverage was significantly higher among adults 50-64 years compared with adults 18-49 years across most socio-demographic and access-to-care characteristics (Table 2).

In multivariable analysis, among adults 18-64 years with high-risk conditions, older age, being female, Hispanic ethnicity or Asian race, having one or more physician visits, a regular physician for health care, health insurance, and having ever received pneumococcal vaccination were independently associated with a higher likelihood of influenza vaccination. Being widowed/divorced/separated and not being employed were independently associated with a lower likelihood of influenza vaccination (Table 3). Among adults 18-49 years with high-risk conditions, characteristics independently associated with a higher likelihood of vaccination were similar to those for 18-64 years. Never having been married and not being employed were independently associated with a lower likelihood of vaccination (Table 3). Among adults 50-64 years with high-risk conditions, Hispanic ethnicity, having two or more physician visits, a regular physician for health care, health insurance, and having ever received pneumococcal vaccination were independently associated with a higher likelihood of vaccination (Table 3).

Among adults 18-64 years, influenza vaccination coverage in the 2012-13 season was 49.5% among those with at least one high-risk condition, 59.5% among those with at least two high-risk conditions, 46.2% among those with lung disease, 50.5% among those with heart disease, 58.0% among those with diabetes, 62.5% among those with renal disease, and 56.4% among those with cancer (Table 4). Additionally, most condition-specific vaccination coverage was significantly higher among persons 50-64 years compared with persons 18-49 years (Table 4).

Potential missed opportunities for influenza vaccination were also evaluated. Among adults 18-64 years with at least one high-risk condition who reported not receiving influenza vaccination in the 2012-13 season, 87.3% had one or more physician contacts in the last 12 months, 15.2% were hospitalized in past year, and 31.7% had visited an emergency room (ER). Overall, 90.1% reported at least one visit to a health care setting where vaccination could have been provided. Among persons reporting 2 ER visits, the proportion was

significantly higher among non-Hispanic blacks (25.2%). Among those with at least one potential missed opportunity, Hispanics had the lowest proportion (85.2%) (Table 5).

Discussion

Findings from this study demonstrate that among adults 18-64 years with high-risk conditions, influenza vaccination coverage was low overall as well as among those with multiple high-risk conditions. During the 2012-13 season, about 40-60% of adults 18-64 years at increased risk for influenza were unvaccinated against influenza. Vaccination coverage remained well below the previous *Healthy People 2020* target of 90% for all the influenza high-risk groups studied and below the current target of 70% set for all adults (6).

Factors associated with lower influenza vaccination coverage among adults with high-risk conditions have been described in other studies and might include: lack of a preexisting relationship of state immunization programs with providers who serve adults at high risk; difficulty in implementing a risk-condition-based vaccination recommendation; persons with underlying health conditions not considering themselves as high risk limiting the effectiveness of targeted messages; and, historically low seasonal influenza vaccination coverage in this population (5, 7-11, 17).

Several ongoing programs or disease-related professional organizations have supported intensive efforts to improve influenza vaccination among persons with high-risk conditions (18-21). For example, the Diabetes Quality Improvement Project, a collaborative effort between public and private organizations to improve preventive care for persons with diabetes, including influenza vaccination, has been ongoing for more than 10 years (18, 19). The National Asthma Education and Prevention Program panel identified influenza vaccination as one of several “key clinical activities that should be considered as essential for quality asthma care” (20). The American Heart Association/American College of Cardiology together with other heart disease organizations recommended influenza vaccination as secondary prevention for cardiovascular disease (21). In addition, the Department of Health and Human Services (HHS) initiated a strategic framework to improve the health status of individuals with multiple chronic conditions (22-24). The HHS framework contains a vision statement, goals, objectives, and discrete strategies for individuals with multiple chronic conditions to guide the department in coordinating its efforts internally and externally through collaborating with stakeholders to improve care coordination, maximize the use of proven self-care management and other services, provide better tools and information to providers who deliver care to persons with multiple chronic conditions, and facilitate research to fill knowledge gaps and develop beneficial interventions. The framework outlines national strategies for improving health and quality of life for individuals with multiple chronic conditions, including maximizing use of proven services like vaccination (22-24). Those ongoing activities may help improve influenza vaccination coverage among persons with high-risk conditions.

As might be expected, this study found that vaccination coverage among persons 50-64 years was significantly higher than among those 18-49 years. This result remained after controlling for other demographic and access to care variables. As people age, the

prevalence of high-risk conditions is likely to increase. In this study, the prevalence of lung disease, heart disease, and diabetes among adults 50-64 years were 10.8%, 13.8%, and 13.8%, respectively, compared with 6.3%, 4.6%, and 3.4%, respectively, among adults 18-49 years. Healthcare providers may be more likely to recommend influenza vaccination to persons 50-64 years with high-risk conditions because of a perception of greater risk for complications from influenza compared with younger persons 18-49 years (25). Healthcare providers should ensure that persons at high risk receive appropriate vaccinations regardless of age.

Influenza vaccination coverage also varied substantially among persons with specific high-risk conditions, ranging from 44.0% for adults with asthma to 62.5% for those with renal disease. Lower coverage for adults with asthma might reflect their concerns that the vaccine could trigger an asthma exacerbation making them less likely to be vaccinated, although studies found no evidence of asthma exacerbation or other severe side effects after influenza vaccination (26-28). Given that respiratory infections such as influenza can be serious in persons with asthma, the lower vaccination coverage in this risk group warrants further consideration (29). Offering influenza vaccination in the ER to those with asthma would be appropriate. Sometimes ERs may be the only place these patients interact with a medical provider (20). Physicians should consider each office or ER visit a potential opportunity to vaccinate persons with asthma (20).

We found that vaccination coverage among persons who have health insurance, have a regular physician for health care, and physician contacts in past 12 months were significantly associated with influenza vaccination. These findings remained after controlling for other variables and are consistent with other reports (8, 9, 30). Physician contact plays an important role in vaccination uptake (8, 9, 31). Having a regular physician and seeing a physician provide opportunities for education about influenza vaccination and offering vaccination and other prevention services. Persons with high-risk conditions may have more frequent contacts with their healthcare providers. Routine physician visits can provide important opportunities for providers to vaccinate persons with high-risk conditions.

There were missed opportunities for vaccinating adults with high-risk conditions. Although our findings suggest that recent physician contacts were independently associated with influenza vaccination, we also found a substantial proportion of individuals with high-risk conditions who had visited their physicians at least 10 times within the past year, but still were not vaccinated. Based on our study, overall, 90.1% of unvaccinated individuals reported at least one visit to a health care setting where vaccination could have been provided including 87.3% who had one or more physician contacts in the last 12 months, 15.2% who were hospitalized in the previous 12 months, and 31.7% who had visited an emergency room. In one study, a significant proportion of generalists and subspecialists failed to recommend influenza vaccination to their high-risk patients (17). Use of standing order programs might help reduce the number of missed opportunities for vaccinating persons who have already accessed the medical system (32-34). In addition, it is also important for subspecialists to recommend and offer influenza vaccination to high-risk adults. Although primary care physicians are the predominant providers for adults with chronic conditions in the health care system, subspecialists also see these patients with great

frequency (35). However, one study indicated that about 22% of subspecialists did not stock the influenza vaccine. The most common factor in the decision to not stock vaccine was the perception that patients will receive the vaccine elsewhere (35). Subspecialists were less likely to stock and recommend influenza vaccine, especially cardiologists (35, 36). To reduce missed opportunities overall, subspecialists should be encouraged to vaccinate high-risk patients or refer their patients for vaccination (35, 35).

One limitation should be considered in interpreting these results. Information on influenza vaccination was self-reported and may be subject to recall bias. However, self-reported seasonal influenza vaccination status among older adults has been shown to have relatively high agreement with vaccination status ascertained from medical records (37-39).

Influenza vaccination coverage among adults with high-risk conditions remains suboptimal. In 2012-13, an estimated 40 million adults 18-64 years had underlying medical conditions, but only about 50% had received the vaccine and 90% of unvaccinated individuals may have missed at least one potential opportunity for receiving vaccination. Even though the influenza vaccination was expanded to include all persons 6 months of age in the 2010-11 season, the ACIP continued to emphasize that persons with high-risk conditions should be a focus of vaccination efforts (5). Substantial improvement in annual influenza vaccination of adults with high-risk conditions is needed to maximally reduce the health impact of influenza. Primary care providers, subspecialists, and pharmacists should routinely recommend and offer vaccinations when patients access the medical system (40). Expanded access through greater use of complimentary settings and vaccine providers, and better use of evidence-based practices at medical sites (e.g., standing orders, and reminder/recall notification) are important to improving influenza vaccination coverage further (33, 41).

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TABLE 1
 Characteristics of participants 18-64 years with high-risk conditions* in the United States, by demographic and access-to-care characteristics--NHIS 2012-13†

Characteristics	Age group					
	18-64 years		18-49 years		50-64 years	
	Sample	%	Sample	%	Sample	%
Total	4,853	100.0	2,264	48.5	2,589	51.5
Sex						
Male	2,074	46.8	879	43.0	1,195	50.4‡
Female	2,779	53.2	1,385	57.0	1,394	49.6
Race/ethnicity						
Non-Hispanic White	2,928	68.2	1,316	65.8	1,612	70.3‡
Non-Hispanic Black	851	13.3	372	13.4	479	13.2
Hispanic	746	12.4	409	14.5	337	10.4
Asian	163	3.2	74	3.0	89	3.4
Other	165	2.9	93	3.3	72	2.6
Marital status						
Married	1,999	53.2	858	46.4	1,141	59.5‡
Widowed/divorced/separated	1,408	20.2	438	14.2	970	25.7
Never married	1,431	26.7	963	39.4	468	14.7
Education						
< High school	851	16.2	370	16.0	481	16.4‡
High school graduate	1,314	27.0	560	25.3	754	28.6
Some college+	2,674	56.8	1,332	58.7	1,342	54.9
Employment status						
Employed	2,611	56.2	1,447	64.0	1,164	48.9‡
Not employed	313	6.3	203	8.7	110	4.0
Not in work force	1,927	37.5	614	27.3	1,313	47.2
Poverty level						
At or above poverty	3,312	79.7	1,509	76.9	1,803	82.4‡

Characteristics	Age group						
	18-64 years		18-49 years		50-64 years		
	Sample	%	Sample	%	Sample	%	
US born status							
	Below poverty	1,178	20.3	613	23.1	565	17.6
	U.S. born	4,165	87.2	1,928	87.0	2,237	87.3 [‡]
	Born outside U.S. -- In U.S. 10 yrs	86	1.7	68	2.9	18	0.7
	Born outside U.S. -- In U.S. > 10 yrs	593	11.1	264	10.1	329	12.0
Region of residence							
	Northeast	779	17.0	372	17.5	407	16.5
	Midwest	983	22.8	455	21.8	528	23.8
	South	1,914	39.0	871	38.8	1,043	39.2
	West	1,177	21.2	566	21.9	611	20.5
Physician contacts within past year							
	None	443	9.4	268	11.8	175	7.2 [‡]
	1	465	10.0	260	12.3	205	7.8
	2-3	1,067	23.3	522	23.1	545	23.5
	4-9	1,550	32.7	662	29.8	888	35.5
	>10	1,223	24.6	511	23.0	712	26.0
Hospitalization within past year							
	Yes	893	17.1	348	15.1	545	19.0 [‡]
	No	3,955	82.9	1,915	84.9	2,040	81.0
Regular physician							
	Yes	4,351	90.4	1,937	86.4	2,414	94.1 [‡]
	No	460	9.6	311	13.6	149	5.9
Health insurance							
	With health insurance	3,966	82.8	1,762	79.3	2,204	86 [‡]
	Without health insurance	869	17.2	494	20.7	375	14.0
Ever received pneumococcal vaccination							
	Yes	1,422	30.5	438	21.3	984	39.0 [‡]
	No	3,196	69.5	1,706	78.7	1,490	61.0

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* High-risk definition: adults categorized as at high risk for influenza-related complications self-reported 1 or more of the following: (1) ever being told by a physician they had diabetes, emphysema, chronic obstructive pulmonary disease, coronary heart disease, angina, heart attack, or other heart condition; (2) having a diagnosis of cancer during the preceding 12 months (excluding nonmelanoma skin cancer) or ever being told by a physician they have lymphoma, leukemia, or blood cancer; (3) being told by a physician they have chronic bronchitis or weak or failing kidneys; or (4) reporting an asthma episode or attack during the preceding 12 months.

[†] Includes respondents interviewed from August 2012 through June 2013.

[‡] $p < 0.05$ by chi-square test (comparing persons 18-49 years with 50-64 years).

TABLE 2

Influenza vaccination coverage* among adults 18-64 years with high-risk conditions† in the United States, by demographic and access-to-care characteristics--NHIS 2012-13

Characteristics	Age group					
	18-64 years		18-49 years		50-64 years	
	%	(95% CI)	%	(95% CI)	%	(95% CI)
Total	49.5	(47.2, 51.9)	39.0	(35.8, 42.4)	59.3	(55.8, 62.8)‡
Sex						
Male§	46.9	(43.2, 50.8)	32.8	(27.8, 38.3)	58.0	(53.0, 63.1)‡
Female	51.8	(48.7, 55.0)	43.6	(39.0, 48.5)¶	60.7	(56.4, 65.0)‡
Race/ethnicity						
Non-Hispanic White§	49.0	(46.1, 52.0)	36.6	(32.7, 40.7)	59.6	(55.3, 63.8)‡
Non-Hispanic Black	45.8	(39.4, 52.7)	40.5	(32.4, 49.8)	50.8	(42.0, 60.3)
Hispanic	49.4	(43.6, 55.4)	39.7	(32.0, 48.5)	62.6	(53.7, 71.4)‡
Asian	65.9	(52.2, 79.2)¶	61.9	(39.8, 84.0)¶	70.5	(56.1, 83.6)
Other	60.6	(48.2, 73.2)	56.2	(40.6, 73.0)¶	68.0	(48.9, 85.6)
Marital status						
Married§	53.5	(50.0, 57.1)	43.8	(38.7, 49.2)	60.6	(55.5, 65.7)‡
Widowed/divorced/separated	49.6	(45.3, 54.1)	36.2	(29.0, 44.5)	56.1	(50.8, 61.7)‡
Never married	42.1	(37.7, 46.8)¶	34.9	(30.2, 40.1)¶	59.3	(51.4, 67.4)‡
Education						
< High school§	45.3	(39.4, 51.7)	34.5	(26.5, 44.1)	55.5	(46.7, 64.7)‡
High school graduate	43.7	(39.2, 48.6)	33.2	(26.3, 41.3)	52.2	(46.4, 58.2)‡
Some college+	53.6	(50.5, 56.6)¶	42.8	(39.0, 46.9)	64.2	(59.5, 68.9)‡
Employment status						
Employed§	48.2	(45.2, 51.3)	40.6	(36.9, 44.6)	57.2	(52.3, 62.1)‡
Not employed	31.4	(23.9, 40.7)¶	26.0	(17.2, 38.0)¶	44.4	(29.2, 63.2)
Not in work force	54.9	(51.3, 58.6)¶	40.1	(33.6, 47.3)	63.2	(58.6, 67.7)‡

Characteristics	Age group					
	18-64 years		18-49 years		50-64 years	
	%	(95% CI)	%	(95% CI)	%	(95% CI)
Poverty level						
At or above poverty	50.4	(47.7, 53.2) ^{//}	40.1	(36.3, 44.1)	59.7	(55.6, 63.8) [‡]
Below poverty [§]	43.6	(38.4, 49.2)	36.2	(29.4, 44.0)	52.8	(45.4, 60.5) [‡]
US born status						
U.S. born [§]	49.4	(46.8, 52.0)	39.1	(35.6, 42.7)	58.9	(55.0, 62.8) [‡]
Born outside U.S. -- In U.S. 10 yrs	31.1	(17.4, 51.7) ^{//}	-- ^{//}	-- ^{//}	68.1	(40.3, 92.0)
Born outside U.S. -- In U.S. > 10 yrs	54.0	(47.6, 60.6)	44.7	(35.7, 54.8)	61.0	(51.6, 70.6) [‡]
Region of residence						
Northeast [§]	51.5	(45.1, 58.2)	39.5	(31.6, 48.4)	63.6	(55.9, 71.2) [‡]
Midwest	49.8	(44.9, 54.9)	41.4	(34.4, 49.3)	56.7	(48.3, 65.5) [‡]
South	48.0	(44.6, 51.4)	36.8	(32.0, 42.2)	58.0	(52.9, 63.2) [‡]
West	50.6	(45.9, 55.6)	40.7	(34.3, 47.8)	60.6	(52.9, 68.3) [‡]
Physician contacts within past year						
None [§]	18.3	(12.8, 25.8)	14.5	(8.6, 23.9)	23.3	(14.8, 35.7)
1	36.1	(29.0, 44.2) ^{//}	27.4	(19.6, 37.6) ^{//}	47.0	(36.2, 59.3) ^{‡//}
2-3	47.7	(43.0, 52.7) ^{//}	38.0	(31.1, 45.8) ^{//}	57.5	(50.2, 65.0) ^{‡//}
4-9	55.9	(51.6, 60.3) ^{//}	46.7	(40.6, 53.3) ^{//}	63.2	(57.4, 69.1) ^{‡//}
>10	60.4	(56.0, 64.8) ^{//}	48.7	(41.9, 56.0) ^{//}	69.8	(64.2, 75.1) ^{‡//}
Hospitalization within past year						
Yes	58.7	(53.3, 64.3) ^{//}	51.6	(43.0, 60.9) ^{//}	64.6	(57.4, 71.7) [‡]
No [§]	47.7	(45.1, 50.4)	36.8	(33.2, 40.7)	58.0	(54.2, 61.9) [‡]
Regular physician						
Yes	53.2	(50.7, 55.7) ^{//}	42.6	(39.0, 46.4) ^{//}	62.1	(58.5, 65.7) ^{‡//}
No [§]	15.1	(10.5, 21.5)	16.5	(11.1, 24.1)	12.2	(6.8, 21.5)
Health insurance						
With health insurance	55.1	(52.5, 57.7) ^{//}	44.5	(40.7, 48.5) ^{//}	64.1	(60.5, 67.7) ^{‡//}

Characteristics	Age group						
	18-64 years		18-49 years		50-64 years		
	%	(95% CI)	%	(95% CI)	%	(95% CI)	
Ever received pneumococcal vaccination	Without health insurance [§]						
	23.9	(19.9, 28.6)	19.4	(14.3, 26.2)	30.0	(23.1, 38.4) [‡]	
	Yes	73.4	(69.6, 77.0) ^{//}	63.7	(56.3, 71.0) ^{//}	78.2	(73.9, 82.3) ^{‡//}
	No [§]	38.7	(36.0, 41.6)	31.6	(28.0, 35.4)	46.9	(42.3, 51.8) [‡]

* Participants vaccinated July 2012-May 2013 and interviewed August 2012-June 2013.

[‡] High-risk definition: adults categorized as at high risk for influenza-related complications self-reported 1 or more of the following: (1) ever being told by a physician they had diabetes, emphysema, chronic obstructive pulmonary disease, coronary heart disease, angina, heart attack, or other heart condition; (2) having a diagnosis of cancer during the preceding 12 months (excluding nonmelanoma skin cancer) or ever being told by a physician they have lymphoma, leukemia, or blood cancer; (3) being told by a physician they have chronic bronchitis or weak or failing kidneys; or (4) reporting an asthma episode or attack during the preceding 12 months.

[‡] p < 0.05 by t-test comparing 18-49 years to 50-64 years.

[§] Reference level.

^{//} p < 0.05 by t-test comparing against the reference group.

[¶] Estimate may not be reliable due to relative standard error > 0.3 or sample size < 30.

TABLE 3

Multivariable logistic regression and predictive marginal analysis* of influenza vaccination among adults 18-64 years with high-risk conditions† in the United States, by demographic and access-to-care characteristics--NHIS 2012-13

Characteristics	Age group			
	18-64 years PR (95% CI)	18-49 years PR (95% CI)	50-64 years PR (95% CI)	
Age				
	18-49 years	Reference	NA	NA
	50-64 years	1.27 (1.17, 1.39) [‡]	NA	NA
Sex				
	Male	Reference	Reference	Reference
	Female	1.12 (1.03, 1.21) [‡]	1.24 (1.07, 1.44) [‡]	1.05 (0.96, 1.15)
Race/ethnicity				
	Non-Hispanic White	Reference	Reference	Reference
	Non-Hispanic Black	0.94 (0.83, 1.06)	1.00 (0.82, 1.22)	0.90 (0.78, 1.05)
	Hispanic	1.21 (1.07, 1.37) [‡]	1.26 (1.03, 1.54) [‡]	1.19 (1.03, 1.38) [‡]
	Asian	1.33 (1.10, 1.63) [‡]	1.64 (1.25, 2.17) [‡]	1.16 (0.90, 1.51)
	Other	1.21 (0.98, 1.50)	1.39 (1.03, 1.87)	1.10 (0.83, 1.45)
Marital status				
	Married	Reference	Reference	Reference
	Widowed/divorced/separated	0.89 (0.81, 0.97) [‡]	0.85 (0.70, 1.03)	0.92 (0.84, 1.01)
	Never married	0.93 (0.85, 1.02)	0.86 (0.74, 1.00) [‡]	1.01 (0.89, 1.14)
Education				
	< High school	Reference	Reference	Reference
	High school graduate	0.95 (0.83, 1.10)	0.92 (0.71, 1.19)	0.98 (0.84, 1.15)
	Some college+	1.10 (0.98, 1.25)	1.05 (0.86, 1.29)	1.13 (0.98, 1.30)
Employment status				
	Employed	Reference	Reference	Reference
	Not employed	0.81 (0.68, 0.97) [‡]	0.77 (0.58, 1.02) [‡]	0.84 (0.65, 1.07)
	Not in work force	0.95 (0.87, 1.04)	0.93 (0.78, 1.12)	0.96 (0.87, 1.06)
Poverty level				
	At or above poverty	1.08 (0.97, 1.21)	1.12 (0.91, 1.37)	1.05 (0.93, 1.20)
	Below poverty	Reference	Reference	Reference
US born status				
	U.S. born	Reference	Reference	Reference
	Born outside U.S. -- In U.S. 10 yrs	1.02 (0.79, 1.33)	0.96 (0.66, 1.40)	1.01 (0.60, 1.72)
	Born outside U.S. -- In U.S. > 10 yrs	1.03 (0.90, 1.17)	0.99 (0.78, 1.25)	1.05 (0.88, 1.24)
Region of residence				
	Northeast	Reference	Reference	Reference
	Midwest	1.01 (0.90, 1.15)	1.02 (0.83, 1.26)	1.02 (0.88, 1.18)

Characteristics	Age group			
	18-64 years	18-49 years	50-64 years	
	PR (95% CI)	PR (95% CI)	PR (95% CI)	
Physician contacts within past year	South	0.98 (0.88, 1.10)	0.98 (0.83, 1.17)	1.00 (0.87, 1.14)
	West	0.99 (0.88, 1.11)	1.02 (0.84, 1.25)	0.97 (0.83, 1.14)
Hospitalization within past year	None	Reference	Reference	Reference
	1	1.27 (1.00, 1.63) [‡]	1.32 (0.92, 1.90)	1.25 (0.92, 1.71)
	2-3	1.47 (1.18, 1.83) [‡]	1.53 (1.10, 2.13) [‡]	1.41 (1.05, 1.90) [‡]
	4-9	1.48 (1.18, 1.85) [‡]	1.53 (1.11, 2.10) [‡]	1.43 (1.05, 1.95) [‡]
	>10	1.54 (1.22, 1.93) [‡]	1.53 (1.07, 2.18) [‡]	1.52 (1.12, 2.06) [‡]
	Yes	1.05 (0.94, 1.17)	1.11 (0.91, 1.37)	1.01 (0.90, 1.13)
Regular physician	No	Reference	Reference	Reference
	Yes	1.68 (1.33, 2.11) [‡]	1.58 (1.17, 2.12) [‡]	2.22 (1.44, 3.43) [‡]
Health insurance	No	Reference	Reference	Reference
	With health insurance	1.41 (1.21, 1.64) [‡]	1.52 (1.21, 1.92) [‡]	1.34 (1.10, 1.64) [‡]
Ever received pneumococcal vaccination	Without health insurance	Reference	Reference	Reference
	Yes	1.76 (1.63, 1.89) [‡]	2.06 (1.80, 2.36) [‡]	1.58 (1.44, 1.72) [‡]
	No	Reference	Reference	Reference

* Participants interviewed August 2012-June 2013 and vaccinated within the past 12 months from date of interview.

[‡]High-risk definition: adults categorized as at high risk for influenza-related complications self-reported 1 or more of the following: (1) ever being told by a physician they had diabetes, emphysema, chronic obstructive pulmonary disease, coronary heart disease, angina, heart attack, or other heart condition; (2) having a diagnosis of cancer during the preceding 12 months (excluding nonmelanoma skin cancer) or ever being told by a physician they have lymphoma, leukemia, or blood cancer; (3) being told by a physician they have chronic bronchitis or weak or failing kidneys; or (4) reporting an asthma episode or attack during the preceding 12 months.

[‡]p < 0.05 compared with the reference level.

Prevalence of specific conditions and vaccination coverage* among adults 18-64 years, United States, NHIS 2012-13

Table 4

	Persons 18-64 years			Persons 18-49 years			Persons 50-64 years		
	Prevalence of conditions	Vaccination Coverage	Population estimates (weighted sample size)	Prevalence of conditions	Vaccination Coverage	Population estimates (weighted sample size)	Prevalence of conditions	Vaccination Coverage	Population estimates (weighted sample size)
	% (%95 CI)	% (%95 CI)	in million	% (%95 CI)	% (%95 CI)	in million	% (%95 CI)	% (%95 CI)	in million
Lung diseases [†]	7.7 (7.3-8.2)	46.2 (42.5, 50.1)	16.3	6.3 (5.9-6.8)	37.6 (32.6, 43.2)	9.1	10.8 (9.9-11.6)	56.6 (51.3, 62.0) [‡]	7.2
Active asthma	3.9 (3.6-4.3)	44.0 (39.1, 49.3)	8.2	4.0 (3.6-4.4)	34.8 (29.4, 41.0)	5.7	3.8 (3.4-4.4)	64.0 (55.1, 72.9) [‡]	2.6
Bronchitis	3.5 (3.2-3.8)	50.0 (44.7, 55.7)	7.3	2.6 (2.3-3.0)	42.9 (35.2, 51.6)	3.8	5.3 (4.7-5.9)	57.1 (48.8, 65.7) [‡]	3.5
Emphysema	1.1 (0.9-1.3)	51.0 (40.4, 62.5)	2.3	0.5 (0.4-0.6)	49.3 (28.3, 74.9)	0.7	2.4 (2.0-2.8)	52.1 (41.5, 63.5)	1.6
COPD	1.8 (1.6-2.1)	55.2 (47.7, 63.0)	3.9	0.8 (0.6-0.9)	45.6 (30.2, 64.4)	1.1	4.2 (3.7-4.8)	59.3 (51.7, 67.1)	2.8
Heart disease [§]	7.5 (7.1-8.0)	50.5 (46.8, 54.3)	15.9	4.6 (4.2-5.0)	38.1 (33.0, 43.6)	6.7	13.8 (12.8-14.8)	59.5 (54.4, 64.7) [‡]	9.2
Diabetes	6.7 (6.3-7.2)	58.0 (53.9, 62.1)	14.2	3.4 (3.1-3.8)	45.1 (38.4, 52.3)	4.9	13.8 (12.9-14.9)	65.0 (59.9, 70.1) [‡]	9.2
Renal disease	1.2 (1.1-1.4)	62.5 (53.6, 71.5)	2.6	0.8 (0.7-1.0)	50.2 (37.3, 64.6)	1.2	2.1 (1.7-2.5)	74.8 (65.2, 83.4) [‡]	1.4
Cancer	0.9 (0.8-1.1)	56.4 (45.2, 68.2)	1.9	0.5 (0.4-0.7)	49.9 (32.5, 70.5)	0.7	1.7 (1.4-2.1)	60.5 (47.1, 74.2)	1.1
1 high-risk condition	18.9 (18.3-19.6)	49.5 (47.2, 51.9)	39.9	13.4 (12.8-14.1)	39.0 (35.8, 42.4)	19.3	30.8 (29.6-32.1)	59.3 (55.8, 62.8) [‡]	20.5
2 high-risk condition [¶]	4.0 (3.7-4.4)	59.5 (54.3, 64.8)	8.5	1.9 (1.7-2.2)	49.0 (39.3, 59.7)	2.8	8.6 (7.8-9.5)	64.7 (58.5, 70.9) [‡]	5.7
No high-risk conditions	81.1 (80.4-81.7)	32.9 (31.6, 34.2)	170.5	86.6 (85.9-87.2)	29.2 (27.8, 30.7)	124.5	69.2 (67.9-70.4)	42.8 (40.5, 45.2) [‡]	46.0

* Participants vaccinated July 2012-May 2013 and interviewed August 2012-June 2013.

[†] Persons reported one or more of the following: being told by a physician they had chronic bronchitis in the past 12 months; being told they had asthma attack in the past 12 months; ever being told they had chronic obstructive pulmonary disease.[‡] p<0.05 by T test for comparisons of vaccination coverage between persons 18-49 years and persons 50-64 years.[§] Persons reporting one or more of the following heart conditions: coronary heart disease, angina, heart attack or other heart condition.^{||} Adults categorized as at high risk for influenza-related complications self-reported 1 or more of the following: (1) ever being told by a physician they had diabetes, emphysema, chronic obstructive pulmonary disease, coronary heart disease, angina, heart attack, or other heart condition; (2) having a diagnosis of cancer during the preceding 12 months (excluding nonmelanoma skin cancer) or ever being told by a physician they have lymphoma, leukemia, or blood cancer; (3) being told by a physician they have chronic bronchitis or weak or failing kidneys; or (4) reporting an asthma episode or attack during the preceding 12 months.[¶] Adults categorized at high risk for influenza-related complications self-reported 2 or more of the following: lung disease, heart disease, diabetes, renal disease, or cancers.

TABLE 5

Select healthcare access characteristics among persons 18-64 with high risk conditions* who reported not receiving influenza vaccination in the 2012-13 season[†] and potential missed opportunities for influenza vaccination – NHIS 2012-13.

Characteristic	sample	Total % (95% CI)	Non-Hispanic white % (95% CI)	Non-Hispanic black % (95% CI)	Hispanic % (95% CI)
Doctor Visit					
	No visit	379	12.7 (11.2-14.3)	12.5 (10.6-14.6)	17.0 (13.3-21.5)
	1 visit	364	11.5 (10.1-13.2)	10.6 (8.9-12.5)	14.1 (10.8-18.2)
	2-3 visits	735	23.9 (22.1-25.8)	23.7 (21.3-26.2)	23.2 (19.0-28.0)
	4-9 visits	992	30.5 (28.5-32.5)	30.6 (28.0-33.3)	27.2 (22.8-32.0)
	10+ visits	725	21.4 (19.6-23.4)	22.7 (20.3-25.4)	18.5 (15.0-22.7)
Hospitalization in past year					
	Yes	509	15.2 (13.7-16.8)	14.8 (13.1-16.8)	12.7 (9.9-16.2)
	No	2,693	84.8 (83.2-86.3)	85.2 (83.2-86.9)	87.3 (83.8-90.1)
Emergency Room (ER) Visit					
	0	2,137	68.3 (66.1-70.4)	69.6 (66.9-72.1)	70.7 (65.8-75.2)
	1	515	16.2 (14.6-18.0)	16.6 (14.6-18.9)	13.9 (10.5-18.1)
	2+	549	15.5 (13.9-17.3)	13.8 (12.0-15.9)	15.4 (12.2-19.3)
At least one possible missed opportunity					
	Yes [§]	2,902	90.1 (88.7-91.3)	90.2 (88.3-91.8)	85.2 (80.8-88.7) [‡]
	No	296	9.9 (8.7-11.3)	9.8 (8.2-11.7)	14.8 (11.3-19.2)

* High-risk definition: adults categorized as at high risk for influenza-related complications self-reported 1 or more of the following: (1) ever being told by a physician they had diabetes, emphysema, chronic obstructive pulmonary disease, coronary heart disease, angina, heart attack, or other heart condition; (2) having a diagnosis of cancer during the preceding 12 months (excluding nonmelanoma skin cancer) or ever being told by a physician they have lymphoma, leukemia, or blood cancer; (3) being told by a physician they have chronic bronchitis or weak or failing kidneys; or (4) reporting an asthma episode or attack during the preceding 12 months.

[†] Includes August 2012-June 2013 interviews; estimates the proportion of adults with high-risk conditions who had not received influenza vaccination from July 2012 through May 2013.

[‡] Indicates p<0.05 (chi-square test for association between race/ethnicity, NH-white is the reference group).

[§] Indicates persons reported one more of the following: had at least one doctor visit, hospitalized in the past year, had at least one ER visit.