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## Influenza A (H1N1) 2009 monovalent and seasonal influenza vaccination among adults 25 to 64 years of age with high-risk conditions—United States, 2010

Peng-jun Lu, MD, PhD\*, Amparo Gonzalez-Feliciano, MPH, Helen Ding, MD, MSPH, Leah N. Bryan, MPH, David Yankey, MS, Elizabeth A. Monsell, BS, Stacie M. Greby, DVM, and Gary L. Euler, DrPH

Immunization Services Division, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, GA

### Abstract

**Background**—Seasonal influenza vaccination has been routinely recommended for adults with high-risk conditions. The Advisory Committee on Immunization Practices recommended that persons 25 to 64 years of age with high-risk conditions be one of the initial target groups to receive H1N1 vaccination during the 2009-2010 season.

**Methods**—We used data from the 2009-2010 Behavioral Risk Factor Surveillance System survey. Vaccination levels of H1N1 and seasonal influenza vaccination among respondents 25 to 64 years with high-risk conditions were assessed. Multivariable logistic regression models were performed to identify factors independently associated with vaccination.

**Results**—Overall, 24.8% of adults 25 to 64 years of age were identified to have high-risk conditions. Among adults 25 to 64 years of age with high-risk conditions, H1N1 and seasonal vaccination coverage were 26.3% and 47.6%, respectively. Characteristics independently associated with an increased likelihood of H1N1 vaccination were as follows: higher age; Hispanic race/ethnicity; medical insurance; ability to see a doctor if needed; having a primary doctor; a routine checkup in the previous year; not being a current smoker; and having high-risk conditions other than asthma, diabetes, and heart disease. Characteristics independently associated with seasonal influenza vaccination were similar compared with factors associated with H1N1 vaccination.

**Conclusion**—Immunization programs should work with provider organizations to review efforts made to reach adults with high-risk conditions during the recent pandemic and assess how and where they can increase vaccination coverage during future pandemics.

### Keywords

Immunization; Influenza vaccine; BRFSS; Multivariable logistic regression; H1N1 vaccination

\*Address correspondence to Peng-jun Lu, MD, PhD, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, 1600 Clifton Road, NE, Mail Stop A-19, Atlanta, GA 30333.

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Annual epidemics of influenza in the United States occur typically during the late fall through early spring. During these annual epidemics, rates of serious illness and death are higher among those who have medical conditions that place them at increased risk for complications from influenza.<sup>1</sup> Vaccination of persons with high-risk conditions is a key public health strategy preventing influenza-related morbidity and mortality in the United States.<sup>1</sup> Prevention of illness through comprehensive vaccination programs is far more cost-effective than case management and other outbreak control measures.<sup>1</sup> Optimal use of vaccination strategies can not only reduce influenza-related morbidity and mortality but can also minimize missed work days because of illness.<sup>1</sup> Persons with high-risk conditions are at increased risk of complications from influenza infection, and annual influenza vaccination was recommended for persons with high-risk conditions by public health services as early as 1960.<sup>1,2</sup>

In April 2009, a H1N1 virus was determined to be the cause of respiratory illness that spread to every region in the United States, throughout North America, and was identified in many other areas of world. Influenza morbidity caused by the H1N1 pandemic remained above seasonal baselines throughout spring and summer 2009 and was the cause of the first pandemic since 1968.<sup>1, 3</sup> During the H1N1 pandemic, adults <65 years of age were at higher risk for influenza-related complications, particularly those who had underlying medical conditions, compared with typical influenza seasons.<sup>1,4-6</sup> In July 2009, the Advisory Committee on Immunization Practices (ACIP) issued recommendations regarding the use of a new monovalent vaccine for protection from infection with the 2009 influenza A (H1N1) virus.<sup>3</sup> Persons 25 to 64 years of age with high-risk conditions were 1 of 5 initial target groups recommended to receive the influenza A (H1N1) 2009 monovalent vaccine (H1N1 vaccine) when it became available in October 2009.<sup>3</sup>

Questions were added to the ongoing Behavioral Risk Factor Surveillance System (BRFSS) survey as part of an influenza supplemental survey during the 2009-2010 influenza season to assess H1N1 and seasonal influenza vaccination coverage in the United States. The objective of this study was to address and examine the following questions: (1) What was the national H1N1 and seasonal influenza vaccination coverage among adults with high-risk conditions? (2) Did vaccination coverage vary by specific types of high-risk conditions? (3) What was state-specific vaccination coverage for adults with high-risk conditions? (4) What factors were significantly associated with influenza vaccination among adults with high-risk conditions? Results from this analysis may help immunization programs and provider organizations review specific activities that were implemented to ensure vaccination of adults with high-risk conditions and prepare for future pandemics.

## Methods

Data from the 2009-2010 BRFSS influenza supplemental survey were used for this analysis. The BRFSS is a continuous, population-based telephone survey coordinated by state health departments in collaboration with the Centers for Disease Control and Prevention (CDC). The BRFSS collects information from noninstitutionalized adults 18 years of age. The objective of the BRFSS is to collect uniform, state-specific data on self-reported preventive health practices and risk behaviors that are linked to preventable infectious diseases, chronic

diseases, and injuries. Individuals are selected randomly using a multistage cluster design. Data are weighted by age, sex, and, in some states, race/ethnicity, to reflect each area's estimated adult population.<sup>7</sup>

The BRFSS Influenza Supplemental Survey began in October 2009 in 49 states, the District of Columbia, and 2 territories. Questions were included to collect H1N1 vaccination information. Those major questions included “There were two ways to get the H1N1 flu vaccination, one is a shot in the arm and the other is a spray, mist or drop in the nose. Since September, 2009, have you been vaccinated either way for the H1N1 flu?” and “During what month did you receive your H1N1 flu vaccine?” Questions regarding seasonal influenza vaccination included “Now I will ask you questions about seasonal flu. A flu shot is an influenza vaccine injected into your arm. During the past 12 months, have you had a seasonal flu shot?” and “During what month did you receive your most recent seasonal flu shot?” “The seasonal flu vaccine sprayed in the nose is also called FluMist. During the past 12 months, have you had a seasonal flu vaccine that was sprayed in your nose?” and “During what month did you receive your most recent seasonal flu vaccine that was sprayed in your nose?” Regarding high-risk conditions, respondents were asked “Have you ever been told by a doctor, nurse, or other health professional that you had asthma?”, “Do you still have asthma?”, “Have you ever been told by a doctor that you have diabetes?”, “Have you ever been told by a doctor that you had a heart attack, also called a myocardial infarction?”, “Have you ever been told by a doctor that you had angina or coronary heart disease?”, “Has a doctor, nurse, or other health professional ever said that you have lung problems, other than asthma, kidney problems, anemia, including sickle cell or a weakened immune system caused by a chronic illness or by medicines taken for a chronic illness?”, and “Do you still have (this/any of these) problem(s)?”

We defined high-risk persons as individuals who self-reported 1 or more of the following: diabetes, asthma, myocardial infarction, coronary heart disease, lung problems other than asthma, kidney problems, anemia (including sickle cell), and a weakened immune system caused by illness or medicines.

Variables included in the analyses were demographic: age group (25-49 years, 50-64 years), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, other), education (less than high school education, high school graduate, higher than high school graduate), employment status (employed, unemployed), household income (<\$20,000, \$20,000-\$49,999, \$50,000-\$74,999, \$75,000), marital status (married, widowed/divorced/separated, never married), and metropolitan statistical area (MSA) (in MSA, not in MSA); health status (perceived health status [excellent/very good, good, fair, poor]), asthma status (yes, no), diabetes status (yes, no), heart diseases status (yes, no), and status of high-risk conditions (yes, no); access to care (medical insurance status [insured, uninsured]), needed to see a doctor in the previous year but could not (yes, no), having a primary doctor (yes, no), and interval since last routine checkup (<1 year, 1 year); behavioral risk factors (activity limitations [yes, no]); and smoking status (current smoker, former smoker, never smoker).

The Council of American Survey Research Organizations response rate is the product of 3 other rates: the resolution rate, which is the proportion of telephone numbers that can be

identified as either for a business or residence; the screening rate, which is the proportion of qualified households that complete the screening process; and the cooperation rate, which is the proportion of contacted eligible households for which a completed interview is obtained. For the 2009-2010 BRFS influenza supplemental survey, the median Council of American Survey Research Organizations state response and cooperation rates were 54% (range: 52%-62%) and 76% (range: 74%-80%), respectively.

SUDAAN (Software for the statistical analysis of correlated data, Research Triangle Institute, Research Triangle Park, NC) was used to calculate point estimates and 95% confidence intervals (CIs). To maximize precision and validity for national and state-specific H1N1 vaccination coverage, we analyzed data from interviews conducted during November 2009 through June 2010 to estimate the cumulative proportion of persons vaccinated during October 2009 through May 2010 using the Kaplan-Meier survival analysis procedure. For national and state-specific 2009-2010 seasonal influenza vaccination coverage, we analyzed data from interviews conducted during October 2009 through June 2010 to estimate the cumulative proportion of persons vaccinated during August 2009 through May 2010 using the Kaplan-Meier survival analysis procedure. Multivariable logistic regression models restricted to individuals interviewed during March through June 2010 were performed to determine adjusted prevalence ratio and identify factors independently associated with vaccination. Respondents who reported unknown or refused influenza vaccination status were excluded from this analysis (H1N1 vaccination = 7%, seasonal influenza vaccination = 3%). Vaccination status was imputed for individuals who said they received vaccination but did not report their month and year of vaccination (H1N1 vaccination = 3%, and seasonal influenza vaccination = 5%). Variables were determined to be significant at  $P < .05$ .

## Results

A total of 182,242 individuals 25 to 64 years of age was included in the analysis. Of the 182,242 adults aged 25 to 64 years, 24.8% reported having high-risk conditions. Demographic characteristics of the study population are given in Table 1. Distributions on each characteristic differed significantly among adults with high-risk conditions compared with adults without high-risk conditions. Adults with high-risk conditions were more likely to be higher age, unemployed, lower income, having a primary doctor, a routine checkup in the previous year, and being current smokers compared with adults without high-risk conditions (Table 1).

Overall, among adults 25 to 64 years of age with high-risk conditions, H1N1 and seasonal vaccination coverage estimates were 26.3% (95% CI: 25.4-27.3) and 47.6% (95% CI: 45.7-49.6), respectively, significantly higher than those without high-risk conditions (18.5% and 31.8%, respectively). Across the majority of subgroups, H1N1 and seasonal influenza vaccination coverage were significantly higher among adults with high-risk conditions compared with those without high-risk conditions (Table 2, Table 3).

Among adults aged 25 to 49 years with high-risk conditions, H1N1 and seasonal influenza vaccination coverage estimates were 23.2% (95% CI: 21.8-24.8) and 37.5% (95% CI: 36.0-39.0), respectively, compared with 18.4% (95% CI: 17.7-19.0) and 28.6% (95% CI:

27.9-29.3), respectively, among those aged 25 to 49 years without high-risk conditions. Among adults aged 50 to 64 years with high-risk conditions, H1N1 and seasonal influenza vaccination coverage was 29.6% (95% CI: 28.4-30.8) and 54.3% (95% CI: 53.1-55.6), respectively, compared with 19.0% (95% CI: 18.3-19.7) and 39.2% (95% CI: 38.4-40.0), respectively, among those aged 50 to 64 years without high-risk conditions (Table 2, Table 3).

Among adults aged 25 to 64 years, H1N1 vaccination coverage was 26.1% for adults with asthma, 29.0% for adults with diabetes, 26.5% for adults with heart disease, and 28.8% for adults with other high-risk conditions. Among adults with high-risk conditions, H1N1 vaccination coverage was significantly higher among adults with diabetes and adults with other high-risk conditions compared with adults without those conditions. Seasonal influenza vaccination coverage was 44.8% for adults with asthma, 52.4% for adults with diabetes, 47.6% for adults with heart disease, and 46.7% for adults with other high-risk conditions. Among adults with high-risk conditions, seasonal influenza vaccination coverage was significantly higher among adults with diabetes compared with adults without diabetes (Table 2, Table 3).

In bivariable analysis, among adults aged 25 to 64 years with high-risk conditions, H1N1 vaccination coverage was significantly lower for non-Hispanic blacks compared with non-Hispanic whites. Coverage was also higher among persons who reported having higher education, having medical insurance, access to a primary care physician, and not being a current smoker. Additionally, persons who needed to see a doctor but could not and those who had not had a routine checkup within a year were less likely to be vaccinated (Table 2). Factors associated with seasonal influenza vaccination were similar compared with factors associated with H1N1 vaccination; however, for race/ethnicity, Hispanics had lower coverage than non-Hispanic whites (Table 3).

In multivariable analysis, most factors that were significantly associated with H1N1 vaccination in the bivariable analysis were still significant in the multivariable analysis except for education and income. Most factors that were significantly associated with seasonal influenza vaccination in the bivariable analysis were still significant in the multivariable analysis except for marital status (Table 2, Table 3).

Overall, state-specific H1N1 vaccination coverage among persons aged 25 to 64 years with high-risk conditions ranged from 15.0% (95% CI: 11.7-19.2) in Mississippi to 44.0% (95% CI: 36.5-52.4) in Massachusetts with a median of 27.6% across all states. Vaccination coverage was below 20% in 4 states—Mississippi, Florida, Alabama, and South Carolina—and coverage was above 40% in 4 states—Maine, Hawaii, Massachusetts, and Minnesota. Vaccination coverage ranged from 9.9% (95% CI: 6.4-15.1) in Mississippi to 46.1% (95% CI: 33.3-61.2) in Maine with a state median of 27.2% for adults with asthma, 15.2% (95% CI: 10.8-21.0) in Mississippi to 64.2% (95% CI: 43.7-84.1) in Massachusetts with a median of 30.7% for adults with diabetes, 12.8% (95% CI: 9.9-16.6) in Florida to 52.1% (95% CI: 39.6-65.8) in South Dakota with a median of 26.8% for adults with heart diseases, and 17.9% (95% CI: 11.6-27.0) in Mississippi to 62.8% (95% CI: 46.3-79.3) in Hawaii with a median of 30.9% for adults with other high-risk conditions.

State-specific seasonal influenza vaccination coverage among persons aged 25 to 64 years with high-risk conditions ranged from 34.9% (95% CI: 31.2-38.9) in Florida to 62.9% (95% CI: 55.6-70.3) in Minnesota with a median of 48.8% across all states. Vaccination coverage was below 40% in 3 states—Florida, Nevada, and Arizona—and coverage was above 60% in 2 states—Nebraska and Minnesota. Vaccination coverage ranged from 35.5% in Arizona to 60.6% in Nebraska with a state median of 46.6% for adults with asthma, 42.3% in Georgia to 89.9% in Alaska with a median of 54.8% for adults with diabetes, 34.9% in Alaska to 73.7% in South Dakota with a median of 48.6% for adults with heart diseases, and 36.4% in Florida to 69.2% in Minnesota with a median of 47.0% for adults with other high-risk conditions. Among persons aged 25 to 64 years with high-risk conditions, the state-specific H1N1 vaccination coverage was highly correlated with seasonal influenza vaccination coverage ( $r = 0.8$ ). (Note: state-specific H1N1 and seasonal vaccination coverage are not shown in tables but are available if requested by readers).

## Discussion

This report assessed H1N1 and seasonal influenza vaccination in the 2009-2010 season by specific types of high-risk conditions; previous reports have assessed seasonal influenza vaccination coverage among persons with high-risk conditions for prior seasons.<sup>8-15</sup> We found that H1N1 and seasonal influenza vaccination coverage was only 26.3% and 47.6%, respectively, among adults with high-risk conditions. Vaccination coverage varied by state and specific types of high-risk conditions.

Overall, H1N1 vaccination coverage among adults aged 25 to 64 years with high-risk conditions was lower (range 26% to 29%) than the coverage among children 6 months to 17 years (37%).<sup>16,17</sup> Reasons for this might include a lesser emphasis on vaccination of this population compared with children; lack of preexisting relationship of state immunization programs with providers who serve adults at high risk; difficulty in implementing a risk-condition-based recommendation for persons in this high-risk group; many high-risk patients do not consider themselves as high risk, which means targeted messages are not getting through to them; historically low seasonal influenza vaccination coverage in this population<sup>1,8-15,18</sup>; and the vaccines for children program (a federally funded program that provides vaccines at no cost to children aged 18 years who might not otherwise be vaccinated because of inability to pay) might help improve vaccination coverage among children.<sup>19,20</sup> Several ongoing programs or disease-related professional organizations have put in great efforts to improve influenza vaccination among persons with high-risk conditions.<sup>21-24</sup> The Diabetes Quality Improvement Project, a collaborative effort between public and private organizations to improve preventive care for persons with diabetes, has been ongoing.<sup>21,22</sup> 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.”<sup>23</sup> The American Heart Association/American College of Cardiology together with other heart diseases organizations recommended influenza vaccination as secondary prevention for cardiovascular disease.<sup>24</sup> Those ongoing activities may help improve vaccination coverage among persons with high-risk conditions.

Vaccine supply and availability may contribute to the low coverage. First, demand for vaccination and initial supply and distribution of vaccines may vary considerably across geographic areas possibly related to timing of the H1N1 epidemic curve and thus may affect vaccination coverage and contribute to variation by state.<sup>3</sup> The cost of the H1N1 vaccine was paid by the federal government and distributed free of charge in partnership with state and local health departments. Available vaccine supplies were allocated to states proportional to their total populations and shipped to public and private provider vaccination sites determined by the states. States developed implementation strategies in accordance with ACIP recommendations for the initial target groups,<sup>3</sup> specifying vaccine distribution by provider type in consideration of local supply and demand or other factors. In addition, even though initial doses of H1N1 vaccine became available at the beginning of October 2009, vaccine supply was limited until early 2010.<sup>25-29</sup>

State-specific H1N1 vaccination coverage among adults with high-risk conditions varied widely. One of the possible reasons that may contribute to wide variability in coverage include the following: epidemic activity had virtually declined or disappeared in many southern states when vaccine became available, whereas it was still ongoing in many northern states, and H1N1 vaccines became available just before the main epidemic developed in a few Northeast states.<sup>25-30</sup> In addition, wide variability in H1N1 vaccination coverage may be due to variations in state-specific pandemic planning: states that were well prepared for a pandemic may have found it easier to implement vaccination programs on very short notice.<sup>31</sup> Wide variability in state-specific seasonal influenza vaccination coverage may suggest that certain factors that differ among states (eg, medical care delivery infrastructure, population norms, and effectiveness of state and local immunization programs) might explain at least part of the state-level variation in vaccination levels.<sup>15,16</sup>

Non-Hispanic blacks had lower H1N1 vaccination coverage than non-Hispanic whites, which was similar to seasonal (trivalent) influenza vaccination coverage from this study and several previous studies.<sup>8-15</sup> Age was associated with vaccination among adults aged 25 to 64 years with high-risk conditions. Our study found that coverage among adults aged 50 to 64 years were significantly higher than those aged 25 to 49 years, and this result remained the same after controlling the other demographic and access to care variables. As people age, they become more likely to acquire high-risk conditions. Health care providers may be more likely to recommend vaccination to high-risk persons aged 50 to 64 years because of a perception of greater risk from complications of influenza infections compared with younger persons aged 25 to 49 years.<sup>32</sup>

We found that vaccination coverage among persons who have medical insurance, have a regular physician, and have visited a physician for routine checkup within a year (past 12 months) was significantly higher than those who did not, and the significant difference remained after controlling for other variables. Physician contacts play an important role in vaccination uptake.<sup>9,12,13,33</sup> Persons with high-risk conditions may have more frequent contacts with their health care providers. Routine physician visits can provide important opportunities for providers to vaccinate persons with high-risk conditions to improve usual seasonal (trivalent) vaccination coverage and vaccination coverage in possible future pandemics.

Lack of awareness of the federal vaccination recommendation for H1N1 vaccination among the general public may have also affected vaccination coverage. Despite comprehensive media coverage in the wake of the H1N1 pandemic, awareness of federal influenza vaccination recommendations among specifically recommended adults was low. One study showed that only 29.5% of recommended adults correctly reported being in the target groups recommended to receive H1N1 vaccination.<sup>34</sup> Awareness of the federal vaccination recommendation for H1N1 vaccination among persons with high-risk conditions was not reported; however, one study showed that awareness was slightly higher among recommended adults with a recent provider visit (32.2%), which may indicate that those persons have high-risk conditions.<sup>34</sup>

The findings in this report are subject to several limitations. First, BRFSS was a landline, telephone-based survey until January 2011 so excluded not only persons without telephones but also those with only cellular phones, which may bias influenza vaccination coverage estimates.<sup>35</sup> Second, self-reported vaccination status is subject to respondents' recall and was not validated with medical records. No studies have evaluated the validity of self-reported of influenza vaccination among adults aged 25 to 64 years with high-risk conditions. However, self-reported seasonal (trivalent) influenza vaccination status has been shown to have relatively high agreement with medical records among older adults.<sup>36-40</sup> Finally, persons also might have confused receipt of H1N1 vaccination with seasonal influenza vaccination.

The 2009-2010 seasonal influenza vaccination coverage among adults with high-risk conditions is significantly higher than H1N1 vaccination coverage; however, there were many differences in the timing and distribution of the seasonal and H1N1 vaccines.<sup>16,25-29</sup> Variation in vaccination coverage observed among states suggests that vaccination coverage could have been improved. Further study of state vaccination programs to understand reasons for variations in state-level coverage and identify program factors associated with high vaccination coverage among states is important for improving state-level seasonal influenza vaccination coverage and applying these lessons learned for potential future influenza pandemics. Efforts are needed to increase influenza vaccination among populations with lower vaccination coverage.<sup>41</sup> The recommendation for influenza vaccination during the 2010-2011 season was expanded to vaccinate all persons 6 months of age; however, the ACIP continued to emphasize that provision of routine annual influenza vaccination to groups at higher risk for influenza infection or complications should be a focus of vaccination efforts as providers and programs transition to routinely vaccinating all persons 6 months of age.<sup>1</sup> Continued efforts are needed to increase vaccination coverage among persons with high-risk conditions. Federal, state, and local governments and community partners should collaborate to increase implementation of culturally appropriate and evidence-based interventions to increase vaccination coverage among persons at risk for complications from influenza infection. Providers should consider each office or emergency room visit a potential opportunity to vaccinate persons with high-risk conditions.

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**Table 1**  
**Selected characteristics among persons aged 25 to 64 years with high-risk conditions**  
**(BRFSS 2010)\***

	All states combined, %	
	Persons with high-risk conditions (n = 50,242) <sup>†</sup>	Persons without high-risk conditions (n = 132,000)
Total	24.8	75.2
Age, yr		
25-49	50.6	69.9 <sup>‡</sup>
50-64	49.4	30.1
Sex		
Male	43.7	49.3 <sup>‡</sup>
Female	56.3	50.7
Race/ethnicity		
White, non-Hispanic	65.0	68.3 <sup>‡</sup>
Black, non-Hispanic	14.3	10.0
Hispanic	12.4	14.0
Other	8.3	7.7
Education level		
Less than high school	13.7	9.4 <sup>‡</sup>
High school graduate	34.3	31.0
More than high school graduate	52.0	59.6
Employment		
Employed	51.3	71.7 <sup>‡</sup>
Unemployed	48.7	28.3
Income, \$		
<20,000	25.8	13.4 <sup>‡</sup>
20,000-49,999	31.3	29.8
50,000-74,999	32.7	17.2
75,000+	10.2	34.2
Marital status		
Married	58.5	69.1 <sup>‡</sup>
Widowed/divorced/separated	25.7	15.5
Never married	15.8	15.4
Perceived health		
Excellent/very good	26.8	61.4 <sup>‡</sup>
Good	33.3	29.2
Fair	25.4	7.8
Poor	14.5	1.6
Insurance status		
Yes	82.1	81.1 <sup>‡</sup>

	All states combined, %	
	Persons with high-risk conditions (n = 50,242) <sup>†</sup>	Persons without high-risk conditions (n = 132,000)
No	17.9	18.9
Need to see a doctor but could not		
Yes	26.0	16.2 <sup>‡</sup>
No	74.0	83.8
Primary doctor		
Yes	86.6	77.0 <sup>‡</sup>
No	13.4	23.0
Activity limitation		
Yes	42.3	13.9 <sup>‡</sup>
No	57.7	86.1
Time since last checkup		
<1 yr	73.8	61.9 <sup>‡</sup>
1 yr	26.2	38.1
Smoke status		
Current smoker	26.9	20.7 <sup>‡</sup>
Former smoker	27.2	22.2
Never smoker	45.9	57.1
Influenza vaccination		
H1N1 and seasonal	15.7	10.7 <sup>‡</sup>
H1N1 only	4.2	4.0
Seasonal only	26.4	18.4
Neither	53.7	66.9
MSA		
In MSA	90.9	92.0 <sup>‡</sup>
Not in a MSA	9.1	8.0
Persons with asthma		
Yes	40.1	N/A
No	59.9	N/A
Persons with diabetes		
Yes	35.9	N/A
No	64.1	N/A
Persons with heart diseases		
Yes	26.0	N/A
No	74.0	N/A
Persons with other high-risk conditions <sup>§</sup>		
Yes	34.7	N/A
No	65.3	N/A

MSA, Metropolitan Statistical Area; N/A, data are not applicable.

\* This table is based on interviews conducted October 2009 through June 2010.

<sup>†</sup>Influenza-related high-risk conditions included diabetes, asthma, myocardial infarction, coronary heart disease, lung problems other than asthma, kidney problems, anemia (including sickle cell), and a weakened immune system caused by illness or medicines.

<sup>‡</sup>Significant difference among persons with high-risk conditions and persons without high-risk conditions (by  $\chi^2$  test,  $P < .05$ ).

<sup>§</sup>Other high-risk conditions included lung problems other than asthma, kidney problems, anemia (including sickle cell), and a weakened immune system caused by illness or medicines.

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**Table 2**  
**The H1N1 vaccination coverage by demographic and access to care variables among persons aged 25 to 64 years with high-risk conditions and without high-risk conditions, 2010**

Demographic	H1N1 vaccination coverage		Adjusted prevalence ratio*	
	Persons w/high-risk conditions <sup>†</sup> % (95% CI)	Persons w/o high-risk conditions % (95% CI)	Persons w/high-risk conditions % (95% CI)	Persons w/o high-risk conditions % (95% CI)
Total	26.3 (25.4-27.3)	18.5 (18.0-19.1) <sup>‡</sup>		
Age, yr				
25-49 <sup>§</sup>	23.2 (21.8-24.8)	18.4 (17.7-19.0) <sup>‡</sup>	Referent	Referent
50-64	29.6 (28.4-30.8) <sup>  </sup>	19.0 (18.3-19.7) <sup>‡</sup>	1.2 (1.0-1.3) <sup>  </sup>	1.0 (0.9-1.0)
Sex				
Male <sup>§</sup>	26.8 (25.2-28.5)	16.8 (16.1-17.6) <sup>‡</sup>	Referent	Referent
Female	26.0 (24.9-27.1)	20.2 (19.6-20.9) <sup>‡,  </sup>	1.0 (0.9-1.1)	1.1 (1.1-1.2) <sup>  </sup>
Race/ethnicity				
White, non-Hispanic <sup>§</sup>	27.5 (26.4-28.6)	18.4 (17.9-19.0) <sup>‡</sup>	Referent	Referent
Black, non-Hispanic	21.2 (18.7-23.9) <sup>  </sup>	14.8 (13.1-16.6) <sup>‡,  </sup>	0.8 (0.7-1.0) <sup>  </sup>	0.7 (0.6-0.9) <sup>  </sup>
Hispanic	26.7 (23.6-30.2)	19.5 (17.8-21.3) <sup>‡</sup>	1.2 (1.1-1.5) <sup>  </sup>	1.1 (1.0-1.2)
Other	26.2 (22.9-30.0)	22.2 (20.2-24.4) <sup>  </sup>	1.0 (0.8-1.2)	1.2 (1.1-1.4) <sup>  </sup>
Education level				
Less than high school <sup>§</sup>	23.8 (21.2-26.7)	14.8 (13.1-16.7) <sup>‡</sup>	Referent	Referent
High school graduate	22.6 (20.9-24.4)	14.1 (13.2-15.1) <sup>‡</sup>	0.9 (0.8-1.1)	0.9 (0.8-1.1)
More than high school graduate	29.4 (28.2-30.7) <sup>  </sup>	21.5 (20.9-22.1) <sup>‡,  </sup>	1.2 (1.0-1.4)	1.2 (1.0-1.4) <sup>  </sup>
Perceived health				
Excellent/very good <sup>§</sup>	27.5 (25.6-29.4)	19.4 (18.8-20.1) <sup>‡</sup>	Referent	Referent
Good	24.8 (23.3-26.3)	17.3 (16.3-18.3) <sup>‡,  </sup>	1.0 (0.9-1.2)	1.0 (0.9-1.1)
Fair	26.0 (24.3-27.8)	16.0 (14.4-17.9) <sup>‡,  </sup>	1.2 (1.0-1.3) <sup>  </sup>	1.1 (0.9-1.3)
Poor	28.6 (25.7-31.7)	19.1 (15.4-23.6) <sup>‡</sup>	1.2 (1.0-1.4)	1.3 (1.0-1.6)
Insurance status				
Yes	28.6 (27.5-29.7) <sup>  </sup>	20.5 (19.9-21.0) <sup>‡,  </sup>	1.2 (1.0-1.4) <sup>  </sup>	1.4 (1.2-1.6) <sup>  </sup>
No <sup>§</sup>	16.6 (14.6-18.8)	10.6 (9.6-11.6) <sup>‡</sup>	Referent	Referent
Need to see a doctor but could not				
Yes <sup>§</sup>	19.0 (17.3-21.8)	12.6 (11.5-13.8) <sup>‡</sup>	Referent	Referent
No	29.0 (27.9-30.2) <sup>  </sup>	19.7 (19.2-20.3) <sup>‡,  </sup>	1.3 (1.2-1.5) <sup>  </sup>	1.2 (1.1-1.4) <sup>  </sup>
Primary doctor				
Yes	28.2 (27.2-29.3) <sup>  </sup>	20.5 (19.9-21.0) <sup>‡,  </sup>	1.3 (1.1-1.7) <sup>  </sup>	1.2 (1.1-1.3) <sup>  </sup>
No <sup>§</sup>	14.4 (12.2-17.0)	12.3 (11.2-13.4)	Referent	Referent

Demographic	H1N1 vaccination coverage		Adjusted prevalence ratio*	
	Persons w/high-risk conditions <sup>†</sup> % (95% CI)	Persons w/o high-risk conditions % (95% CI)	Persons w/high-risk conditions % (95% CI)	Persons w/o high-risk conditions % (95% CI)
Time since last checkup				
<1 yr	29.4 (28.3-30.6) <sup>//</sup>	22.4 (21.8-23.1) <sup>‡,  </sup>	1.3 (1.1-1.5) <sup>//</sup>	1.5 (1.4-1.6) <sup>//</sup>
1 yr <sup>§</sup>	18.5 (16.9-20.2)	12.7 (12.0-13.4) <sup>‡</sup>	Referent	Referent
Smoke status				
Current smoker <sup>§</sup>	20.9 (18.9-23.0)	12.9 (11.8-14.0) <sup>‡</sup>	Referent	Referent
Former smoker	30.4 (28.6-32.2) <sup>//</sup>	19.3 (18.4-20.3) <sup>‡,  </sup>	1.3 (1.1-1.5) <sup>//</sup>	1.3 (1.2-1.5) <sup>//</sup>
Never smoker	27.1 (25.8-28.5) <sup>//</sup>	20.4 (19.7-21.1) <sup>‡,  </sup>	1.3 (1.1-1.4) <sup>//</sup>	1.3 (1.1-1.4) <sup>//</sup>
Persons with asthma				
Yes	26.1 (24.7-27.5)	N/A	1.1 (1.0-1.2)	N/A
No <sup>§</sup>	26.6 (25.3-27.9)	N/A	Referent	N/A
Persons with diabetes				
Yes	29.0 (27.5-30.6) <sup>//</sup>	N/A	1.1 (1.0-1.2)	N/A
No <sup>§</sup>	24.9 (23.7-26.1)	N/A	Referent	N/A
Persons with heart diseases				
Yes	26.5 (24.5-28.7)	N/A	1.0 (0.9-1.2)	N/A
No <sup>§</sup>	26.3 (25.3-27.4)	N/A	Referent	N/A
Persons with other high-risk conditions <sup>¶</sup>				
Yes	28.8 (27.2-30.6) <sup>//</sup>	N/A	1.2 (1.1-1.3) <sup>//</sup>	N/A
No <sup>§</sup>	24.9 (23.8-26.1)	N/A	Referent	N/A

MSA, Metropolitan Statistical Area; N/A, data are not applicable; w/, with; w/o, without.

NOTE. Vaccination coverage is based on interviews conducted during November 2009 through June 2010. Multivariable analysis (adjusted prevalence ratio) is based on interviews conducted during March through June 2010.

\* Activity limitation, employment status, Metropolitan Statistical Area (MSA) status, income, and marital status were included in the multivariable models but not shown in the table because those variables are not significant for both models (persons with high-risk conditions and persons without high-risk conditions).

<sup>†</sup> Influenza-related high-risk conditions included diabetes, asthma, myocardial infarction, coronary heart disease, lung problems other than asthma, kidney problems, anemia (including sickle cell), and a weakened immune system caused by illness or medicines.

<sup>‡</sup>  $P < .05$  by  $\chi^2$  test for comparisons between persons with high-risk conditions and persons without high-risk conditions.

<sup>§</sup> Reference level.

<sup>//</sup>  $P < .05$  by  $\chi^2$  test for comparisons within each variable with indicated reference level.

<sup>¶</sup> Other high-risk conditions included lung problems other than asthma, kidney problems, anemia (including sickle cell), and a weakened immune system caused by illness or medicines.



**Table 3**  
**Seasonal influenza vaccination coverage by demographic and access to care variables among persons aged 25 to 64 years with high-risk conditions and without high-risk conditions, 2010**

Demographic	Seasonal influenza vaccination coverage		Adjusted prevalence ratio*	
	Persons w/high-risk conditions <sup>†</sup> % (95% CI)	Persons w/o high-risk conditions % (95% CI)	Persons w/high-risk conditions % (95% CI)	Persons w/o high-risk conditions % (95% CI)
Total	47.6 (45.7-49.6)	31.8 (31.2-32.3) <sup>‡</sup>		
Age, yr				
25-49 <sup>§</sup>	37.5 (36.0-39.0)	28.6 (27.9-29.3) <sup>‡</sup>	Referent	Referent
50-64	54.3 (53.1-55.6) <sup>  </sup>	39.2 (38.4-40.0) <sup>‡,  </sup>	1.2 (1.1-1.3) <sup>  </sup>	1.2 (1.2-1.3) <sup>  </sup>
Sex				
Male <sup>§</sup>	42.4 (40.4-44.4)	26.2 (25.2-27.2) <sup>‡</sup>	Referent	Referent
Female	44.2 (42.8-45.7)	32.7 (31.8-33.5) <sup>‡,  </sup>	1.1 (1.0-1.2) <sup>  </sup>	1.2 (1.1-1.2) <sup>  </sup>
Race/ethnicity				
White, non-Hispanic <sup>§</sup>	48.3 (47.2-49.4)	34.0 (33.5-34.6) <sup>‡</sup>	Referent	Referent
Black, non-Hispanic	39.6 (36.8-42.4) <sup>  </sup>	25.9 (23.8-28.1) <sup>‡,  </sup>	0.9 (0.8-1.0) <sup>  </sup>	0.8 (0.7-0.9) <sup>  </sup>
Hispanic	41.4 (37.9-45.0) <sup>  </sup>	24.1 (22.5-25.7) <sup>‡,  </sup>	1.1 (1.0-1.2)	0.9 (0.8-1.0) <sup>  </sup>
Other	43.6 (38.9-48.6)	33.4 (31.3-35.6) <sup>‡</sup>	0.9 (0.8-1.0)	1.0 (0.9-1.1)
Education level				
Less than high school <sup>§</sup>	38.5 (35.8-41.3)	18.0 (16.4-19.7) <sup>‡</sup>	Referent	Referent
High school graduate	42.9 (41.1-44.7)	26.1 (25.1-27.1) <sup>‡,  </sup>	1.0 (0.9-1.2)	1.2 (1.0-1.4) <sup>  </sup>
More than high school graduate	49.7 (48.3-51.1) <sup>  </sup>	36.9 (36.3-37.6) <sup>‡,  </sup>	1.1 (1.0-1.3) <sup>  </sup>	1.4 (1.2-1.6) <sup>  </sup>
Employment				
Employed	46.9 (45.5-48.4)	33.5 (32.9-34.1) <sup>‡,  </sup>	1.0 (1.0-1.1)	1.1 (1.1-1.2) <sup>  </sup>
Unemployed <sup>§</sup>	44.7 (43.3-46.2)	27.5 (26.4-28.5) <sup>‡</sup>	Referent	Referent
Income, \$				
<20,000 <sup>§</sup>	40.0 (37.8-42.3)	19.3 (18.0-20.7) <sup>‡</sup>	Referent	Referent
20,000-49,999	44.5 (42.8-46.3) <sup>  </sup>	27.3 (26.4-28.4) <sup>‡,  </sup>	1.1 (1.0-1.2)	1.1 (1.0-1.2)
50,000-74,999	49.6 (46.8-52.4) <sup>  </sup>	34.5 (33.3-35.8) <sup>‡,  </sup>	1.1 (0.9-1.2)	1.1 (0.9-1.2)
75,000+	53.4 (51.4-55.4) <sup>  </sup>	40.5 (39.5-41.5) <sup>‡,  </sup>	1.2 (1.0-1.3) <sup>  </sup>	1.2 (1.1-1.3) <sup>  </sup>
Insurance status				
Yes	50.1 (49.0-51.2) <sup>  </sup>	35.9 (35.3-36.5) <sup>‡,  </sup>	1.2 (1.1-1.4) <sup>  </sup>	1.4 (1.3-1.6) <sup>  </sup>
No <sup>§</sup>	26.5 (24.3-28.8)	14.2 (13.2-15.2) <sup>‡</sup>	Referent	Referent
Need to see a doctor but could not				
Yes <sup>§</sup>	31.8 (29.9-33.7)	19.2 (18.0-20.4) <sup>‡</sup>	Referent	Referent
No	50.7 (49.6-51.9) <sup>  </sup>	34.2 (33.7-34.8) <sup>‡,  </sup>	1.3 (1.2-1.4) <sup>  </sup>	1.2 (1.1-1.3) <sup>  </sup>

Demographic	Seasonal influenza vaccination coverage		Adjusted prevalence ratio*	
	Persons w/high-risk conditions <sup>†</sup> % (95% CI)	Persons w/o high-risk conditions % (95% CI)	Persons w/high-risk conditions % (95% CI)	Persons w/o high-risk conditions % (95% CI)
Primary doctor				
Yes	49.5 (48.5-50.6) <sup>//</sup>	36.4 (35.9-37.1) <sup>‡,  </sup>	1.4 (1.2-1.6) <sup>//</sup>	1.4 (1.3-1.5) <sup>//</sup>
No <sup>§</sup>	21.7 (19.3-24.3)	16.2 (15.2-17.3)	Referent	Referent
Activity limitation				
Yes	48.8 (47.3-50.4) <sup>//</sup>	33.3 (31.9-34.7) <sup>‡,  </sup>	1.1 (1.1-1.2) <sup>//</sup>	1.1 (1.0-1.2) <sup>//</sup>
No <sup>§</sup>	43.6 (42.3-44.9)	31.6 (31.0-32.1) <sup>‡</sup>	Referent	Referent
Time since last checkup				
<1 yr	51.7 (50.5-52.9) <sup>//</sup>	38.9 (38.1-39.6) <sup>‡,  </sup>	1.3 (1.2-1.4) <sup>//</sup>	1.4 (1.3-1.5) <sup>//</sup>
1 yr <sup>§</sup>	29.7 (28.0-31.5)	21.1 (20.4-21.9) <sup>‡</sup>	Referent	Referent
Smoke status				
Current smoker <sup>§</sup>	36.4 (34.6-38.3)	22.6 (21.4-23.9) <sup>‡</sup>	Referent	Referent
Former smoker	52.8 (51.0-54.7) <sup>//</sup>	34.6 (33.5-35.6) <sup>‡,  </sup>	1.2 (1.1-1.3) <sup>//</sup>	1.2 (1.1-1.3) <sup>//</sup>
Never smoker	47.2 (45.6-48.7) <sup>//</sup>	34.2 (33.5-34.9) <sup>‡,  </sup>	1.2 (1.1-1.3) <sup>//</sup>	1.2 (1.1-1.3) <sup>//</sup>
Persons with asthma				
Yes	44.8 (43.2-46.4)	N/A	1.1 (1.0-1.1)	N/A
No <sup>§</sup>	46.6 (45.3-47.9)	N/A	Referent	N/A
Persons with diabetes				
Yes	52.4 (50.7-54.1) <sup>//</sup>	N/A	1.2 (1.1-1.2) <sup>//</sup>	N/A
No <sup>§</sup>	42.1 (40.9-43.4)	N/A	Referent	N/A
Persons with heart diseases				
Yes	47.6 (45.7-49.6)	N/A	1.0 (1.0-1.1)	N/A
No <sup>§</sup>	45.4 (44.2-46.6)	N/A	Referent	N/A
Persons with other high-risk conditions <sup>//</sup>				
Yes	46.7 (44.9-48.6)	N/A	1.0 (1.0-1.1)	N/A
No <sup>§</sup>	45.2 (43.9-46.4)	N/A	Referent	N/A

N/A, data are not applicable; w/, with; w/o, without.

NOTE. Vaccination coverage is based on interviews conducted during October 2009 through June 2010. Multivariable analysis (adjusted prevalence ratio) is based on interviews conducted during March through June 2010.

\* Marital status, perceived health status and Metropolitan Statistical Area (MSA) status were included in the multivariable models but not shown in the table because those variables are not significant for both models (persons with high-risk conditions and persons without high-risk conditions).

<sup>†</sup> Influenza-related high-risk conditions included diabetes, asthma, myocardial infarction, coronary heart disease, lung problems other than asthma, kidney problems, anemia (including sickle cell), and a weakened immune system caused by illness or medicines.

<sup>‡</sup>  $P < .05$  by  $\chi^2$  test for comparisons between persons with high-risk conditions and persons without high-risk conditions.

<sup>§</sup> Reference level.

<sup>//</sup>  $P < .05$  by  $\chi^2$  test for comparisons within each variable with indicated reference level.

<sup>7</sup>Other high-risk conditions included lung problems other than asthma, kidney problems, anemia (including sickle cell), and a weakened immune system caused by illness or medicines.

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