

Influenza A (H1N1) 2009 Monovalent Vaccination Among Adults with Asthma, U.S., 2010

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Background: The 2009 pandemic influenza A (H1N1) virus (2009 H1N1) was first identified in April 2009 and quickly spread around the world. The first doses of influenza A (H1N1) 2009 monovalent vaccine (2009 H1N1 vaccine) became available in the U.S. in early October 2009. Because people with asthma are at increased risk of complications from influenza, people with asthma were included among the initial prioritized groups.

Purpose: To evaluate 2009 H1N1 vaccination coverage and identify factors independently associated with vaccination among adults with asthma in the U.S.

Methods: Data from the 2009–2010 BRFSS (Behavioral Risk Factor Surveillance System) influenza supplemental survey were used; responses from March through June 2010 were analyzed to estimate vaccination levels of 2009 H1N1 vaccine among respondents aged 25–64 years with asthma. Multi-variable logistic regression and predictive marginal models were performed to identify factors independently associated with vaccination.

Results: Among adults aged 25–64 years with asthma, 25.5% (95% CI=23.9%, 27.2%) received the 2009 H1N1 vaccination. 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. Characteristics independently associated with an increased likelihood of vaccination among adults with asthma were as follows: had a primary doctor, had other high-risk conditions, and received seasonal influenza vaccination in the 2009–2010 season.

Conclusions: Vaccination coverage among adults aged 25–64 years with asthma was only 25.5% and varied widely by state and demographic characteristics. National and state-specific 2009 H1N1 vaccination coverage data for adults with asthma are useful for evaluating the vaccination campaign and for planning and implementing strategies for increasing vaccination coverage in possible future pandemics.

(Am J Prev Med 2011;41(6):619–626) Published by Elsevier Inc. on behalf of American Journal of Preventive Medicine

Introduction

Asthma is a chronic respiratory disease, with episodic symptoms including wheezing, coughing, and shortness of breath. Asthma episodes or attacks can vary from mild to life threatening.¹ Asthma prevalence in the U.S. increased from 1980 to 1996, plateaued from 1997 to 2008, and slightly increased in

2009.^{1–4} In 2009, approximately 7.1 million (9.6%) U.S. children (aged <18 years) and 17.5 million (7.7%) U.S. adults (aged ≥18 years) were reported to have asthma.⁴ In 2007, asthma accounted for 3447 deaths, approximately 456,000 hospitalizations, an estimated 1.8 million emergency department visits, and approximately 13.9 million physician office visits.⁴

Asthma causes substantial morbidity and is associated with high direct and indirect medical and economic costs. Influenza is responsible for 11%–21% of asthma attacks or exacerbations in adults and children.^{5–8} Because influenza vaccine may prevent 70%–90% of influenza illness among adults aged <65 years when vaccine and circulating viruses are antigenically similar, vaccination can substantially reduce influenza-related morbidity among people with asthma.^{6,9} To

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0749-3797/\$36.00

doi: 10.1016/j.amepre.2011.08.004

reduce asthma morbidity and mortality, the National Asthma Education and Prevention Program (NAEPP) panel identified influenza vaccination as one of several “key clinical activities that should be considered as essential for quality asthma care.”^{10,11}

A novel influenza A (H1N1) virus infecting humans was first identified in April 2009 and quickly spread around the world.¹² In July 2009, the Advisory Committee on Immunization Practices (ACIP) issued recommendations regarding the use of a new monovalent vaccine against infection with the 2009 influenza A (H1N1) virus.¹² In September 2009, the Food and Drug Administration approved for use the influenza A (H1N1) 2009 monovalent vaccine (2009 H1N1 vaccine).¹³ In any influenza season, people with asthma are at increased risk of complications from influenza infection, and vaccination of people with asthma has been recommended for many years.⁹ The ACIP recommended 2009 H1N1 vaccine for all people aged <25 years as well as people aged 25–64 years who have medical conditions including asthma that put them at higher risk for influenza-related complications.¹²

Questions were added to the ongoing Behavioral Risk Factor Surveillance System (BRFSS) survey as part of an influenza supplemental survey. To identify strategies to improve vaccination coverage for the possible future influenza pandemics, analysis was performed on the 2009–2010 BRFSS influenza supplemental survey to examine the following questions: (1) What is the national 2009 H1N1 vaccination coverage among adults aged 25–64 years with asthma? (2) What is the state-specific 2009 H1N1 vaccination coverage among adults aged 25–64 years with asthma? (3) What factors affect 2009 H1N1 vaccination coverage among adults aged 25–64 years with asthma?

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 CDC.¹⁴ The BRFSS Influenza Supplemental Survey began in October 2009 in 49 states, the District of Columbia, and two territories. For the 2009–2010 BRFSS influenza supplemental survey, the median CASRO response and cooperation rate were 54% (range=52%–62%) and 76% (range=74%–80%).

Point estimates and 95% CIs were calculated using SUDAAN. To estimate H1N1 vaccination coverage during the 2009–2010 season, analyses were restricted to individuals interviewed during March through June 2010 and vaccination during October 2009 through February 2010. All analyses were weighted to reflect the age, gender, and race/ethnicity of the U.S. non-institutionalized, civilian population. All tests were two-tailed with the significance level set at $\alpha < 0.05$.

To increase sample size and get reliable state-specific H1N1 vaccination coverage, analysis was conducted on data gathered during November 2009–June 2010, and the cumulative proportion of people vaccinated during October 2009–May 2010 was estimated using Kaplan-Meier survival analysis procedure. The adjusted percentages (i.e., predictive margins) are a type of direct standardization that averages the predicted values from the logistic model, controlling for the confounding factors measured in the population.^{15,16} Coverage was adjusted by all demographic and access-to-care variables. Variables were determined to be significant at $p < 0.05$.

Results

A total of 91,877 individuals aged 25–64 years were included in the analysis. Respondents who reported unknown 2009 H1N1 vaccination status (6.7%) were excluded. Of the 91,877 adults aged 25–64 years, 9.0% reported having asthma. Overall, among adults aged 25–64 years, 2009 H1N1 vaccination coverage was higher among those with asthma (25.5%, 95% CI=23.9%, 27.2%) than those without asthma (19.1%, 95% CI=18.6%, 19.6%). Across the majority of subgroups, vaccination coverage was higher among adults with asthma compared to those without asthma (Table 1).

In bivariable analysis, among adults aged 25–64 years with asthma, 2009 H1N1 vaccination coverage was higher in women, whites, and individuals aged 50–64 years. Coverage was also higher among people who reported having higher levels of education, current employment, higher income, being married, having other health conditions such as diabetes and heart disease, access to a primary care physician, former or never smoking, having health insurance, and receiving seasonal influenza vaccination. Additionally, people who needed to see a doctor but could not and those who had not had a routine checkup within 1 year were less likely to be vaccinated (Table 1).

Adjusted coverage estimates from the predictive model did not differ greatly from the crude vaccination coverage. Characteristics independently associated with an increased likelihood of vaccination among adults with asthma were having a primary doctor, having other high-risk conditions, and receipt of seasonal influenza vaccination (Table 1). State-specific 2009 H1N1 vaccination coverage among people aged 25–64 years with asthma 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 median of 27.2% across all states (Table 2, Figure 1).

Discussion

This is the first study to assess national and state-specific 2009 H1N1 vaccination coverage among adults with

Table 1. H1N1 vaccination coverage among people aged 25–64 years with asthma and without asthma, 2010,^a % (95% CI)

Demographic	H1N1 vaccination coverage		Adjusted H1N1 vaccination coverage	
	People with asthma (n=8833)	People without asthma (n=82,466)	People with asthma	People without asthma
Total	25.5 (23.9, 27.2)	19.1 (18.6, 19.6) ^b	—	—
Age (years)				
25–49 ^c	22.9 (20.7, 25.2)	18.0 (17.3, 18.7) ^b	25.6 (23.1, 28.1)	20.4 (19.7, 21.2)
50–64	30.2 (28.0, 32.5) ^d	21.2 (20.5, 21.9) ^b	25.7 (23.4, 28.0)	18.1 (17.4, 18.8) ^d
Gender				
Male ^c	22.5 (19.6, 25.7)	17.9 (17.1, 18.6) ^b	24.2 (21.0, 27.4)	19.5 (18.7, 20.4)
Female	26.9 (25.0, 28.9) ^d	20.3 (19.6, 20.9) ^b	26.2 (24.2, 28.3)	19.5 (18.8, 20.2)
Race/ethnicity				
White, non-Hispanic ^c	27.3 (25.4, 29.3)	19.4 (18.9, 20.0) ^b	26.1 (24.1, 28.1)	19.0 (18.4, 19.7)
Black, non-Hispanic	18.3 (14.3, 23.1) ^d	14.8 (13.4, 16.3)	22.3 (17.5, 27.1)	16.6 (14.9, 18.2) ^d
Hispanic	23.3 (17.9, 29.8)	19.0 (17.4, 20.7)	25.8 (19.3, 32.3)	22.6 (20.7, 24.5) ^d
Other	25.5 (19.7, 32.4)	22.3 (20.2, 24.6)	26.0 (20.1, 31.9)	22.4 (20.1, 24.6) ^d
Education level				
Less than high school ^c	20.5 (15.9, 25.8)	16.0 (14.4, 17.8)	25.4 (19.2, 31.5)	19.9 (17.6, 22.1)
High school graduate	21.0 (18.3, 24.1)	14.8 (14.0, 15.7) ^b	23.1 (19.9, 26.2)	17.1 (16.1, 18.2) ^d
College	29.1 (27.0, 31.4) ^d	22.1 (21.4, 22.7) ^b	26.9 (24.7, 29.1)	20.5 (19.9, 21.2)
Employment				
Employed	27.7 (25.5, 30.1) ^d	19.4 (18.8, 20.0) ^b	26.8 (24.3, 29.4)	19.5 (18.8, 20.2)
Unemployed ^c	23.0 (20.7, 25.5)	18.4 (17.6, 19.3) ^b	24.0 (21.2, 26.8)	19.5 (18.5, 20.5)
Income (\$)				
<20,000 ^c	22.1 (19.0, 25.6)	16.3 (15.0, 17.7) ^b	26.1 (22.0, 30.1)	22.0 (20.1, 23.8)
20,000–50,000	23.2 (20.4, 26.4)	16.7 (15.8, 17.7) ^b	24.3 (21.4, 27.2)	19.1 (18.1, 20.1) ^d
>50,000	30.6 (27.7, 33.5) ^d	22.0 (21.3, 22.7) ^b	26.3 (23.4, 29.3)	19.1 (18.4, 19.9) ^d
Marital status				
Married	26.8 (24.7, 29.0) ^d	20.4 (19.8, 21.0) ^b	24.7 (22.4, 26.9)	19.9 (19.2, 20.5)
Widowed/divorced/separated	25.3 (22.2, 28.6)	16.9 (15.8, 18.1) ^b	26.0 (22.5, 29.4)	18.5 (17.2, 19.7)
Never married ^c	21.8 (18.0, 26.1)	16.0 (14.6, 17.5) ^b	29.0 (24.4, 33.7)	19.0 (17.4, 20.6)
Perceived health				
Excellent/very good ^c	27.6 (24.8, 30.6)	19.3 (18.6, 20.0) ^b	24.7 (21.7, 27.7)	19.3 (18.6, 20.1)
Good	23.0 (20.3, 26.0) ^d	17.7 (16.8, 18.6) ^b	24.7 (21.8, 27.7)	19.2 (18.2, 20.1)
Fair	24.2 (20.8, 28.0)	20.0 (18.5, 21.6) ^b	26.6 (22.4, 30.8)	20.5 (18.7, 22.3)
Poor	27.9 (23.8, 32.5)	24.4 (21.4, 27.6)	29.1 (23.5, 34.6)	22.0 (18.8, 25.1)
Other high-risk conditions				
Yes	28.9 (26.3, 31.7) ^d	26.0 (24.7, 27.4)	28.3 (25.3, 31.4) ^d	22.0 (20.7, 23.3)
No ^c	23.1 (21.0, 25.3)	17.9 (17.3, 18.4) ^b	23.7 (21.4, 26.0)	19.0 (18.4, 19.6)

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Table 1. H1N1 vaccination coverage among people aged 25–64 years with asthma and without asthma, 2010,^a % (95% CI) (continued)

Demographic	H1N1 vaccination coverage		Adjusted H1N1 vaccination coverage	
	People with asthma (n=8833)	People without asthma (n=82,466)	People with asthma	People without asthma
Insurance status				
Yes	27.4 (25.6, 29.3) ^d	21.2 (20.6, 21.8) ^b	25.5 (23.5, 27.4)	19.9 (19.3, 20.5) ^d
No ^c	16.1 (12.8, 20.0)	10.6 (9.6, 11.6) ^b	26.9 (22.0, 31.8)	17.1 (15.4, 18.8)
Need to see a doctor but not able to				
Yes ^c	17.3 (14.7, 20.3)	13.0 (11.9, 14.1) ^b	24.4 (20.7, 28.2)	17.6 (16.1, 19.1)
No	28.6 (26.6, 30.7) ^d	20.4 (19.9, 21.0) ^b	25.9 (23.8, 28.0)	19.8 (19.2, 20.4) ^d
Primary doctor				
Yes	27.8 (26.0, 29.6) ^d	21.1 (20.6, 21.7) ^b	26.3 (24.3, 28.2) ^d	19.5 (18.9, 20.1)
No ^c	11.9 (8.8, 15.9)	12.0 (10.9, 13.1)	19.1 (13.4, 24.7)	19.5 (17.9, 21.1)
Activity limitation				
Yes	24.9 (22.6, 27.4)	21.2 (20.1, 22.4) ^b	24.4 (21.6, 27.2)	19.1 (17.9, 20.4)
No ^c	25.9 (23.7, 28.3)	18.6 (18.0, 19.2) ^b	26.5 (23.9, 29.1)	19.6 (19.0, 20.3)
Time since last checkup (years)				
<1	28.6 (26.6, 30.6) ^d	22.9 (22.2, 23.6) ^b	25.9 (23.8, 27.9)	20.7 (20.0, 21.4) ^d
≥1 ^c	18.9 (16.2, 21.9)	12.9 (12.1, 13.6) ^b	24.9 (21.4, 28.5)	16.8 (15.8, 17.7)
Status as a smoker				
Current ^c	19.4 (16.6, 22.6)	13.6 (12.6, 14.8) ^b	23.9 (20.2, 27.5)	17.4 (16.2, 18.7)
Former	29.8 (26.4, 33.5) ^d	21.0 (20.0, 22.0) ^b	28.3 (25.0, 31.6)	20.3 (19.3, 21.4) ^d
Never	26.7 (24.4, 29.2) ^d	20.5 (19.8, 21.2) ^b	25.1 (22.6, 27.6)	19.8 (19.1, 20.6) ^d
Seasonal influenza vaccination				
Yes	48.6 (45.8, 51.4) ^d	45.2 (44.2, 46.3) ^b	47.0 (43.7, 50.4) ^d	43.2 (41.9, 44.6) ^d
No ^c	9.1 (7.6, 10.7)	7.3 (6.8, 7.7) ^b	9.4 (7.6, 11.1)	7.7 (7.2, 8.2)
MSA status				
In MSA	25.5 (23.8, 27.3)	19.1 (18.6, 19.7) ^b	25.6 (23.7, 27.5)	19.5 (18.9, 20.1)
Not in MSA ^c	26.0 (21.2, 31.5)	18.5 (16.9, 20.1) ^b	26.3 (21.5, 31.2)	19.8 (18.1, 21.5)

^aThis table is based on interviews conducted during March through June only.

^b $p < 0.05$ by *t*-test for comparisons of people with asthma to people without asthma

^cReference level

^d $p < 0.05$ by *t*-test for comparisons within each variable with indicated reference level

MSA, metropolitan statistical area

asthma even though seasonal influenza vaccination coverage among people with asthma or other high-risk conditions was reported previously.^{5,17,18} It was found that adults with asthma were more likely to be vaccinated with 2009 H1N1 than those without asthma, but even among adults with asthma, vaccination coverage was only 25.5%. Overall, 2009 H1N1 vaccination coverage (25%) among adults with asthma was lower than usual seasonal influenza vaccination coverage (coverage was around 40% in

recent seasons) and seasonal influenza vaccination during pandemic (40%).

The low coverage may be due in part to lack of vaccine availability at the time of epidemic activity. U.S. 2009 H1N1 disease activity was first recognized in April 2009, peaked in October, and declined substantially by January 2010. Research and development of 2009 H1N1 vaccines began right after the virus emerged in late April 2009. By late June, several man-

Table 2. State-specific H1N1 vaccination coverage by asthma status, adults aged 25–64 years, BRFSS 2010

State	H1N1 vaccination coverage				Percentage point differences between people with and without asthma % (95% CI)
	Sample size	Asthma prevalence (%)	People with asthma % (95% CI)	People without asthma % (95% CI)	
Alaska	1,038	9.3	— ^a	26.8 (21.7, 32.8)	−0.8 (−6.1, 4.5)
Vermont ^b	2,961	11.5	—	—	—
Mississippi	3,660	7.5	9.9 (6.4, 15.1)	10.0 (8.4, 11.9)	−0.1 (−1.8, 1.6)
Georgia	2,302	8.5	13.6 (7.8, 23.1)	19.1 (15.6, 23.3)	−5.5 (−9.1, −1.9)
South Carolina	3,792	8.1	17.4 (11.7, 25.6)	18.5 (15.8, 21.4)	−1.1 (−3.7, 1.5)
Arizona	2,031	10.7	17.8 (11.4, 27.4)	22.1 (18.4, 26.4)	−4.3 (−7.9, −0.7)
Alabama	3,056	8.1	18.9 (12.4, 28.3)	12.8 (11.1, 14.8)	6.1 (4.2, 8.0)
New Jersey	5,241	9.2	19.4 (14.8, 25.3)	16.3 (14.5, 18.4)	3.1 (1.3, 4.9)
New York	3,021	11.2	19.6 (13.1, 28.8)	18.2 (15.7, 21.0)	1.4 (−1.0, 3.8)
Tennessee	2,298	7.0	21.2 (13.4, 32.7)	19.1 (16.3, 22.3)	2.1 (−0.7, 4.9)
Florida	10,418	8.4	21.5 (16.9, 27.1)	14.3 (12.7, 16.0)	7.2 (5.7, 8.7)
Illinois	1,881	9.4	21.7 (13.3, 34.1)	28.4 (17.9, 43.3)	−6.7 (−18.3, 4.9)
Nevada	1,872	9.3	21.9 (13.9, 33.4)	15.5 (12.7, 18.9)	6.4 (3.4, 9.4)
Maryland	4,064	9.8	22.3 (16.7, 29.4)	23.6 (21.4, 26.1)	−1.3 (−3.5, 0.9)
District of Columbia	1,580	11.2	23.5 (15.7, 34.4)	23.6 (20.3, 27.3)	−0.1 (−3.4, 3.2)
Wyoming	2,442	10.2	23.9 (17.6, 31.9)	21.9 (19.4, 24.6)	2.0 (−0.4, 4.4)
Texas	6,902	7.4	23.9 (17.6, 32.0)	16.5 (14.8, 18.4)	7.4 (5.7, 9.1)
Louisiana	2,942	5.7	24.8 (15.2, 38.9)	16.0 (14.0, 18.4)	8.8 (6.7, 10.9)
Connecticut	2,463	9.5	25.1 (18.0, 34.4)	18.1 (15.5, 21.2)	7.0 (4.2, 9.8)
Ohio	4,603	9.7	25.1 (19.6, 31.7)	17.9 (16.1, 20.0)	7.2 (5.3, 9.1)
Kansas	4,622	8.7	25.4 (19.2, 33.3)	21.2 (19.2, 23.3)	4.2 (2.3, 6.1)
Wisconsin	1,355	6.2	25.8 (15.2, 41.8)	21.7 (18.5, 25.4)	4.1 (0.9, 7.3)
North Carolina	4,830	7.8	26.6 (20.7, 33.8)	22.5 (19.7, 25.6)	4.1 (1.3, 6.9)
Michigan	3,661	10.3	26.8 (21.0, 33.9)	17.7 (15.7, 19.8)	9.1 (7.2, 11.0)
Indiana	3,640	9.7	26.9 (20.9, 34.2)	20.1 (17.9, 22.5)	6.8 (4.6, 9.0)
Colorado	4,957	8.9	27.0 (21.8, 33.3)	19.9 (18.1, 21.8)	7.1 (5.4, 8.8)
Oklahoma	3,259	10.0	27.2 (20.9, 35.0)	18.3 (16.4, 20.4)	8.9 (7.0, 10.8)
Missouri	1,979	8.7	27.5 (19.6, 37.8)	18.0 (15.2, 21.3)	9.5 (6.7, 12.3)
Kentucky	3,399	11.2	27.8 (21.0, 36.2)	16.8 (14.8, 19.2)	11.0 (8.9, 13.1)
Virginia	2,232	9.4	28.1 (17.7, 42.8)	23.9 (20.8, 27.3)	4.2 (1.1, 7.3)
Pennsylvania	4,062	10.0	28.2 (22.2, 35.4)	16.2 (14.6, 18.1)	12.0 (10.3, 13.7)
Arkansas	1,432	8.4	28.3 (16.8, 45.2)	18.0 (15.1, 21.4)	10.3 (7.2, 13.4)
Delaware	1,910	11.8	28.8 (20.3, 39.9)	21.7 (18.7, 25.2)	7.1 (4.1, 10.1)
California	6,880	8.1	28.9 (23.6, 35.1)	20.7 (19.1, 22.4)	8.2 (6.7, 9.7)
Montana	3,082	9.4	29.0 (21.4, 38.5)	21.1 (18.9, 23.5)	7.9 (5.6, 10.2)

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Table 2. State-specific H1N1 vaccination coverage by asthma status, adults aged 25–64 years, BRFSS 2010 (continued)

State	H1N1 vaccination coverage				Percentage point differences between people with and without asthma % (95% CI)
	Sample size	Asthma prevalence (%)	People with asthma % (95% CI)	People without asthma % (95% CI)	
Utah	4,076	8.7	29.1 (23.2, 36.2)	24.5 (22.5, 26.6)	4.6 (2.7, 6.5)
Oregon	2,227	9.2	29.5 (21.0, 40.6)	22.2 (19.5, 25.3)	7.3 (4.5, 10.1)
Idaho	3,283	9.2	29.6 (23.1, 37.3)	19.6 (17.6, 21.6)	10.0 (8.1, 11.9)
West Virginia	1,883	7.4	30.1 (21.5, 41.0)	18.1 (15.8, 20.7)	12.0 (9.7, 14.3)
South Dakota	2,902	7.8	30.1 (21.9, 40.4)	32.0 (29.1, 35.1)	–1.9 (–4.7, 0.9)
North Dakota	2,129	8.0	31.4 (22.2, 43.1)	26.1 (22.8, 29.8)	5.3 (1.9, 8.7)
Minnesota	3,226	8.0	35.8 (25.3, 49.0)	29.8 (26.2, 33.7)	6.0 (2.4, 9.6)
Rhode Island	2,833	11.0	36.8 (27.7, 47.7)	31.0 (28.0, 34.3)	5.8 (2.8, 8.8)
Hawaii	3,178	11.1	37.5 (28.4, 48.5)	29.7 (26.8, 32.7)	7.8 (5.0, 10.6)
Washington	7,655	9.7	38.4 (32.3, 45.2)	23.8 (22.2, 25.6)	14.6 (12.9, 16.3)
Iowa	2,376	7.6	39.1 (29.9, 49.9)	26.7 (24.2, 29.4)	12.4 (9.9, 14.9)
New Hampshire	2,366	9.9	41.0 (32.6, 50.5)	25.4 (22.7, 28.5)	15.6 (12.8, 18.4)
Nebraska	6,107	9.2	41.1 (30.2, 54.1)	26.3 (23.0, 30.0)	14.8 (11.4, 18.2)
Massachusetts	7,042	11.5	41.4 (34.6, 49.0)	30.3 (27.8, 33.0)	11.1 (8.7, 13.5)
New Mexico	2,823	8.7	42.7 (31.6, 55.7)	26.8 (22.8, 31.4)	15.9 (11.8, 20.0)
Maine	3,294	10.3	46.1 (33.3, 61.2)	26.5 (23.3, 30.0)	19.6 (16.3, 22.9)
Median		9.2	27.2	21.2	7.1
Range		5.7–11.8	9.9–46.1	10.0–32.0	–6.7–19.6

^aEstimates are not reliable because relative SE is >0.3.

^bData were not collected for Vermont.

BRFSS, Behavioral Risk Factor Surveillance System

ufacturers had begun the process of producing vaccine. Initial doses of H1N1 vaccine became available at the beginning of October 2009. However, vaccine supply was limited until early 2010.^{12,13,19–22}

Only live H1N1 vaccine (H1N1 mist) was available and distributed during the first week of October, and both vaccines (H1N1 mist and H1N1 shot) were available from the second week on (CDC unpublished data), this vaccine supply issue may affect vaccination coverage since live vaccine is contraindicated in those with asthma.¹⁰ In addition, demand for vaccination and initial supply and distribution of both vaccines may vary considerably across geographic areas and thus may also affect vaccination coverage.¹²

Only a few variables were significant in the multivariable model and those variables included having a primary doctor, having other high-risk conditions, and receipt of seasonal influenza vaccination. People with a primary doctor and people with other high-risk conditions were

more likely to receive vaccination, which concurred with one previous study.¹⁸ Seasonal influenza vaccination is a significant predictor of 2009 H1N1 vaccination among adults with asthma, which may indicate that an individual's tendency to receive one vaccine may positively affect his or her decision to receive another vaccination. Increasing seasonal vaccination efforts may help increase influenza vaccination coverage in possible future pandemics. Seasonal influenza vaccination could provide a platform for delivering other adult vaccines.

Low awareness of the federal vaccination recommendation for 2009 H1N1 vaccination among the general public may have also affected vaccination coverage. Despite comprehensive media coverage in the wake of the 2009 H1N1 pandemic, the level of awareness of federal influenza vaccination recommendations among specifically recommended adults was low. One study showed that only 29.5% of recommended adults correctly re-

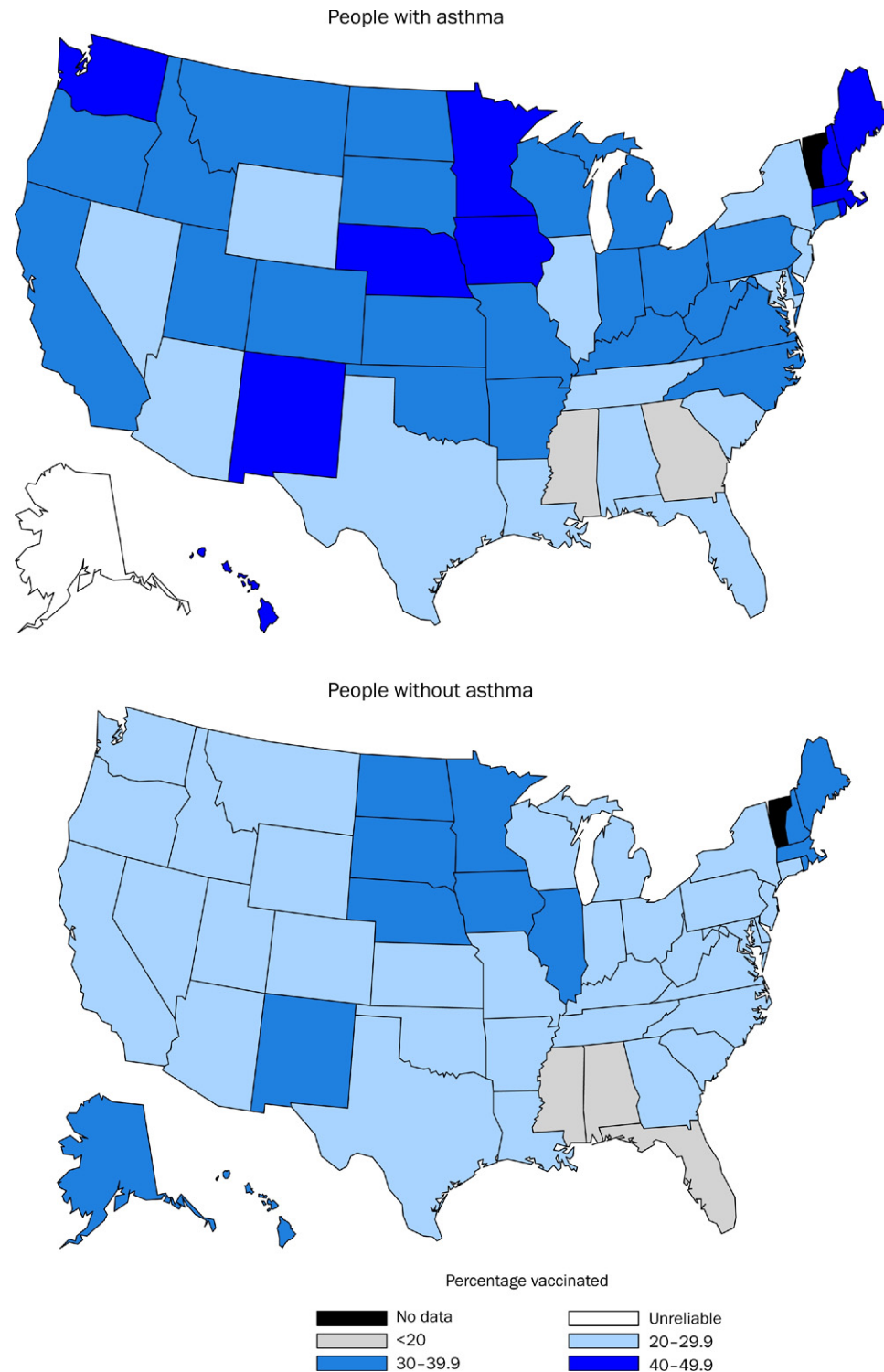


Figure 1. State-specific H1N1 vaccination coverage by asthma status, adults aged 25–64 years, BRFSS 2010
 Note: Data were not collected for Vermont. Unreliable estimates are those for which relative SE is >0.3.
 BRFSS, Behavioral Risk Factor Surveillance System

ported being in the target groups recommended to receive H1N1 vaccination.²³

The findings in this report are subject to several limitations. First, BRFSS is a landline, telephone-based survey and

excludes people without telephones and those with only cellular phones, and thus may bias the coverage estimate.²⁴ Second, self-reported vaccination status is subject to recall bias and was not validated with medical records. Finally,

people also might have confused receipt of 2009 H1N1 vaccination with seasonal influenza vaccination.

The 2009–2010 seasonal influenza vaccination coverage among adults with asthma was about 40%, which is significantly higher than H1N1 vaccination coverage; however, there were many differences in the timing and distribution of the seasonal and 2009 H1N1 vaccines.^{19–22,25} Variation in H1N1 vaccination coverage observed among states suggests that vaccination coverage could have been improved. Further research on 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.

We thank Elizabeth Monsell, James A. Singleton, Stacy M. Greby, Abigail M. Shefer, and Carolyn B. Bridges for their important contributions to this manuscript.

No financial disclosures were reported by the authors of this paper.

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