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RESEARCH ARTICLE

National and State-Specific Shingles Vaccination Among Adults Aged ≥60 Years

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Introduction: Shingles (herpes zoster) causes substantial morbidity, especially among older adults. The shingles vaccine has been recommended for people aged ≥60 years since 2006. This study assessed recent shingles vaccination at national and state levels among adults aged ≥60 years.

Methods: The 2014 Behavioral Risk Factor Surveillance System data were analyzed in 2015 to assess shingles vaccination coverage among adults aged ≥60 years at national and state levels. Multivariable logistic regression and predictive marginal models identified factors independently associated with vaccination.

Results: Shingles vaccination coverage among adults aged ≥60 years was 31.8% (95% CI=31.4%, 32.2%). Among states, shingles vaccination coverage ranged from 17.8% (95% CI=15.8%, 20.0%) in Mississippi to 46.6% (95% CI=44.3%, 48.8%) in Vermont, with a median of 33.3%. Coverage was <25% in four states and >40% in nine states. For all states, coverage was significantly higher among non-Hispanic whites compared with non-white races except for Oregon, with coverage differences ranging from −33.2% in the District of Columbia to 0.9% in Oregon and a median of −16.0%. Characteristics independently associated with vaccination were age, race/ethnicity, sex, education, employment status, household income, region, perceived health status, health insurance status, personal healthcare provider, routine checkup status, and whether reporting that cost was a barrier to seeing a doctor.

Conclusions: Coverage varied dramatically by state. State-level comparisons may aid in designing tailored intervention programs through sharing of best practices. Strategies are needed to mitigate financial barriers for both provider and patients, improve awareness, and increase provider recommendation of the vaccine.

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INTRODUCTION

Herpes zoster, or shingles, is caused by reactivation of the varicella zoster virus. The risk of shingles increases with age and is approximately three times higher among adults aged ≥65 years compared with those aged <65 years.[1–4] More than half of all people diagnosed with shingles each year are aged ≥50 years.[4] In the U.S., more than 99% of adults have serologic evidence of varicella zoster virus infection and are susceptible to shingles,[5] with an estimated individual lifetime risk of approximately 30%.[4] Ten to 30 percent of people experiencing shingles develop postherpetic neuralgia (PHN), a debilitating neuropathic pain syndrome that can last months or even years and is often refractory to treatment, with the risk of PHN increasing with age.[3,4,6] Approximately 1 million new cases of shingles are diagnosed annually.[4–11] The incidence rate of shingles ranges between three and five per 1,000 person-years in prior studies in the U.S. and other countries, depending

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on the studied population and immunocompetency of subjects.[4–11] Shingles results in an estimated $566 million in total healthcare costs.[12] Additionally, shingles causes indirect cost with an average loss exceeding 129 hours of work per episode.[7,13] Much of the burden of shingles and PHN is, however, borne by patients as reduced quality of life because of associated pain and suffering.[3,6]

The zoster vaccine, Zostavax®, was licensed in 2006 by the U.S. Food and Drug Administration for prevention of shingles, as well as prevention and treatment of PHN. The Advisory Committee on Immunization Practices (ACIP) recommended routine vaccination of all people aged ≥60 years with one dose of zoster vaccine in October 2006; these recommendations were published in May 2008.[6,14] Cost effectiveness of Zostavax varies depending on patients' age and is more cost effective for patients aged 60–70 years but is not as cost effective for patients aged >80 years.[15,16]

This study used data from the 2014 Behavioral Risk Factor Surveillance System (BRFSS) to assess recent national and state-specific shingles vaccination coverage and identify factors independently associated with vaccination among adults aged ≥60 years in the U.S. Such information may help identify which strategies can help improve vaccination coverage among adult populations.

METHODS

The 2014 BRFSS data were analyzed in 2015. BRFSS is a continuous, population-based telephone survey coordinated by state health departments in collaboration with the Centers for Disease Control and Prevention (CDC). BRFSS collects information from non-institutionalized adults aged ≥18 years. BRFSS is conducted monthly in all 50 states and the District of Columbia (DC). The objective of BRFSS is to collect uniform, state-specific data on self-reported preventive health practices and risk behaviors that are linked to chronic diseases, injuries, and preventable infectious diseases. 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.[17] Beginning in 2011, surveys included landline and cellular telephone households and used a new method for weighting.[18]

To determine shingles vaccination status in all states, a question on shingles vaccination was added to the 2014 BRFSS core questionnaire as part of a 3-year rotation with questions to assess tetanus diphtheria and tetanus, diphtheria, and acellular pertussis vaccination coverage (2013) and in place of influenza vaccination (2015). Respondents were asked, *Have you ever had the shingles or zoster vaccine?* Respondents who answered *yes* were considered vaccinated. For 2014 BRFSS, the median American Association of Public Opinion Research (RR4) landline, cellular phone, and combined response rates were 48.7% (range, 26.7%–61.6%); 40.5% (range, 22.2%–60.0%); and 25.1% (range, 25.1%–60.1%), respectively.[19]

SUDAAN, version 11.0.1, was used to calculate point estimates and 95% CIs.[20] All analyses were weighted to reflect the age, sex, and race/ethnicity of the U.S. non-institutionalized civilian population. All tests were two-tailed with the significance level set at $\alpha < 0.05$. State-specific shingles vaccination coverage was also evaluated. Multivariable logistic regression models were conducted (all variables selected were included in the model) and predictive marginal models[20] were used to generate adjusted prevalence and adjusted prevalence differences and to identify variables independently associated with shingles vaccination among adults aged ≥60 years.

RESULTS

A total of 208,505 adults aged ≥60 years were included in the 2014 BRFSS. Of those, 1.7% (3,486) who answered *don't know* or *declined* to the question were excluded from the assessment of shingles vaccination. Demographic characteristics of the study population are provided in Table 1. The majority of participants were aged 60–74 years (70.0%); female (54.8%); white (77.5%); married or a member of an unmarried couple (59.1%); had some college (or technical school) education or higher (54.5%); were not in workforce (72.9%); had household income <$50,000 (61.5%); living in South or West (59.7%); perceived their health status as being excellent/very good or good (74.7%); had medical insurance (96.1%); had a personal healthcare provider (92.9%); had a routine checkup last year (85.6%); and did not report that cost prevented them from seeing a doctor during the past 12 months (93.0%).

In the univariate analysis, shingles vaccination coverage was 31.8% (95% CI=31.4%, 32.2%) among adults aged ≥60 years. Shingles vaccination coverage was significantly higher among adults aged 65–74 years (35.9%); 75–79 years (37.7%); and ≥80 years (34.3%) compared with adults aged 60–64 years (22.0%) (Table 2). Coverage was 5.9% among adults aged 50–59 years (data not shown). Shingles vaccination coverage among adults aged ≥60 years was significantly lower among non-Hispanic blacks (16.0%); Hispanics (16.7%); and American Indians and Alaska Natives (27.2%) compared with non-Hispanic whites (35.4%), but was not significantly lower for Asians (30.2%) compared with non-Hispanic whites. Shingles vaccination coverage was significantly higher among adults who were female, reported having higher education, reported higher income, were not in workforce, were living in the Midwest or West of the U.S., perceived their health status as being excellent/very good or good, reported having medical insurance, reported having a personal healthcare provider, reported having a routine checkup in the previous year, and did not report that cost prevented them from seeing a doctor (Table 2). Shingles vaccination coverage was significantly lower among those who reported being widowed, divorced, separated, or

Table 1. Sample Characteristics Among Adults Aged ≥60 years, U.S., BRFSS 2014

Characteristic	All adults	
	Sample (*n*)	Weighted %
Total	208,505	100.0
Age (years)		
60–64	51,850	29.3
65–74	89,423	40.7
75–79	28,837	13.9
≥80	38,395	16.1
Sex		
Male	81,386	45.2
Female	127,119	54.8
Race/ethnicity		
White, non-Hispanic	176,277	77.5
Black, non-Hispanic	13,506	9.7
Hispanic	6,717	7.9
Asian, non-Hispanic	2,135	2.7
American Indian/Alaska Native, non-Hispanic	2,320	0.8
Other	4,025	1.4
Marital status		
Married or unmarried couple	108,322	59.1
Divorced, widowed, or separated	87,366	36.2
Never married	11,408	4.7
Education level		
Less than high school	17,757	15.2
High school graduate	63,552	30.3
Some college or technical school	54,998	29.7
College graduate or higher education	70,688	24.8
Employment		
Employed	50,179	24.5
Unemployed	4,099	2.6
Not in workforce	152,259	72.9
Income ($)		
<20,000	33,848	21.1
20,000–49,999	71,840	40.4
50,000–74,999	26,891	15.5
≥75,000	37,788	23.0
Region		
Northeast	37,378	18.5
Midwest	57,096	21.8
South	64,449	37.6
West	49,582	22.1
Perceived health		
Excellent or very good	92,772	42.2
Good	67,071	32.5
Fair	33,259	17.5
Poor	14,431	7.8
Have medical insurance		
Yes	202,433	96.1
No	5,552	3.9
Have personal healthcare provider		
Yes	193,696	92.9
No	13,979	7.1
Time since last routine checkup		
<1 year	173,335	85.6
≥1 year	31,257	14.4
Unable to see doctor due to cost		
Yes	11,878	7.0
No	196,036	93

BRFSS, Behavioral Risk Factor Surveillance System.

never married; being unemployed; or living in the South of the U.S. (Table 2).

In multivariable analysis, characteristics independently associated with an increased likelihood of shingles vaccination among adults aged ≥60 years were older age; being female; higher education; not being in the workforce, household income ≥$20,000; living in the Midwest, West, or South of the U.S.; perceived health status being excellent/very good, good, or fair; having health insurance; having a personal healthcare provider; having a routine checkup in the previous year; and not reporting that cost prevented them from seeing a doctor during the past 12 months (Table 3). African American and Asian race and Hispanic ethnicity were independently associated with a decreased likelihood of shingles vaccination (Table 3).

Among all 50 states and DC, shingles vaccination coverage among adults aged ≥60 years varied widely, ranging from 17.8% in Mississippi to 46.6% in Vermont, with a median of 33.3%. Overall coverage ranged from 25.1% in DHHS Region 2 to 43.2% in Region 10. Shingles vaccination coverage among adults aged ≥60 years was <25% in four states (Mississippi, New Jersey, Louisiana, and Alabama) and >40% in nine states (Vermont, Oregon, Washington, Minnesota, North Dakota, Colorado, Maine, South Dakota, and Nebraska) (Table 4).

Shingles vaccination coverage among non-Hispanic white adults aged ≥60 years ranged from 22.3% in Mississippi to 52.8% in DC, with a median of 35.7%. Coverage was <25% in two states (Mississippi and New Jersey); >45% in four states (DC, Vermont, Washington, Minnesota); and >30% in 34 states (Table 4). Shingles vaccination coverage among non-white adults aged ≥60 years ranged from 6.3% in Mississippi to 45.6% in Oregon, with a median of 20.3%. Coverage among non-white adults aged ≥60 years was <15% in nine states (Illinois, Missouri, Georgia, Florida, New York,

Table 2. Shingles Vaccination Coverage Among Adults Aged ≥60 Years by Selected Demographic and Access-to-Care Characteristics—U.S., BRFSS 2014

Characteristic	Shingles vaccination coverage, % (95% CI)	Difference,[a] % (95% CI)
Total	31.8 (31.4, 32.2)	NA
Age (years)		
60–64[b]	22.0 (21.3, 22.7)	ref
65–74	**35.9 (35.3, 36.6)***	14.0 (13.0, 14.9)
75–79	**37.7 (36.6, 38.9)***	15.8 (14.4, 17.1)
≥80	**34.3 (33.3, 35.2)***	12.3 (11.1, 13.5)
Sex		
Male[b]	30.6 (29.9, 31.2)	ref
Female	**32.9 (32.3, 33.4)***	2.3 (1.5, 3.1)
Race/ethnicity		
White, non-Hispanic[b]	35.4 (35.0, 35.8)	ref
Black, non-Hispanic	**16.0 (14.7, 17.4)***	−19.4 (−20.8, −18.0)
Hispanic	**16.7 (14.9, 18.6)***	−18.7 (−20.6, −16.8)
Asian, non-Hispanic	30.2 (25.2, 35.8)	−5.1 (−10.4, 0.2)
American Indian/Alaska Native, non-Hispanic	**27.2 (23.6, 31.1)***	−8.2 (−12.0, −4.4)
Other	**27.2 (24.2, 30.6)***	−8.1 (−11.3, −4.9)
Marital status		
Married or unmarried couple[b]	34.3 (33.7, 34.8)	ref
Divorced, widowed, or separated	**28.7 (28.1, 29.4)***	−5.6 (−6.4, −4.7)
Never married	**25.0 (23.3, 26.7)***	−9.3 (−11.1, −7.5)
Education level		
Less than high school[b]	17.9 (16.8, 19.0)	ref
High school graduate	**28.5 (27.8, 29.2)***	10.6 (9.3, 11.9)
Some college or technical school	**32.7 (31.9, 33.5)***	14.8 (13.5, 16.2)
College graduate or higher education	**43.0 (42.3, 43.7)***	25.1 (23.8, 26.4)
Employment		
Employed[b]	26.8 (26.1, 27.6)	ref
Unemployed	**17.8 (15.6, 20.3)***	−9.0 (−11.5, −6.5)
Not in workforce	**34.0 (33.5, 34.5)***	7.2 (6.3, 8.1)
Income ($)		
<20,000[b]	18.4 (17.5, 19.3)	ref
20,000–49,999	**30.1 (29.5, 30.8)***	11.8 (10.7, 12.8)
50,000–74,999	**38.0 (36.9, 39.2)***	19.7 (18.2, 21.1)
≥75,000	**41.9 (40.9, 42.9)***	23.5 (22.2, 24.8)
Region		
Northeast[b]	30.3 (29.4, 31.2)	ref
Midwest	**33.2 (32.5, 33.9)***	2.9 (1.8, 4.1)
South	**28.7 (28.1, 29.3)***	−1.5 (−2.6, −0.5)
West	**37.4 (36.3, 38.6)***	7.1 (5.7, 8.6)
Perceived health		
Excellent or very good	**37.0 (36.4, 37.6)***	17.2 (15.8, 18.6)
Good	**31.8 (31.1, 32.5)***	12.0 (10.5, 13.4)
Fair	**24.6 (23.7, 25.6)***	4.8 (3.2, 6.4)
Poor[b]	19.8 (18.6, 21.1)	ref
Have medical insurance		
Yes	**32.7 (32.3, 33.1)***	23.3 (21.9, 24.8)
No[b]	9.4 (8.1, 10.9)	ref

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Table 2. Shingles Vaccination Coverage Among Adults Aged ≥60 Years by Selected Demographic and Access-to-Care Characteristics—U.S., BRFSS 2014 *(continued)*

Characteristic	Shingles vaccination coverage, % (95% CI)	Difference,[a] % (95% CI)
Have personal health care provider		
Yes	**33.1 (32.7, 33.5)***	17.4 (15.9, 18.8)
No[b]	15.7 (14.4, 17.1)	ref
Time since last routine checkup		
<1 year	**34.0 (33.5, 34.4)***	13.6 (12.6, 14.6)
≥1 year[b]	20.4 (19.5, 21.3)	ref
Unable to see doctor due to cost		
Yes[b]	15.9 (14.6, 17.3)	ref
No	**33.0 (32.6, 33.5)***	17.1 (15.7, 18.5)

Note: Boldface indicates statistical significance (*$p<0.05$ by *t* test comparing against reference group).
[a]Percentage point difference compared to the reference group.
[b]Reference level.
BRFSS, Behavioral Risk Factor Surveillance System.

South Carolina, Alabama, Louisiana, and Mississippi) and >30% in eight states (Oregon, Hawaii, North Dakota, New Hampshire, Washington, Colorado, Minnesota, and Wyoming) (Table 4). For all states, shingles coverage was significantly higher among non-Hispanic whites compared with non-white races except for Oregon, with coverage differences ranging from –33.2% in DC to 0.9% in Oregon and a median of –16.0%.

DISCUSSION

Shingles vaccination coverage exceeded 30% in 34 states, indicating that a majority of states reached the *Healthy People 2020* target of 30% coverage among adults aged ≥60 years,[21] although a large majority of Americans have not received the shingles vaccine. Although BRFSS is a population-based survey designed to produce representative state-level assessments, data are routinely aggregated for national estimation of certain behavior and health outcomes. Comparing the shingles vaccination coverage estimate in this study derived by aggregating 2014 BRFSS state-level data (31.8%) to the estimate (27.9%) from the nationally representative 2014 National Health Interview Survey[22] revealed a 3.9–percentage point difference. The difference in coverage estimates between these two surveys might be due to differences in survey design and administration; operations (in-person survey for the National Health Interview Survey, and telephone survey for BRFSS), and weighting procedures.[18,19,22,23]

A 2007 U.S. study showed that soon after shingles vaccine was licensed and recommended for people aged ≥60 years in 2006, vaccination coverage in this target population was 1.9%.[24] Shingles vaccination coverage has steadily increased since vaccine licensure.[22,24,25] Shingles vaccination coverage among adults aged ≥60 years reached 31.8% in 2014, which was 8 years after the recommendation. Shingles vaccination coverage could be compared to pneumococcal polysaccharide vaccination, another vaccine that was recommended to senior adults in 1983. Pneumococcal vaccine coverage increased to 21%–24% among adults aged ≥65 years by 1991–1992 (8 years after recommendation); coverage then further increased to 58%–69% in 2014.[22,26,27] To increase vaccination coverage among senior adults, healthcare providers are encouraged to include vaccination status assessment, recommendation and offer of vaccination, or referral if vaccines that are needed are not available, as a routine in their practices.[28]

Several factors might have contributed to slower shingles vaccination uptake. First, shortages of herpes zoster vaccine and a resulting lack of vaccine promotion likely contributed to low uptake during the first years after vaccine licensure. Although these shortages have been resolved, other barriers persist, particularly high vaccine cost for providers and challenges to stocking the vaccine (stringent storage and handling requirements) and receiving reimbursement for vaccination services.[22,25,29] Second, coverage for shingles vaccine under Medicare Part D results in billing challenges for providers (except pharmacists) and out-of-pocket expenses for some Medicare Part D beneficiaries (high co-pays; median, approximately $70–$80), and additionally, not every Medicare recipient has elected to participate in Part D.[22,29] Third, physicians were not strongly promoting shingles vaccination to their patients. One study showed that only 41% of providers strongly recommended shingles vaccine to their patients compared with more than 90% who strongly recommended influenza and pneumococcal vaccination.[29] Fourth, awareness of

Table 3. Multivariable Logistic Regression Analysis of Persons Aged ≥60 Years Who Reported Shingles Vaccination, by Selected Demographic and Access-to-Care Characteristics, U.S., BRFSS 2014

Characteristic	Adjusted shingles vaccination coverage, % (95% CI)	Adjusted prevalence difference (PD), PD (95% CI)
Age (years)		
60–64[a]	24.1 (23.2, 24.9)	ref
65–74	35.0 (34.3, 35.7)	**10.9 (9.8, 12.0)***
75–79	37.7 (36.4, 39.0)	**13.7 (12.1, 15.2)***
≥80	34.9 (33.8, 36.1)	**10.9 (9.4, 12.4)***
Sex		
Male[a]	30.4 (29.7, 31.0)	ref
Female	33.7 (33.1, 34.3)	**3.4 (2.5, 4.3)***
Race/ethnicity		
White, non-Hispanic[a]	34.0 (33.6, 34.5)	ref
Black, non-Hispanic	20.1 (18.3, 21.9)	**−13.9 (−15.8, −12.1)***
Hispanic	25.2 (22.6, 27.8)	**−8.9 (−11.5, −6.2)***
Asian, non-Hispanic	27.3 (22.5, 32.0)	**−6.8 (−11.5, −2.0)***
American Indian/Alaska Native, non-Hispanic	34.0 (29.4, 38.6)	−0.1 (−4.7, 4.5)
Other	30.8 (27.0, 34.7)	−3.2 (−7.1, 0.7)
Marital status		
Married or unmarried couple[a]	32.3 (31.7, 32.9)	ref
Divorced, widowed, or separated	31.9 (31.1, 32.6)	−0.5 (−1.5, 0.6)
Never married	31.7 (29.5, 33.9)	−0.6 (−2.9, 1.7)
Education level		
Less than high school[a]	25.5 (23.8, 27.2)	ref
High school graduate	29.1 (28.3, 29.9)	**3.5 (1.7, 5.4)***
Some college or technical school	31.9 (31.1, 32.7)	**6.3 (4.5, 8.2)***
College graduate or higher education	38.2 (37.4, 39.0)	**12.6 (10.7, 14.6)***
Employment		
Employed[a]	26.6 (25.7, 27.4)	ref
Unemployed	26.9 (23.6, 30.3)	0.4 (−3.1, 3.8)
Not in workforce	34.3 (33.8, 34.9)	**7.8 (6.7, 8.8)***
Income ($)		
<20,000[a]	23.7 (22.6, 24.9)	ref
20,000–49,999	30.0 (29.3, 30.7)	**6.3 (5.0, 7.6)***
50,000–74,999	35.9 (34.8, 37.0)	**12.2 (10.5, 13.9)***
≥75,000	39.1 (38.0, 40.2)	**15.4 (13.6, 17.2)***
Region		
Northeast[a]	29.1 (28.2, 30.0)	ref
Midwest	32.7 (31.9, 33.4)	**3.6 (2.4, 4.8)***
South	30.4 (29.7, 31.1)	**1.3 (0.2, 2.5)***
West	37.2 (36.1, 38.4)	**8.1 (6.7, 9.6)***
Perceived health		
Excellent or very good	34.3 (33.6, 35.0)	**9.0 (7.1, 10.9)***
Good	32.2 (31.4, 33.0)	**6.9 (5.0, 8.8)***
Fair	28.4 (27.2, 29.5)	**3.1 (1.0, 5.1)***
Poor[a]	25.3 (23.6, 27.0)	ref
Have medical insurance		
Yes	32.3 (31.8, 32.8)	**8.9 (5.6, 12.3)***
No[a]	23.4 (20.1, 26.7)	ref
Have personal healthcare provider		
Yes	32.5 (32.0, 33.0)	**7.3 (5.0, 9.6)***
No[a]	25.2 (23.0, 27.5)	ref

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Table 3. Multivariable Logistic Regression Analysis of Persons Aged ≥60 Years Who Reported Shingles Vaccination, by Selected Demographic and Access-to-Care Characteristics, U.S., BRFSS 2014 *(continued)*

Characteristic	Adjusted shingles vaccination coverage, % (95% CI)	Adjusted prevalence difference (PD), PD (95% CI)
Time since last routine checkup		
<1 year	33.6 (33.1, 34.1)	**10.7 (9.5, 11.9)***
≥1 year[a]	22.9 (21.8, 24.0)	ref
Unable to see doctor due to cost		
Yes[a]	26.7 (24.6, 28.7)	ref
No	32.4 (31.9, 32.9)	**5.8 (3.7, 7.8)***

Note: Boldface indicates statistical significance ($p<0.05$ by t test comparing against reference group).
[a]Reference level.
BRFSS, Behavioral Risk Factor Surveillance System.

shingles vaccine among patients was low,[24] particularly if providers were not aggressively promoting the shingles vaccination. One study reported that in 2008, 2 years after vaccine licensure, only 27% of adults aged ≥60 years were aware of the shingles vaccine.[24] In 2015, 73.4% of the target population reported awareness of the shingles vaccine (CDC, Immunization Services Division, unpublished data), indicating that by the end of 2014, 8 years after shingles vaccine was recommended, the large majority of adults were aware of the shingles vaccine but approximately one fourth of adults aged ≥60 years did not know about the vaccine despite a major sustained direct-to-consumer TV advertising campaign sponsored by the manufacturer. Compared with shingles vaccine, in 2015, a total of 86.6% of adults ≥65 years reported awareness of the pneumococcal vaccine. Finally, most people without medical insurance were confronted with substantial financial barriers, as the high retail price of shingles vaccine would need to be paid out of pocket. For those with commercial insurance, out-of-pocket costs are less clear. For adults aged ≥60 years with non-grandfathered private health insurance plans, shingles vaccine is available with no out-of-pocket costs because of provisions of the Affordable Care Act.[22,29] Strategies are needed to mitigate financial barriers, improve awareness, and increase provider recommendation of the vaccine.

Because shingles vaccination information was newly added to the 2014 BRFSS core questionnaire, this is the first study to assess state-specific shingles vaccination coverage among adult populations across the entire U.S. The shingles vaccination question will be added to the 2017 BRFSS core questionnaire as part of its 3-year rotation with two other questions. Results from this study provide a baseline for state-level shingles coverage in the U.S. Substantial differences in coverage among states were observed for shingles vaccination. Variation in state coverage could be due to differing medical care delivery infrastructure, population composition, socioeconomic factors, state laws, effectiveness of state and local immunization programs among states, and other factors.[23,30–33] Wide variation in vaccination coverage among states has also been observed for influenza and pneumococcal vaccination among older adults in a similar pattern as shingles vaccination,[27,34] possibly because of comparable factors. State-specific influenza vaccination coverage in the 2014–2015 season among adults aged ≥65 years ranged from 57.2% to 76.8%, and pneumococcal vaccination coverage in 2014 among adults aged ≥65 years ranged from 60.5% to 76.1%.[27,34] Because there is a wide variation in vaccination of elderly adults across states, future research on state-specific factors associated with vaccination could prompt actions, policies, and programs in other states to increase vaccination uptake. State immunization programs are encouraged to engage providers and other stakeholders to implement interventions shown to be effective in increasing vaccination among adults.[35]

Of note, this analysis showed that shingles vaccination coverage was 5.9% among adults aged 50–59 years for whom the vaccine is licensed by the U.S. Food and Drug Administration but not recommended by ACIP.[36] The lower coverage among adults aged 50–59 years compared with other age groups may be partially due to lack of official recommendation of the vaccine by ACIP. Additional information is needed on long-term protection afforded by herpes zoster vaccine in this age group and cost effectiveness of vaccination at younger versus older ages to assist future decisions on recommending shingles vaccination in younger groups.

Racial and ethnic disparities in vaccination rates have been reported for adult vaccines, including those for influenza, pneumococcal, tetanus, shingles, human papillomavirus, and hepatitis B vaccines.[37–40] The present findings are consistent with those reported previously from a nationally representative survey.[40] In this study,

Table 4. State-Specific Shingles Vaccination Coverage Among Adults Aged ≥60 Years by DHHS Regions, U.S., BRFSS 2014

DHHS region/state	Sample size	Total, % (95% CI)	Non-Hispanic white, % (95% CI)	Persons of all other racial/ethnic groups, % (95% CI)	Difference,[a] % (95% CI)
Region 1	22,347	37.6 (36.6, 38.6)	39.6 (38.6, 40.6)	21.1 (18.0, 24.4)	**−18.5 (−21.9, −15.2)***
Connecticut	3,265	32.0 (30.0, 34.2)	35.1 (32.8, 37.4)	17.0 (12.5, 22.7)	**−18.0 (−23.6, −12.5)***
Maine	4,258	42.1 (40.3, 43.9)	42.5 (40.6, 44.4)	26.3 (17.5, 37.5)	**−16.2 (−26.5, −5.9)***
Massachusetts	6,823	38.6 (36.9, 40.3)	40.8 (39.0, 42.6)	22.8 (18.1, 28.1)	**−18.0 (−23.3, −12.7)***
New Hampshire	2,773	39.3 (37.0, 41.7)	39.3 (36.9, 41.7)	36.3 (24.0, 50.7)	−3.0 (−16.8, 10.9)
Rhode Island	2,789	34.7 (32.6, 36.9)	36.5 (34.3, 38.8)	19.2 (14.0, 25.8)	**−17.3 (−23.7, −11.0)***
Vermont	2,439	46.6 (44.3, 48.8)	47.7 (45.3, 50.0)	24.9 (15.7, 37.3)	**−22.7 (−33.9, −11.6)***
Region 2	7,490	25.1 (23.6, 26.7)	29.6 (27.9, 31.4)	13.6 (10.9, 17.0)	**−16.0 (−19.5, −12.5)***
New Jersey	4,960	22.5 (20.8, 24.3)	24.9 (23.0, 26.9)	15.9 (12.5, 20.0)	**−9.0 (−13.2, −4.8)***
New York	2,530	26.4 (24.3, 28.5)	31.9 (29.5, 34.4)	12.7 (9.2, 17.3)	**−19.2 (−23.9, −14.5)***
Region 3	21,048	32.8 (31.9, 33.8)	35.6 (34.6, 36.7)	20.4 (18.2, 22.7)	**−15.3 (−17.8, −12.7)***
Delaware	1,980	30.4 (28.0, 33.0)	33.3 (30.6, 36.2)	17.9 (13.3, 23.7)	**−15.4 (−21.3, −9.5)***
District of Columbia	1,821	32.6 (29.8, 35.6)	52.8 (48.3, 57.3)	19.6 (16.2, 23.6)	**−33.2 (−39.1, −27.3)***
Maryland	5,817	34.4 (32.4, 36.5)	38.6 (36.4, 40.8)	25.5 (21.0, 30.6)	**−13.1 (−18.4, −7.8)***
Pennsylvania	4,921	32.3 (30.7, 34.0)	34.2 (32.5, 36.0)	17.0 (13.2, 21.7)	**−17.2 (−21.8, −12.6)***
Virginia	3,803	34.7 (32.8, 36.7)	39.3 (37.2, 41.6)	19.0 (15.6, 23.0)	**−20.3 (−24.6, −16.0)***
West Virginia	2,706	26.6 (24.8, 28.5)	27.4 (25.6, 29.4)	15.2 (9.3, 23.9)	**−12.2 (−19.7, −4.8)***
Region 4	28,940	27.9 (27.1, 28.6)	32.2 (31.4, 33.1)	12.6 (11.2, 14.2)	**−19.6 (−21.3, −17.9)***
Alabama	3,964	23.7 (22.1, 25.4)	27.4 (25.4, 29.4)	11.7 (9.2, 14.7)	**−15.7 (−19.1, −12.3)***
Florida	4,873	28.5 (26.9, 30.0)	33.6 (31.9, 35.3)	12.9 (10.1, 16.3)	**−20.7 (−24.2, −17.2)***
Georgia	2,715	27.2 (25.2, 29.3)	32.8 (30.4, 35.3)	13.0 (10.1, 16.6)	**−19.8 (−23.9, −15.8)***
Kentucky	4,981	29.8 (27.8, 31.8)	30.8 (28.8, 32.9)	17.9 (12.1, 25.6)	**−12.9 (−20.0, −5.9)***
Mississippi	1,993	17.8 (15.8, 20.0)	22.3 (19.7, 25.1)	6.3 (4.3, 9.2)	**−16.0 (−19.6, −12.4)***
North Carolina	2,950	32.2 (30.3, 34.1)	36.2 (34.0, 38.4)	16.3 (13.0, 20.3)	**−19.9 (−24.1, −15.6)***
South Carolina	5,035	26.4 (24.9, 28.0)	30.7 (28.9, 32.5)	12.2 (9.8, 15.1)	**−18.5 (−21.7, −15.3)***
Tennessee	2,429	27.8 (25.6, 30.1)	31.1 (28.7, 33.7)	—[b]	**−23.3 (−28.8, −17.8)***
Region 5	24,927	32.7 (31.9, 33.6)	35.1 (34.1, 36.0)	18.2 (15.7, 20.9)	**−16.9 (−19.7, −14.1)***
Illinois	2,064	28.1 (25.8, 30.6)	32.2 (29.6, 34.9)	14.1 (9.9, 19.8)	**−18.0 (−23.7, −12.4)***
Indiana	5,157	29.4 (27.9, 30.9)	31.1 (29.5, 32.7)	15.1 (11.0, 20.5)	**−16.0 (−21.0, −11.0)***
Michigan	3,725	33.3 (31.6, 35.1)	35.7 (33.8, 37.6)	20.3 (15.9, 25.7)	**−15.4 (−20.6, −10.1)***
Minnesota	5,953	44.2 (42.7, 45.7)	45.2 (43.7, 46.7)	31.1 (24.1, 39.0)	**−14.1 (−21.7, −6.5)***
Ohio	5,099	31.4 (29.6, 33.3)	33.0 (31.0, 35.0)	21.3 (16.4, 27.2)	**−11.7 (−17.4, −5.9)***
Wisconsin	2,929	37.1 (34.6, 39.6)	38.0 (35.5, 40.5)	20.4 (12.8, 30.9)	**−17.6 (−27.0, −8.2)***
Region 6	19,296	28.7 (27.4, 30.0)	33.0 (31.6, 34.5)	18.7 (16.1, 21.6)	**−14.3 (−17.4, −11.2)***
Arkansas	2,744	27.8 (25.7, 30.1)	29.6 (27.3, 32.1)	17.2 (11.6, 24.6)	**−12.5 (−19.4, −5.6)***
Louisiana	2,672	22.5 (20.7, 24.4)	27.1 (24.8, 29.4)	11.7 (9.2, 14.7)	**−15.4 (−18.9, −11.8)***
New Mexico	3,705	37.5 (35.3, 39.8)	44.5 (41.7, 47.3)	27.1 (23.6, 31.0)	**−17.3 (−22.0, −12.7)***
Oklahoma	3,823	28.4 (26.8, 30.1)	29.4 (27.7, 31.3)	23.1 (19.3, 27.4)	**−6.3 (−10.7, −1.9)***
Texas	6,352	29.3 (27.3, 31.4)	34.9 (32.5, 37.3)	18.7 (15.1, 22.8)	**−16.2 (−20.8, −11.7)***
Region 7	22,653	34.1 (33.0, 35.2)	36.0 (34.9, 37.1)	15.5 (12.9, 18.5)	**−20.5 (−23.5, −17.5)***
Iowa	3,618	39.4 (37.6, 41.3)	40.3 (38.4, 42.2)	16.6 (9.5, 27.4)	**−23.7 (−32.7, −14.7)***
Kansas	5,676	33.6 (32.3, 35.0)	35.5 (34.1, 36.9)	16.6 (13.1, 20.9)	**−18.8 (−23.0, −14.7)***
Missouri	3,417	29.6 (27.5, 31.7)	31.7 (29.5, 34.0)	13.8 (10.2, 18.5)	**−17.9 (−22.6, −13.2)***
Nebraska	9,942	41.0 (39.5, 42.4)	42.7 (41.2, 44.1)	21.1 (15.9, 27.4)	**−21.5 (−27.5, −15.6)***
Region 8	23,652	40.0 (39.1, 40.9)	41.3 (40.4, 42.3)	30.3 (26.9, 34.0)	**−11.0 (−14.7, −7.3)***
Colorado	5,236	42.4 (40.8, 44.0)	44.7 (43.0, 46.4)	31.7 (27.2, 36.7)	**−13.0 (−18.1, −7.9)***
Montana	3,632	36.3 (34.1, 38.5)	37.3 (35.0, 39.6)	22.0 (16.4, 28.8)	**−15.3 (−21.9, −8.7)***
North Dakota	3,561	42.6 (40.3, 44.8)	43.0 (40.8, 45.3)	36.4 (19.5, 57.4)	−6.6 (−26.6, 13.3)
South Dakota	3,204	41.1 (38.3, 44.1)	42.0 (39.1, 45.0)	28.2 (16.3, 44.2)	−13.8 (−28.4, 0.7)

(continued on next page)

Table 4. State-Specific Shingles Vaccination Coverage Among Adults Aged ≥60 Years by DHHS Regions, U.S., BRFSS 2014 *(continued)*

DHHS region/state	Sample size	Total, % (95% CI)	Non-Hispanic white, % (95% CI)	Persons of all other racial/ethnic groups, % (95% CI)	Difference,[a] % (95% CI)
Utah	4,635	37.4 (35.7, 39.1)	38.5 (36.8, 40.3)	27.7 (21.1, 35.5)	**−10.8 (−18.3, −3.4)***
Wyoming	3,384	32.7 (30.6, 34.9)	32.7 (30.6, 34.8)	30.1 (20.5, 42.0)	−2.5 (−13.6, 8.6)
Region 9	14,421	34.9 (33.1, 36.7)	40.1 (38.1, 42.0)	25.9 (22.6, 29.6)	**−14.1 (−18.2, −10.1)***
Arizona	7,639	33.4 (32.0, 34.9)	36.9 (35.3, 38.4)	20.5 (16.7, 24.8)	**−16.4 (−20.7, −12.1)***
California	2,406	35.5 (33.1, 38.0)	42.0 (39.2, 44.8)	25.4 (21.2, 30.1)	**−16.6 (−21.9, −11.3)***
Hawaii	2,776	38.8 (36.2, 41.4)	40.7 (36.7, 44.7)	38.2 (34.9, 41.5)	−2.5 (−7.7, 2.7)
Nevada	1,600	30.1 (26.6, 33.9)	31.9 (28.6, 35.5)	26.1 (17.6, 37.0)	−5.8 (−16.2, 4.6)
Region 10	10,897	43.2 (41.9, 44.4)	44.2 (42.9, 45.4)	36.5 (31.9, 41.3)	**−7.7 (−12.6, −2.8)***
Alaska	1,397	33.4 (30.2, 36.9)	35.3 (31.9, 38.9)	27.3 (19.5, 36.7)	−8.0 (−17.4, 1.3)
Idaho	2,436	37.0 (34.4, 39.7)	37.6 (35.0, 40.3)	29.7 (17.5, 45.7)	−7.9 (−22.6, 6.7)
Oregon	2,455	44.6 (42.3, 47.0)	44.7 (42.4, 47.1)	45.6 (36.0, 55.6)	0.9 (−9.3, 11.1)
Washington	4,609	44.4 (42.6, 46.2)	46.0 (44.1, 47.8)	35.1 (29.1, 41.6)	**−10.8 (−17.4, −4.3)***
Median		33.3	35.7	20.3	−16.0
Range		17.8, 46.6	22.3, 52.8	6.3, 45.6	−33.2, 0.9

Note: Boldface indicates statistical significance ($p < 0.05$ by t test comparing non-Hispanic white with persons of all other racial/ethnic groups).
[a]Difference between non-Hispanic white and persons of all other racial/ethnic groups.
[b]Estimate may not be reliable because of relative SE >30%.
BRFSS, Behavioral Risk Factor Surveillance System; DHHS, Department of Health and Human Services.

racial and ethnic disparities in shingles vaccination coverage also were observed in most states. In addition, although shingles vaccination is publically funded in the United Kingdom with an aggressive vaccination program, disparities in shingles vaccine uptake between white and racial and ethnic minority populations also exist.[41] These disparities may reflect differences in general quality of care, community differences in attitudes toward vaccination and preventive care in general, differences in concerns about vaccination, including safety, or differences in doctor–patient interactions.[37–40] To improve coverage and eliminate disparities in adult vaccination, greater implementation of evidence-based interventions are needed, including the use of reminder/recall systems, standing orders for vaccination, regular assessments of vaccination coverage levels among provider practices, vaccination registries, and improving public and provider awareness of the importance of vaccinations for adults.[35,37–42]

Women were more likely to receive shingles vaccination than men. This may partly be because women are more aware of shingles and shingles vaccine or generally see healthcare providers and use preventive service more frequently than men.[24,43,44] Educational levels were also independently positively associated with shingles vaccination. People with less education may experience more barriers to receiving care perhaps because of lack of knowledge regarding preventive services[45,46] in general or regarding shingles vaccine specifically.[24,29] Additionally, having health insurance, a personal healthcare provider, and a routine checkup in the previous year were independently associated with higher shingles vaccination coverage. These findings are consistent with previous reports.[37–39,47–50]

Limitations

The findings in this report are subject to at least two limitations. First, vaccination coverage was self-reported and therefore might be subject to recall bias. However, adult self-reported vaccination status for shingles and other vaccines has been shown to be sensitive and specific.[51] In addition, the authors were not able to determine age-specific vaccine uptake, as BRFSS respondents were asked whether they had ever received the vaccine, and time of vaccination was not collected. Thus, for instance, a person aged 80 years who reported receipt of shingles vaccine might have been vaccinated soon after vaccine licensure in 2006, when they were aged 72 years.

CONCLUSIONS

Use of zoster vaccine can significantly reduce morbidity caused by shingles among adults aged ≥60 years. CDC is actively monitoring post-marketing data on duration of vaccine protection in adults vaccinated at age ≥60 years. As additional data become available, ACIP will re-evaluate the need for a booster dose to maintain

protection against herpes zoster and its complications.[36] If all eligible adults aged ≥60 years are vaccinated in accordance with ACIP recommendations, the vaccine could prevent a quarter of a million cases of shingles annually.[52,53] However, this study found that 8 years after shingles vaccine became available, vaccination coverage was only 31.8%, and coverage varied by states. Increased state and national efforts using comprehensive strategies shown to be effective are needed to improve shingles vaccination coverage levels. Financial barriers to providers (vaccine purchase and compensation) and patients (out-of-pocket expenses) play a role in shingles vaccine uptake and should be mitigated. Pharmacies are playing an important role in shingles vaccination, partially because they can be reimbursed by Medicare Part D benefits.[29,54] Evidence suggests some success of pharmacy interventions to remove barriers to shingles vaccination and increase shingles vaccination coverage.[55–58] Because of Part D reimbursement structure, convenience of pharmacy locations and hours, and pharmacists' established roles as vaccination providers, pharmacists are in an optimal position to identify, educate, and vaccinate eligible patients against shingles.[29,54–58] Other comprehensive strategies for improving shingles vaccination uptake include use of reminder/recall systems; educational campaigns; use of standing orders; linking delivery of shingles vaccine to delivery of other indicated adult vaccines (e.g., influenza); and routinely assessing patients' vaccination status.[6,35,59–61]

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