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Shingles vaccination of adults 50–59 and ≥60 years, U.S.:

Prior to recommendations for use of recombinant zoster vaccine

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Abstract

Background: In 2006, Zoster Vaccine Live (ZVL) was recommended for adults aged ≥60 years. In 2011, ZVL was approved for use, but not recommended, for adults aged 50–59 years.

Purpose: To assess ZVL coverage among adults aged 50–59 and ≥60 years.

Methods: Data from the 2013–2017 National Health Interview Surveys (NHIS) were analyzed in 2019 to estimate national ZVL coverage among adults aged ≥50 years. State-specific ZVL coverage among adults aged ≥50 years was assessed using data from the 2017 Behavioral Risk Factor Surveillance System.

Results: Among adults aged 50–59 years, ZVL coverage was 5.7% in 2017; ranging from 4% to 6% during 2013–2017 (test for trend, $p>0.05$). ZVL coverage among adults aged 50–59 years ranged from 5.8% in Pennsylvania to 14.7% in South Dakota. By 2017, 34.9% of adults aged ≥60 years received ZVL, a significant increase from 24.2% in 2013. ZVL coverage among adults aged ≥60 years in 2017 ranged from 26.0% in Mississippi to 51.8% in Vermont. In 2017, major characteristics significantly associated with increased likelihood of ZVL vaccination among adults aged 50–59 and ≥60 years were older age, having 4–9 physician contacts in the past 12 months, and having a usual place for health care.

Conclusions: This study provides an assessment of ZVL coverage among persons aged ≥50 years before the newly recommended Recombinant Zoster Vaccine (RZV) came into widespread use. Providers should routinely assess adults' vaccination status, strongly recommend or offer needed vaccines to their patients.

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Conflict of Interest Statement:

All authors have no conflicts of interest to be stated.

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Keywords

Shingles vaccine; vaccination; coverage; adult vaccination; herpes zoster; zoster vaccine live (ZVL); recombinant zoster vaccine (RZV)

Introduction

Herpes zoster (HZ), also known as shingles, is caused by reactivation of the varicella zoster virus (VZV).[1–3] HZ causes substantial burden in the United States that increases with age, with older persons much more likely to experience postherpetic neuralgia (PHN), which is the most common complication of shingles.[1–4] Zoster Vaccine Live (ZVL, Zostavax®) Merck) was licensed in 2006 by the U.S. Food and Drug Administration (FDA) for use among adults aged ≥60 years to prevent HZ. The Advisory Committee on Immunization Practices (ACIP) recommended routine vaccination of adults aged ≥60 years with one dose of ZVL in October 2006; the recommendation became official Centers for Disease Control and Prevention (CDC) policy in 2008.[4] In 2011, FDA approved the use of ZVL in adults aged 50 through 59 years; however, ACIP declined to recommend the vaccine for this age group, citing shortages of ZVL and limited data on long-term protection.[5] Following review of new information, in 2011, ACIP reaffirmed its recommendation for routine ZVL vaccination of adults aged ≥60 years noting substantial zoster morbidity in the United States, only short-term vaccine efficacy in adults aged 50 through 59 years, longer-term efficacy and effectiveness in adults aged ≥60 years, and cost-effectiveness analyses.[5, 6]

In October 2017, the ACIP recommended the newly licensed recombinant zoster vaccine (RZV, Shingrix, GlaxoSmithKline) for use in immunocompetent adults aged ≥50 years, revaccination of those who previously received ZVL, and preferential use of RZV over ZVL, given its higher and more long-lasting efficacy.[7]

Information on ZVL coverage among adults aged 50–59 years prior to the recommendation for use of RZV, vaccination trends, and characteristics of ZVL recipients is limited.[2–3] This study assessed national ZVL coverage among adults aged 50–59 years and ≥60 years by sociodemographic characteristics and trends in coverage from 2013–2017, before extensive distribution and use of RZV.

Methods

Data from the 2013–2017 National Health Interview Survey (NHIS) were analyzed in 2019. NHIS is an annual household survey conducted by the U.S. Census Bureau for CDC's National Center for Health Statistics.[8] NHIS provides estimates on health indicators, healthcare utilization and access, and health-related behaviors for the U.S. resident civilian noninstitutionalized population. Data collected over the period of a calendar year form the basis for annual estimates of the health characteristics of the U.S. population and the analysis of health trends.

The NHIS sample was selected using a complex sampling design involving stratification, clustering, and multistage sampling with a nonzero probability of selection for each person.

Estimates were weighted to the adult civilian population of the United States. Face-to-face interviews were conducted in a probability sample of households. In the sample adult component, one adult per sampled family was randomly selected and asked to complete the sample adult questionnaire. Final response rates for the core survey sample of adults ranged from 61.2% in 2013 to 53.0% in 2017.[8]

The sample adult core survey included questions on shingles vaccination. Respondents were asked: "*Have you ever had the shingles vaccine?*" Vaccination coverage was stratified by age groups (50–59 years and ≥60 years) for the following demographic and access-to-care factors: sex, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic Asian, or others, including American Indian/Alaska Native and multiple races), marital status, educational level, employment status, poverty level, region of residence, U.S. born status, number of physician contacts in the previous year, hospitalization in the past year, usual place for healthcare, and health insurance status. The poverty thresholds used in the 2017 NHIS were estimated from several sources: the weighted average Census poverty thresholds from 2015, the average Consumer Price Index from 2015, actual Consumer Price Index values for January-July 2015, and projected Consumer Price Index values for August-December 2016.[8]

Data from the 2017 Behavioral Risk Factor Surveillance System (BRFSS) were analyzed in 2019. BRFSS is a continuous, population-based telephone survey of non-institutionalized adults aged ≥18 years coordinated by state health departments in collaboration with CDC. The BRFSS collects information on health conditions and risk behaviors from randomly selected adults. To determine shingles vaccination status in all states, a question on shingles vaccination was added to the 2017 BRFSS core questionnaires as part of a 3-year rotation. Respondents were asked "*Have you ever had the shingles or zoster vaccine?*" Respondents who answered "yes" were considered vaccinated. Response rates for BRFSS are calculated using standards set by the American Association for Public Opinion Research. Landline, cellular phone, and landline–cellular phone combined median response rates were 45.3%, 44.5%, and 45.9%, respectively, for the 2017 BRFSS.[9, 10]

SUDAAN statistical software, a statistical tool for complex sample surveys (Research Triangle Institute, Research Triangle Park, NC) was used to calculate point estimates and 95% confidence intervals (CI). All analyses were weighted to reflect the age, sex, and race/ethnicity of the U.S. noninstitutionalized civilian population. ZVL coverage, stratified by two age groups (age 50–59 years and age ≥60 years), was assessed. State-specific ZVL coverage among adults aged ≥50 years was assessed using data from the 2017 BRFSS. *T*-tests were used to identify differences in coverage between the two age groups and by demographic and access-to-care factors at a significance level of $p<0.05$. *T*-tests for linear trends in vaccination coverage during 2013–2017 were conducted for each age group. Multivariable logistic regression under a predictive marginal model was performed to identify factors independently associated with ZVL vaccination using the 2017 NHIS data.

Results

The characteristics of the NHIS study population are described in Table 1. In the 2017 NHIS, a total of 4,529 adults aged 50–59 years and 9,779 adults aged ≥60 years were included in the analysis. Among all adults aged ≥50 years, 3.1% (n=440) who answered "don't know" or "refused" to the vaccination question were excluded from the assessment of ZVL coverage. Characteristics among those aged 50–59 years differed significantly from those aged ≥60 years for all characteristics assessed except poverty level and region (Table 1).

Overall, in 2017, coverage was significantly lower among adults aged 50–59 years compared with adults aged ≥60 years for all characteristics assessed (Table 2). Among adults aged 50–59 years, national ZVL coverage in 2017 was 5.7% (95% CI: 4.9%, 6.7%) (Table 2). Coverage was significantly lower among non-Hispanic blacks (3.7%) compared with non-Hispanic whites (6.0%). Coverage was significantly higher among those with ≥4 physician contacts compared with those who had no physician contact in the last 12 months. In addition, ZVL coverage was significantly lower among those who were hospitalized in the past 12 months compared with those who were not (Table 2).

Among adults aged ≥60 years, national ZVL coverage in 2017 was 34.9% (Table 2). ZVL coverage was significantly higher among adults aged 65–74 years (40.7%), 75–79 years (41.2%), and ≥80 years (38.3%) compared with those aged 60–64 years (22.4%). ZVL coverage was significantly lower among males (33.1%) compared with females (36.4%). Coverage was significantly lower among non-Hispanic blacks (17.1%), Hispanics (19.9%), non-Hispanic Asians (31.9%), and non-Hispanic others (27.9%) compared with non-Hispanic whites (39.3%).

Vaccination coverage among adults aged ≥60 years who reported being currently married (37.7%) or widowed/divorced/separated (31.9%) was significantly higher compared with those who were never married (26.6%) (Table 2). There was a significant upward trend in reported vaccination levels with increasing educational level. Coverage was significantly higher among adults who were not employed (37.3%) compared with those were employed (29.1%). Coverage was significantly higher among adults at or above the poverty level (36.7%) compared with those living below the poverty level (17.0%). Coverage was also significantly higher among adults residing in the Western region of the United States (39.1%) compared with those residing in the Northeast region (33.8%).

Among adults aged ≥60 years, coverage was significantly lower among foreign-born individuals who had lived in the United States ≥10 years (20.9%) compared with residents who were born in the United States (37.4%). ZVL coverage among adults aged ≥60 years increased with the increasing number of physician contacts in the past year. Additionally, coverage was significantly higher among those who had a usual place for healthcare (35.9%) compared with those who did not (13.0%) (Table 2).

Among states, ZVL coverage among adults 50–59 years ranged from 5.8% in Pennsylvania to 14.7% in South Dakota, with a median of 8.1%. Coverage among adults aged 50–59 years was below 6% in three states (Michigan, Missouri, and Pennsylvania) and above 12% in four

states (Arkansas, Kentucky, Nebraska, and South Dakota) (Table 3). ZVL coverage among adults aged ≥60 years in 2017 ranged from 26.0% in Mississippi to 51.8% in Vermont, with a median of 40.0%. Coverage among adults aged ≥60 years was below 30% in one state (Mississippi), and above 50% in two states (Vermont and South Dakota) (Table 3). Additionally, in 2017, coverage was significantly higher among adults aged ≥60 years for all states compared with those aged 50–59 years (Table 3).

Based on multivariable logistic regression analysis using the 2017 NHIS data, characteristics independently associated with increased likelihood of ZVL vaccination among adults aged 50–59 years included: being 55–59 years old, being Asian, having 4–9 physician contacts in the past 12 months, and having a usual place for health care (Table 4). Having health insurance was not independently associated with increased likelihood of ZVL vaccination (Table 4). Having been hospitalized within the past year was independently associated with decreased likelihood of ZVL vaccination (Table 4). Characteristics independently associated with increased likelihood of ZVL vaccination among adults aged ≥60 years were older age (≥65 years), Asian race, being currently married, having education beyond high school, not being employed, living at or above poverty level, living in the Western region of the United States, having ≥1 physician contacts in the past 12 months, having a usual place for health care, and having medical insurance (Table 4). Being male, non-Hispanic black, other race/ethnicity, or born outside United States were independently associated with decreased likelihood of ZVL vaccination (Table 4).

Overall, based on trend analyses of NHIS data, ZVL coverage among adults aged 50–59 years remained stable during 2013–2017, ranging from 4.4% to 6.1% (test for trend, $p>0.05$) (Figure 1). ZVL coverage among adults aged ≥60 years significantly increased from 24.2% in 2013 to 34.9% in 2017 (test for trend, $p<0.05$) (Figure 1).

Discussion

ZVL was licensed by the FDA for adults aged ≥50 years, but not recommended by the ACIP for persons aged 50–59 years. The ACIP recommendation was driven by considerations of the short-term vaccine efficacy of ZVL in adults aged 50 through 59 years, long-term ZVL efficacy and effectiveness in adults aged ≥60 years, and cost-effectiveness analyses.[6] The differences between FDA's ZVL licensing policy and the ACIP recommendations for ZVL use likely influenced the usage patterns of ZVL before widespread distribution of RZV. Our study indicates that use of ZVL in persons aged 50–59 years was limited, with only 5.7% having reported receipt in 2017 and during 2013–2017, reported ZVL vaccination remaining low and stable, ranging from 4.4% to 6.1%. The limited use of ZVL in persons aged 50–59 years likely reflects use of an FDA-approved vaccine in the absence of an ACIP recommendation, illustrating the strong influence of ACIP recommendations on national vaccination practices. Additionally, the lack of association between having health insurance and receipt of ZVL among adults aged 50–59 years might be that health insurers may not cover the cost for ZVL vaccination among adults aged 50–59 years because it was not recommended by ACIP.

ZVL coverage among adults aged ≥60 years in 2017 was 34.9%. Coverage exceeded 30% among non-Hispanic whites, non-Hispanic Asians, and many other subgroups based on demographic and access-to-care characteristics, indicating achievement of the *Healthy People 2020* shingles vaccination target of 30% among some populations of adults aged ≥60 years.[11] However, we observed that by 2017, the majority of U.S. adults aged ≥60 years had not been vaccinated and that major racial/ethnic differences existed in ZVL coverage.

Our study showed non-Hispanic black race and Hispanic ethnicity were associated with a decreased likelihood of zoster vaccination. Living at or above the poverty level, having a usual place for health care, and having medical insurance were associated with an increased likelihood of zoster vaccination. These findings highlight the negative impact of the intersection of race/ethnicity, poverty, and lack of access to care on the receipt of prevention services like vaccination. The findings from this study indicate the importance of access-to-care and poverty as barriers to receiving this vaccine. Even though pharmacies administer a large proportion of shingles vaccine, having a usual place for healthcare was still associated with higher ZVL coverage.[12–14] Additionally, multiple factors might contribute to racial and ethnic differences in adult vaccination, including differences in attitudes toward vaccination and preventive care, propensity to seek and accept vaccination, variation in the likelihood that providers recommend vaccination, differences in quality of care received by racial and ethnic populations, and differences in concerns about vaccination including vaccine safety.[15–22]

Barriers that might have constrained overall ZVL uptake include financial and logistic challenges. First, the high cost for providers to purchase a supply, as well as high out-of-pocket costs for patients were well-documented barriers.[12, 23] Second, challenges existed to stocking the vaccine (which requires freezer storage), as well as coverage for the vaccine under Medicare Part D, which resulted in billing challenges for medical providers other than pharmacist vaccine providers, variation in out-of-pocket payments for some Medicare Part D beneficiaries depending on their specific plan, and not every Medicare beneficiary elects to participate in Part D.[2, 23]

Comparing ZVL coverage among adults aged 50–59 and ≥60 years from NHIS (5.7% and 34.9%, respectively) to the estimates (8.2%, and 39.4%, respectively) derived by aggregating 2017 BRFSS state-level data, identified a 2.5 and 4.5 percentage point difference, respectively. This difference in coverage estimates between these two surveys might be due to differences in survey design and administration, operations (in-person survey for the NHIS, and telephone survey for BRFSS), and weighting procedures.[9, 10, 21] In addition, results from BRFSS showed that ZVL coverage varied widely by state. Coverage variation among states could be due to differing medical care delivery infrastructure, population composition, social-economic factors, effectiveness of state or local immunization programs, effectiveness of state or local immunization promotion strategies (e.g., TV, media and educational programs), and other factors.[24–28]

Wide variation in vaccination coverage among states has also been observed for influenza, pneumococcal, tetanus, as well as the combination vaccine tetanus, diphtheria and acellular pertussis among older adults,[29, 30] possibly due to similar factors. That vaccination

coverage over 50% was achieved by some states suggests that overall vaccination coverage could be improved in other jurisdictions through sharing information about successful state-level vaccination practices. State immunization programs are encouraged to collaborate with their colleagues in other states and engage providers and other stakeholders to implement interventions shown to be effective in increasing vaccination coverage among adults.[31]

Results from the multivariable logistic model based on NHIS indicated that having ≥1 physician contacts in the past 12 months, having a usual place for healthcare, and having health insurance were associated with increased likelihood of receiving ZVL vaccination. Findings based on multivariable logistic model from BRFSS also showed that ZVL vaccination coverage was higher among persons who have health insurance, have a provider for health care, and have a routine checkup in the previous year. Physician contact and physician recommendation for vaccination continues to play an important role in vaccination uptake.[22, 32, 33] Having a regular healthcare provider and seeing a physician provide opportunities for education about vaccination and offering vaccination and other prevention services.[22, 32, 33]

The findings from this study provide a baseline for assessing changes in shingles vaccination coverage following introduction of RZV. To meet the challenge of evaluating shingles vaccination coverage by type of vaccine (RZV vs ZVL), number of vaccine doses received, and timing of vaccine receipt, CDC added additional shingles vaccination questions to the 2018 NHIS.[34]

The findings in this report are subject to at least six limitations. First, vaccination coverage was self-reported and therefore might be subject to recall bias or social desirability bias. However, adult self-reported vaccination status for ZVL has been shown to be sensitive (90.7%) and specific (89.7%).[35] Second, the NHIS did not collect data regarding reasons for decisions related to ZVL vaccination. Third, BRFSS is a telephone survey, which excludes people without telephones. Fourth, the 2017 response rate was 53.0% for NHIS, and 45.9% for BRFSS, and nonresponse bias may remain if survey weighting does not fully correct for it. Fifth, both NHIS and BRFSS excluded persons in the military and those residing in institutions, which might result in underestimation or overestimation of vaccination coverage levels. Finally, age-specific vaccination coverage (coverage by age at vaccination) could help identify age groups with lower coverage so that tailored intervention programs, education programs, or other strategies could be developed to target the specific groups to improve ZVL coverage, however, we were not able to determine age-specific vaccine uptake, since respondents were asked whether they had ever received the vaccine, and time of vaccination was not collected. For instance, an 80-year-old person who reported receipt of HZ vaccine might have been vaccinated soon after vaccine licensure in 2006, when they were 69 years old.

Shingles vaccine can have a significant impact on the morbidity caused by HZ. However, we found that almost two thirds of adults who are recommended to get ZVL had not received it by 2017, nine years after the recommendation became official CDC policy. Healthcare providers should routinely assess adults' vaccination status, strongly recommend needed vaccines, and either offer needed vaccines or refer their patients to another provider who can

administer the recommended vaccine.[31, 36, 37] Other comprehensive strategies for improving adult vaccination uptake include using reminder-recall systems; conducting educational campaigns; using standing orders; using immunization information systems, reducing client out-of-pocket costs, and linking delivery of zoster vaccine to delivery of other indicated adult vaccines (e.g., influenza and pneumococcal vaccines).[31, 36, 37]

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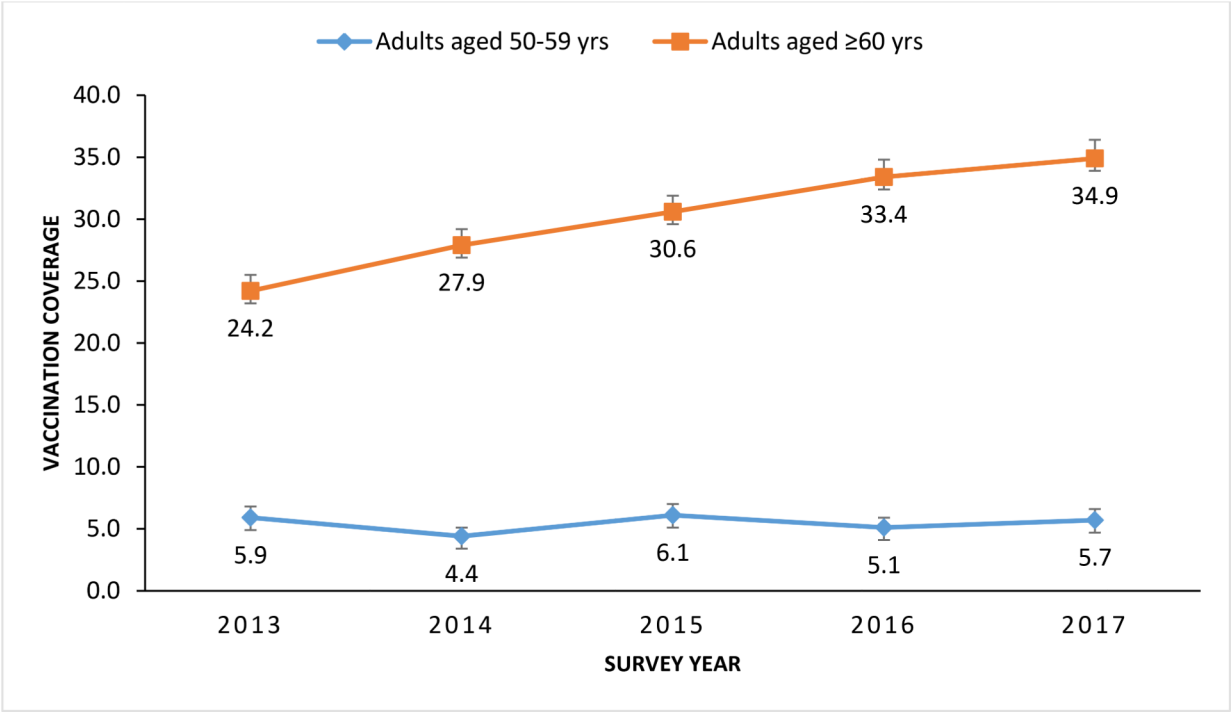

Figure 1.

Shingles vaccination coverage among adults aged ≥50 years, United States, 2013–2017 National Health Interview Survey

Table 1.

Sample characteristics of adults aged ≥50 years, by demographic and access-to-care variables—2017 NHIS

Characteristic		Adults aged 50–59 years		Adults aged ≥60 years	
		Sample	Weighted %	Sample	Weighted %
Total		4,529	37.5	9,779	62.5
Age groups					
	50–54 years	2,212	51.1	NA	NA
	55–59 years	2,317	48.9	NA	NA
	60–64 years	NA	NA	2,445	29.8
	65–74 years	NA	NA	4,217	41.8
	75–79 years	NA	NA	1,294	12.1
	≥80 years	NA	NA	1,823	16.4
Sex					
	Male	2,046	48.2	4,187	**45.8** [a]
	Female	2,483	51.8	5,592	**54.2**
Race/ethnicity					
	Non-Hispanic White	3,268	67.2	7,600	**74.7** [a]
	Non-Hispanic Black	519	12.2	927	**9.7**
	Hispanic	451	13.2	702	**9.1**
	Non-Hispanic Asian	162	5.1	362	**4.7**
	Non-Hispanic Other	129	2.2	188	**1.8**
Marital status					
	Married	2,294	63.3	4,391	**58.8** [a]
	Widowed/divorced/separated	1,418	22.1	4,424	**32.8**
	Never married	804	14.6	941	**8.5**
Education					
	High school or less	1,655	36.7	4,032	**41.1** [a]
	Some college or college graduate	2,295	49.9	4,479	**45.8**
	Above college graduate	559	13.4	1,223	**13.1**
Employment status					
	Employed	3,268	73.0	2,586	**28.7** [a]
	Not employed	1,259	27.0	7,190	**71.3**
Poverty level					
	At or above poverty	3,788	89.9	8,195	91.0
	Below poverty	542	10.1	910	9.0
Region[b]					
	Northeast	756	19.8	1,706	19.3
	Midwest	1,064	21.1	2,321	22.3
	South	1,727	37.9	3,581	35.5
	West	982	21.2	2,171	23.0

Characteristic	Adults aged 50–59 years		Adults aged ≥60 years	
	Sample	Weighted %	Sample	Weighted %
US born status				
U.S. born	3,874	80.6	8,686	**85.6** [a]
Born outside U.S. -- In U.S. < 10 years	51	1.5	55	**1.0**
Born outside U.S. -- In U.S. ≥ 10 years	584	17.9	1,019	**13.5**
Physician contacts within past year				
None	554	12.7	705	**7.7** [a]
1	783	18.8	1,151	**12.5**
2–3	1,271	28.3	2,698	**28.0**
4–9	1,133	25.4	3,279	**33.6**
≥10	711	14.8	1,784	**18.2**
Hospitalization within past year				
Yes	406	8.4	1,425	**14.0** [a]
No	4,122	91.6	8,349	**86.0**
Usual place for healthcare				
Yes	4,064	90.7	9,269	**95.6** [a]
No	427	9.3	441	**4.4**
Health insurance				
Yes	4,090	90.9	9,538	**97.3** [a]
No	422	9.1	229	**2.7**

Note: Boldface indicates statistical significance ($p<0.05$), NA= not applicable.

[a] Significant difference between adults aged 50–59 years and ≥60 years (by chi-square test, $p<0.05$).

[b] Northeast: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania; Midwest: Ohio, Michigan, Indiana, Wisconsin, Illinois, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas; South: Delaware, Maryland, Virginia, District of Columbia, West Virginia, Kentucky, North Carolina, South Carolina, Tennessee, Georgia, Florida, Alabama, Mississippi, Arkansas, Louisiana, Texas, and Oklahoma; West: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, California, Oregon, Washington, Alaska, and Hawaii.

Table 2.

Shingles vaccination coverage of adults aged ≥50 years, by demographic and access-to-care variables—2017 NHIS

Characteristic	Vaccination coverage among adults aged 50–59 years % (95% CI)	Vaccination coverage among adults aged ≥60 years % (95% CI)
Total	5.7 (4.9–6.7)	**34.9 (33.5–36.4)** [a]
Age groups		
50–54 years[c]	4.7 (3.7–6.0)	NA
55–59 years	**6.7 (5.4–8.3)** [b]	NA
60–64 years[c]	NA	22.4 (20.5–24.6)
65–74 years	NA	**40.7 (38.7–42.7)** [b]
75–79 years	NA	**41.2 (38.1–44.5)** [b]
≥80 years	NA	**38.3 (35.4–41.3)** †
Sex		
Male	4.9 (3.8–6.2)	**33.1 (31.2–35.0)** [a,b]
Female[c]	6.5 (5.3–7.8)	**36.4 (34.7–38.2)** [a]
Race/ethnicity		
Non-Hispanic White[c]	6.0 (5.0–7.2)	**39.3 (37.7–40.9)** [a]
Non-Hispanic Black	**3.7 (2.1–6.6)** [b]	**17.1 (14.1–20.5)** [a,b]
Hispanic	--[d]	**19.9 (16.0–24.6)** [b]
Non-Hispanic Asian	12.1 (7.1–19.8)	**31.9 (26.3–37.9)** [a,b]
Non-Hispanic Other	--[d]	**27.9 (21.3–35.7)** [b]
Marital status		
Married	6.1 (5.0–7.4)	**37.7 (35.8–39.6)** [a,b]
Widowed/divorced/separated	4.8 (3.3–6.8)	**31.9 (30.1–33.8)** [a,b]
Never married[c]	5.4 (3.6–7.9)	**26.6 (23.3–30.1)** [a]
Education		
High school or less[c]	4.8 (3.6–6.5)	**27.6 (25.8–29.4)** [a]
Some college or college graduate	6.1 (4.9–7.5)	**37.4 (35.5–39.4)** [a,b]
Above college graduate	6.5 (4.3–9.7)	**49.1 (45.6–52.5)** ¶,[b]
Employment status		
Employed[c]	5.2 (4.3–6.2)	**29.1 (26.9–31.4)** [a]
Not employed	7.1 (5.3–9.5)	**37.3 (35.7–38.9)** [a,b]
Poverty level		

Characteristic	Vaccination coverage among adults aged 50–59 years % (95% CI)	Vaccination coverage among adults aged ≥60 years % (95% CI)
At or above poverty	5.5 (4.6–6.6)	**36.7 (35.2–38.2)** [a,b]
Below poverty[c]	7.2 (4.5–11.5)	**17.0 (14.1–20.4)** [a]
Region		
Northeast[c]	5.6 (3.6–8.5)	**33.8 (30.7–37.2)** [a]
Midwest	6.8 (4.9–9.2)	**37.8 (35.1–40.5)** [a]
South	5.1 (3.9–6.6)	**31.0 (28.7–33.3)** [a]
West	5.8 (4.4–7.7)	**39.1 (35.8–42.5)** [a,b]
US born status		
U.S. born[c]	5.8 (4.8–6.9)	**37.4 (35.9–38.8)** [a]
Born outside U.S. -- In U.S. < 10 years	--[d]	--[d]
Born outside U.S. -- In U.S. ≥ 10 years	5.5 (3.6–8.4)	**20.9 (17.9–24.2)** [a,b]
Physician contacts within past year		
None[c]	--[d]	14.8 (11.8–18.6)
1	4.0 (2.5–6.4)	**29.2 (25.9–32.7)** [a,b]
2–3	4.7 (3.5–6.3)	**36.1 (33.5–38.7)** [a,b]
4–9	**8.9 (6.9–11.4** [b]	**39.1 (36.9–41.4)** [a,b]
≥10	**6.9 (4.9–9.5)** [b]	**38.0 (35.3–40.7)** [a,b]
Hospitalization within past year		
Yes	**3.6 (2.3–5.7)** [b]	**36.7 (33.6–40.0)** [a]
No[c]	5.9 (5.0–6.9)	**34.6 (33.1–36.1)** [a]
Usual place for healthcare		
Yes	6.1 (5.2–7.2)	**35.9 (34.4–37.4)** [a,b]
No[c]	--[d]	13.0 (9.5–17.5)
Health insurance		
Yes	6.0 (5.0–7.0)	**35.8 (34.3–37.3)** [a]
No[c]	--[d]	--[d]

Note: Boldface indicates statistical significance (p<0.05), NA= not applicable.

[a] p<0.05 by t-test for comparisons between adults aged 50–59 years and ≥60 years within each level of each characteristic.

[b] p<0.05 by t-test for comparisons within each variable with the reference level as indicated.

[c] Reference level.

[d] Estimate is not reliable due to relative standard error (standard error/estimates) >0.3.

Table 3.

State-specific shingles vaccination coverage among adults aged ≥50 years, United States—2017 BRFSS

State	Total sample size	Adults aged 50–59 years % (95% CI)	Adults aged ≥60 years % (95% CI)	Percent difference between adults aged 50–59 and ≥60 years
U.S. National	285,709	8.2 (7.8, 8.6)	39.4 (38.9, 39.9)	**31.2** [a]
Alabama	4,426	8.1 (6.3, 10.5)	35.0 (32.9, 37.2)	**26.9** [a]
Alaska	2,030	9.1 (6.0, 13.4)	40.6 (36.4, 44.9)	**31.5** [a]
Arizona	10,157	7.6 (6.4, 9.0)	41.2 (39.8, 42.6)	**33.6** [a]
Arkansas	4,170	12.2 (8.3, 17.5)	34.7 (32.2, 37.4)	**22.5** [a]
California	4,627	9.9 (8.0, 12.3)	44.5 (41.7, 47.3)	**34.6** [a]
Colorado	6,068	7.5 (6.1, 9.1)	48.2 (46.3, 50.1)	**40.7** [a]
Connecticut	7,243	9.1 (7.7, 10.8)	40.4 (38.6, 42.2)	**31.2** [a]
Delaware	2,636	8.1 (5.7, 11.2)	36.2 (33.3, 39.1)	**28.1** [a]
District of Columbia	2,503	9.2 (7.1, 12.0)	39.2 (36.4, 42.2)	**30.0** [a]
Florida	14,094	7.7 (6.0, 10.0)	33.8 (31.8, 35.8)	**26.0** [a]
Georgia	3,674	7.9 (6.1, 10.3)	36.7 (34.3, 39.1)	**28.7** [a]
Hawaii	4,622	9.5 (7.5, 12.1)	46.7 (44.2, 49.3)	**37.2** [a]
Idaho	3,107	7.6 (5.5, 10.4)	38.7 (36.0, 41.5)	**31.1** [a]
Illinois	3,451	9.9 (7.7, 12.6)	35.4 (33.1, 37.8)	**25.6** [a]
Indiana	9,426	7.0 (5.9, 8.3)	36.1 (34.6, 37.5)	**29.1** [a]
Iowa	4,748	10.3 (8.6, 12.3)	48.6 (46.6, 50.7)	**38.3** [a]
Kansas	13,581	9.1 (8.1, 10.3)	41.3 (40.0, 42.5)	**32.1** [a]
Kentucky	5,443	12.1 (9.5, 15.2)	37.3 (34.7, 39.9)	**25.2** [a]
Louisiana	2,868	7.2 (5.4, 9.4)	32.3 (29.6, 35.2)	**25.1** [a]
Maine	6,918	8.1 (6.4, 10.2)	47.0 (45.0, 49.1)	**38.9** [a]
Maryland	9,684	9.5 (8.1, 11.2)	43.3 (41.5, 45.1)	**33.8** [a]
Massachusetts	4,416	6.8 (4.9, 9.5)	45.9 (42.5, 49.4)	**39.1** [a]
Michigan	6,922	5.9 (4.7, 7.3)	38.8 (37.1, 40.6)	**32.9** [a]
Minnesota	10,492	8.8 (7.6, 10.2)	49.9 (48.4, 51.4)	**41.1** [a]
Mississippi	3,523	8.0 (5.9, 10.6)	26.0 (23.8, 28.3)	**18.0** [a]
Missouri	4,974	5.9 (4.4, 8.0)	38.3 (36.1, 40.5)	**32.3** [a]
Montana	3,959	7.7 (5.8, 10.2)	41.5 (39.0, 44.0)	**33.8** [a]

	Total sample size	Adults aged 50–59 years	Adults aged ≥60 years	Percent difference between adults aged 50–59 and ≥60 years
State		**% (95% CI)**	**% (95% CI)**	
Nebraska	9,823	12.9 (11.0, 15.1)	48.0 (46.2, 49.8)	**35.1** [a]
Nevada	2,407	6.9 (4.5, 10.3)	34.1 (30.7, 37.7)	**27.2** [a]
New Hampshire	4,194	8.0 (6.3, 10.1)	47.2 (44.8, 49.6)	**39.2** [a]
New Jersey	8,056	6.3 (5.0, 7.9)	31.8 (29.7, 34.0)	**25.5** [a]
New Mexico	4,334	8.6 (6.7, 11.0)	43.8 (41.2, 46.5)	**35.3** [a]
New York	7,211	7.5 (6.2, 9.2)	34.3 (32.3, 36.3)	**26.7** [a]
North Carolina	2,812	9.1 (6.8, 12.2)	39.2 (36.3, 42.3)	**30.1** [a]
North Dakota	4,746	10.4 (8.6, 12.6)	48.9 (46.9, 51.0)	**38.5** [a]
Ohio	8,564	8.9 (7.4, 10.6)	40.0 (38.2, 41.8)	**31.1** [a]
Oklahoma	4,444	10.4 (8.4, 12.8)	38.9 (36.9, 41.0)	**28.5** [a]
Oregon	3,190	6.3 (4.6, 8.5)	49.5 (47.0, 52.1)	**43.3** [a]
Pennsylvania	3,843	5.8 (4.4, 7.6)	40.0 (37.4, 42.6)	**34.1** [a]
Rhode Island	3,881	10.1 (8.1, 12.6)	44.3 (41.8, 46.8)	**34.2** [a]
South Carolina	7,964	6.5 (5.3, 8.0)	35.7 (34.1, 37.3)	**29.1** [a]
South Dakota	4,708	14.7 (11.4, 18.8)	50.7 (47.5, 53.8)	**35.9** [a]
Tennessee	3,575	6.1 (4.6, 8.1)	33.8 (31.2, 36.4)	**27.6** [a]
Texas	7,830	7.7 (5.6, 10.5)	36.6 (33.2, 40.1)	**28.9** [a]
Utah	4,987	9.1 (7.5, 11.1)	44.7 (42.5, 46.8)	**35.5** [a]
Vermont	4,404	9.3 (7.2, 11.9)	51.8 (49.4, 54.2)	**42.5** [a]
Virginia	6,220	10.1 (8.5, 12.0)	42.7 (40.7, 44.7)	**32.6** [a]
Washington	8,329	9.1 (7.6, 10.7)	48.9 (47.2, 50.6)	**39.9** [a]
West Virginia	3,686	7.1 (5.5, 9.1)	38.0 (35.9, 40.2)	**30.8** [a]
Wisconsin	3,677	6.1 (4.4, 8.4)	42.9 (40.1, 45.6)	**36.8** [a]
Wyoming	3,062	8.0 (6.1, 10.5)	37.2 (34.8, 39.6)	**29.1** [a]
Median		8.1	40.0	32.1
Range		5.8, 14.7	26.0, 51.8	18.0, 43.3

Note: Boldface indicates statistical significance ($p<0.05$).

[a] *p* value by *t*-test comparing between adults aged 50–59 and ≥60 years.

TABLE 4.

Multivariable logistic regression analyses of adults aged ≥50 years who reported receiving shingles vaccination—2017 NHIS

Characteristic		Prevalence Ratio (PR) of shingles vaccination among adults aged 50–59 years PR (95% CI)	Prevalence Ratio (PR) of shingles vaccination among adults aged ≥ 60 years PR (95% CI)
Age	50–54 years	reference	NA
	55–59 years	**1.39 (1.01, 1.91)** [a]	NA
	60–64 years	NA	reference
	65–74 years	NA	**1.52 (1.37, 1.69)** [a]
	75–79 years	NA	**1.59 (1.42, 1.79)** [a]
	≥80 years	NA	**1.45 (1.28, 1.64)** [a]
Sex			
	Male	0.88 (0.65, 1.19)	**0.86 (0.80, 0.91)** [a]
	Female	reference	reference
Race/ethnicity			
	Non-Hispanic White	reference	reference
	Non-Hispanic Black	0.60 (0.31, 1.14)	**0.57 (0.47, 0.69)** [a]
	Hispanic	0.84 (0.44, 1.60)	0.85 (0.70, 1.05)
	Non-Hispanic Asian	**2.73 (1.43, 5.20)** [a]	**1.21 (1.01, 1.44)** [a]
	Non-Hispanic Other	0.87 (0.25, 3.09)	**0.73 (0.56, 0.96)** [a]
Marital Status			
	Married	0.98 (0.61, 1.57)	**1.14 (1.01, 1.30)** [a]
	Widowed/divorced/separated	0.77 (0.46, 1.30)	**1.00 (0.88, 1.14)**
	Never married	reference	reference
Education			
	High school or less	reference	reference
	Some college or college graduate	1.15 (0.80, 1.64)	**1.24 (1.15, 1.34)** [a]
	Above college graduate	1.24 (0.73, 2.13)	**1.61 (1.47, 1.77)** [a]
Employment status			
	Employed	reference	reference
	Not employed	1.19 (0.78, 1.83)	**1.16 (1.06, 1.27)** [a]
Poverty level			
	At or above poverty	0.65 (0.35, 1.23)	**1.41 (1.18, 1.69)** [a]
	Below poverty	reference	reference
Region			
	Northeast	reference	reference
	Midwest	1.24 (0.70, 2.20)	1.10 (0.98, 1.23)

Characteristic		Prevalence Ratio (PR) of shingles vaccination among adults aged 50–59 years PR (95% CI)	Prevalence Ratio (PR) of shingles vaccination among adults aged ≥ 60 years PR (95% CI)
	South	1.00 (0.58, 1.73)	1.02 (0.91, 1.13)
	West	1.04 (0.61, 1.76)	**1.20 (1.06, 1.36)** [a]
US born status			
	U.S. born	reference	reference
	Born outside U.S. -- In U.S. < 10 years	0.84 (0.16, 4.32)	**0.32 (0.15, 0.71)** [a]
	Born outside U.S. -- In U.S. ≥ 10 years	0.87 (0.46, 1.64)	**0.61 (0.51, 0.72)** [a]
Physician contacts within past year			
	None	reference	reference
	1	1.06 (0.40, 2.77)	**1.51 (1.17, 1.95)** [a]
	2–3	1.39 (0.57, 3.40)	**1.77 (1.41, 2.22)** [a]
	4–9	**2.47 (1.02, 6.00)** [a]	**1.87 (1.50, 2.33)** [a]
	>10	2.13 (0.83, 5.46)	**1.79 (1.43, 2.25)** [a]
Hospitalization within past year			
	Yes	**0.51 (0.31, 0.87)** [a]	0.98 (0.89, 1.08)
	No	reference	reference
Usual place for health care			
	Yes	**2.70 (1.01, 7.24)** [a]	**1.51 (1.13, 2.01)** [a]
	No	reference	reference
Health insurance			
	Yes	1.04 (0.48, 2.26)	**4.07 (2.17, 7.63)** [a]
	No	reference	reference

Note: Boldface indicates statistical significance ($p<0.05$), NA= not applicable.

[a] $p<0.05$ by t test for comparisons within each covariate category with the indicated reference level.