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Hepatitis A vaccination coverage among adolescents (13–17 years) in the United States, 2008–2016

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Abstract

Background—The hepatitis A (HepA) vaccine was recommended by the Advisory Committee on Immunization Practices (ACIP) incrementally from 1996 to 1999. In 2006, HepA vaccine was recommended (1) universally for children aged 12–23 months, (2) for persons who are at increased risk for infection, or (3) for any person wishing to obtain immunity. Catch-up vaccination can be considered.

Objective—To assess HepA vaccine coverage among adolescents and factors independently associated with vaccination administration in the US.

Methods—The 2008–2016 National Immunization Survey–Teen was utilized to determine 1 and ≥2 dose HepA vaccination coverage among adolescents aged 13–17 years. Factors associated with HepA vaccine series initiation (1 dose) were determined by bivariate and multivariable analyses. Data were stratified by state groups based on ACIP recommendation: universal child vaccination recommended since 1999 (group 1); child vaccination considered since 1999 (group 2); universal child vaccination recommendation since 2006 (group 3).

Results—In 2016, national vaccination coverage for 1 and ≥2 doses of HepA vaccine among adolescents was 73.9% and 64.4%, respectively. Nationally, a 40 percentage point increase in

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Conflict of interest

The authors have no conflicts of interest to disclose.

Disclaimer

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Contributor's statement

Noele P. Nelson: Dr. Nelson conceptualized the study, reviewed the analysis, drafted the initial manuscript and revised the manuscript.
David Yankey: Mr. Yankey carried out the data analysis, contributed to drafting of the manuscript, reviewed and revised the manuscript and approved the final manuscript as submitted.
James A. Singleton: Dr. Singleton supervised the data analysis and interpretation, contributed to and critically reviewed the manuscript, and approved the final manuscript as submitted.
Laurie D. Elam-Evans: Dr. Elam-Evans supervised the data analysis and interpretation, contributed to, critically reviewed and revised the manuscript, and approved the final manuscript as submitted.

vaccination coverage occurred among adolescents born in 1995 compared to adolescents born in 2003. Nationally, the independent factors associated with increased vaccine initiation was race/ethnicity (Hispanic, American Indian/Alaskan Native, Asian), military payment source and provider recommendation for HepA vaccination (2008–2013). Living in a suburban or rural region, living in poverty (level <1.33–5.03), and absence of state daycare or school HepA requirement were common factors associated with decreased likelihood of vaccine initiation.

Conclusions—Efforts to increase HepA vaccine coverage in adolescents in all regions of the country would strengthen population protection from hepatitis A virus (HAV).

Keywords

Hepatitis A; Hepatitis A vaccine; Adolescents; Teens; Vaccination; Immunization; Coverage

1. Introduction

Hepatitis A is a communicable, vaccine preventable acute infection of the liver caused by the hepatitis A virus (HAV). Young children are usually asymptomatic; severity of hepatitis A disease typically increases with age. The mean age of persons hospitalized and hospitalization rates for reported hepatitis A cases have increased recently. Serious complications due to HAV infection are rare, but can result in liver failure and death [1–3].

Hepatitis A (HepA) vaccine was licensed by the United States (US) Food and Drug Administration in 1995, and was introduced incrementally by the Advisory Committee on Immunization Practices (ACIP) [4,5]. During 1996–1999, the vaccine was recommended for individuals at high risk of HAV infection or for children at age 2 years in 11 states where HAV infection rates were at least twice the national average [4,5]. Vaccination was to be considered for children living in 6 states where infection rates were greater than the national average but lower than twice the national average [4,5]. In 2006, the ACIP expanded recommendations to include routine HepA vaccination for (1) all children aged 12–23 months, (2) for persons who are at increased risk for infection, or (3) for any person wishing to obtain immunity [6]. Children who were not vaccinated by age 2 years can be vaccinated at subsequent visits, and catch-up vaccination of unvaccinated children aged 2–18 years can be considered [6].

HepA vaccines are administered on a two-dose schedule [6]. In clinical trials, protective antibody levels were identified in 97–100% of children and adolescents and 94–100% of adults, 1 month after the first dose [6].

Following HepA vaccine introduction, the number of reported hepatitis A cases decreased by >95%, and incidence rates declined sharply [3,7]. In the US in 2015, rates were 0.4 cases/100,000 population (1390 reported cases). Among children currently aged 0–9 years, HAV infection rates were the lowest reported, at 0.10 cases/100,000 population, followed by those aged 10–19 years at 0.20 cases/100,000 population [3].

The overall antibody to HAV (anti-HAV) seroprevalence in the US among children and adolescents aged 6–19 years was 24.4% in 2003–2006 and increased to 37.6% in 2007–2010

due to routine vaccination of children aged 12–23 months [8]. However, herd immunity provided by routine vaccination has also resulted in a significant decrease in seroprevalence among adults aged ≥20 years, from 29.5% (95% CI 28.0–31.1) during 1999–2006 to 24.2% during 2007–2012 [9]. Despite demonstrated safety and efficacy of the vaccine, two-dose coverage with HepA vaccine is below the Healthy People 2020 target of 85% to achieve and maintain an effective coverage level of 2 doses of HepA vaccine among children by age 19–35 months [10]. In 2016, for children aged 19–35 months, HepA vaccine coverage was 86.1% for ≥1 dose and 60.6% for ≥2 doses [11]. Among adults aged 19–49 years in 2015, coverage with ≥2 HepA doses was only 12.1% [12]. There are limited data describing HepA vaccination coverage among school-aged children and adolescents.

In recent years, multiple food associated outbreaks and outbreaks among high risk populations have occurred, with substantial morbidity and mortality, particularly among adults [13,14]. Considering the declining anti-HAV seroprevalence in older adults and the poor two-dose vaccination coverage overall, it is important to improve adult HepA vaccination as a short-term strategy, and to maximize HepA vaccination coverage for children and adolescents aged 2–18 years to improve population protection from HAV infection, as a long-term strategy.

To assess HepA vaccine coverage among adolescents aged 13–17 years and factors independently associated with vaccination administration in the US, we used the 2008–2016 National Immunization Survey—Teen (NIS-Teen) to evaluate state vaccination coverage stratified by state specific ACIP recommendations.

2. Methods

The NIS-Teen is an ongoing cross-sectional survey conducted by the Centers for Disease Control and Prevention (CDC), using random-digit-dial telephone interviews with parents/guardians to obtain demographic and vaccination information for their adolescents aged 13–17 years. NIS-Teen also includes a mailed survey to all vaccination providers identified by the parent and for which consent was granted to contact for vaccination history [15,16]. The NIS-Teen uses a national probability sample of households in the US, which includes all 50 states, the District of Columbia, and some select local areas. The NIS-Teen is conducted using the sampling frame of telephone numbers selected for the NIS-Child [16].

We analyzed NIS-Teen data from 2008 to 2016 for adolescents born from 1990 to 2004, including interviews from landline telephone households (2008–2010) and interviews from landline and cellular telephone households (2011–2016) [17–19]. Data on demographic characteristics for HepA vaccine administration were obtained from the household interview with the parent or guardian [Table 1]. Poverty thresholds were based on census data; poverty level <1.33 (income for the household is <33% higher than the poverty threshold for the composition of the household) is commonly used by states to determine households that are eligible for Medicaid [20]. Data on the state's HepA vaccination recommendation status were obtained from the ACIP recommendations [4–6]. Health insurance status was self-reported. Metropolitan statistical area status was based on census data and householdreported county of residence. States were categorized as follows: HepA

vaccination recommended since 1999 (group 1), considered since 1999 (group 2), and recommended since 2006 (group 3). The data on specific states with daycare and school HepA vaccine prevention mandates for kindergarten through 12th grade were used to categorize the state's school/daycare vaccination requirement status (yes mandate/no mandate) [21]. State requirement is defined as a state mandate being in place and impacting the adolescent cohort during the timeframe of the study. Provider recommendation has been determined to be one of the strongest predictors of vaccination acceptance and thus was included [22,23]. However, data for provider recommendation were only available for 2008–2013, because the NIS-Teen questionnaire was shortened in 2014 and this question was no longer asked on the questionnaire. Provider-reported vaccination histories from the mailed questionnaire to providers were used to determine HepA vaccination coverage estimates.

Details of the NIS-Teen methodology were published previously [17,18]. The precision of estimates of vaccination coverage can be improved by combining multiple years of NIS-Teen data. Estimates from combined years of NIS-Teen data represent an average over multiple years. To estimate a multi-year mean for a given NISTeen variable, the weights in each participating file should be divided by the number of years being combined [17,18]. NISTeen was approved by the Research Ethics Review Board at the National Center for Health Statistics, CDC. Only adolescents with adequate provider data, sufficient vaccination information obtained to determine vaccination status, were included in this analysis [17,18].

2.1. Statistical analysis

Point estimates and 95% confidence intervals (CIs) were calculated with SUDAAN 11.0.1 (Software for the statistical analysis of complex sampling data, Research Triangle Institute, Research Triangle Park, NC). All analyses account for the complex sampling design of the NIS-Teen and the survey sampling weights. T-tests were used to examine associations at significance level $p < .05$. The adjusted prevalence ratio (aPR) was obtained by multivariable logistic regression and predictive marginal modeling. All variables examined for this analysis were included in the multivariable model. Independent variables included in the analysis were identified in the literature as being associated with HepA vaccination and/or other vaccinations [11,12,24]. The cumulative proportion of adolescents vaccinated over time by birth cohort was estimated by Kaplan-Meier survival analysis. Vaccination status as of the day before the 6th, 13th and 17th birthdays were chosen for analysis because these ages coincide with school groups, such as elementary and middle school; 17 is the last age the NIS-Teen survey captures.

3. Results

During 2016, 41,994 parents completed the NIS-Teen household survey. The Council of American Survey Research Organizations (CASRO) response rate was 55.5% for landline and 29.5% for cellphone [16]. For completed interviews, 4684 by landline (53.8%) and 15,791 by cell phone (47.4%) had adequate provider-reported vaccination histories and were included in the analysis of the 2016 data [24]. For 2008–2016, 327,861 surveys were completed, including 182,593 (55.7%) for which adequate provider data were available.

Sociodemographic characteristics of the survey sample for 2008–2016 and 2016 alone are described in Table 1.

National vaccination coverage for 1 and ≥2 doses of HepA vaccine among adolescents was 73.9% and 64.4%, respectively in 2016, compared to 36.2% and 25.3% for 1 and ≥2 doses, respectively in 2008 (Table 2). The percentage of adolescents with 1 dose vaccination coverage was 87.8%, 79.5% and 67.5% for groups 1, 2 and 3, respectively in 2016, representing a 16.9%, 26.6% and 47.6% percentage point increase for groups 1, 2 and 3, respectively from 2008 to 2016. The percentage of adolescents with ≥2 dose vaccination coverage was 79.5%, 69.0% and 57.8% for groups 1, 2 and 3, respectively in 2016; representing an increase of 23.4, 26.4 and 47.5 percentage points, respectively for groups 1, 2 and 3 from 2008 to 2016.

State estimates for 1 and ≥2 doses of HepA vaccine increased from 2008 to 2016 for all states with available data except Oklahoma (Table 2). In 2016, estimates for 1 and ≥2 dose coverage were highest in group 1; >80% and > 70%, respectively for all states except South Dakota.

Weighted percents from the bivariate analyses and adjusted prevalence ratios from the multivariable analyses are listed in Table 3. Nationally, in bivariate analyses, indicators associated with higher HepA vaccination initiation included Black –non-Hispanic, Hispanic, and Asian racial/ethnic groups compared to White, non-Hispanic; having a mother with less than high school education, having Medicaid/CHIP, and military insurance and reporting receipt of a provider recommendation for HepA vaccination (2008–2013). Adolescents aged 16–17 years, those living at a poverty level 1.33–5.03, those living in rural and suburban areas, and those living in a state that does not have an immunization requirement were less likely to initiate the vaccine series. In bivariate analyses, across all three groups, Black, non-Hispanic race/ethnicity was the only factor associated with HepA vaccination initiation, while adolescents aged 16–17 years was commonly associated with decreased likelihood of vaccine initiation (1 dose).

Nationally, in multivariable analysis, factors associated with increased likelihood of HepA vaccination initiation included race/ ethnicity (Hispanic, American Indian/Alaskan Native (AI/AN), and Asian), military vaccination payment source, and reporting receipt of a provider recommendation (2008–2013). Adolescents age 16–17 years, those living at a poverty level < 5.03 those living in suburban and rural areas, and those living in a state that does not have an immunization requirement were less likely to initiate the vaccine series. In multivariable analyses, across all three groups, provider recommendation (2008–2013) was associated with HepA vaccination initiation. States without a state daycare or school HepA requirement in Group 1 and Group 2 had decreased likelihood of vaccine initiation, while Group 3 had increased likelihood of vaccine initiation. Additional independent factors associated with likelihood of vaccine initiation are noted in Table 3.

The percent of adolescents who initiated HepA vaccination increased nationally among all teens aged 13–17 years from 2008 to 2016. The percent of adolescents who have initiated HepA vaccination increased for all race/ethnicities from 2008 to 2016 (Fig. 1). In 2016,

AI/AN, Asians and Hispanics had the highest percent of HepA vaccination initiation for adolescents nationally at 75.7%, 85.0% and 80.2%, respectively. In 2016, AI/ AN, Asian and Hispanic, adolescents were all above the national average (73.9%), while White-non Hispanic and Black non- Hispanic adolescents were below the national average, at 68.7% and 73.4%, respectively.

HepA vaccination initiation rates stratified by birth cohort, using vaccination status as of the day before the 6th, 13th and 17th birthdays are described in Table 4. The percent of adolescents who received HepA vaccination prior to 6 years of age increased significantly for adolescents born in 1995–2003 by 39.7 percentage points nationally, and 46.8, 55.9 and 32.8 percentage points for groups 1, 2, and 3, respectively (Table 4, Fig. 2). The percent of adolescents born in 1995–2003 who received HepA vaccination prior to age 13 years also increased significantly by 40.2 percentage points nationally, and 23.1, 37.7 and 46.5 percentage points for groups 1, 2, and 3, respectively (Table 4). The percent of adolescents born in 1995–2003 who received HepA vaccination prior to age 17 years increased significantly by 25.3 percentage points nationally, and 18.9, 23.3 and 28.3 percentage points for groups 1, 2, and 3, respectively (Table 4). Nationally, most adolescents (38.4%) had received their first dose of HepA at ages 5–10 years (Fig. 3). The later the region recommended universal vaccination, the older the children were when they received the first dose of vaccine.

4. Discussion

This study reported national and state estimates of HepA vaccination coverage among adolescents by year of ACIP recommendation for 2008 and 2016. HepA vaccination series 1 dose and ≥2 dose coverage among adolescents who began the series increased substantially for adolescents from 2008 to 2016 nationally and for adolescents living in states with universal child vaccination recommended in 2006. Moderate increases were observed for adolescents living in states with earlier recommendations.

In 2016, the published estimate of ≥1 dose coverage for children aged 19–35 months (covered by the ACIP 2006 universal recommendation) was 86.1% [25]. In 2016, our analysis indicates that 1 dose coverage for adolescents was 73.9%, far below ≥1 dose coverage for children aged 19–35 months. This is not surprising considering the universal vaccination recommendation will not reach the current adolescent cohort until 2018, and the permissive catch-up recommendation for adolescents. The 2016 adolescent 1 dose coverage is also substantially lower than 2016 ≥1 dose coverage for other vaccines administered during adolescence, Tdap (88.0%) and MenACWY (82.2%), but higher than HPV for females (65.1%) [24]. HepA vaccination status can be reviewed at the time of Tdap or MenACWY vaccination, and HepA vaccine can be administered when appropriate in conjunction with these routine adolescent vaccinations at age 11–12 years, thus avoiding missed opportunities. In contrast to 1 dose coverage, in 2016≥2 dose HepA coverage for adolescents (64.4%) was comparable to 2016≥2 dose HepA coverage for children age 19–35 months (60.6%) [25].

Among adolescents in 2016, the percent of adolescents who had received 1 and ≥2 HepA vaccine doses was higher in states that introduced the vaccine earlier. The number of states with poor 1 dose (<60%) and ≥2 dose coverage (<50%) decreased substantially from 2008 to 2016; however the number of states with 1 dose or ≥2 dose coverage > 90% only increased from 1 to 3 states reflecting moderate vaccine coverage nationally (Table 2). One dose HepA vaccine rates at any age in group 1 (87.8%) were comparable to ≥1 dose coverage for children aged 19–35 months (86.1%) in 2016, whereas coverage rates for group 3 were much lower. This suggests that 1 dose coverage for adolescents in states with an ACIP recommendation in 1999 (group 1) now reflect the coverage rate for routinely vaccinated children following the ACIP 2006 recommendation, while coverage for adolescents in groups 2 and 3 lag behind. Adolescents had lower ≥2 dose HepA vaccine coverage, <80% overall. The second HepA vaccine dose should be given as soon as possible after 6 months, however it can be given at any time without restarting the vaccine series. Enhanced provider and patient education on the benefits of completing the HepA vaccine 2-dose series, as well as reminder-recall and standing orders might be valuable [23].

Independent factors associated with increased likelihood of vaccine initiation, evaluated by multivariable and bivariate analyses, included race/ethnicity (Black - non-Hispanic, Hispanic, AI/AN, and Asian) and provider recommendation (2008–2013). The Vaccines for Children (VFC) program [26], which provides vaccines at no cost to eligible children, might contribute to higher vaccine initiation among certain racial/ethnic groups. Though provider recommendation increases the likelihood of vaccination initiation, only 30% of adolescents included in this study were reported to have received a provider recommendation (2008–2013). More intensive focus on provider education and identification of provider barriers to recommending vaccination is needed. Though the percentage of children living in states with mandates was low, not having a state requirement for HepA vaccine was associated with a decreased likelihood of vaccination, suggesting that daycare and school mandates may be effective.

Adolescents aged 16–17 years and states without a state daycare or school HepA requirement (Group 1 and Group 2) were commonly associated with decreased likelihood of receiving one dose of HepA vaccine. Additional common factors associated with decreased likelihood of receiving one dose included living in a rural region (national, groups 2 and 3) and living at a poverty level <5.03 (national, group 3). An opportunity to vaccinate older adolescents occurs when they are administered the second meningococcal vaccine or during pre-college routine health visits. Multiple socioeconomic factors have been associated with barriers to healthcare access among rural adolescents [27]. A lower concentration of pediatricians in rural areas might also contribute to the decreased likelihood of initiating vaccination in rural areas [28,29]. The higher 1 dose HepA vaccination rates among adolescents living below poverty (<1.33) might be attributable to the effectiveness of the VFC program.

Though the percent of adolescents who received 1 dose of HepA vaccine has increased across all race/ethnicities, disparities remain. AI/AN, Hispanics and Asians had the highest percentage of vaccination initiators. White non-Hispanic and Black non-Hispanic adolescents were below the national average. These groups should be targeted for parental

and patient education since they are more likely to enter adulthood without protection from vaccination. Interventions to improve parental knowledge about vaccines and to further facilitate access to vaccinations can also help to reduce disparities in coverage.

The percent of adolescents initiating the vaccine series prior to age 6, 13 and 17 years increased among adolescents born in 1995–2003 for all ACIP recommendation groups, however disparities based on timing of recommendation introduction were evident. Increases were greatest for initiating the series prior to age 6 years among groups 1 (46.8%) and 2 (55.9%), and prior to age 13 years for group 3 (46.5%), reflecting the evolution of the HepA vaccine recommendations from 1999 to 2006. Adolescent HepA vaccination initiation at any age lags behind for states with a later recommendation. The percentage point increases in HepA vaccine initiation prior to age 17 years by birth cohort were only modest for groups 1 and 2. From 2008 to 2016, most teens nationally received their first dose of HepA vaccine between 5 and 10 years of age, indicating that provider recommendation is important for vaccination initiation since this age range is beyond the universal recommendation age of 12–23 months.

This analysis has several limitations. NIS-Teen utilized landline households in 2008–2010, and landline and cellular telephone households in 2011–2016. The data from 2008 to 2010 may not be representative of non-landline and wireless-only households, contributing to non-coverage bias. In addition, the response rate for cellular telephone households for 2011–2016 was 22.4–31.2%. This was approximately half the response rate of landline households (55.1–60.3%). Monte Carlo simulation-based approach to assess bias in NIS suggests a small overestimation exists in NISTeen vaccination coverage rates even after adjustment for household and provider nonresponse and phoneless households. However, these estimates do not account for possible under-ascertainment of vaccination status [30–32]. Parent report of receiving a provider recommendation for the vaccine is subject to recall bias. Nonresponse bias may remain after weighting adjustments. Provider data or vaccination histories may be incomplete. Adolescents with inadequate provider data may have less access to primary health care and may be less likely to have received HepA vaccine. Excluding this group may have overestimated vaccination coverage.

The increase in adolescent vaccination coverage from 2008 to 2016 likely reflects the increased time since universal vaccine recommendation, increased provider recommendations [23,24] and the increased number of states with mandates [21]. One-dose adolescent coverage (87.8%) for states where vaccine was recommended in 1999 is comparable to 2016 one-dose coverage for 19–35 month olds nationally (86.1% [11]. This demonstrates substantial improvements in adolescent coverage. However, twodose coverage remains low overall and one-dose coverage in states where HepA vaccination was recommended after 1999 lags compared to those recommended prior to 1999.

Despite a significant decrease in hepatitis A disease rates since vaccination initiation, cases and outbreaks still occur, primarily due to HAV-contaminated food [13], person to person contact among high risk groups [14] or infected international travelers [3]. The population risk for HAV infection remains due to suboptimal two-dose vaccination coverage and decreasing anti-HAV seroprevalence among older adults, the population where disease is

most severe. Maximizing HepA vaccination coverage for children and adolescents aged 2–18 years will improve population protection from HAV infection in the long-term.

5. Conclusion

Strengthening the ACIP recommendations for catch-up would likely help improve HepA vaccine series 1 and ≥2 dose coverage. It is important for physicians to follow the current permissive ACIP recommendations and consider catch-up vaccination of unvaccinated children aged 2–18 years in order to improve population protection from HAV.

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Abbreviations

ACIP	Advisory Committee on Immunization Practices
CHIP	Children's Health Insurance Program
95% CI	95% confidence interval
HAV	hepatitis A virus
HepA vaccine	hepatitis A vaccine
MSA	metropolitan statistical area
NIS-Teen	National Immunization Survey-Teen
PR	prevalence ratio
PVL	poverty level
VFC	Vaccines for Children
Tdap	tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis
MenACWY	meningococcal conjugate
HPV	human papillomavirus
AI/AN	American Indian/Alaskan Native

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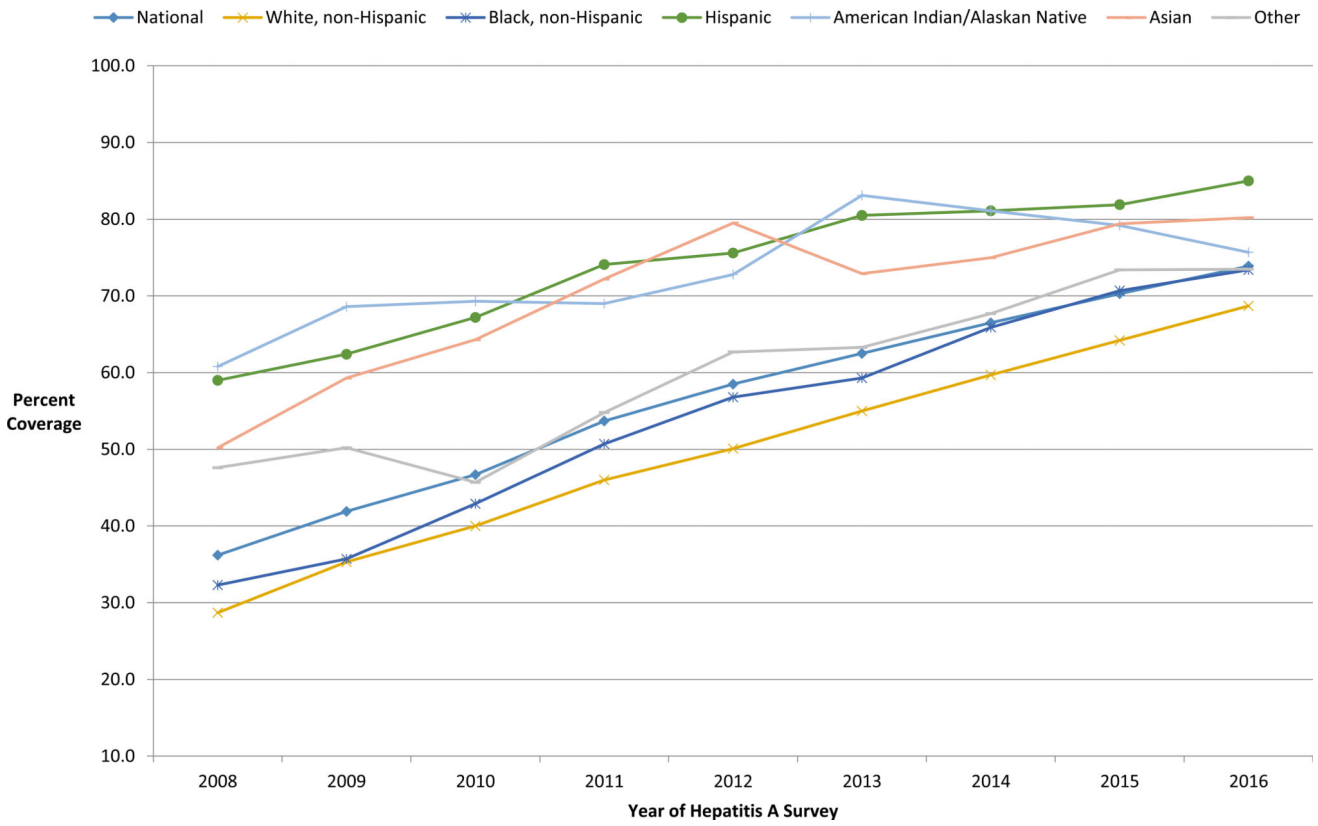

Fig. 1.

Percent who received 1 dose of Hepatitis A vaccine among adolescents, age 13–17 years, nationally and by race/ethnicity, National Immunization Survey–Teen (NISTeen), 2008–2016.

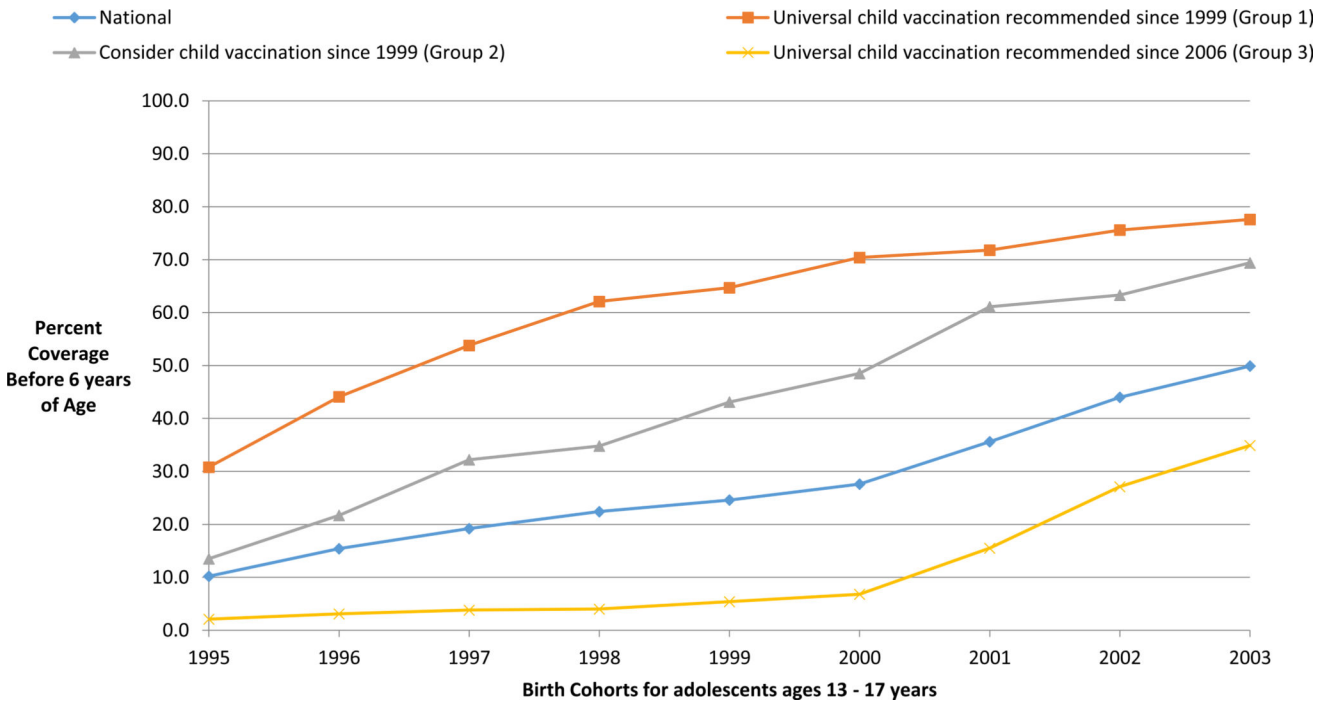

Fig. 2.

Trends in HepA vaccination coverage before age 6, by timing of universal vaccination recommendation, National Immunization Survey–Teen (NIS-Teen), 2008–2016.

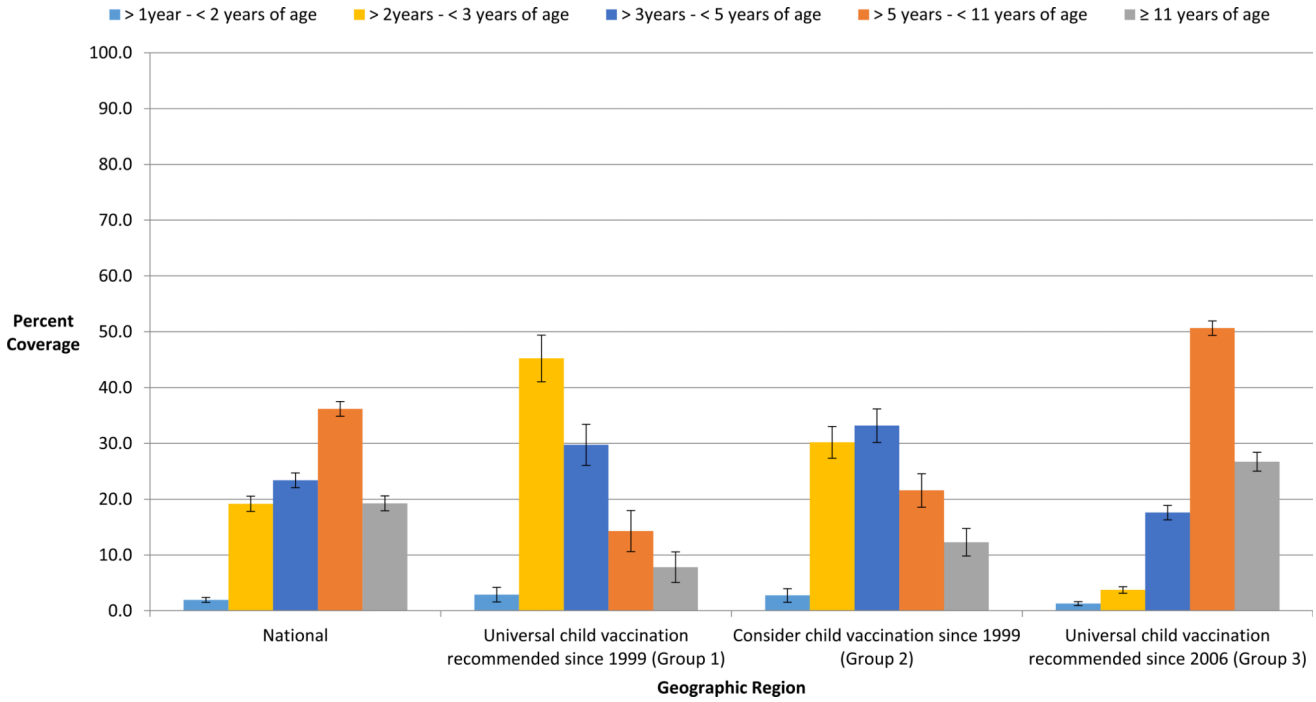

Fig. 3.

Distribution of children who received at least one HepA vaccination, by age at first vaccination and state timing of universal vaccination recommendation, National Immunization Survey–Teen (NIS-Teen), 2008–2016.

Table 1

Demographic characteristics of adolescents aged 13–17 years in the US, National Immunization Survey-Teen (NIS-Teen).

Characteristic	NIS-Teen 2008–2016		NIS-Teen 2016	
	Sample size, n	Weighted percentage, % (95% CI)	Sample size, n	Weighted percentage,% (95% CI)
Age (years)	**181,362**	**100.0 (-------)**	**20,475**	**100.0 (-------)**
13–15	111,012	60.5 (60.1–60.9)	12,578	60.5 (59.2–61.7)
16–17	70,350	39.5 (39.1–39.9)	7897	39.5 (38.3–40.8)
Gender	**181,362**	**100.0 (-------)**	**20,475**	**100.0 (-------)**
Male	94,657	51.2 (50.7–51.6)	10,814	51.1 (49.8–52.3)
Female	86,705	48.8 (48.4–49.3)	9661	48.9 (47.7–50.2)
Race/ethnicity	**181,362**	**100.0 (-------)**	**20,475**	**100.0 (-------)**
White, non-Hispanic	120,083	56.4 (55.9–56.8)	12,883	52.7 (51.5–54.0)
Black, non-Hispanic	18,150	14.2 (13.9–14.6)	1990	13.7 (12.9–14.6)
Hispanic	26,580	20.9 (20.5–21.3)	3223	23.2 (22.0–24.5)
American Indian/Alaskan Native	2479	0.9 (0.8–0.9)	300	1.0 (0.8–1.2)
Asian	5505	3.4 (3.3–3.6)	862	4.2 (3.7–4.8)
Other[a]	8565	4.2 (4.0–4.3)	1217	5.1 (4.6–5.7)
Poverty level[b]	**181,362**	**100.0 (-------)**	**20,475**	**100.0 (-------)**
<1.33%	41,771	30.7 (30.3–31.1)	5103	31.7 (30.5–33.0)
1.33% – <3.22%	54,258	30.2 (29.8–30.6)	5787	28.8 (27.6–30.0)
3.22% – <5.03%	41,055	19.3 (18.9–19.6)	4121	17.6 (16.8–18.6)
>5.03%	44,278	19.9 (19.5–20.2)	5464	21.8 (20.8–22.8)
Metropolitan statistical area	**181,362**	**100.0 (-------)**	**20,475**	**100.0 (-------)**
Urban	71,136	39.1 (38.7–39.6)	7979	40.1 (38.9–41.4)
Suburban	69,910	46.1 (45.7–46.5)	8248	46.9 (45.6–48.1)
Rural	40,316	14.8 (14.5–15.0)	4248	13.0 (12.4–13.6)
Region	**181,362**	**100.0 (-------)**	**20,475**	**100.0 (-------)**
Northeast	35,251	17.1 (16.9–17.2)	4049	16.5 (16.0–16.9)
Midwest	40,262	21.8 (21.7–22.0)	4313	21.4 (20.9–22.0)
South	65,393	37.2 (36.9–37.5)	7620	38.3 (37.5–39.0)
West	40,456	23.9 (23.6–24.2)	4493	23.8 (23.0–24.7)
Mother's education	**181,180**	**100.0 (-------)**	**20,475**	**100.0 (-------)**
< High school	18,824	13.7 (13.4–14.1)	2205	13.4 (12.4–14.4)
High school	33,605	25.1 (24.7–25.5)	3253	22.4 (21.3–23.6)
>High school, college non-grad	50,438	25.8 (25.5–26.2)	5369	25.0 (23.9–26.1)
College graduate	78,313	35.4 (35.0–35.8)	9648	39.2 (38.0–40.4)
Vaccination payment source	**181,116**	**100.0 (-------)**	**20,473**	**100.0 (-------)**
Private only	101,677	50.3 (49.9–50.8)	10,214	44.6 (43.3–45.8)
Medicaid/CHIP	50,864	34.8 (34.3–35.2)	6755	40.0 (38.7–41.3)
Uninsured	8224	5.9 (5.6–6.1)	702	4.1 (3.5–4.7)

Characteristic	NIS-Teen 2008–2016		NIS-Teen 2016	
	Sample size, n	Weighted percentage, % (95% CI)	Sample size, n	Weighted percentage,% (95% CI)
Military	5151	2.4 (2.3–2.5)	715	3.0 (2.7–3.4)
Other	15,200	6.6 (6.4–6.8)	2087	8.3 (7.7–9.0)
Provider recommendation[c]	**98,442**	**100.0 (-------)**		
Yes	29,642	30.0 (29.5–30.6)	N/A	N/A
No	68,800	70.0 (69.4–70.5)	N/A	N/A
State requirement[d]	**181,362**	**100.0 (-------)**	**20,475**	**100.0 (-------)**
Yes	20,994	10.7 (10.5–10.9)	2521	11.4 (11.0–11.9)
No	160,368	89.3 (89.1–89.5)	17,954	88.6 (88.1–89.0)

Abbreviations: CI = confidence interval; N/A = not available.

[a]Other includes Native Hawaiian, other Pacific Islanders, and Multiple-race categories.

[b]Poverty Level <1.33 is commonly used by states to determine households that are eligible for Medicaid.

[c]Recommendation for hepatitis A vaccination. Data were only available for 2008–2013 because the NIS-Teen questionnaire was shortened in 2014 and this question was no longer asked on the questionnaire.

[d]Yes = Mandate and teens impacted by mandate; No = No mandate or teens not impacted by mandate.

Table 2

Estimated Hepatitis A coverage by State for adolescents aged 13–17 years in the US, National Immunization Survey - Teen (NIS-Teen).

States	NIS-Teen 2008		NIS-Teen 2016		Percentage Point Difference[a]	
	1 Dose % (95% CI)	≥2 Doses % (95% CI)	1 Dose % (95% CI)	≥2 Doses % (95% CI)	1 Dose % (95% CI)	≥2 Doses % (95% CI)
Sample size	N = 17,835	N = 17,835	N = 20,475	N = 20,475	N = 38,310	N = 38,310
United States	**36.2 (34.8–37.6)**	**25.3 (23.9–26.7)**	**73.9 (72.9–74.9)**	**64.4 (63.3–65.6)**	**37.8 (36.0–39.5)**	**39.1 (37.3–41.0)**
Vaccination recommended since 1999 (11 states overall) (Group 1)						
Total	**70.9 (67.2–74.4)**	**56.1 (51.9–60.2)**	**87.8 (85.1–90.1)**	**79.5 (76.3–82.4)**	**16.9 (12.5–21.3)**	**23.4 (18.2–28.6)**
Alaska	86.9 (82.0–90.6)	82.1 (76.7–86.5)	92.5 (88.4–95.3)	90.4 (85.9–93.5)	5.6 (0.1–11.1)	8.3 (2.1–14.4)
Arizona	57.6 (50.3–64.5)	34.2 (27.7–41.2)	84.5 (79.1–88.7)	74.6 (68.4–80.0)	26.9 (18.3–35.6)	40.5 (31.5–49.4)
California	78.2 (71.5–83.6)	63.8 (56.3–70.6)	89.1 (83.9–92.8)	80.5 (74.4–85.4)	11.0 (3.5–18.5)	16.7 (7.7–25.7)
Idaho	48.6 (41.9–55.3)	33.8 (27.9–40.3)	81.9 (76.4–86.3)	73.7 (67.9–78.9)	33.3 (24.9–41.6)	39.9 (31.6–48.2)
Nevada	70.0 (62.8–76.4)	52.0 (44.6–59.3)	94.0 (89.7–96.6)	87.9 (82.9–91.6)	24.0 (16.4–31.5)	36.0 (27.4–44.5)
New Mexico	63.0 (56.5–69.2)	49.7 (43.1–56.4)	86.3 (81.8–89.8)	76.5 (71.1–81.2)	23.3 (15.7–30.8)	26.8 (18.4–35.2)
Oklahoma	93.2 (89.3–95.8)	90.2 (85.9–93.4)	92.8 (88.5–95.6)	90.2 (85.6–93.5)	−0.4 (−5.0–4.3)	0.0 (−5.4–5.4)
Oregon	53.1 (45.8–60.3)	38.4 (31.8–45.4)	89.0 (83.7–92.7)	79.1 (72.8–84.2)	35.9 (27.3–44.4)	40.7 (31.7–49.6)
South Dakota	26.3 (21.0–32.4)	16.7 (12.4–22.1)	60.6 (54.0–66.8)	51.1 (44.5–57.6)	34.3 (25.7–42.9)	34.4 (26.2–42.6)
Utah	58.4 (50.8–65.7)	45.8 (38.5–53.4)	86.8 (81.6–90.7)	80.3 (74.6–85.0)	28.4 (19.6–37.1)	34.5 (25.3–43.6)
Washington	56.5 (49.7–63.1)	38.8 (32.5–45.5)	83.1 (77.3–87.6)	73.9 (67.6–79.4)	26.6 (18.1–35.1)	35.1 (26.3–43.9)
Range	***26.3–93.2***	***16.7–90.2***	***60.6–94.0***	***51.1–90.4***	***−0.4–35.9***	***0.0–40.7***
Vaccination to be considered since 1999 (6 states overall) (Group 2)						
Total	**52.9 (48.3–57.5)**	**42.6 (37.9–47.4)**	**79.5 (77.2–81.5)**	**69.0 (66.4–71.4)**	**26.6 (21.5–31.7)**	**26.4 (21.1–31.8)**
Arkansas	6.7 (4.3–10.3)	3.2 (1.8–5.7)	64.8 (58.7–70.4)	44.8 (38.6–51.1)	58.1 (51.5–64.7)	41.5 (35.0–48.1)
Colorado	42.6 (35.7–49.8)	30.6 (24.1–37.9)	82.4 (76.8–86.9)	70.2 (63.4–76.1)	39.8 (31.1–48.5)	39.5 (30.1–49.0)
Missouri	35.4 (29.7–41.6)	27.5 (22.1–33.6)	64.9 (58.4–71.0)	53.7 (47.1–60.1)	29.5 (20.9–38.2)	26.2 (17.4–34.9)
Montana	34.9 (28.9–41.5)	27.6 (21.9–34.1)	67.7 (61.4–73.5)	56.7 (50.2–62.9)	32.8 (24.1–41.6)	29.1 (20.3–37.9)
Texas	65.2 (57.9–71.8)	53.6 (46.4–60.7)	83.9 (80.9–86.5)	74.8 (71.4–78.0)	18.7 (11.2–26.3)	21.2 (13.3–29.1)
Wyoming	28.4 (23.1–34.3)	18.8 (14.5–24.1)	64.8 (58.8–70.3)	52.1 (46.1–58.1)	36.4 (28.3–44.5)	33.3 (25.6–41.0)
Range	***6.7–65.2***	***3.2–53.6***	***64.8–83.9***	***44.8–74.8***	***18.7–58.1***	***21.2–41.5***
Vaccination recommended since 2006 (33 states and District of Columbia overall) (Group 3)						
Total	**19.9 (18.8–21.0)**	**10.3 (9.5–11.1)**	**67.5 (66.2–68.7)**	**57.8 (56.4–59.1)**	**47.6 (46.0–49.3)**	**47.5 (46.0–49.1)**

States	NIS-Teen 2008		NIS-Teen 2016		Percentage Point Difference[a]	
	1 Dose % (95% CI)	≥2 Doses % (95% CI)	1 Dose % (95% CI)	≥2 Doses % (95% CI)	1 Dose % (95% CI)	≥2 Doses % (95% CI)
Alabama	16.2 (12.3–21.2)	5.8 (3.7–8.8)	61.9 (55.6–67.9)	48.2 (41.9–54.6)	45.7 (38.1–53.3)	42.5 (35.6–49.3)
Connecticut	11.9 (8.2–17.0)	6.6 (4.1–10.6)	65.5 (59.3–71.1)	62.3 (56.1–68.2)	53.6 (46.2–60.9)	55.7 (48.9–62.5)
Delaware	14.5 (10.3–19.9)	5.8 (3.6–9.1)	73.3 (67.4–78.4)	63.7 (57.5–69.5)	58.8 (51.5–66.1)	57.9 (51.4–64.5)
District of Columbia	40.8 (34.6–47.2)	16.8 (12.8–21.9)	87.6 (83.0–91.1)	81.7 (76.1–86.2)	46.9 (39.3–54.4)	64.9 (58.1–71.6)
Florida	16.0 (11.4–22.0)	7.7 (5.0–11.6)	65.0 (58.3–71.2)	57.0 (50.2–63.5)	49.0 (40.7–57.4)	49.2 (41.8–56.7)
Georgia	28.8 (23.3–35.1)	14.9 (11.4–19.3)	79.8 (74.1–84.5)	68.5 (62.1–74.3)	50.9 (43.1–58.8)	53.6 (46.3–60.8)
Hawaii	39.2 (33.3–45.5)	23.3 (18.6–28.7)	84.5 (79.2–88.7)	73.4 (67.1–78.9)	45.3 (37.6–53.0)	50.1 (42.3–57.9)
Illinois	20.5 (16.8–24.7)	11.6 (8.9–15.0)	68.6 (63.7–73.1)	62.1 (57.2–66.8)	48.1 (42.0–54.3)	50.5 (44.9–56.2)
Indiana	12.1 (8.6–16.8)	5.1 (3.0–8.5)	63.7 (57.4–69.6)	51.1 (44.7–57.5)	51.6 (44.3–59.0)	46.0 (39.0–53.0)
Iowa	11.8 (8.2–16.7)	6.0 (3.6–9.9)	62.1 (56.3–67.6)	51.2 (45.3–57.1)	50.3 (43.3–57.4)	45.2 (38.5–51.8)
Kansas	22.6 (17.2–28.9)	14.2 (9.9–19.9)	73.1 (67.0–78.4)	60.5 (54.0–66.6)	50.6 (42.4–58.8)	46.3 (38.2–54.4)
Kentucky	9.4 (6.4–13.6)	6.0 (3.6–9.8)	49.4 (43.0–55.7)	38.1 (32.1–44.6)	40.0 (32.7–47.3)	32.1 (25.2–39.1)
Louisiana	10.2 (6.9–14.9)	4.5 (2.6–7.5)	43.6 (37.6–49.8)	29.5 (24.1–35.5)	33.4 (26.1–40.7)	25.0 (18.8–31.2)
Maine	10.4 (7.0–15.4)	4.5 (2.7–7.3)	75.9 (70.3–80.8)	64.0 (57.8–69.8)	65.5 (58.8–72.2)	59.6 (53.1–66.0)
Maryland	26.8 (21.5–32.9)	18.7 (14.2–24.2)	69.1 (62.6–74.9)	60.3 (53.7–66.6)	42.3 (33.9–50.7)	41.6 (33.4–49.8)
Massachusetts	10.6 (7.4–14.9)	5.6 (3.6–8.7)	53.0 (47.0–58.9)	42.8 (37.0–48.9)	42.4 (35.3–49.4)	37.2 (30.7–43.7)
Michigan	18.6 (13.9–24.5)	8.1 (5.4–11.9)	81.1 (75.1–85.9)	72.3 (65.4–78.2)	62.5 (55.0–70.0)	64.2 (57.0–71.3)
Minnesota	20.0 (15.6–25.1)	10.3 (7.1–14.5)	70.0 (64.2–75.3)	54.5 (48.3–60.6)	50.1 (42.7–57.4)	44.2 (37.0–51.4)
Mississippi	6.8 (4.5–10.2)	2.6 (1.5–4.6)	40.6 (34.5–47.1)	30.0 (24.4–36.3)	33.8 (26.9–40.7)	27.4 (21.2–33.5)
Nebraska	11.8 (8.5–16.2)	5.5 (3.4–8.5)	67.5 (61.1–73.3)	53.8 (47.2–60.2)	55.7 (48.5–62.9)	48.3 (41.3–55.3)
New Hampshire	7.9 (5.2–11.9)	N/A	64.1 (57.6–70.2)	55.4 (48.7–61.8)	56.3 (49.1–63.4)	N/A
New Jersey	35.2 (29.3–41.6)	19.9 (15.1–25.7)	82.4 (77.9–86.2)	72.7 (67.0–77.7)	47.2 (39.8–54.7)	52.8 (45.3–60.3)
New York	29.9 (25.8–34.3)	18.4 (15.1–22.3)	73.5 (69.3–77.3)	65.8 (61.3–70.1)	43.6 (37.8–49.5)	47.3 (41.7–53.0)
North Carolina	28.3 (22.8–34.5)	11.6 (8.6–15.6)	76.6 (70.8–81.5)	66.5 (60.1–72.4)	48.3 (40.3–56.2)	54.9 (47.8–62.0)
North Dakota	20.0 (15.9–25.0)	14.6 (11.0–19.1)	78.5 (72.3–83.7)	67.1 (60.3–73.1)	58.5 (51.2–65.8)	52.5 (44.9–60.1)
Ohio	9.8 (6.8–14.1)	3.5 (1.9–6.1)	59.0 (52.3–65.5)	49.6 (42.9–56.3)	49.2 (41.7–56.7)	46.1 (39.1–53.2)
Pennsylvania	26.2 (21.6–31.3)	12.5 (9.2–16.8)	74.6 (69.9–78.8)	67.7 (62.6–72.4)	48.4 (41.8–55.0)	55.2 (49.0–61.4)
Rhode Island	7.8 (4.9–12.2)	4.8 (2.7–8.3)	79.1 (73.4–83.8)	68.7 (62.4–74.3)	71.3 (65.0–77.6)	63.9 (57.3–70.5)
South Carolina	6.6 (4.0–10.7)	N/A	27.8 (22.0–34.5)	15.8 (11.6–21.0)	21.2 (14.2–28.3)	N/A
Tennessee	25.4 (20.2–31.4)	12.1 (8.6–16.8)	78.9 (72.7–84.0)	67.7 (61.0–73.7)	53.4 (45.5–61.4)	55.6 (48.0–63.2)

States	NIS-Teen 2008		NIS-Teen 2016		Percentage Point Difference[a]	
	1 Dose % (95% CI)	≥2 Doses % (95% CI)	1 Dose % (95% CI)	≥2 Doses % (95% CI)	1 Dose % (95% CI)	≥2 Doses % (95% CI)
Vermont	8.4 (5.7–12.1)	5.0 (3.0–8.3)	56.3 (50.5–61.9)	43.3 (37.7–49.2)	47.9 (41.4–54.5)	38.3 (32.0–44.6)
Virginia	19.5 (14.7–25.5)	9.8 (6.5–14.4)	67.7 (60.3–74.4)	57.2 (49.6–64.5)	48.2 (39.3–57.1)	47.4 (39.0–55.9)
West Virginia	6.7 (4.3–10.2)	N/A	45.7 (39.1–52.4)	32.5 (26.6–39.1)	39.0 (31.7–46.3)	N/A
Wisconsin	20.6 (15.6–26.7)	13.9 (9.8–19.4)	59.4 (52.9–65.5)	50.0 (43.5–56.4)	38.8 (30.3–47.2)	36.1 (28.0–44.1)
Range	***6.6–40.8***	***2.6–23.3***	***27.8–87.6***	***15.8–81.7***	***21.2–71.3***	***25.0–64.9***

Abbreviations: CI = confidence interval; N/A = not available (estimate not reported because 95% CI half width/estimate > 0.6).

[a]Percentage Point Difference = Survey Year 2016 - Survey Year 2008.

Table 3

Factors independently associated with receipt of 1 dose of hepatitis A vaccine by sociodemographic characteristics for adolescents aged 13–17 by ACIP recommendation group, National Immunization Survey-Teen (NIS-Teen) 2016.

	National		States with universal child vaccination recommended since 1999 (Group 1)		States with recommendation to consider child vaccination since 1999 (Group 2)		States with universal child vaccination recommended since 2006 (Group 3)	
	Weighted percentage (95% CI)[f]	Adjusted PR (95% CI)[g]	Weighted percentage (95% CI)[f]	Adjusted PR (95% CI)[g]	Weighted percentage (95% CI)[f]	Adjusted PR (95% CI)[g]	Weighted percentage (95% CI)[f]	Adjusted PR (95% CI)[g]
Sample size	**N = 20,475**		**N = 3729**		**N = 3709**		**N = 12,586**	
Age (years)								
13–15	76.6 (75.3–77.8)	**Referent**	91.0 (87.9–93.4)	**Referent**	82.9 (80.4–85.1)	**Referent**	69.5 (67.9–71.1)	**Referent**
16–17	69.8 (68.0–71.6)[a]	0.92 (0.89–0.95)[a]	82.5 (77.3–86.8)[a]	0.91 (0.86–0.96)[a]	74.2 (70.0–78.0)[a]	0.90 (0.85–0.95)[a]	64.5 (62.5–66.6)[a]	0.94 (0.90–0.97)[a]
Gender								
Male	73.2 (71.7–74.6)	0.98 (0.95–1.01)	86.2 (81.9–89.6)	0.97 (0.92–1.02)	79.4 (76.2–82.3)	1.00 (0.95–1.06)	66.9 (65.1–68.6)	0.98 (0.95–1.02)
Female	74.7 (73.2–76.1)	**Referent**	89.5 (86.0–92.1)	**Referent**	79.6 (76.3–82.5)	**Referent**	68.2 (66.4–70.0)	**Referent**
Race/ethnicity								
White, non-Hispanic	68.7 (67.4–70.0)	**Referent**	85.5 (82.0–88.4)	**Referent**	75.0 (71.8–77.9)	**Referent**	63.0 (61.5–64.6)	**Referent**
Black, non-Hispanic	73.4 (70.4–76.2)[a]	1.03 (0.99–1.08)	97.0 (90.8–99.1)[a]	1.12 (1.06–1.18)[a]	84.2 (77.4–89.2)[a]	1.06 (0.97–1.15)	69.8 (66.3–73.1)[a]	1.09 (1.03–1.16)[a]
Hispanic	85.0 (82.6–87.1)[a]	1.19 (1.14–1.24)[a]	90.0 (85.2–93.3)	1.02 (0.95–1.10)	84.3 (80.1–87.7)[a]	1.05 (0.98–1.12)	80.5 (76.8–83.7)[a]	1.24 (1.18–1.31)[a]
American Indian/Alaskan Native	75.7 (66.6–83.0)	1.13 (1.02–1.25)[a]	93.3 (83.3–97.5)[a]	1.08 (0.99–1.17)	63.2 (34.8–84.6)[b]	0.90 (0.64–1.27)	59.8 (44.4–73.6)[b]	0.99 (0.77–1.26)
Asian	80.2 (73.1–85.7)[a]	1.12 (1.02–1.22)[a]	81.4 (53.3–94.4)[b]	0.93 (0.72–1.21)	82.8 (69.9–90.9)[b]	1.03 (0.89–1.19)	78.5 (72.7–83.3)[a]	1.18 (1.09–1.28)[a]
Other	73.5 (68.5–77.9)	1.05 (0.99–1.12)	87.1 (71.0–94.9)[b]	1.00 (0.89–1.12)	68.2 (54.4–79.4)[b]	0.92 (0.78–1.10)	68.7 (63.0–73.8)	1.07 (0.98–1.17)
Poverty level[c]								
<1.33	76.5 (74.6–78.3)	0.94 (0.90–0.99)[a]	90.9 (86.8–93.8)	0.96 (0.89–1.04)	82.8 (78.9–86.1)	1.06 (0.96–1.18)	69.2 (66.7–71.5)[a]	0.93 (0.86–0.99)[a]
1.33 - <3.22	71.3 (69.2–73.3)[a]	0.93 (0.90–0.97)[a]	84.7 (78.9–89.1)	0.93 (0.87–1.00)	78.2 (73.9–82.0)	1.01 (0.93–1.11)	64.7 (62.2–67.1)[a]	0.92 (0.88–0.97)[a]
3.22 - <5.03	70.7 (68.2–73.0)[a]	0.94 (0.90–0.98)[a]	86.1 (79.2–91.0)	0.97 (0.90–1.04)	75.5 (69.3–80.8)	0.96 (0.88–1.06)	65.0 (62.1–67.8)[a]	0.93 (0.88–0.98)[a]
>5.03	76.2 (74.1–78.2)	**Referent**	88.3 (80.7–93.2)	**Referent**	78.8 (73.9–83.1)	**Referent**	71.1 (68.8–73.3)	**Referent**
Metropolitan statistical area								
Urban	78.4 (76.7–80.0)	**Referent**	87.1 (82.6–90.6)	**Referent**	83.6 (80.4–86.3)	**Referent**	72.5 (70.4–74.6)	**Referent**
Suburban	74.1 (72.6–75.5)[a]	0.96 (0.93–0.99)[a]	89.8 (86.0–92.7)	1.03 (0.97–1.09)	79.1 (75.4–82.4)	0.95 (0.89–1.00)	68.2 (66.4–69.9)[a]	0.95 (0.92–0.99)[a]
Rural	59.6 (57.0–62.1)[a]	0.81 (0.77–0.85)[a]	81.9 (74.9–87.3)	0.93 (0.85–1.01)	69.0 (63.0–74.4)[a]	0.88 (0.81–0.96)[a]	53.1 (49.9–56.3)[a]	0.79 (0.74–0.84)[a]

	National		States with universal child vaccination recommended since 1999 (Group 1)		States with recommendation to consider child vaccination since 1999 (Group 2)		States with universal child vaccination recommended since 2006 (Group 3)	
	Weighted percentage (95% CI)[f]	**Adjusted PR (95% CI)[g]**	**Weighted percentage (95% CI)[f]**	**Adjusted PR (95% CI) [g]**	**Weighted percentage (95% CI)[f]**	**Adjusted PR (95% CI) [g]**	**Weighted percentage (95% CI)[f]**	**Adjusted PR (95% CI) [g]**
Sample size	**N = 20,475**		**N = 3729**		**N = 3709**		**N = 12,586**	
Region								
Northeast	N/A	N/A	N/A	N/A	N/A	N/A	72.0 (69.9–74.0)	**Referent**
Midwest	N/A	N/A	N/A	N/A	N/A	N/A	67.5 (65.3–69.6)[a]	0.98 (0.94–1.03)
South	N/A	N/A	N/A	N/A	N/A	N/A	64.2 (62.0–66.4)[a]	0.91 (0.87–0.96)[a]
West	N/A	N/A	N/A	N/A	N/A	N/A	84.5 (79.2–88.7)[a]	1.16 (1.08–1.25)[a]
Mother's education								
< High school	81.8 (79.1–84.3)[a]	1.04 (0.99–1.10)	93.5 (89.2–96.2)[a]	1.09 (1.00–1.19)	82.3 (75.9–87.4)	0.92 (0.82–1.03)	73.9 (70.0–77.4)[a]	1.04 (0.96–1.12)
High school	72.6 (70.2–74.9)	0.98 (0.94–1.03)	87.1 (81.6–91.2)	1.01 (0.93–1.10)	78.4 (72.8–83.0)	0.94 (0.86–1.02)	66.5 (63.5–69.4)	0.98 (0.93–1.04)
>High school, college non-graduate	71.9 (69.8–74.0)	0.99 (0.96–1.03)	87.0 (80.7–91.4)	1.02 (0.96–1.09)	77.4 (72.9–81.3)	0.95 (0.89–1.01)	64.7 (62.2–67.2)[a]	0.97 (0.93–1.02)
College graduate	73.2 (71.6–74.8)	**Referent**	85.6 (80.1–89.8)	**Referent**	80.2 (76.8–83.2)	**Referent**	68.2 (66.3–70.0)	**Referent**
Vaccination payment source								
Private Only	72.3 (70.8–73.8)	**Referent**	85.7 (80.9–89.4)	**Referent**	78.9 (75.4–82.0)	**Referent**	66.4 (64.6–68.1)	**Referent**
Medicaid/CHIP	76.1 (74.5–77.7)[a]	1.03 (0.99–1.07)	90.3 (86.6–93.0)	1.02 (0.95–1.09)	81.1 (77.4–84.3)	1.01 (0.93–1.10)	69.2 (67.1–71.2)[a]	1.04 (0.99–1.10)
Uninsured	70.5 (63.5–76.7)	0.91 (0.82–1.01)	77.6 (49.8–92.3)[b]	0.90 (0.71–1.13)	84.1 (76.8–89.4)	1.04 (0.94–1.15)	60.9 (52.3–68.8)	0.88 (0.76–1.02)
Military	78.5 (73.1–83.0)[a]	1.08 (1.01–1.15)[a]	87.9 (78.7–93.4)	1.01 (0.92–1.11)	79.4 (65.8–88.5)[b]	0.99 (0.86–1.15)	76.5 (69.3–82.4)[a]	1.17 (1.07–1.27)[a]
Other	71.8 (68.3–75.1)	0.99 (0.95–1.05)	89.7 (82.8–94.1)	1.04 (0.97–1.11)	71.5 (62.3–79.2)	0.93 (0.83–1.05)	65.2 (60.6–69.6)	1.00 (0.93–1.07)
Provider recommendation[d] (2008–2013)								
Yes	78.4 (76.3–80.5)[a]	1.42 (1.36–1.48)[a]	89.1 (83.3–93.0)[a]	1.12 (1.05–1.20)[a]	82.3 (76.2–87.1)[a]	1.18 (1.09–1.29)[a]	72.3 (69.8–74.8)[a]	1.65 (1.56–1.75)[a]
No	54.4 (52.7–56.1)	Referent	81.9 (77.1–85.9)	Referent	67.0 (62.8–70.9)	Referent	42.4 (40.5–44.3)	Referent
State requirement[e]								
Yes	83.2 (80.6–85.4)	**Referent**	92.8 (88.5–95.6)	**Referent**	83.9 (80.9–86.5)	**Referent**	45.7 (39.1–52.4)	**Referent**
No	72.7 (71.6–73.8)[a]	0.90 (0.87–0.93)[a]	87.5 (84.6–89.9)[a]	0.93 (0.89–0.97)[a]	71.0 (67.7–74.1)[a]	0.88 (0.82–0.93)[a]	67.7 (66.4–68.9)[a]	1.20 (1.06–1.36)[a]
	58.7 (57.2–60.1)	0.81 (0.78–0.84)[a]	83.2 (79.1–86.6)[a]	0.91 (0.87–0.96)[a]	55.0 (51.1–59.0)[a]	0.80 (0.73–0.88)[a]	50.1 (48.5–51.6)	0.81 (0.76–0.86)[a]

Abbreviations: CI = confidence interval; N/A = not available (estimate not reported because unweighted sample size for denominator was <30 or 95% CI half width/estimate >0.6).

[a]Statistically significant difference (P-value < 0.05) compared with reference level.

[b] Estimates with 95% Confidence Intervals > 20 may not be reliable.

[c] Poverty Level < 1.33 is commonly used by states to determine households that are eligible for Medicaid.

[d] Recommendation for hepatitis A vaccination. Data were only available for 2008–2013 because the NIS-Teen questionnaire was shortened in 2014 and this question was no longer asked on the questionnaire.

[e] Yes = Mandate and teens impacted by mandate; No = No mandate (line 1) or teens not impacted by mandate (line 2).

[f] Weighted percents are from the bivariate analyses.

[g] Adjusted prevalence ratios are from the multivariable analyses.

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Table 4

Hepatitis A vaccination coverage with at least one dose, by birth cohort age, National Immunization Survey-Teen (NIS-Teen) 2008–2016.

	National		States with universal child vaccination recommended since 1999 (Group 1)		States with recommendation to consider child vaccination since 1999 (Group 2)		States with universal child vaccination recommended since 2006 (Group 3)	
	Weighted percent vaccinated % (95% CI)	**Total percentage point change**	**Weighted percent vaccinated (95% CI)**	**Total percentage point change**	**Weighted percent vaccinated (95% CI)**	**Total percentage point change**	**Weighted percent vaccinated (95% CI)**	**Total percentage point change**
Sample size	**N = 131,461**		**N = 25,631**		**N = 23,272**		**N = 82,558**	
Vaccination before Age 6 years, by birth cohort								
1995	10.2 (9.3–11.2)	**Referent**	30.8 (27.6–34.4)	**Referent**	13.5 (11.2–16.3)	**Referent**	2.1 (1.7–2.5)	**Referent**
1996	15.4 (14.3–16.5)	5.2	44.1 (40.7–47.6)	13.3	21.7 (19.0–24.6)	8.2	3.1 (2.6–3.6)	1.0
1997	19.2 (18.1–20.5)	9.0	53.8 (50.1–57.5)	23.0	32.2 (29.2–35.4)	18.7	3.8 (3.2–4.4)	1.7
1998	22.4 (21.1–23.7)	12.2	62.1 (58.5–65.7)	31.3	34.8 (31.9–37.9)	21.3	4.0 (3.5–4.5)	1.9
1999	24.6 (23.3–25.9)	14.4	64.7 (61.2–68.2)	33.9	43.1 (40.0–46.4)	29.6	5.4 (4.7–6.0)	3.3
2000	27.6 (26.1–29.2)	17.4	70.4 (66.4–74.4)	39.6	48.5 (45.1–52.0)	35.0	6.8 (6.1–7.7)	4.7
2001	35.6 (33.7–37.6)	25.4	71.8 (66.8–76.6)	41.0	61.1 (57.4–64.8)	47.6	15.5 (14.1–16.9)	13.4
2002	44.0 (41.7–46.5)	33.8	75.6 (69.3–81.5)	44.8	63.3 (58.8–67.8)	49.8	27.1 (25.0–29.5)	25.0
2003	49.9 (46.3–53.6)	39.7	77.6 (68.1–85.9)	46.8	69.4 (62.6–75.9)	55.9	34.9 (31.2–39.0)	32.8
Vaccination before Age 13 years, by birth cohort								
1995	36.8 (35.5–38.1)	**Referent**	71.3 (68.2–74.4)	**Referent**	48.4 (45.0–51.9)	**Referent**	21.8 (20.7–23.0)	**Referent**
1996	43.5 (42.3–44.8)	6.7	73.5 (70.3–76.6)	2.2	60.4 (57.3–63.5)	12.0	28.3 (27.1–29.6)	6.5
1997	50.3 (49.0–51.6)	13.5	81.0 (78.1–83.8)	9.7	62.8 (59.7–65.9)	14.4	36.4 (35.0–37.7)	14.6
1998	54.3 (53.0–55.6)	17.5	80.8 (77.6–83.8)	9.5	66.0 (63.1–69.0)	17.6	41.2 (39.8–42.6)	19.4
1999	58.2 (57.0–59.5)	21.4	82.4 (79.4–85.1)	11.1	70.6 (67.8–73.3)	22.2	46.4 (44.9–47.8)	24.6
2000	63.7 (62.3–65.2)	27.0	86.2 (82.9–89.2)	14.9	71.4 (68.3–74.5)	23.0	53.6 (52.0–55.3)	31.8
2001	69.4 (67.8–71.0)	32.6	86.1 (81.8–89.8)	14.8	79.0 (76.0–81.8)	30.6	60.7 (58.9–62.6)	38.9
2002	73.7 (71.8–75.6)	36.9	85.9 (80.2–90.6)	14.6	79.3 (75.4–82.9)	30.9	67.7 (65.5–69.8)	45.9
2003	77.0 (74.1–79.8)	40.2	94.4 (90.1–97.3)	23.1	86.1 (80.9–90.5)	37.7	68.3 (64.4–72.1)	46.5
Vaccination before Age 17 years, by birth cohort								
1995	56.3 (54.8–57.9)	**Referent**	80.4 (77.1–83.5)	**Referent**	65.5 (61.4–69.6)	**Referent**	45.6 (43.8–47.5)	**Referent**
1996	60.9 (59.4–62.4)	4.6	81.0 (77.8–83.9)	0.6	72.7 (69.7–75.8)	7.2	50.7 (48.8–52.5)	5.1
1997	65.9 (64.4–67.3)	9.6	86.3 (83.5–88.8)	5.9	73.9 (70.2–77.4)	8.4	56.8 (55.0–58.6)	11.2

	National		States with universal child vaccination recommended since 1999 (Group 1)		States with recommendation to consider child vaccination since 1999 (Group 2)		States with universal child vaccination recommended since 2006 (Group 3)	
	Weighted percent vaccinated % (95% CI)	Total percentage point change	Weighted percent vaccinated (95% CI)	Total percentage point change	Weighted percent vaccinated (95% CI)	Total percentage point change	Weighted percent vaccinated (95% CI)	Total percentage point change
Sample size	**N = 131,461**		**N = 25,631**		**N = 23,272**		**N = 82,558**	
1998	68.4 (67.0–69.9)	12.1	85.7 (82.3–88.8)	5.3	75.2 (72.2–78.2)	9.7	60.1 (58.4–61.8)	14.5
1999	73.0 (71.5–74.6)	16.7	88.3 (84.8–91.3)	7.9	80.7 (77.6–83.5)	15.2	65.6 (63.7–67.5)	20.0
2000	83.6 (79.8–87.0)	27.3	91.4 (88.3–94.0)	11.0	88.3 (80.3–94.1)	22.8	78.9 (73.5–83.9)	33.3
2001 (Age at interview < 15.8 years)	82.1 (77.8–86.1)	25.8	91.6 (86.6–95.2)	11.2	83.5 (80.6–86.3)	18.0	80.7 (75.1–85.8)	35.1
2002 (Age at interview < 14.8 years)	86.0 (81.9–89.6)	29.7	98.0 (92.9–99.7)	17.6	86.2 (78.6–92.1)	20.7	81.4 (76.3–85.9)	35.8
2003 (Age at interview < 13.6 years)	81.6 (77.4–85.4)	25.3	99.3 (97.1–99.9)	18.9	88.8 (82.2–93.7)	23.3	73.9 (67.8–79.7)	28.3