Adolescent Vaccination-Coverage Levels in the United States: 2006–2009

WHAT'S KNOWN ON THIS SUBJECT: From 2005 to 2007, the recommended vaccination schedule for adolescents was greatly expanded. Vaccination-coverage estimates among adolescents aged 13 to 17 years are measured annually through the National Immunization Survey–Teen (NIS-Teen).

WHAT THIS STUDY ADDS: This article provides a comprehensive assessment of the adolescent vaccination-coverage data available from the 2006–2009 NIS-Teen and highlights several areas for improvement, including simultaneous administration of vaccines, provider endorsement of vaccines, and parental awareness and acceptance of recommended vaccines.

abstract

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BACKGROUND: From 2005 through 2007, 3 vaccines were added to the adolescent vaccination schedule: tetanus-diphtheria-acellular pertussis (TdaP); meningococcal conjugate (MenACWY); and human papillomavirus (HPV) for girls.

OBJECTIVE: To assess implementation of new adolescent vaccination recommendations.

METHODS: Data from the 2006–2009 National Immunization Survey–Teen, an annual provider-verified random-digit-dial survey of vaccination coverage in US adolescents aged 13 to 17 years, were analyzed. Main outcome measures included percentage of adolescents who received each vaccine according to survey year; potential coverage if all vaccines were administered during the same vaccination visit; and, among unvaccinated adolescents, the reasons for not receiving vaccine.

RESULTS: Between 2006 and 2009, ≥1 TdaP and ≥1 MenACWY coverage increased from 11% to 56% and 12% to 54%, respectively. Between 2007 and 2009, ≥1 HPV coverage among girls increased from 25% to 44%; between 2008 and 2009, ≥3 HPV coverage increased from 18% to 27%. In 2009, vaccination coverage could have been >80% for Td/TdaP and MenACWY and as high as 74% for the first HPV dose if providers had administered all recommended vaccines during the same vaccination visit. For all years, the top reported reasons for not vaccinating were no knowledge about the vaccine, provider did not recommend, and vaccine is not needed/necessary (for TdaP and MenACWY) and adolescent is not sexually active, no knowledge about the vaccine, and vaccine is not needed/necessary (for HPV).

CONCLUSIONS: Adolescent vaccination coverage is increasing but could be improved. Strategies are needed to increase parental knowledge about adolescent vaccines and improve provider recommendation and administration of all vaccines during the same visit. *Pediatrics* 2011;128:1078–1086

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KEY WORDS

vaccination, adolescents

ABBREVIATIONS

MenACWY—meningococcal conjugate vaccine
TdaP—tetanus and diptheria toxoids and acellular pertussis
Td—tetanus and diphtheria toxoids
HPV—human papillomavirus
NIS-Teen—National Immunization Survey–Teen
UTD—up-to-date
CI—confidence interval

Ms Stokley had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Ms Stokley and Drs Cohn, Dorell, Hariri, Messonnier, and Wortley conceived of and designed the study; Ms Stokley acquired the data; Ms Stokley, Drs Cohn, Dorell, and Hariri, Mr Yankey, and Drs Messonnier and Wortley analyzed and interpreted the data; Ms Stokley drafted the manuscript; Ms Stokley, Drs Cohn, Dorell, and Hariri, Mr Yankey, and Drs Messonnier and Wortley critically revised the manuscript for important intellectual content; Ms Stokley and Mr Yankey performed statistical analysis; and Ms Stokley supervised the study.

The findings and conclusions in this article are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

www.pediatrics.org/cgi/doi/10.1542/peds.2011-1048

doi:10.1542/peds.2011-1048

Accepted for publication Aug 20, 2011

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: *The authors have indicated they have no financial relationships relevant to this article to disclose.*

From 2005 through 2007, 3 vaccines were added to the adolescent schedule: meningococcal conjugate vaccine (MenACWY); acellular pertussis vaccine given in combination with the tetanus and diphtheria toxoids (Td) vaccine (TdaP); and, for girls, the human papillomavirus vaccine (HPV).[1–3] These vaccines protect against serious diseases and provide new opportunities to engage adolescents with the health care system. The Advisory Committee on Immunization Practices has recommended that these vaccines be administered at ages 11 to 12 years, thereby strengthening the "adolescent platform" that was established in 1996.[4]

In 2006, the annual National Immunization Survey–Teen (NIS-Teen) was created to assess vaccination coverage of adolescents aged 13 to 17 years.[5–8] The NIS-Teen was modeled after the National Immunization Survey and serves as the official source for estimating US vaccination-coverage levels. In addition to collecting immunization information, the NIS-Teen includes questions regarding provider recommendations for vaccinations, a parent's reasons for not vaccinating, and a parent's intention to have his or her teenager receive the HPV vaccine in the next 12 months.

We analyzed NIS-Teen data from the 2006–2009 survey years to assess progress in implementing new vaccination recommendations for adolescents.

METHODS

Survey Design and Collection of Data

We analyzed data from the 2006–2009 NIS-Teen, which was conducted by the Centers for Disease Control and Prevention to estimate vaccination-coverage rates for US adolescents aged 13 to 17 years. The NIS-Teen uses the same sampling and weighting methodology as the National Immunization Survey.[9,10] The NIS-Teen uses random-digit dialing to survey parents in households with age-eligible adolescents and obtains consent to contact vaccination providers. An immunization-history questionnaire is mailed to vaccination providers identified by parents during the interview to record the types of vaccines received and the dates on which they were administered. A single immunization history is constructed for adolescents with multiple providers. The NIS-Teen was approved by the Centers for Disease Control and Prevention's institutional review board.

Analysis of NIS-Teen data was limited to adolescents with a completed household interview and adequate vaccination-history information from the vaccination provider(s) to determine if the adolescent was up-to-date (UTD) with respect to the recommended vaccination schedule. All estimates were weighted to adjust for nonresponse. The National Immunization Survey weighting methodology has been described previously.[9,10] The 2006 and 2007 surveys were conducted in the fourth quarter of the year; only national estimates could be provided. In 2008, the survey was expanded to collect data during all 4 quarters of the year, and the sample size increased to provide both state- and national-level estimates. The data-collection periods (Council of American Research Organization [CASRO] response rate [the product of the resolution rate, the screening-completion rate, and the interview-completion rate] and final analytic sample for each survey year) were as follows: the 2006 NIS-Teen was conducted from October 2006 through February 2007 (CASRO response rate: 56.2%; $n = 2882$ adolescents born between October 1988 and February 1994); the 2007 NIS-Teen was conducted from October 2007 through February 2008 (CASRO response rate: 55.9%; $n = 2947$ adolescents born between October 1989 and February 1995); the 2008 NIS-Teen was conducted from January 2008 through February 2009 (CASRO response rate: 58.7%; $n = 17\,835$ adolescents born between January 1990 and February 1996); and the 2009 NIS-Teen was conducted from January 2009 through February 2010 (CASRO response rate: 58.0%; $n = 20\,066$ adolescents born between January 1991 and February 1997).

Outcome Measures

For each survey year, we calculated the percentage of adolescents UTD for each individual vaccine (≥1 dose of Td/TdaP, ≥1 dose of MenACWY, and, among girls, ≥1 dose and ≥3 doses of HPV) as well as all vaccines appropriate for gender based on the immunization history reported by the provider. Analysis of HPV was limited to girls only, because the vaccine was not licensed for boys until late 2009 and is not recommended for routine use among boys.[11] In addition, because the HPV recommendations for girls were not published until March 2007, ≥1 HPV coverage was not assessed with the 2006 survey and ≥3 HPV coverage was not assessed with the 2006 and 2007 surveys.

Vaccine-coverage estimates for 2009 and percentage-point change from 2008 were calculated for 56 federal immunization program grantees (all 50 states and the District of Columbia, Chicago, IL, Philadelphia County, PA, New York City, NY, and Bexar County and Houston, TX). Because of small sample sizes that yielded unreliable estimates, coverage for ≥3 doses of HPV was not reported at the grantee level.

We determined the percentage of adolescents who made at least 1 vaccination visit at 11 or 12 years of age (to evaluate visits made during the recommended ages) and at 13 years or older

(to evaluate visits made during later adolescence). A vaccination visit was defined as a health care encounter in which ≥1 vaccine was administered. Visit dates and vaccination information were obtained from the immunization providers' records and include childhood and adolescent vaccines. Because the NIS-Teen does not collect information about the dates of well-child care, chronic illness care, or acute care visits in which vaccinations were not administered, these other health care visits could not be included in our analysis.

We calculated vaccination coverage that could be attained if all indicated adolescent vaccines were administered during existing vaccination visits (potentially achievable coverage). Using a conservative approach to allow providers sufficient time to implement a new vaccine recommendation, we assumed that a given vaccine would not be administered until the vaccine recommendation was officially published, which happened from 4 to 9 months after vaccine licensure. Therefore, the MenACWY could be administered during vaccination visits that occurred on or after May 27, 2005,[1] and HPV could be administered during vaccination visits that occurred on or after March 23, 2007.[3] We assumed that an adolescent could have received a tetanus booster during any visit that occurred on or after 11 years of age because tetanus boosters have been recommended at 11 to 12 years of age since 1995.

TABLE 1 Comparison of Actual Vaccination Coverage and Potentially Achievable[a] Vaccination Coverage if All Indicated Vaccines Had Been Administered During the Same Visit: Adolescents Aged 13 to 17 Years, NIS-Teen 2006–2009

Vaccine	Survey Year, % (95% CI)			
	2006	2007	2008	2009
≥1 TdaP only				
Actual coverage	10.8 (9.4–12.3)	30.4 (28.2–32.7)	40.8 (39.3–42.3)	55.6 (54.3–56.8)
Potential coverage[b]	—	—	—	—
≥1 Td/TdaP				
Actual coverage	60.1 (57.8–62.4)	72.3 (70.3–74.3)	72.2 (70.8–73.4)	76.2 (75.1–77.2)
Potential coverage[b]	74.8 (72.7–76.7)	82.2 (80.4–83.8)	82.1 (81.0–83.1)	84.7 (83.8–85.6)
Difference	14.7	9.9	9.9	8.5
≥1 MenACWY				
Actual coverage	11.7 (10.3–13.2)	32.4 (30.2–34.7)	41.8 (40.3–43.2)	53.6 (52.4–54.9)
Potential coverage	35.7 (33.4–37.9)	63.4 (61.1–65.7)	71.1 (69.8–72.4)	81.0 (80.0–82.0)
Difference	24.0	31.0	29.3	27.4
≥1 HPV[c]				
Actual coverage	—	25.1 (22.3–28.1)	37.2 (35.2–39.3)	44.3 (42.4–46.1)
Potential coverage	—	40.7 (37.3–44.0)	56.5 (54.4–58.6)	73.6 (72.0–75.2)
Difference	—	15.6	19.3	29.3
≥3 HPV[c]				
Actual coverage	—	—	17.9 (16.3–19.6)	26.7 (25.2–28.3)
Potential coverage	—	—	18.5 (16.9–20.2)	29.7 (28.1–31.3)
Difference	—	—	0.6	3.0
All[d]				
Actual coverage	10.1 (8.9–11.6)	23.4 (21.4–25.4)	32.4 (31.0–33.8)	41.8 (40.5–43.1)
Potential coverage	35.7 (33.4–37.9)	51.1 (48.7–53.4)	62.9 (61.5–64.3)	76.0 (74.9–77.1)
Difference	25.6	27.7	30.5	34.2

[a] Potential coverage includes adolescents who actually received the vaccine plus adolescents who did not receive the vaccine but made a vaccination visit on or after the publication date of the Advisory Committee on Immunization Practices recommendation for the vaccine of interest.

[b] Potential coverage was assessed for Td/TdaP instead of TdaP only, because adolescents who received Td before the licensure of TdaP were considered UTD.

[c] HPV results are among girls only; ≥1 HPV coverage was not assessed in 2006, and ≥3 HPV coverage was not assessed in 2006 and 2007.

[d] "All" was defined as boys receiving ≥1 Td/TdaP and ≥1 MenACWY and girls receiving ≥1 Td/TdaP and ≥1 MenACWY (2006 NIS-Teen) or ≥1 Td/TdaP, ≥1 MenACWY, and ≥1 HPV (2007–2009 NIS-Teen)

We assessed implementation of using the TdaP for the adolescent tetanus booster by determining, among adolescents who received at least 1 Td or TdaP vaccine, the type of vaccine received as reported by the provider.

The extent to which providers recommended each vaccine in the 2007–2009 surveys was estimated on the basis of responses to "Has a doctor or other health care professional ever recommended that [teen] receive [vaccine]?" ("[vaccine]" referred to "tetanus booster," "meningitis shots," or "HPV shots"), and responses were stratified according to vaccination status. Intentions of parents to have their daughter receive HPV vaccine in the next 12 months were assessed, and 5 response categories were grouped into 2 (very/somewhat likely and not likely/unsure).

Statistical Analysis

Outcome measures were determined for each survey year. Data management was conducted by using SAS 9.2 (SAS Institute, Inc, Cary, NC). Estimates of percentages and 95% confidence intervals (CIs) were calculated by using SUDAAN 10.0 (Research Triangle Institute, Research Triangle Park, NC). All analyses were weighted to account for the unequal probabilities of selection and adjustment for nonresponse.

RESULTS

Vaccination Coverage

Vaccination coverage for each vaccine has increased steadily over time (Table 1). In the first year after the Advisory Committee on Immunization Practices recommendation, uptake with ≥1 HPV was higher compared with uptake of the other adolescent vaccines during the first year after the recommendation. However, although ≥1 TdaP and MenACWY coverage has increased ≥10 percentage points each year, the increase for ≥1 HPV was

lower between 2008 and 2009 (7.1 percentage points) compared with the increase between 2007 and 2008 (12.1 percentage points) (Tables 1 and 2). Coverage with ≥3 HPV was generally low and only increased 8.8 percentage points between 2008 and 2009 (Table 1). However, among girls who initiated the HPV series and had at least 24 weeks to complete the series before the NIS-Teen interview, 59.6% (2008) and 67.5% (2009) received all 3 doses. Among adolescents who received a tetanus booster, the proportion of those who received the TdaP for their first tetanus booster increased steadily over time: 19.8% (2005); 78.6% (2006); 89.5% (2007); 91.7% (2008); and 93.0% (2009).

The proportion of adolescents UTD for all routinely recommended vaccines (as indicated by gender) also increased from 10.1% (2006) to 41.8% (2009) (Table 1). The proportion of those who were UTD was similar for boys and girls in 2006; however, starting in 2007 when ≥1 HPV was included in the analysis, the proportion of girls UTD was lower than boys (Fig 1). When HPV was excluded from the analysis, the proportion UTD did not vary according to gender.

Grantee Vaccination Coverage

Vaccination coverage varied widely according to grantee (Table 2). Coverage was >70% for ≥1 TdaP for 6 grantees (Colorado; New Hampshire; New York City, NY; North Dakota; Vermont; and Wisconsin) and >70% for ≥1 MenACWY for 6 grantees (Massachusetts; New Jersey; Pennsylvania; Philadelphia, PA; Rhode Island; and Washington, DC). Coverage did not exceed 70% for ≥1 HPV for any grantee. Overall coverage appropriate for gender was ≥50% for 10 grantees (Arizona; Connecticut; Washington, DC; Massachusetts; New Hampshire; New Jersey; Pennsylvania; Philadelphia, PA; Rhode Island; and Houston, TX).

Change in coverage between 2008 and 2009 also varied according to grantee (Table 2). No grantees experienced a significant decrease in coverage. Fifty grantees experienced significant increases in coverage for ≥1 TdaP, 44 grantees had significant increases in coverage for ≥1 MenACWY, and 21 grantees had significant increases in coverage for ≥1 HPV.

Potentially Achievable Vaccination Coverage

On the basis of vaccination visits captured in the 2009 NIS-Teen, more than three-quarters of adolescents could have been UTD for all recommended vaccines had providers administered all indicated vaccines during the same visit (Table 1). Over time, the magnitude of the gap between actual and potential coverage seems to be decreasing for Td/TdaP, increasing for HPV, and remaining the same for MenACWY, although data from more years are needed to further examine temporal trends.

Vaccination Visits

Between the 2006 and 2009 surveys, there was a significant increase in the proportion of adolescents who made at least 1 vaccination visit at the recommended ages of 11 to 12 years; however, no significant differences were observed according to gender (Table 3). Between the 2006 and 2009 surveys, there was a significant increase in the proportion of adolescents who made at least 1 vaccination visit on or after 13 years of age; significant differences according to gender were observed in 2008 and 2009, years in which girls made more visits compared with boys.

Report of Provider Recommendation

Between 2007 and 2009, the percentage of respondents that reported a provider recommendation increased significantly: from 42.8% to 45.8% for a "tetanus booster," from 24.6% to 30.6% for a "meningitis shot," and from 38.6% to 55.0% for "HPV shots" ($P < .01$ for each vaccine). For each vaccine and survey year, parents of adolescents who were UTD for a given vaccine were significantly more likely to report a provider recommendation than parents of adolescents who were not UTD (2009 results: tetanus, 49.7% vs 33.2%; MenACWY, 42.9% vs 16.5%; HPV, 73.9% vs 40.0%) ($P < .01$ for each vaccine).

Intent to Vaccinate With HPV in Next 12 Months

Between 2006 and 2008, the distribution of responses regarding intent to vaccinate with HPV in the next 12 months among parents of adolescent girls who had not yet initiated the HPV series remained stable; ~46% were somewhat or very likely, 44% were not too likely or not likely at all, and 10% were unsure. In 2009, however, the proportion of parents who were not too likely or not likely at all increased to 51%, whereas the proportion of those who were somewhat or very likely to vaccinate decreased to 40%. Among parents of teenagers who had not initiated the HPV series, report of a provider recommendation was significantly associated with being somewhat/very likely to obtain the vaccine in the next 12 months ($P < .0001$ for each survey year).

Reasons for Not Vaccinating

Between 2007 and 2009, the top 3 reasons for not vaccinating remained the same for each vaccine. For both the "tetanus booster" and "meningitis shot" the top 3 reasons were lack of knowledge about the vaccine, provider did not recommend the vaccine, and the vaccine was not needed/necessary; however, lack of a provider recommendation was reported more frequently as a reason for the "meningitis shot" than for the "tetanus booster" (43.6% and 29.6%, respectively, 2009 NIS-Teen). The top 3 reasons for not ob-

TABLE 2 2009 Estimated Vaccination Coverage and Change in Coverage From Previous Year According to Grantee: Adolescents Aged 13 to 17 Years, 2009 NIS-Teen

Grantee	≥1 Td or TdaP		≥1 TdaP		≥1 MenACWY		≥1 HPV		All[a]	
	2009 Estimate, % (95% CI)	Difference From 2008	2009 Estimate, % (95% CI)	Difference From 2008	2009 Estimate, % (95% CI)	Difference From 2008	2009 Estimate, % (95% CI)	Difference From 2008	2009 Estimate, % (95% CI)	Difference From 2008
National/United States	76.2 (75.1–77.2)	4.0[b]	55.6 (54.3–56.8)	14.8[b]	53.6 (52.4–54.9)	11.8[b]	44.3 (42.4–46.1)	7.1[b]	41.8 (40.5–43.1)	9.4[b]
Alabama	71.6 (65.5–77.0)	1.5	57.6 (51.4–63.6)	13.6[b]	43.5 (37.5–49.8)	13.6[b]	49.4 (40.8–58.1)	16.6[b]	34.4 (28.8–40.6)	11.4[b]
Alaska	70.1 (63.6–75.8)	1.8	55.8 (49.0–62.4)	13.7[b]	40.2 (33.8–46.9)	9.7[b]	40.8 (31.7–50.6)	2.0	33.1 (27.0–39.7)	9.3[b]
Arizona	83.6 (78.3–87.8)	9.6[b]	66.6 (60.0–72.7)	12.8[b]	69.7 (63.4–75.3)	18.2[b]	52.8 (43.6–61.7)	2.3	55.9 (49.3–62.3)	15.9[b]
Arkansas	52.7 (46.7–58.6)	6.6	34.6 (28.9–40.7)	10.8[b]	21.9 (17.3–27.2)	7.4[b]	34.6 (26.6–43.5)	12.2[b]	17.7 (13.4–22.9)	5.6[b]
California	76.7 (71.0–81.5)	5.4	53.1 (46.7–59.5)	9.4	58.4 (52.0–64.6)	10.4[b]	49.2 (39.9–58.6)	2.6	47.7 (41.4–54.2)	7.6
Colorado	83.6 (78.8–87.5)	6.2	76.6 (70.9–81.5)	13.6[b]	53.7 (47.5–59.9)	21.3[b]	52.7 (43.7–61.4)	19.2[b]	41.2 (35.1–47.6)	14.5[b]
Connecticut	88.9 (84.2–92.4)	9.1[b]	68.3 (62.2–73.8)	22.9[b]	68.1 (61.8–73.9)	22.9[b]	61.2 (52.7–69.2)	16.2[b]	53.9 (47.5–60.2)	16.8[b]
Delaware	74.4 (67.9–80.0)	−4.2	53.4 (46.9–59.7)	10.3[b]	58.4 (51.8–64.7)	−0.2	51.5 (42.4–60.5)	4.7	48.1 (41.8–54.5)	2.7
District of Columbia	89.3 (85.4–92.2)	4.6	46.2 (40.2–52.2)	13.5[b]	78.3 (72.6–83.1)	20.2[b]	60.0 (51.4–68.0)	21.3[b]	61.4 (55.3–67.1)	20.6[b]
Florida	86.8 (80.9–91.1)	7.4	47.2 (41.2–53.3)	18.2[b]	52.7 (46.6–58.7)	19.1[b]	39.3 (31.3–48.0)	2.6	41.3 (35.5–47.4)	15.6[b]
Georgia	73.0 (67.1–78.2)	2.1	50.8 (44.7–56.9)	13.0[b]	53.3 (47.2–59.4)	11.7[b]	38.6 (30.8–47.1)	20.1[b]	39.5 (33.7–45.5)	9.1[b]
Hawaii	79.1 (73.0–84.1)	7.5	46.1 (39.3–52.9)	14.1[b]	51.0 (44.2–57.7)	6.9	65.0 (55.2–73.6)	24.8[b]	43.7 (37.1–50.5)	8.1
Idaho	61.4 (53.5–68.7)	10.1	38.6 (31.4–46.3)	6.9[b]	34.2 (27.3–41.8)	4.3	30.2 (21.0–41.4)	1.8	27.3 (20.9–34.7)	2.3
Illinois	72.1 (67.3–76.4)	−0.8	59.5 (54.5–64.3)	14.1[b]	53.5 (48.5–58.4)	11.6[b]	34.3 (28.0–41.3)	7.3	37.8 (33.2–42.7)	8.7[b]
Chicago, IL	71.4 (65.2–76.8)	−0.4	58.7 (52.5–64.7)	14.5[b]	58.4 (52.2–64.3)	17.3[b]	36.2 (28.8–44.2)	7.6	43.0 (37.1–49.0)	13.8[b]
Indiana	57.9 (52.3–63.3)	4.3	44.4 (39.0–49.9)	13.2[b]	41.7 (36.5–47.2)	9.9[b]	37.1 (30.2–44.6)	11.0[b]	29.7 (25.2–34.7)	5.8
Iowa	70.5 (64.2–76.1)	4.6	61.2 (54.9–67.1)	17.7[b]	46.4 (40.4–52.6)	14.5[b]	42.4 (34.3–51.1)	0.5	35.2 (29.7–41.1)	9.6[b]
Kansas	74.5 (67.8–80.2)	4.6	63.6 (56.6–70.0)	16.8[b]	38.3 (31.7–45.4)	12.7[b]	44.1 (33.9–54.9)	14.0[b]	31.1 (24.9–38.0)	12.0[b]
Kentucky	80.7 (75.5–85.1)	−1.3	37.5 (32.1–43.1)	9.4[b]	36.3 (31.2–41.7)	5.4	31.0 (23.8–39.2)	4.7	29.5 (24.8–34.6)	6.0
Louisiana	70.1 (63.0–76.4)	−4.8	47.3 (40.2–54.6)	12.0[b]	65.8 (58.5–72.4)	12.2[b]	48.6 (37.6–59.7)	12.0	49.0 (41.8–56.3)	9.5
Maine	75.7 (69.4–81.0)	0.7	54.0 (47.2–60.6)	11.0[b]	47.3 (40.7–54.1)	11.7[b]	44.4 (35.3–53.8)	4.1	34.6 (28.6–41.1)	7.4
Maryland	80.2 (72.5–86.2)	1.2	51.8 (43.9–59.7)	13.9[b]	59.3 (51.1–67.0)	4.7	39.6 (28.7–51.6)	−1.5	43.3 (35.8–51.2)	7.4
Massachusetts	93.7 (89.9–96.2)	−0.7	62.7 (56.8–68.2)	19.4[b]	74.0 (68.6–78.8)	18.1[b]	69.0 (60.4–76.5)	15.7[b]	62.3 (56.5–67.8)	18.9[b]
Michigan	69.3 (64.0–74.2)	−0.6	46.2 (40.8–51.8)	12.6[b]	52.6 (47.0–58.1)	12.7[b]	39.0 (31.5–47.1)	6.7	36.8 (31.6–42.3)	6.4
Minnesota	90.3 (85.7–93.5)	1.6	52.0 (46.0–58.0)	11.3[b]	43.9 (38.1–49.9)	5.0	44.9 (36.5–53.5)	11.3	35.2 (29.8–41.1)	4.7
Mississippi	29.1 (24.5–34.1)	0.4	22.6 (18.4–27.3)	3.0	19.3 (15.5–23.7)	4.5	22.9 (16.5–30.9)	7.1	15.1 (11.8–19.3)	4.1
Missouri	74.7 (69.3–79.4)	6.8	60.1 (54.3–65.7)	16.0[b]	45.5 (39.6–51.4)	10.2[b]	32.7 (25.5–40.8)	1.1	33.8 (28.4–39.6)	6.7
Montana	81.1 (75.8–85.4)	12.0[b]	63.8 (57.6–69.6)	19.6[b]	26.9 (21.7–32.9)	9.1[b]	35.0 (26.8–44.2)	17.2[b]	20.0 (15.4–25.5)	6.3
Nebraska	78.8 (73.1–83.5)	7.3	51.6 (45.1–57.9)	9.4[b]	53.2 (46.8–59.6)	16.0[b]	49.4 (40.2–58.6)	19.9[b]	42.5 (36.2–49.0)	16.6[b]
Nevada	75.3 (69.0–80.7)	6.3	64.0 (57.4–70.1)	18.1[b]	39.5 (33.4–45.9)	9.9[b]	39.0 (30.2–48.4)	9.0	32.5 (26.8–38.8)	10.2[b]
New Hampshire	88.0 (82.7–91.8)	3.8	72.2 (66.2–77.5)	19.1[b]	67.8 (61.6–73.5)	13.2[b]	60.0 (51.3–68.2)	5.6	56.5 (50.1–62.8)	12.1[b]
New Jersey	81.2 (76.2–85.4)	3.1	61.1 (55.4–66.5)	18.1[b]	71.4 (65.7–76.5)	10.8[b]	42.2 (34.4–50.4)	−0.8	50.2 (44.5–55.9)	6.5
New Mexico	84.4 (79.8–88.1)	9.3[b]	63.5 (57.8–68.8)	13.1[b]	51.2 (45.6–56.8)	11.6[b]	53.1 (45.0–60.9)	4.8	45.7 (40.2–51.4)	13.5[b]
New York	87.7 (84.0–90.6)	2.2	69.2 (64.3–73.7)	15.4[b]	62.9 (57.7–67.8)	6.9	48.8 (41.4–56.3)	−1.4	49.8 (44.7–54.9)	5.2
New York City, NY	89.1 (84.2–92.6)	3.7	72.2 (65.1–78.4)	22.8[b]	61.0 (53.0–68.4)	7.5	43.2 (32.4–54.7)	−5.1	47.9 (40.4–55.4)	4.7
North Carolina	73.8 (67.7–79.1)	10.2[b]	54.7 (48.3–61.1)	26.7[b]	46.8 (40.4–53.3)	16.1[b]	50.3 (40.9–59.6)	15.9[b]	36.9 (30.8–43.3)	14.0[b]
North Dakota	85.7 (80.4–89.8)	10.7[b]	71.6 (65.4–77.1)	23.8[b]	66.0 (59.5–72.0)	18.6[b]	45.1 (36.0–54.6)	16.4[b]	48.5 (42.0–55.1)	14.8[b]
Ohio	67.7 (61.6–73.2)	9.9[b]	50.2 (44.0–56.4)	19.6[b]	53.7 (47.5–59.9)	16.0[b]	40.6 (31.8–49.9)	11.5[b]	38.1 (32.2–44.3)	12.4[b]
Oklahoma	55.5 (49.3–61.5)	−4.0	35.1 (29.6–41.1)	6.5	29.5 (24.4–35.2)	4.4	40.1 (31.9–48.9)	4.6	23.7 (19.1–29.1)	4.9
Oregon	68.8 (63.2–73.9)	4.7	55.5 (49.9–61.1)	16.6[b]	41.6 (36.1–47.2)	12.0[b]	52.9 (45.2–60.5)	18.1[b]	36.7 (31.4–42.3)	11.5[b]
Pennsylvania	84.7 (79.6–88.7)	2.7	67.9 (61.7–73.5)	16.7[b]	71.9 (65.8–77.3)	12.2[b]	53.2 (43.8–62.4)	7.1	54.1 (47.7–60.4)	7.4
Philadelphia County, PA	82.0 (77.0–86.0)	2.3	65.2 (59.2–70.8)	16.6[b]	75.3 (69.7–80.2)	9.0[b]	58.2 (49.1–66.8)	6.4	58.7 (52.6–64.6)	10.2[b]
Rhode Island	91.4 (87.9–94.0)	−0.1	60.1 (54.0–65.9)	18.5[b]	75.7 (70.2–80.5)	13.1[b]	68.3 (58.9–76.4)	13.6	63.3 (57.3–69.0)	11.5[b]
South Carolina	52.7 (45.8–59.5)	−1.0	37.5 (31.4–44.0)	10.2[b]	34.5 (28.6–40.9)	9.4[b]	28.5 (21.0–37.4)	9.8[b]	26.6 (21.3–32.6)	6.9
South Dakota	58.0 (51.2–64.4)	12.7[b]	39.6 (33.2–46.4)	20.3[b]	24.9 (19.6–31.1)	10.9[b]	62.4 (53.2–70.8)	16.5[b]	19.0 (14.3–24.8)	8.5[b]
Tennessee	63.3 (57.3–68.9)	13.0[b]	48.0 (42.0–54.0)	13.7[b]	52.1 (46.1–58.1)	15.6[b]	43.6 (35.4–52.1)	14.0[b]	42.7 (36.8–48.7)	14.9[b]
Texas	75.8 (71.0–80.1)	−3.5	57.2 (52.0–62.3)	16.4[b]	51.0 (45.7–56.2)	13.6[b]	37.6 (31.3–44.5)	6.0	40.4 (35.4–45.6)	9.7[b]
Bexar County, TX	79.3 (72.7–84.7)	1.6	56.4 (49.1–63.4)	14.4[b]	54.8 (47.5–61.9)	11.6[b]	47.7 (37.7–57.9)	7.0	43.9 (36.9–51.1)	9.5

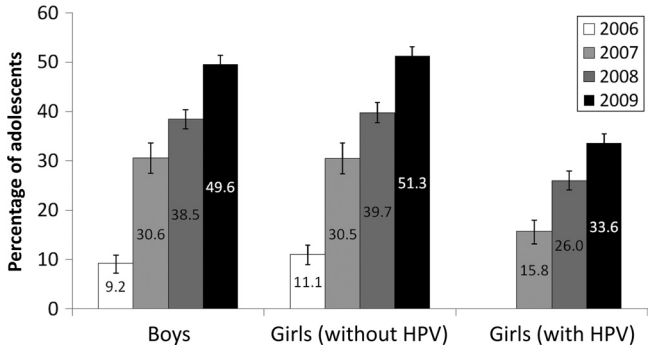

FIGURE 1

Percentage of adolescents who received all vaccines routinely recommended for adolescents, according to gender and survey year: 2006–2009 NIS-Teen. For boys and girls (without HPV), "all" vaccines include ≥1 dose of tetanus-containing vaccine and ≥1 dose of MenACWY; for girls (with HPV), "all" vaccines include ≥1 dose of tetanus-containing vaccine, ≥1 dose of MenACWY, and ≥1 dose of HPV.

TABLE 3 Percentage of Adolescents With ≥1 Vaccination Visit According to Age and Gender: 2006–2009 NIS-Teen

Age at Visit	Survey Year, % (95% CI)			
	2006	2007	2008	2009
11–12 y	50.3 (48.0–52.6)	52.5 (50.2–54.8)	52.6 (51.1–54.0)	54.9 (53.7–56.2)
Boys	48.8 (45.5–52.0)	52.0 (48.7–55.3)	51.3 (49.3–53.4)	54.9 (53.1–56.6)
Girls	52.0 (48.6–55.3)	53.1 (49.7–56.4)	53.9 (51.8–55.9)	55.0 (53.2–56.8)
≥13 y[a]	44.6 (42.3–46.9)	59.5 (57.1–61.8)	59.6 (57.7–60.6)	61.7 (60.5–62.9)
Boys	43.9 (40.7–47.2)	57.8 (54.4–61.1)	55.8 (53.8–57.9)	58.3 (56.6–60.0)
Girls	45.3 (41.9–48.6)	61.2 (57.9–64.4)	62.6 (60.6–64.6)[c]	65.3 (63.6–67.0)[c]
≥11 y[b]	73.1 (71.0–75.1)	81.1 (79.3–82.8)	81.0 (79.9–82.2)	83.9 (83.0–84.8)
Boys	71.1 (68.0–74.0)	80.0 (77.3–82.5)	79.4 (77.6–81.0)	82.6 (81.2–83.9)
Girls	75.2 (72.2–78.0)	82.3 (79.7–84.5)	82.8 (81.3–84.2)[c]	85.4 (84.0–86.6)[c]

[a] Vaccination visits made between 13 years of age and the date of the NIS-Teen interview; the observation period varied according to survey participant on the basis of their age at interview.

[b] Vaccination visits made between 11 years of age and the date of the NIS-Teen interview; the observation period varied according to survey participant on the basis of their age at interview.

[c] Significantly different from boys ($P < .05$).

TABLE 2 Continued

Grantee	≥1 Td or TdaP		≥1 TdaP		≥1 MenACWY		≥1 HPV		All[a]	
	2009 Estimate, % (95% CI)	Difference From 2008	2009 Estimate, % (95% CI)	Difference From 2008	2009 Estimate, % (95% CI)	Difference From 2008	2009 Estimate, % (95% CI)	Difference From 2008	2009 Estimate, % (95% CI)	Difference From 2008
Houston, TX	76.0 (67.8–82.7)	3.0	52.6 (44.0–61.0)	10.0	64.8 (56.0–72.8)	12.9[b]	41.7 (29.8–54.7)	11.5	50.0 (41.4–58.6)	12.4[b]
Utah	73.2 (67.1–78.6)	10.5[b]	64.1 (57.9–70.0)	17.3[b]	42.1 (36.0–48.3)	10.8[b]	32.5 (24.7–41.4)	15.4[b]	31.8 (26.3–37.8)	7.1
Vermont	87.0 (82.7–90.3)	7.2	70.7 (65.4–75.6)	21.5[b]	43.9 (38.5–49.5)	23.9[b]	60.7 (52.5–68.4)	10.3	36.2 (31.0–41.6)	18.9[b]
Virginia	79.9 (74.3–84.6)	9.6[b]	56.1 (49.7–62.3)	7.0	48.1 (41.9–54.4)	4.3	36.8 (28.6–45.8)	−3.8	38.0 (32.1–44.2)	5.5
Washington	76.3 (70.1–81.5)	12.1[b]	60.1 (53.8–66.2)	25.4[b]	55.8 (49.4–62.0)	15.8[b]	60.0 (50.9–68.5)	13.5[b]	48.7 (42.5–55.0)	15.7[b]
West Virginia	52.2 (45.1–59.2)	7.5	40.5 (33.8–47.5)	16.4[b]	39.0 (32.5–45.9)	8.8[b]	38.5 (29.5–48.4)	4.9	30.2 (24.3–36.8)	9.3[b]
Wisconsin	85.3 (80.1–89.3)	9.9[b]	72.3 (66.3–77.5)	18.5[b]	55.7 (49.5–61.8)	3.5	49.2 (40.7–57.6)	2.2	44.3 (38.3–50.4)	3.2
Wyoming	82.8 (78.0–86.7)	3.7	48.2 (42.4–54.0)	19.9[b]	47.8 (42.0–53.6)	15.0[b]	43.6 (35.8–51.7)	7.4	39.1 (33.6–45.0)	11.1[b]
Range	29.1 to 93.7	−4.8 to 13.0	22.6 to 76.6	3.0 to 26.7	19.3 to 78.3	−0.2 to 23.9	22.9 to 69.0	−5.1 to 24.8	15.1 to 63.3	2.3 to 20.6

[a] "All" was defined as boys receiving ≥1 Td/TdaP and ≥1 MenACWY and girls receiving ≥1 Td/TdaP, ≥1 MenACWY, and ≥1 HPV.

[b] Difference between 2009 and 2008 estimates are significantly different ($P < .05$).

taining "HPV shots" included adolescent not sexually active, lack of knowledge about the vaccine, and the vaccine was not needed/necessary.

DISCUSSION

The results of this review of 4 years of adolescent vaccination-coverage data indicate that coverage levels have increased but that there is wide variation at the state and local levels. Although the progress is encouraging, the data highlight several areas for improvement, including increasing opportunities to receive vaccines, simultaneous administration of vaccines, provider endorsement of vaccines, and parental awareness and acceptance of recommended vaccines.

Health care utilization patterns of adolescents characterized by few preventive visits and decreasing visits with age resulted in concern over the ability to attain high coverage.[12–14] In addition, physicians have reported that infrequent health care visits is a major barrier to vaccinating adolescents.[15,16] Our data suggest, however, that although only 55% of adolescents made a vaccination visit during the recommended ages of 11 to 12 years, 83% made at least 1 vaccination visit by the time they were 18 years old. Although efforts to increase vaccination visits at ages 11 to 12 years are needed, vaccination efforts at older ages need to be continued to ensure that adolescents are caught up with the recommended

vaccines. Approximately 15% of the 2009 sample did not have any vaccination encounter during adolescence. We were unable to determine if this resulted from lack of access, lack of utilization, or missed opportunity. Further evaluation is needed to understand how best to reach this group. It is possible that, for this population, alternative venues such as schools would be appropriate.[17–19]

Results from our review of NIS-Teen data provide a glimpse into provider practices and identify several areas for improvement. Vaccination coverage could have been >80% for Td/TdaP and MenACWY and as high as 74% for the first dose of HPV had providers taken advantage of existing vaccination visits and administered all indicated vaccines. These best-case estimates are conservative, because we could only quantify visits in which vaccines were administered. If we were able to quantify missed opportunities at visits in which no vaccination occurred, potential coverage would likely be higher. Administering all indicated vaccines during the same visit is a recommended standard of child and adolescent immunization[20] and is endorsed by numerous professional organizations.[17–19] Efforts at the practice level should focus on removing the barriers that prevent providers from offering simultaneous vaccinations.

Provider counseling and recommendations strongly influence parental acceptance of vaccines.[21–24] Although reported provider recommendations increased over time, only one-third of respondents reported receiving a recommendation for the meningococcal vaccine, and approximately half reported receiving a recommendation for a tetanus booster or HPV vaccine. For all vaccines, parent report of provider recommendation was associated with the adolescent being UTD for the vaccine. Because these data were self-reported, parents of vaccinated adolescents might have been more likely to recall a provider recommendation than parents of unvaccinated adolescents, thus underestimating actual practice. However, studies have found that providers are less likely to strongly recommend HPV to younger adolescent girls[25,26] and are likely to delay administration of the MenACWY because of concerns over duration of protection and waning immunity.[27–29] Providing a weak recommendation or delaying vaccination might signal to the parent that the vaccine is not necessary or not important and might reduce the likelihood of the parent returning to have his or her adolescent vaccinated at a later date.

Although overall coverage with 3 doses of HPV was low, completion of the series among girls who initiated the series was 68% (2009 NIS-Teen). Strategies such as sending out reminder notices might help with improving completion rates; however, the diminishing increases in girls initiating the series between 2007 and 2009 and the level of parents of unvaccinated girls who have no intentions of vaccinating their daughter in the next 12 months is of concern.

Understanding reasons for not vaccinating will help guide development of future communication activities. The main reasons cited (lack of provider recommendation, lack of knowledge about the vaccine/disease, adolescent not needing the vaccine, daughter not sexually active [specific to HPV vaccine]) could be addressed through education and working with providers to recommend the vaccines. Materials for educating parents are available through the Centers for Disease Control and Prevention (available at: www.cdc.gov/vaccines/who/teens/index.html) and its partners, but these materials are fairly broad in scope. Developing tailored materials to address the specific concern that a parent may have toward a particular vaccine might be needed.

This study has several limitations. The NIS-Teen is a random-digit-dialed survey and is limited to households that have a landline. It might not be representative of households without a landline and wireless-only households and might contribute to noncoverage bias. According to data from the 2009 National Health Interview Survey (NHIS), a face-to-face household survey that includes households with or without a landline and wireless-only households, the number of wireless-only households is increasing; 25.9% of children currently live in wireless-only households.[30] Only 1.9% of children live in households without telephone service.[30] Benchmark comparisons of sociodemographic and health-related variables among adolescents in the NIS-Teen and NHIS have found no significant evidence of coverage bias after adjusting sampling weights for noncoverage of households without a landline and wireless-only households in the NIS-Teen.[31] Underestimates of vaccination coverage might have resulted from the exclusive use of provider-verified vaccination histories, because completeness of these records is unknown. Estimates with wider CIs should be interpreted with caution.

CONCLUSIONS

The first 5 years of the expanded adolescent vaccination schedule has resulted in significant increases in adolescent vaccination coverage; however, current vaccination rates are still below target levels and are lower than levels achieved for vaccines routinely recommended for children aged 19 to 35 months.[32] The adolescent vaccination schedule continues to evolve; recent recommendations include annual vaccination with seasonal influenza vaccine for children aged 5 to 18

years,[33] removal of the recommended 5-year interval between the Td and TdaP,[34] and a booster dose of MenACWY at 16 years of age.[35] Healthy People 2020 objectives for adolescents aged 13 to 15 years have also been established and are targeted at 80% coverage for ≥1 TdaP, ≥1 MenACWY, and ≥3 doses of HPV (among girls).[36] Achieving Healthy People 2020 goals for HPV and completing the booster dose of MenACWY will be particularly challenging. Evaluating policies at the state and local levels (including vaccine requirements for school entry) and identifying effective and sustainable strategies at the community and practice levels to increase coverage are needed.

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RECRUITING OVERSEAS: *The main topic of conversation along the soccer sidelines these days has nothing to do with the weather, politics, or even the economy. The main topic is the college application process. Stories are swapped about how ill-prepared the students are for selecting a college, the importance (or not) of the ACT scores, where others have looked, and how hard it is to get into one of the "premier" schools. While there are many talented young men and women at our local high school, only a few of the 400 graduating students will get into an Ivy League or NESCAC (New England Small College Athletic Conference) school. Parents earnestly debate whether applying early action (the consensus is no) or early decision (the consensus is yes) improves the likelihood of being accepted into one of these schools. While we fret about the 10% admission rate to the most competitive schools, imagine the worry among Indian parents. As reported in* The New York Times *(World: October 13, 2011), the acceptance rate at The Indian Institutes of Technology is less than 2% among students who score high enough on standardized examinations to even apply. The most competitive schools essentially require perfect scores on the final high school examinations or entrance examination to be considered. Simply put, there are far too many talented youth applying for the few positions available. For many students, the alternative is to apply to U.S. schools. Indian students are now the second largest group of foreign students in the U.S. While many have historically gone to graduate schools, the number of applicants to undergraduate schools is surging, up 20% a year for the past few years. Many schools, including Ivy League schools, now recruit in India and are looking to establish partnerships with Indian schools. For most Indian students, studying in the U.S. allows for greater flexibility and creativity. The downside is that the cost can be staggering. Tuition at an Ivy League school can be orders of magnitude higher than a comparable Indian University. So, when parents ask me about my son, I merely reply that he's in the mix for the colleges he wants and that he will have options. I can't ask for more than that.*

Noted by WVR, MD

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