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Short communication

Factors associated with early adoption of the HPV vaccine in US male adolescents include Hispanic ethnicity and receipt of other vaccines

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ABSTRACT

Adolescent males' HPV vaccine initiation and completion in the United States is far below the Healthy People 2020 goal of 80% 3-dose completion among boys. In 2012, less than 7% of males ages 13–17 years had completed the 3-dose series. The Diffusion of Innovations framework guided this investigation of factors related to early adoption of HPV vaccination among male adolescents. Provider-validated data from the 2012 National Immunization Survey-Teen (NIS-Teen) for male adolescents ages 13–17 years were analyzed via a multivariable Poisson regression to estimate prevalence ratios for factors associated with HPV vaccine initiation and completion. Adolescent males who are Hispanic and those who are up to date on other recommended adolescent vaccinations were most likely to complete the HPV vaccine. Public health interventions are needed to improve low HPV vaccination rates among adolescent males in the United States. Description of early adopters of the HPV vaccine provides historical context of HPV vaccination acceptance that is needed to inform the design of targeted vaccination interventions to prevent negative HPV-associated outcomes.

1. Introduction

In 2009, an estimated 13,446 human papillomavirus (HPV)-associated cancers were diagnosed among men in the United States (US) (Chaturvedi et al., 2011), including oropharyngeal (78.2%), anal (14.4%), and penile (7.4%) cancers (Jemal et al., 2013). HPV-associated cancers are increasing in incidence; for example, as of 2011 approximately 70% of cancers of the oropharynx were linked to oral HPV infection (Chaturvedi et al., 2011). The increase in oropharyngeal cancers has been attributed to oral infection of high-risk (oncogenic) HPV type 16, the prevalence of which is estimated to be 1.6% among men aged 14 to 69 years (Gillison et al., 2012). In addition, it is estimated that approximately 250,000 cases of HPV-related genital warts occur annually in the US among sexually active males (Hoy et al., 2009; Anon., 2011).

However, there is no routine screening for HPV-associated morbidities among males, leaving HPV vaccination as the best prevention strategy for these cancers and genital warts. The HPV vaccine, recommended by the Advisory Committee on Immunization Practices (ACIP) for boys ages 11–21 in 2011, (Anon., 2011) may be effective in reducing oral HPV infections and anal pre-cancer associated with HPV (Giuliano et al., 2011; Herrero et al., 2013; Palefsky et al., 2011). For example, Herrero et al. demonstrated that four years after women were randomized to receive the HPV vaccine or a control vaccine, women who received the HPV vaccine had significantly fewer infections with oral HPV (Herrero et al., 2013). Although the HPV vaccine is not currently approved for prevention of oropharyngeal cancer, it is possible that the protection against oral HPV infection that was observed in vaccinated women will also extend to vaccinated men. A vaccine that protects against oral HPV and HPV-related anal pre-cancerous lesions may in turn reduce the incidence of associated HPV oropharyngeal, anal, and other cancers.

As of 2014, the Healthy People 2020 HPV target for vaccination coverage is now 80% 3-dose-completion for males aged 13–15 years (Anon., 2014a). In 2010–2011, the first year that National Immunization Survey-Teen (NIS-Teen) data is available, barriers to HPV vaccination included lack of information and lack of provider recommendation (Reiter et al., 2013). Despite efforts to improve HPV vaccination, the most recent data from 2014 indicate that male completion of HPV vaccination is at 21.6%, (Anon., 2012a; Anon., 2014b) far below Healthy People 2020 goals. Moreover, within the first year after ACIP recommended HPV vaccination, national HPV vaccine initiation was lower

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among boys compared to the first year initiation rates observed in girls in 2007 (Anon., 2007, 2012a).

To reach the national Healthy People 2020 goal of 80% vaccination coverage among adolescent males, research is needed to identify factors that are associated with HPV vaccination among adolescent boys. Knowledge of demographic or other factors that relate to early adoption of the HPV vaccine can provide historical context that informs the design of future interventions to increase receipt of the HPV vaccine among boys in the US. Using Rogers' Diffusion of Innovations (DOI) theory (Rogers, 1983a) for interpreting adoption of the HPV vaccine enhances our understanding of how vaccine innovations diffuse throughout social systems. This study was guided by DOI, which posits that populations can be segregated into different segments based on their willingness to adopt a particular innovation that ranges from innovators and early adopters to late majority and laggards. This paper aimed to identify factors that were associated with early adoption of HPV vaccination among adolescent boys. According to the DOI, we expected early adopters to have higher social status (e.g., higher education, being above poverty level, majority race/ethnicity, privately insured) (Rogers, 1983b).

2. Methods

The NIS-Teen is a cross-sectional national survey conducted annually using random digit dialing to sample parents of eligible adolescents regarding vaccination in the US (Anon., 2008-2014). Upon obtaining parental consent, adolescents' healthcare providers are contacted to validate vaccination records. Provider-validated data from the 2012 National Immunization Survey-Teen for male adolescents ages 13–17 years (N = 10,141) were analyzed using survey sample weighted statistics (Anon., 2012b) which adjust for non-response and reflect post stratification adjustments to reflect the control totals from national data from the National Center for Health Statistics (Anon., 2013a). Adequate provider-verified vaccination data was available for 23.6% of cellular and 55.2% of landline respondents. Provider-phase sampling weights for both landline and cell-phone samples in the US proper were used to produce dual-frame point estimates and corresponding 95% confidence intervals. Frequency counts and survey-weighted percentages were reported for the entire US boys subgroup. A survey weighted multivariable Poisson regression was fitted to assess the impact of predictor variables (mother's education, poverty status, ethnicity/race, adolescent's age, source of health insurance, facility type, and receipt of other adolescent vaccinations) and reported as an adjusted prevalence ratio with 95% CI. All predictor variables were clinically important and were included in the multivariable analysis regardless of their statistical significance. Participants with complete information for all factors in our multivariate analysis were included. A multivariable sensitivity analysis compared factors related to males completing three doses of the HPV vaccine among those who had a minimum of 24 weeks between receipt of the first dose of the HPV vaccine and the date of the interview. All tests were two-sided comparisons in STATA version 13.1. The University of Utah Institutional Review Board considers analysis of publicly available data, the NIS-Teen, exempt.

3. Results

3.1. Demographic and healthcare characteristics of male adolescents

A total of 10,141 adolescent boys with vaccination provider-reported vaccination records were included in the analysis. Of these, 2050 (20.8%) had initiated and 655 (6.8%) had completed the HPV vaccine series. In Table 1 mothers of the boys were mostly aged ≥35, had received some of or completed a college education, and were married. Adolescents were primarily living above poverty level, Non-Hispanic White, and had health insurance through a parent's employment or union.

3.2. Multivariable analysis of factors predicting HPV vaccine completion among male adolescents

In Table 2, respondents whose mothers had some college, but no college degree, were less likely to initiate the HPV vaccine series than those whose mothers had less than 12 years of education (PR = 0.78, 95% CI = 0.62–0.99). Non-Hispanic Whites and those with unclassified ethnicities listed as 'Other' were less likely to initiate the HPV vaccine series than Hispanic boys (PR = 0.66, 95% CI = 0.55–0.80; PR = 0.73, 95% CI = 0.56–0.96). For HPV vaccine completion, Non-Hispanic Whites were still less likely than Hispanics to complete (PR = 0.50, 95% CI = 0.38–0.77). Non-Hispanic Blacks were also less likely to complete HPV vaccination than Hispanics (PR = 0.55, 95% = 0.36–0.83). No statistical differences were observed for Other ethnicities. Consistent with the results observed in the descriptive analysis, adolescent boys who received their health insurance through a source other than a parent's employer or union were more likely to have both initiated (PR = 1.24, 95% CI = 1.02–1.51) and completed the HPV vaccine (PR = 1.55, 95% CI = 1.05–2.28) than boys who had received insurance through a parent's employer or union. A similar percentage of boys who received insurance through a parent's employer or union reported that their provider had recommended the HPV vaccine compared to those who did not have this type of insurance (29.2% vs. 26.8%, data not shown).

Receipt of other adolescent vaccinations was the strongest predictor of the likelihood of HPV vaccine initiation and completion. Those with at least one dose of seasonal influenza vaccination in the past three years were more likely to initiate HPV vaccination (PR = 1.77, 95% CI = 1.54–2.05) and to complete HPV vaccination (PR = 3.20, 95% CI = 2.37–4.33) than those without influenza vaccination. Adolescents with at least one dose of TDAP vaccination ages 10–13 years were more likely to complete HPV vaccination (PR = 1.61, 95% CI = 1.16–2.25) than those who had not received TDAP. Adolescents with at least one Meningitis vaccination were also more likely to initiate HPV vaccination than those without a Meningitis vaccination (PR = 4.98, 95% CI = 3.53–7.00), and were also more likely to complete HPV vaccination than those without a Meningitis vaccination (PR = 5.55, 95% CI = 2.82–10.91).

Multivariable models were used to compare factors related to males completing three doses of the HPV vaccine among those who had at least 24 weeks between the receipt of the first dose of the HPV vaccine and the date of the interview. Source of health insurance and meningitis vaccination were no longer significantly associated with 3-dose completion within the recommended time frame (data not shown).

4. Discussion

Increasing HPV vaccination coverage among adolescent males is a public health priority. Herein we identified factors associated with early adoption of HPV vaccination among adolescent boys from the 2012 NIS-Teen to inform interventional programs and policies that are effectively targeted to increase HPV vaccination among males. According to DOI, early adopters have higher social status, education, incomes, and are willing to take risks (Rogers, 1983b). However, male early adopters of the HPV vaccine do not appear to mirror the DOI early adopter profile and in fact tend to have opposite characteristics (e.g., public health insurance, lower income & education). This important difference in the profile of early adopters is unexpected, but has implications for designing interventions that appropriately target individuals who are slower to uptake the HPV vaccine.

In our analysis, HPV vaccination among boys differed by racial/ethnic group, in that Hispanic teens were more likely to be vaccinated than non-Hispanic teens. Similar to previous research, this finding reflects varying levels of support for HPV vaccination by racial/ethnic groups. Attitudes regarding vaccines generally, and the HPV vaccine specifically, may be more positive among Hispanic parents compared to non-Hispanic parents (Kornfeld et al., 2013). This finding mirrors

Table 1
Demographic and healthcare characteristics of male adolescents in the United States[a,b], NIS-Teen 2012 (N = 10141).

Characteristics	Total N (%[b])	No vaccination N (col. %[b])	HPV Initiation (≥1 dose)[c] N (col. %[b])	HPV Completion (≥3 doses)[d] N (col. %[b])
Total, n (row %[b])	10,141	8091 (79.2)	2050 (20.8)	655 (6.8)
Age (Mother/Parent)				
≤34 years	763 (9.9)	562 (9.1)	201 (13.3)	66 (13.6)
35 years < age ≤ 44 years	4102 (47.3)	3285 (46.8)	817 (49.4)	234 (47.8)
≥45 years	5276 (42.7)	4244 (44.2)	1032 (37.3)	355 (38.7)
Education (Mother)				
<12 years	969 (13.8)	969 (11.5)	281 (22.7)	87 (26.8)
12 years	1941 (25.7)	1941 (25.8)	380 (25.2)	115 (21.0)
>12 years (some college)	2829 (25.6)	2829 (26.9)	473 (20.5)	143 (20.5)
College graduate	4402 (35.0)	4402 (35.9)	916 (31.7)	310 (31.7)
Poverty status[e]				
Above poverty (>$75k)	4474 (34.4)	3597 (36.0)	877 (27.9)	280 (25.6)
Above poverty (≤$75k)	3714 (39.7)	3065 (41.0)	649 (34.4)	203 (33.7)
Below poverty	1621 (26.0)	1161 (22.9)	460 (37.7)	151 (40.7)
Missing, n (%)	332 (3.27)			
Marital status of mother				
Married	7526 (65.1)	6116 (66.1)	1410 (61.4)	467 (66.0)
Other	2615 (34.9)	1975 (33.9)	640 (38.6)	188 (34.0)
Ethnicity/Race of teens				
Hispanic	1321 (21.7)	943 (18.7)	378 (33.0)	140 (41.0)
Non-Hispanic White only	6872 (55.7)	5719 (59.6)	1153 (40.6)	376 (37.5)
Non-Hispanic Black only	1029 (14.0)	734 (13.1)	295 (17.3)	72 (11.1)
Other	919 (8.7)	695 (8.6)	224 (9.0)	67 (10.4)
Age in years of selected teen				
13 years old	2050 (19.8)	1655 (20.2)	395 (18.6)	125 (19.4)
14 years old	2135 (20.0)	1672 (19.7)	463 (21.4)	130 (17.4)
15 years old	2032 (21.4)	1612 (21.4)	420 (21.5)	132 (25.4)
16 years old	1984 (19.3)	1585 (19.3)	399 (19.6)	130 (17.0)
17 years old	1940 (19.4)	1567 (19.5)	373 (18.9)	138 (20.8)
Source of health insurance for teens				
Provided through employment or union	6627 (56.4)	5448 (59.3)	1179 (45.1)	371 (42.2)
Not Provided through employment or union	3426 (43.6)	2577 (40.7)	849 (54.9)	276 (57.8)
Missing, n (%)	88 (0.87)			
Facility type for teen's providers				
All public facilities	1357 (14.8)	1125 (14.8)	232 (14.5)	67 (14.0)
All hospital facilities	931 (7.9)	711 (8.2)	220 (6.8)	65 (5.4)
All private facilities	4790 (52.9)	3814 (52.9)	976 (52.8)	320 (54.7)
Mixed/Other	2684 (24.5)	2137 (24.1)	547 (25.9)	179 (26.0)
Missing, n (%)	379 (3.74)			
Do teen's providers order vaccination from state/local health department				
All providers	6828 (66.2)	5363 (64.6)	1464 (72.3)	467 (71.7)
Some but possibly not all	1416 (12.3)	1139 (12.2)	277 (12.6)	100 (13.4)
No providers	1043 (12.3)	891 (13.2)	152 (8.7)	43 (9.0)
Don't know	823 (9.2)	666 (10.0)	157 (6.3)	45 (5.9)
Missing, n (%)	32 (0.32)			
Influenza vaccination[f]				
Yes	4258 (39.3)	2956 (33.8)	1302 (60.0)	464 (74.6)
No	5883 (60.7)	5135 (66.2)	748 (40.0)	191 (25.4)
TDAP vaccination[g]				
Yes	6681 (63.8)	5155 (62.1)	1526 (70.0)	518 (76.0)
No	3460 (36.3)	2936 (37.9)	524 (30.0)	137 (24.0)
Meningitis vaccination[h]				
Yes	7527 (74.5)	5593 (69.4)	1934 (94.1)	630 (95.6)
No	2614 (25.5)	2498 (30.6)	116 (5.9)	25 (4.4)

[a] Male adolescents with adequately complete provider-reported immunization records in the 2012 NIS-Teen survey were included. U.S. Virgin Islands was excluded.
[b] Weighted percentages from Dual-Frame Sampling Weights.
[c] HPV initiation includes those who had received at least 1 dose of the HPV vaccine.
[d] HPV completion includes those who had received at least 3 doses of the HPV vaccine.
[e] Adolescents were classified as below federal poverty level if their total family income was less than the federal poverty level specified for the applicable family size and number of children aged <18 years.
[f] Adolescent has taken at least one dose of seasonal influenza vaccination in the past three years.
[g] Adolescent has taken at least one dose of TDAP only vaccination since age 10 years old and before 13 years old.
[h] Adolescent has taken at least one dose of Meningitis vaccination.

Meningitis vaccination, for which Hispanic teens have higher prevalence of vaccination compared to non-Hispanic Whites, meaning that approaches for improving other adolescent vaccinations may be useful for improving HPV vaccination as well.

Additionally, boys who received health insurance through their parent's employer or union were less likely to have been vaccinated as compared to those who did not, which may reveal differences in HPV vaccination distribution patterns in government-funded healthcare settings or among the uninsured as compared to private insurers. For example, individuals with public health insurance (e.g., Children's Health Insurance Program, Medicaid) may be eligible for low- or no-cost vaccinations, and may also receive financial assistance for completing the HPV vaccine that individuals with employer or union sponsored insurance may lack (e.g., Vaccines for Children Program).

In 1996, TDAP booster vaccination was recommended for adolescents at ages 11–12 to harmonize with the vaccination schedule for

Table 2
Multivariable analysis of factors predicting HPV vaccine Initiation and Completion among male adolescents, NIS-Teen 2012 (N = 9376).

	HPV initiation		HPV completion	
	Adjusted vaccination coverage[a] % (95%CI)	Adjusted prevalence ratio (95%CI)	Adjusted vaccination coverage[a] % (95%CI)	Adjusted prevalence ratio (95%CI)
Age (Mother/Parent)				
≤34 years	23.6 (18.6, 28.7)	Reference	7.1 (4.5, 9.7)	Reference
35 years < age ≤ 44 years	20.2 (18.0, 22.3)	0.85 (0.67, 1.08)	6.1 (4.8, 7.4)	0.86 (0.56, 1.31)
≥45 years	19.6 (17.4, 21.7)	0.83 (0.65, 1.06)	6.9 (5.4, 8.4)	0.97 (0.62, 1.52)
Education (Mother)				
<12 years	22.6 (18.5, 26.7)	Reference	6.9 (4.6, 9.3)	Reference
12 years	18.5 (15.6, 21.4)	0.82 (0.65, 1.03)	5.3 (3.7, 6.8)	0.76(0.51, 1.14)
>12 years (some college)	17.7 (15.1, 20.3)	0.78 (0.62, 0.99)	5.9 (4.2, 7.6)	0.85(0.55, 1.33)
College graduate	22.7 (19.6, 25.9)	1.00 (0.78, 1.29)	7.8 (5.7, 9.9)	1.12(0.70, 1.80)
Poverty status [e]				
Above poverty (>$75k)	18.8 (15.8, 21.7)	Reference	5.3 (3.9, 6.7)	Reference
Above poverty (≤$75k)	18.9 (16.5, 21.3)	1.01 (0.83, 1.22)	6.3 (4.8, 7.7)	1.19(0.85, 1.67)
Below poverty	23.6 (19.8, 27.5)	1.26 (0.96, 1.65)	8.0 (5.8, 10.2)	1.51 (0.97, 2.37)
Marital status of mother				
Married	20.2 (18.1, 22.2)	Reference	6.6 (5.4, 7.8)	Reference
Other	20.6 (18.1, 23.2)	1.02 (0.87, 1.20)	6.3 (4.8, 7.8)	0.95 (0.70, 1.30)
Ethnicity/Race of teens				
Hispanic	25.6 (21.7, 29.5)	Reference	9.4 (6.9, 11.8)	Reference
Non-Hispanic White only	17.0 (15.2, 18.7)	0.66 (0.55, 0.80)	5.1 (4.0, 6.1)	0.50 (0.38, 0.77)
Non-Hispanic Black only	23.4 (19.2, 27.7)	0.92 (0.72, 1.16)	5.1 (3.3, 6.9)	0.55 (0.36, 0.83)
Other	18.8 (14.5, 23.1)	0.73 (0.56, 0.96)	8.1 (4.8, 11.3)	0.86 (0.54, 1.38)
Age in years of selected teen				
13 years old	18.8 (15.9, 21.7)	Reference	5.4 (3.9, 6.9)	Reference
14 years old	22.3 (18.7, 25.8)	1.19 (0.96, 1.46)	5.7 (3.8, 7.7)	1.06 (0.69, 1.63)
15 years old	20.1 (17.0, 23.3)	1.07 (0.87, 1.33)	7.4 (5.2, 9.7)	1.38 (0.91, 2.07)
16 years old	21.2 (18.1, 24.4)	1.13 (0.92, 1.40)	6.8 (4.8, 8.7)	1.25 (0.83, 1.87)
17 years old	19.4 (15.9, 22.9)	1.03 (0.82, 1.30)	7.6 (5.4, 9.7)	1.40 (0.95, 2.05)
Source of health insurance for teens				
Provided through employment or union	18.2 (15.9, 20.5)	Reference	5.2 (3.9, 6.5)	Reference
Not Provided through employment or union	22.6 (20.0, 25.2)	1.24 (1.02, 1.51)	8.0 (6.2, 9.8)	1.55 (1.05, 2.28)
Facility type for teen's providers				
All public facilities	19.6 (15.3, 23.9)	Reference	5.6 (3.3, 8.0)	Reference
All hospital facilities	18.3 (13.9, 22.7)	0.93 (0.68, 1.29)	4.2 (2.4, 5.9)	0.74 (0.41, 1.33)
All private facilities	19.6 (17.5, 21.7)	1.00 (0.78, 1.28)	6.5 (5.2, 7.7)	1.15 (0.72, 1.84)
Mixed/Other	23.2 (20.3, 26.1)	1.18 (0.92, 1.52)	7.8 (5.7, 9.9)	1.38 (0.85, 2.26)
Do teen's providers order vaccination from state/local health department				
All providers	21.2 (19.4, 22.9)	Reference	6.7 (5.6, 7.8)	Reference
Some but possibly not all	19.5 (15.4, 23.7)	0.92 (0.74, 1.15)	5.7 (3.6, 7.8)	0.86 (0.57, 1.28)
No providers	18.0 (13.6, 22.5)	0.85 (0.66, 1.11)	6.0 (3.0, 9.0)	0.89 (0.53, 1.50)
Don't know	16.7 (12.1, 21.3)	0.79 (0.59, 1.05)	6.5 (3.1, 9.9)	0.97 (0.56, 1.67)
Influenza vaccination[b]				
Yes	26.9 (24.6, 29.2)	1.77 (1.52, 2.05)	10.3 (8.7, 12.0)	3.20 (2.37, 4.33)
No	15.2 (13.3, 17.1)	Reference	3.2 (2.4, 4.1)	Reference
TDAP vaccination[c]				
Yes	20.2 (18.4, 21.9)	0.97 (0.82, 1.15)	7.3 (6.2, 8.5)	1.61 (1.16, 2.25)
No	20.8 (17.7, 23.9)	Reference	4.6 (3.2, 5.9)	Reference
Meningitis vaccination[d]				
Yes	24.7 (22.7, 26.6)	4.98 (3.53, 7.00)	7.5 (6.5, 8.6)	5.55 (2.82, 10.91)
No	5.0 (3.3, 6.6)	Reference	1.4 (0.5, 2.3)	Reference

[a] Multivariable Poisson regression with all variables are included in the model simultaneously. There were 765 (7.54%) subjects excluded due to missing information.
[b] Adolescent has taken at least one dose of seasonal influenza vaccination in the past three years.
[c] Adolescent has taken at least one dose of TDAP only vaccination since age 10 years old and before 13 years old.
[d] Adolescent has taken at least one dose of Meningitis vaccination.
[e] Adolescents were classified as below federal poverty level if their total family income was less than the federal poverty level specified for the applicable family size and number of children aged <18 years.

other adolescent vaccines (e.g. Meningitis), (Anon., 1996, 2006) the same ages as HPV vaccination is now recommended. Over the next two decades, TDAP vaccination consistently increased in prevalence. In 2012, NIS-Teen data for TDAP reflected that 84.6% of adolescents ages 11–18 had received TDAP vaccination (Anon., 2013b). Our results show that 63.8% of adolescent boys had received a TDAP vaccination at the recommended ages of 11–12 years. Efforts to improve and sustain high TDAP vaccination have been successful and may elucidate opportunities to improve HPV vaccination.

Finally, receipt of other adolescent vaccinations, particularly meningitis, was strongly associated with HPV vaccine initiation and completion among boys. The discrepancy between the level of HPV vaccination and that of other recommended adolescent vaccines highlights missed opportunities. Considering that receipt of other adolescent immunizations by age 18, such as TDAP, is above the Healthy People 2020 targets of 80%, (Anon., 2012a) it is evident that there exist opportunities to initiate HPV vaccination that are currently underutilized. The 2012–2013 President's Cancer Panel Report on HPV vaccination identified reducing missed opportunities for HPV vaccination as the first goal for accelerating HPV vaccination in the US (Anon., 2014c). Interventions that couple the HPV vaccine with other recommended adolescent immunizations are needed. Additionally, future research that explores how provider and patient level factors relate to low HPV vaccination receipt among boys is needed.

There are limitations of this study. After weighting adjustments, bias from non-response, errors in vaccination status, and differential

sampling coverage may persist. Given that all independent variables were included in the multivariate model based on their clinical relevance, there may still be some unmeasured confounding.

5. Conclusions

This study highlights certain demographic factors that are associated with receipt of HPV vaccination among adolescent boys. Additionally, our results indicate a need to study the effectiveness of healthcare provider education on HPV vaccination rates. Healthcare providers should be encouraged to make strong recommendations for the receipt of HPV vaccination, and to consider pairing the initiation of the HPV vaccine with the administration of other recommended adolescent immunizations.

Abbreviations

NIS-Teen	National Immunization Survey-Teen
DOI	Diffusion of Innovations
HPV	human papillomavirus
US	United States
TDAP	tetanus, diphtheria, and pertussis

Authors' contributions

All authors made substantial contributions to the conception and design of the study, the gathering of data, and/or analysis and interpretation of the data. All authors participated in the writing, reviewing, and revising of the manuscript, and approved the final version before submission.

Conflict of interest

The authors have no conflicts to disclose.

Transparency document

The Transparency document associated with this article can be found, in online version.

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