

Trends in Reasons for Human Papillomavirus Vaccine Hesitancy: 2010–2020

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abstract

OBJECTIVES: We sought to identify trends in the main reasons United States parents of unvaccinated children gave for not intending to vaccinate their adolescent children against HPV from 2010 to 2020. As interventions designed to increase vaccine uptake have been implemented across the United States, we predicted that reasons for hesitancy have changed over this period.

METHODS: We analyzed data from the 2010 to 2020 National Immunization Survey-Teen, which included 119 695 adolescents aged 13 to 17 years. Joinpoint regression estimated yearly changes in the top five cited reasons for not intending to vaccinate using annual percentage changes.

RESULTS: The five most frequently cited reasons for not intending to vaccinate included “not necessary,” “safety concerns,” “lack of recommendation,” “lack of knowledge,” and “not sexually active.” Overall, parental HPV vaccine hesitancy decreased by 5.5% annually between 2010 and 2012 and then remained stable for the 9-year period of 2012 through 2020. The proportion of parents citing “safety or side effects” as a reason for vaccine hesitancy increased significantly by 15.6% annually from 2010 to 2018. The proportion of parents citing “not recommended,” “lack of knowledge,” or “child not sexually active” as reasons for vaccine hesitancy decreased significantly by 6.8%, 9.9%, and 5.9% respectively per year between 2013 and 2020. No significant changes were observed for parents citing “not necessary.”

CONCLUSIONS: Parents who cited vaccine safety as a reason for not intending to vaccinate their adolescent children against HPV increased over time. Findings support efforts to address parental safety concerns surrounding HPV vaccination.



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WHAT'S KNOWN ON THIS SUBJECT: Despite the proven safety and effectiveness of HPV vaccination, coverage falls below the Healthy People 2020 target of attaining an 80% vaccination rate. HPV vaccine hesitancy is one key factor contributing to low HPV vaccine uptake.

WHAT THIS STUDY ADDS: We identify trends in the five most frequently endorsed reasons for HPV vaccine hesitancy among parents with unvaccinated adolescents from 2010 to 2020. Findings support efforts to enhance confidence in HPV vaccination and develop strategies for addressing HPV vaccine hesitancy.

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Human papillomavirus (HPV) is the most common sexually transmitted infection in the United States,¹ with an estimated 14 million new cases each year.² Oncogenic HPV infections contribute to virtually all cases of cervical, 90% of anal, 69% of vaginal, 60% of oropharyngeal, 51% of vulvar, and 40% of penile cancers¹ and second primary cancers.^{1,3-7} HPV accounts for ~44 000 HPV-associated cancers per year: ~25 000 among women and ~19 000 among men.⁸ Although overall cancer incidence has been decreasing in the United States, HPV-associated oropharyngeal and anal cancers are some of the few cancers with increasing incidence rates.^{9,10} To reduce HPV-associated infections and cancer burden, the Advisory Committee on Immunization Practices recommends routine HPV vaccination for adolescents between 11 and 12 years of age; however, it is also appropriate for children aged 9 to 10 to receive the vaccination.^{11,12} Catch-up vaccination is recommended for males and females aged 13 to 26 years.^{11,12} It is estimated that the HPV vaccine could prevent >90% of HPV-attributable cancers.⁸ Despite the proven safety and effectiveness of the HPV vaccine, vaccination coverage remains low and falls short of the *Healthy People 2030* goal of 80% completion among adolescents aged 13 to 15 years old.¹³ As of 2020, only 75.1% of adolescents aged 13 to 17 years had received at least 1 dose of the HPV vaccine and 58.6% had completed the series, either 2 or 3 doses based on the age of initiation.¹⁴

One of the main reasons for suboptimal HPV vaccination coverage is parental vaccine hesitancy.^{15,16} Vaccine hesitancy was identified as a significant public health challenge by the World Health Organization's Strategic Advisory Group of Experts on Immunization in 2014 and one of the top 10 health threats in the world.¹⁶ The World Health Organization's Strategic Advisory

Group of Experts on Immunization defines vaccine hesitancy as "the reluctance or refusal to vaccinate despite the availability of vaccines," which may "reverse the progress made in tackling vaccine-preventable diseases."¹⁶ Adolescent vaccination practices are primarily driven by their parent/guardian's decision-making, thus understanding the reasons for parental/guardian HPV vaccine hesitancy may inform interventions to improve overall vaccination uptake.¹⁷ In the years after the release of the HPV vaccine, primary barriers to HPV vaccination voiced by parents included lack of provider recommendation and lack of knowledge along with concerns about cost, the newness of the vaccine, and potential effects on child sexual behavior.¹⁸ More recent studies suggest reasons for parental HPV vaccine hesitancy may be changing.^{17, 19-21} For example, a study examining reasons parents did not intend to vaccinate their adolescent for HPV over the 9-year period from 2008 to 2016 revealed an increase in safety concerns and lack of school entry requirements, but a decrease in lack of provider recommendation, lack of knowledge, and statements about their child not being sexually active.²²

As provider- and community-based interventions to increase HPV vaccination coverage have been implemented across the United States,²³⁻²⁵ it is possible that parents' primary reasons for HPV vaccine hesitancy have changed over the years, especially after 2016. Nevertheless, little research has investigated this possibility. Therefore, the current study examined whether US parents' top five reasons for not intending to vaccinate their adolescent children against HPV changed from 2010 to 2020. Findings from this study could be critical to developing tailored and targeted interventions to address parents' concerns and increase HPV vaccine uptake.

METHODS

Data Source and Study Sample

To examine trends in reasons for parents of unvaccinated children gave for not intending to vaccinate their adolescent children against HPV, we used data from the 2010 to 2020 National Immunization Survey-Teen (NIS-Teen). The NIS-Teen is a nationally representative random-dial-digit telephone survey of parents or guardians of adolescents aged 13 to 17 years in their household and of their primary care professionals conducted by the Centers for Disease Control and Prevention (CDC). Vaccination coverage is based on a provider-reported vaccination history; however, the provider-reported vaccination data are not verified by NIS-Teen. Details of NIS-Teen survey sampling, data collection, and weighting operations have been described previously.²⁶ The NIS-Teen study was approved by the National Center for Health Statistics research ethics review board and is deidentified and publicly available data; therefore, ethical review and informed consent were not required for this study.

Data for the current study were limited to parents/guardians of unvaccinated adolescents (i.e., adolescents aged 13 to 17 years who had not received any HPV vaccine doses at the time of the survey) who did not intend to vaccinate their child for HPV in the next 12 months. More specifically, parents in the current study selected "not likely at all," "not too likely," or "not sure/do not know" in response to the question "How likely is it that [adolescent's name] will receive HPV shots in the next 12 months?" Thus, when considering the continuum of vaccine hesitancy that ranges from complete refusal to complete acceptance of all vaccines,²⁷ the current sample of parents can be described as "non-intenders" who

are “highly hesitant” with respect to HPV vaccination.

Primary Outcome Measure

The primary outcome was the main reason parents/guardians endorsed to indicate why they were not intending to vaccinate their adolescent child against HPV (also referred to as parental HPV vaccine hesitancy). Parents/guardians of unvaccinated adolescents who were not intending to vaccinate their child (i.e., selected “not at all likely,” “not too likely,” or “not sure/do not know” to the question about whether their child would receive HPV vaccination in the next 12 months) were further asked, “What is the main reason [your teen] will not receive HPV shots in the next 12 months?” Parents/guardians were asked to select the main reason from a total of 28 unique reasons. For the trend analyses, we limited the analysis to the top five most frequently cited reasons between the years 2010 and 2020.

Statistical Analyses

Analyses were weighted to account for the complex survey design used by the NIS-Teen by using SAS survey procedures, which reduced bias owing to nonresponse and noncoverage and allowed the results to be generalized to the US adult population. Descriptive statistics were employed to describe the characteristics of the study sample (both adolescent and parent/guardian), as well as reasons for not intending to vaccinate adolescents against HPV infection. Descriptive statistics were conducted by using SAS, version 9.4 (SAS Institute Inc).

Trends in parental/guardian reasons for vaccine hesitancy were calculated by using joinpoint regression, a variant of log-linear regression.²⁸ This method determines the number of joinpoints that are adequate for assessing significant changes in incidence

trends over time. Joinpoint regression models determined the starting and ending years of increases/decreases (joinpoints) and then estimated the annual percentage change (APC) and 95% confidence intervals (CI) on the basis of a regression model between the 2 joinpoint years. The final joinpoint models were based on log-transformed percentages to better ensure the normality of residuals. The permutation test method determined the model with the fewest number of joinpoints necessary to effectively characterize trends with a maximum of 2 joinpoints. Statistical tests were 2-tailed, and $P < .05$ was considered statistically significant. Joinpoint regression was performed in Joinpoint 4.9.0.1 (National Cancer Institute Statistical Research Applications Branch, Bethesda, MD).

RESULTS

A total of 180 103 unvaccinated adolescents were included in the study, of whom 119 695 ($n = 65.7\%$) parents/guardians were classified as “highly hesitant” with respect to HPV vaccination (i.e., their child had not received any HPV doses and they did not intend to vaccinate in the next 12 months). Adolescent and maternal characteristics are summarized in Table 1. Respondent race/ethnicity was included to describe the study sample characteristics. There was equal distribution among age groups. Most adolescents were male (60.0%), non-Hispanic white race/ethnicity (63.5%), lived above the poverty line (84.2%), and had not received a provider recommendation to get vaccinated for HPV (69.6%). Approximately 71.0% of mothers were married, and 40.4% had a college degree or higher.

Table 2 provides frequencies and proportions for all 28 reasons parents/guardians endorsed for not vaccinating their adolescents against

HPV infection. The five most frequently endorsed reasons for HPV vaccine hesitancy over the entire 11-year period included “not necessary” (20.3%), “safety/side effects” (15.3%), “not recommended” (14.4%), “lack of knowledge” (12.4%), and “not sexually active” (10.3%). After the fifth most common reason, the next most frequent reason was “not appropriate age,” endorsed by 4799 parents (4.2%). The five most common reasons given by hesitant parents/guardians for not vaccinating their adolescent against HPV infection stratified by year are presented in Table 3. The results are similar to the trends from the joinpoint analyses reported below. The proportion of hesitant parents/guardians endorsing safety or side effect concerns increased over the 11-year period from 8.9% in 2010% to 25.1% in 2020. The remaining 4 reasons remained relatively stable or decreased over the 11-year period. For example, the proportion of hesitant parents/guardians endorsing “not sexually active” decreased from 14.6% in 2010% to 7.4% in 2020.

Figures 1A and 1B show the trends in parental/guardian HPV vaccine hesitancy and reasons for HPV vaccine hesitancy, respectively, and Table 4 details the corresponding APC. Overall, parental/guardian HPV vaccine hesitancy decreased by 5.5% annually between 2010 and 2012 (APC, -5.5 ; 95% CI, -8.5 to -2.3 ; $P = .006$) and then remained stable for the 9-year period of 2012 through 2020 (Fig 1A and Table 4). The proportion of parents/guardians citing “safety or side effects” as the main reason for vaccine hesitancy increased significantly by 15.6% annually from 2010 to 2018 (APC, 15.6 ; 95% CI, 10.5 to 20.8 ; $P \leq .001$) and has remained stable from 2018 to 2020. The proportion of parents/guardians citing “not recommended” as the main reason for vaccine hesitancy remained stable

TABLE 1 Characteristics of Study Sample: NIS-Teen, 2010 to 2020 (Unweighted $n = 119\,695$)

	Unweighted Frequency (Weighted %)
Adolescent	
Age, y	
13	24 716 (20.5)
14	24 575 (20.4)
15	23 661 (19.7)
16	24 106 (19.9)
17	22 637 (19.3)
Sex	
Female	46 570 (39.0)
Male	73 125 (60.0)
Race/ethnicity	
Non-Hispanic white	83 869 (63.5)
Non-Hispanic Black	10 375 (12.1)
Hispanic	14 404 (16.0)
Non-Hispanic other	11 047 (8.4)
Poverty status	
Above poverty	99 339 (84.2)
Below poverty	12 478 (15.7)
Number of doctor's visits in the past 12 mo	
≥4	20 612 (16.9)
2–3	39 268 (32.6)
1	36 928 (31.0)
None	22 125 (19.4)
Census region	
Northeast	19 288 (15.4)
Midwest	27 012 (23.7)
South	45 902 (38.9)
West	27 493 (22.0)
Provider recommendation	
Yes	36 080 (30.4)
No	79 234 (69.6)
Mother	
Age, y	
≤34	8053 (7.4)
35–44	51 517 (44.7)
≥45	60 125 (47.8)
Marital status	
Married	91 905 (71.0)
Not married	27 790 (29.0)
Education	
College graduate or higher	54 912 (40.4)
Some college	35 962 (27.9)
High school graduate	20 561 (23.0)
Less than high school	8260 (8.7)
No of children aged <18 y in household	
1	47 596 (32.8)
2–3	59 293 (54.2)
≥4	12 806 (13.0)

from 2010 to 2013 but decreased by 6.8% per year between 2013 and 2020 (APC, -6.8% ; 95% CI, -11.0% to -2.4% ; $P = .010$). Similarly, parents/guardians citing “lack of knowledge” as the main reason for vaccine hesitancy remained stable from 2010 to 2013 but then decreased by 9.9% annually from 2013 to 2020 (APC, -9.9% ; 95% CI, -14.4% to -5.1% ; $P = .003$). Finally, parents/guardians

citing “child not sexually active” as the main reason for vaccine hesitancy remained stable from 2010 to 2012 and then decreased by 5.9% per year from 2012 to 2020 (APC, -5.9% ; 95% CI, -10.4% to -1.2% ; $P = .022$). No significant changes were observed for parents citing “not necessary” over the reporting period.

DISCUSSION

Although HPV vaccination rates in the United States have steadily improved over the past decade, a sizeable subset of parents remains highly hesitant about administering the vaccine to their adolescent children. In this study, we examined trends in the top five reasons for HPV vaccine hesitancy from 2010 to 2020 among US parents/guardians who had not vaccinated their adolescents for HPV and had no intention to vaccinate them in the next 12 months. During the 11-year period, the most common reasons parents endorsed were “not needed or not necessary,” “safety/side effects concerns,” “not recommended,” “lack of knowledge,” and “child not sexually active.” We also observed important trends in these reasons over time, namely an increase in the percentage of parents/guardians citing safety concerns and a decrease in nearly all other reasons.

Decreases in the percentage of parents/guardians citing lack of provider recommendation, lack of knowledge, and child “not sexually active” as the main reason for HPV vaccine hesitancy during the 11-year period are encouraging and suggest that interventions have been successful in reducing perceived barriers to HPV vaccination. Indeed, these findings are consistent with previous research, including studies that have examined data from NIS-Teen, which revealed similar declines.^{20–22,29,30} To increase the uptake of HPV vaccination, the National Vaccination Advisory Committee has proposed several recommendations that are focused on improving provider recommendation and reducing missed clinical opportunities for vaccination, as well as increasing parental demand for the vaccine.³¹ Provider recommendation has been shown to be the single best predictor of HPV vaccine uptake and vaccine acceptability.^{32–34} One explanation for the decrease in

TABLE 2 Reasons Given by Parents/Guardians for Not Intending to Vaccinate Adolescent Against HPV Infection, National Immunization Survey-Teen, 2010 to 2020 (*n* = 119 695)

	Unweighted Frequency (Weighted %)
Not necessary	22 987 (20.3)
Safety/side effects	18 057 (15.3)
Not recommended	15 825 (14.4)
Lack of knowledge	13 398 (12.4)
Not sexually active	11 803 (10.3)
Not appropriate age	4799 (4.2)
Parental decision	3869 (3.4)
Child is male	3620 (3.3)
Not required for school	2805 (2.5)
Already up to date	2890 (2.4)
Need more information	2445 (2.1)
Other reason	1682 (1.5)
Cost	1315 (1.3)
Child fearful	1344 (1.2)
Do not believe in vaccines	1258 (1.1)
Child should make the decision	1155 (1.1)
Special needs/illness	906 (0.7)
No doctor visit scheduled	761 (0.6)
Religion	751 (0.6)
Increased sexual activity concern	722 (0.5)
Effectiveness concerns	347 (0.3)
Intend to complete but not planned	213 (0.2)
Not available	147 (0.1)
Time	133 (0.1)
Transportation/appointment difficulty	117 (0.1)
College shot	76 (0.1)
Already sexually active	32 (0.0)
No OB/GYN	10 (0.0)

parents citing these 3 reasons for hesitancy is that provider recommendation for HPV vaccination has increased. For instance, Sonawane et al found that provider recommendation for the HPV vaccine increased from 27.0% in 2012% to 49.3% in 2018.³⁵ Second, the decrease could be attributed to improved educational outreach and evidence that the vaccine is not associated with increased sexual

behavior,^{36,37} as well as interventions addressing lack of knowledge.²⁵ Despite the decrease in these 3 reasons, a substantial group of parents/guardians remain unwilling to vaccinate their children for HPV, which may indicate that provider recommendation or improved knowledge about the vaccine alone may be ineffective in motivating these hesitant parents/guardians to vaccinate.

Over the 11-year period, we also found a significant increase in the proportion of parents/guardians citing safety/side effect concerns as the main reason for HPV vaccine hesitancy. This increasing trend in safety concerns is consistent with previous research.^{22,29,30} Our study advances the literature by examining the primary reasons for HPV vaccine hesitancy over a decade-long period and by using data through 2020 versus 2016.²² The observed increase in safety concerns may be due to several reasons. One likely possibility could be related to the widespread distribution of vaccine misinformation on the internet. According to the Pew Research Center, internet use in the United States has increased from 76% in 2010 to 93% in 2021,³⁸ and social media accounts run by antivaccination proponents have increased by 7.8 million since 2019.³⁹ Fear tactics are often used by antivaccine campaigners to dissuade parents from vaccinating their children. There have been several myths propagated about vaccines causing adverse reactions, including diseases like autism, multiple sclerosis, autoimmune diseases, ovarian failure, and even death. Although these myths have been scientifically debunked, they continue to circulate.^{40,41} Doubts about HPV vaccine safety are exacerbated by misinformation spread through social media and other platforms.⁴² It has been documented that exposure to or

TABLE 3 Most Commonly Reasons Given by Parents/Guardians for Not Intending to Vaccinate Adolescent Against HPV Infection Stratified by Year, National Immunization Survey-Teen, 2010 to 2020 (*n* = 119 695)

Year	Not Necessary	Not Recommended	Safety/Side Effect Concerns	Lack of Knowledge	Not Sexually Active	All Other Reasons Combined
2010	3525 (20.9)	2427 (15.1)	1482 (8.9)	2184 (13.6)	2549 (14.6)	4618 (27.0)
2011	2093 (22.5)	1301 (14.3)	784 (8.8)	1008 (11.7)	1391 (14.9)	2525 (27.3)
2012	2598 (21.8)	2234 (19.1)	1114 (9.1)	1860 (15.9)	1182 (10.1)	2775 (24.1)
2013	2045 (19.2)	1935 (19.1)	1071 (11.0)	1501 (15.9)	1018 (9.3)	2744 (25.6)
2014	2474 (22.3)	1453 (13.0)	1387 (12.7)	1436 (13.9)	1134 (10.5)	3054 (27.6)
2015	2608 (24.0)	1522 (13.6)	1542 (13.0)	1477 (13.2)	1233 (11.1)	2883 (25.1)
2016	2307 (22.7)	1229 (12.6)	2065 (19.3)	1172 (12.2)	976 (9.1)	2470 (24.1)
2017	1518 (15.3)	1131 (12.8)	2169 (22.1)	942 (10.6)	757 (7.4)	3094 (31.8)
2018	1289 (17.0)	968 (11.5)	2013 (23.4)	745 (8.3)	665 (7.8)	2576 (32.0)
2019	1201 (15.6)	945 (11.7)	1973 (26.2)	685 (8.9)	597 (6.8)	2352 (30.8)
2020	1170 (15.6)	839 (11.4)	1882 (25.1)	606 (8.1)	557 (7.4)	2407 (32.5)

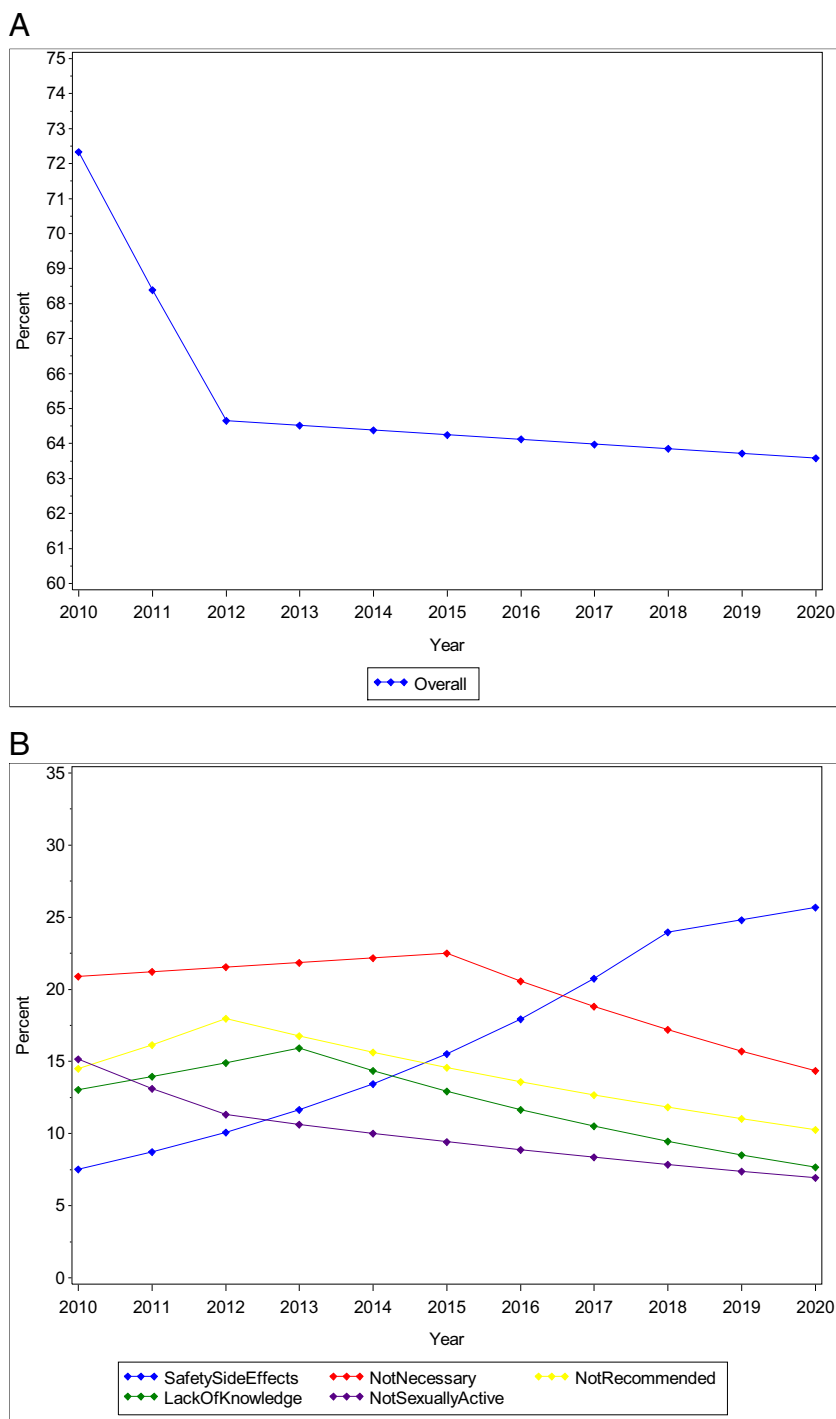


FIGURE 1 APC in HPV vaccine hesitancy and reasons given by parents/guardians for not intending to vaccinate adolescent against HPV infection from 2010 to 2020: (A) overall HPV vaccine hesitancy (B) reasons given for HPV vaccine hesitancy. Data: NIS-Teen

engagement with negative HPV vaccine content is associated with HPV vaccine hesitancy.^{42,43} Unfortunately, there has been an

increase in such content on social media and other platforms over the years, which may, in part, explain the rise in safety concerns we observed.⁴⁴

⁴⁵ It should be noted that these data were collected before the coronavirus disease 2019 pandemic and, therefore, it is reasonable to expect that HPV vaccine-related safety concerns may continue to rise because of the plethora of misinformation surrounding coronavirus disease 2019 vaccination.⁴⁶

Although parental concerns about the safety of the vaccine have been on the rise, there is no scientific basis underlying the belief that the HPV vaccine is unsafe. In fact, a recent study by Sonawane et al revealed a decreasing trend in nonserious adverse effects (AE) and no change in serious AE reporting trends from 2015 to 2018.³⁰ They reported that, of the 16 621 AEs reported to the Vaccine Adverse Event Reporting System after HPV vaccination, 95.4% were nonserious AEs.³⁰ In addition, the CDC monitors the safety of vaccines and reports that, of the ~108 million HPV doses administered between June 2006 and December 2017, there has been no association between vaccination and death.⁴⁷ Moreover, neither the Food and Drug Administration nor the CDC has found any association between HPV vaccination and reproductive issues such as primary ovarian insufficiency or early menopause.⁴⁷

STRENGTHS AND LIMITATIONS

Despite several strengths of our study, including using a nationally representative data source, a large sample size, and more than a decade of data to evaluate trends over time, our study is not without limitations. First, reasons underlying HPV vaccine hesitancy may be broader than those represented in this study because NIS-Teen does not ask parents of vaccinated children about hesitancy; thus, parents who overcame their hesitancy to vaccinate their child are not clearly delineated here. Accordingly, the reasons given by the

TABLE 4 Annual Percentage Change Over Time in the Parent/Guardian Reasons for Human Papillomavirus Vaccine Hesitancy From 2010 to 2020 (National Immunization Survey-Teen)

Barriers	APC	Lower CI	Upper CI	P
Overall				
2010–2012	–5.5	–8.5	–2.3	.006
2012–2020	–0.2	–0.7	0.3	.322
Safety or side effects				
2010–2018	15.6	10.5	20.8	<.001
2018–2020	3.5	–28.3	49.4	.825
Not necessary				
2010–2015	1.5	–5.5	9.0	.628
2015–2020	–8.6	–16.9	0.5	.059
Not recommended				
2010–2013	11.4	–22.0	59.1	.488
2013–2020	–6.8	–11.0	–2.4	.010
Lack of knowledge				
2010–2013	6.9	–5.7	21.1	.240
2013–2020	–9.9	–14.4	–5.1	.003
Child not sexually active				
2010–2012	–13.6	–34.0	13.1	.232
2012–2020	–5.9	–10.4	–1.2	.022

current subset of parents may not be representative of the reasons parents/guardians are hesitant overall. Second, there is a possibility of recall bias on children’s HPV vaccination status, however, the use of provider-verified records should help reduce the bias. The third is nonresponse bias (sampling bias), although the use of weighting potentially reduces this bias. It is possible that vaccine-hesitant parents/guardians who are leery of research and the medical establishment may have refused to respond to the NIS-Teen survey. Thus, these subgroups may not be represented in the current findings. Finally, vaccine decision-making is complex, and the reasons for the lack of intent to vaccinate are likely

multifactorial. We were able to report only the primary reason from each parent, whereas interventions may need to address multiple reasons concurrently.

CONCLUSIONS

We demonstrated that parents’ reasons for not intending to vaccinate their adolescent son or daughter against HPV infection have changed over time. Although reasons relating to lack of provider recommendation, lack of knowledge, and their child not being sexually active decreased in importance from 2013 to 2020, concerns regarding HPV vaccine safety have increased despite consistent evidence of the vaccine’s favorable safety profile. HPV

vaccine uptake has improved over time with >70% of US adolescents estimated to have initiated the series as of 2020. Closing the gap on the remaining 28% will likely require a mix of current and newer approaches to address vaccine hesitancy. Our findings suggest that strategies to combat safety concerns and improve vaccine confidence are urgently warranted. These findings support local, state, and national efforts to inform parents of the benefits of HPV vaccination for cancer prevention and to develop and disseminate strategies for addressing parental concerns about HPV vaccination. It may also be beneficial to tailor interventions to parents’ level of hesitancy and the main reason they are hesitant to vaccinate their children.²¹ Future studies are needed to identify and implement tailored interventions that address common reasons for parental HPV vaccine hesitancy, particularly increasing safety concerns.

ABBREVIATIONS

AE: adverse effects
 APC: annual percentage change
 CDC: Centers for Disease Control and Prevention
 CI: confidence interval
 HPV: human papillomavirus
 NIS-Teen: National Immunization Survey-Teen

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