



A Mixed-Methods Analysis of Barriers to and Facilitators of Human Papillomavirus Vaccination Among Adolescents in Montana

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Abstract

Objectives: Human papillomavirus (HPV) vaccination rates among adolescents are lower in rural areas than in urban areas of the United States. The objective of this study was to identify barriers to and facilitators of adolescent HPV vaccination in Montana, a large, primarily rural state.

Methods: Using a mixed-methods design, we integrated quantitative analyses of Montana's National Immunization Survey–Teen (NIS-Teen) data from 2013–2017 with qualitative data collected at a statewide meeting in October 2018 and from stakeholder interviews conducted from October 2018 through June 2019. Using NIS-Teen data, we identified trends and estimated adjusted prevalence ratios (aPRs) to identify factors associated with vaccine uptake. Using directed content analysis of qualitative data, we identified themes related to vaccine uptake.

Results: In Montana, initiation of the HPV vaccine series among adolescents aged 13–17 increased from 34.4% in 2013 to 65.5% in 2017. We identified 6 themes related to HPV vaccination from qualitative analyses, including medical providers' recommendation style as a facilitator of vaccination and parental vaccine hesitancy as a barrier to vaccination. In NIS-Teen 2017 data ($n = 326$ adolescents), receiving a medical provider recommendation was significantly associated with series initiation (aPR = 2.3; 95% CI, 1.5–3.6). Among parents who did not intend to initiate the vaccine series for their adolescent within 12 months ($n = 71$), vaccine safety was the top concern (aPR = 24.5%; 95% CI, 12.1%–36.9%).

Conclusions: HPV vaccination rates have increased in Montana but remain lower than rates for other adolescent vaccines. Future work should focus on reducing missed opportunities, increasing parents' knowledge of and confidence in vaccination, and training medical providers on addressing common vaccine concerns.

Keywords

vaccines, adolescent health, rural health, public health, infectious disease, NIS-Teen

Human papillomavirus (HPV) infections are the most common sexually transmitted infection in the United States.^{1,2} HPV infection can cause several types of cancer, including cervical, penile, oropharyngeal, and anal cancers.³ In 2006, a quadrivalent HPV vaccine was licensed in the United States as a 3-dose series. After licensure, the Advisory Committee on Immunization Practices (ACIP) recommended HPV vaccination for adolescent females; in 2011, the recommendation was expanded to include adolescent males.⁴ In 2014, a 9-valent HPV vaccine was introduced, and in 2016, the ACIP recommendation on the number of doses in the series changed. Currently, adolescents are recommended to start the 2-dose vaccine series at age 11 or 12,

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Table 1. Factors influencing human papillomavirus vaccine uptake and adherence, modified from the Vaccine Perceptions, Accountability and Adherence Model^a

Factors	Examples
Environmental	<ul style="list-style-type: none"> • External communications messaging (eg, media) • State and local policies
Structural and sociocultural	<ul style="list-style-type: none"> • Vaccine availability and access • Sociodemographic and sociogeographic influences
Adolescent and caregiver	<ul style="list-style-type: none"> • Knowledge of the vaccine • Health beliefs • Use of preventive health care services • Adolescent–caregiver relationship • Self-efficacy
Medical provider	<ul style="list-style-type: none"> • Knowledge of the vaccine • Support for and perceived importance of the vaccine • Providing an effective recommendation for vaccination

^aModel developed by Katz et al.¹⁷

but 3 doses are recommended if the series is initiated at or after age 15.^{5,6}

Nationally, HPV vaccine coverage has lagged behind uptake of other adolescent vaccines. In 2017, the percentage of US adolescents aged 13–17 who had received the tetanus-diphtheria-acellular pertussis (Tdap) vaccine was 88.7%. In contrast, initiation of the HPV vaccine series (ie, receipt of ≥ 1 HPV vaccine dose) was 65.5%, and completion of the HPV vaccine series was 48.6%, below the Healthy People 2020 goal of 80%.⁷ Studies have identified wide-ranging barriers to adolescent HPV vaccination, including financial barriers, parental hesitancy about the necessity and safety of the vaccine, and lack of strong recommendations from medical providers.⁸ Interventions to increase HPV vaccine uptake have focused on addressing these barriers, including providing increased access to immunization services and educating medical providers about the vaccine, including effective communication strategies.^{9,10}

Although HPV vaccination rates among adolescents have been increasing nationally,⁷ a persistent disparity in vaccination rates exists between rural and urban areas. In 2017, HPV vaccination initiation rates were 10.8 percentage points lower among adolescents residing in rural areas than in urban areas of the United States.⁷ A recent study reported that among rural US adolescents unvaccinated against HPV, 78.9% had a missed opportunity for vaccination, defined as receipt of another vaccine at age 11 or 12 but not the HPV vaccine during the same health care encounter.¹¹ The National Vaccine Advisory Committee has recommended additional research on barriers to HPV vaccination in rural areas,¹² and the National HPV Vaccination Roundtable has

prioritized the identification of strategies to increase immunization rates in rural areas as a top research priority.¹³

Montana is the fourth-largest state in geographic size but 44th in population size, with approximately 1.1 million residents.¹⁴ Montana's current State Health Improvement Plan includes goals to increase rates of early childhood and adolescent vaccination, including HPV, by 2023.¹⁵ Similar to US trends, rates of adolescent HPV vaccination in Montana have been lower than rates of adolescent Tdap vaccination, which is required for school attendance in Montana. To inform how Montana may increase HPV vaccination rates, the objectives of our study were to identify current barriers to and facilitators of adolescent HPV vaccine uptake in Montana. We used a mixed-methods approach that integrated analysis of National Immunization Survey–Teen (NIS-Teen) data with qualitative data collected from medical and public health stakeholders.

Methods

Study Overview

We used NIS-Teen public-use data to identify factors associated with adolescent HPV vaccine series initiation in Montana.¹⁶ We collected qualitative data at a statewide meeting of organizations involved in HPV prevention and through interviews with medical providers and other public health stakeholders. Our preliminary analyses of NIS-Teen data informed development of semi-structured tools to guide these interviews. We then conducted additional NIS-Teen analyses on the basis of interview findings, thus integrating our quantitative and qualitative methodology.

We used the Vaccine Perceptions, Accountability and Adherence Model by Katz et al¹⁷ as a conceptual framework to inform our approach. The model was developed to guide community- and population-level efforts in increasing HPV vaccine series initiation and completion. The model addresses how environmental, structural and sociocultural, and individual adolescent and caregiver factors influence HPV vaccine acceptance.¹⁷ We also considered how medical provider factors, including medical providers' support of and recommendation for the vaccine, influence vaccine uptake in Montana (Table 1).

The University of Montana's Institutional Review Board classified this study as exempt.

Quantitative Data and Analyses

NIS-Teen is a nationally representative survey conducted annually by the Centers for Disease Control and Prevention (CDC) to monitor adolescent vaccination coverage levels at national, state, and some local levels. NIS-Teen methodology is described in detail elsewhere,¹⁸ and survey interview tools are publicly available.¹⁹ Briefly, NIS-Teen uses random-digit dialing of cell phones and landline telephones,

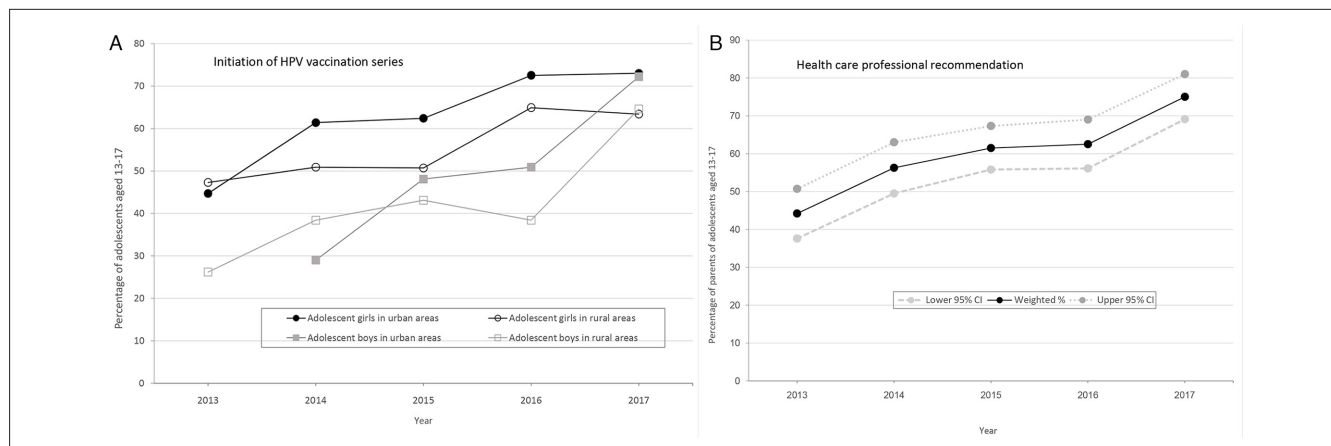


Figure. Trends in initiation of human papillomavirus (HPV) vaccine series and medical provider recommendations among adolescents aged 13-17, National Immunization Survey–Teen (NIS-Teen), Montana, 2013-2017. (A) Percentage of adolescents who initiated HPV vaccination series, by sex and rural or urban residence. NIS-Teen designates whether adolescents live in a metropolitan statistical area (MSA) principal city, an MSA nonprincipal city (ie, suburban), or a non-MSA. In this study, MSA principal city areas are considered urban and non-MSAs are considered rural. Montana does not have any MSA nonprincipal city areas. Data obtained from the Centers for Disease Control and Prevention’s TeenVaxView online tool.²⁰ (B) Percentage of parents or guardians who responded yes to the question, “Had or has doctor or other health care professional ever recommended that teen receive HPV shots?” Data obtained from NIS-Teen’s 2013-2017 public-use data files.¹⁹ Because of a change in how adequate provider data for immunization records were assessed starting with the 2014 NIS-Teen, vaccine series initiation rates from 2013 may not be directly comparable with rates from later years.¹⁶

and interviews are conducted with parents or guardians of adolescents aged 13-17. Parents are asked to consent to allowing survey administrators to contact the adolescent’s immunization provider to obtain immunization records. We limited our analyses to adolescents in Montana with medical provider–confirmed immunization data (our only inclusion criterion). Analyses accounted for the complex survey design and incorporated NIS-provided sampling weights.¹⁶ NIS-Teen designates whether the adolescent lives in 1 of 3 areas: a metropolitan statistical area (MSA) principal city, an MSA nonprincipal city (ie, suburban), or a non-MSA. Similar to other studies using NIS-Teen data,¹¹ our study refers to non-MSAs as rural areas and MSA principal cities as urban areas. Montana does not have any MSA nonprincipal cities.

Using NIS-Teen data available in CDC’s TeenVaxView online tool,²⁰ we examined trends in the initiation of the adolescent HPV vaccine series during 2013-2017 by sex and by whether the adolescent lived in a rural or urban area. We also examined rates of Tdap and meningococcal vaccination, which are also recommended by the ACIP for the same age group. Using NIS-Teen public-use files,²¹ we examined overall rates of HPV vaccine series initiation in 2013-2017 and conducted bivariate and multivariable analyses of factors associated with series initiation in 2017. For these analyses, we combined or masked some categories to report results only from subgroups with at least 30 people.¹⁶ We considered the following factors: sex (male or female), maternal education (\geq some post-high school or \leq high school graduate), type of health insurance (Medicaid, private health insurance only, other health insurance, uninsured), and annual family household income (\leq \$75 000 or $>$ \$75 000). We also examined data on the adolescent’s

race/ethnicity and whether the adolescent had received a checkup in the previous 2 years; however, we did not report these data because of small cell sizes. We reported characteristics of Montana adolescents who did and did not initiate the HPV vaccine series, and we compared these characteristics using linear regression and Rao-Scott χ^2 tests. We estimated prevalence ratios for series initiation based on demographic, socioeconomic, and health access factors in unadjusted and multivariable models. Statistical tests were 2-sided with an α level of .05.

On the basis of results from stakeholder interviews, we also examined data from 2 additional survey questions available in NIS-Teen public-use files: parents’ report that a medical provider had recommended the HPV vaccine for their adolescent child (NIS-Teen survey question: “Has a doctor or other health care professional ever recommended that [TEEN] receive HPV shots?”) in survey years 2013-2017, and parent-reported reasons for not initiating the HPV vaccine series in 2017 (NIS-Teen survey question: “What is the main reason [TEEN] will not receive HPV shots in the next 12 months?”; parent response coded as 1 of 16 potential reasons).¹⁹

We conducted quantitative analyses from October 2018 through June 2019. We analyzed NIS-Teen public-use files with SAS version 9.4 (SAS Institute Inc).

Qualitative Data and Analyses

We collected qualitative data on barriers to and facilitators of adolescent HPV vaccination in Montana in 2 phases. The first phase consisted of collecting qualitative data consisting

Table 2. Characteristics of adolescents aged 13-17 who did and did not initiate the human papillomavirus (HPV) vaccine series, Montana, National Immunization Survey–Teen (NIS-Teen), 2017^a

Characteristic	Total (N = 326)	Initiated the HPV vaccine series (n = 209)	Did not initiate the HPV vaccine series (n = 117)	P value ^b
Weighted % (95% CI) of total	—	65.5 (59.1-71.8)	34.5 (28.2-40.9)	—
Age of adolescent, weighted mean (95% CI), years	15.0 (14.8-15.2)	15.1 (14.8-15.3)	14.8 (14.5-15.1)	.18
Sex				
Female	150 (48.8 [42.2-55.5])	100 (48.2 [39.9-56.4])	50 (50.2 [38.9-61.4])	.78
Male	176 (51.2 [44.5-57.8])	109 (51.8 [43.6-60.1])	67 (49.8 [38.6-61.1])	
Maternal education ^c				
≥Some post–high school	163 (55.9 [49.4-62.4])	105 (58.3 [50.4-66.3])	58 (51.3 [40.1-62.5])	.31
≤High school	163 (44.1 [37.6-50.6])	104 (41.7 [33.7-49.6])	59 (48.7 [37.5-59.9])	
Type of health insurance ^d				
Medicaid	117 (40.8 [34.1-47.5])	74 (42.7 [34.4-51.1])	43 (37.1 [26.0-48.2])	.33
Private health insurance only	168 (46.6 [40.0-53.2])	108 (44.6 [36.4-52.7])	60 (50.4 [39.1-61.7])	
Annual family household income, \$ ^e				
≤75 000	184 (64.4 [58.2-70.5])	112 (64.0 [56.4-71.6])	72 (65.1 [54.6-75.6])	.87
>75 000	134 (35.6 [29.5-41.8])	92 (36.0 [28.4-43.6])	42 (34.9 [24.4-45.4])	

^aData source: Centers for Disease Control and Prevention.¹⁹ Analyses were limited to adolescents for whom adequate health care provider data on immunization history were available. Analyses accounted for the complex survey design and incorporated NIS-Teen–provided sampling weights. Data for race/ethnicity and whether the child had a checkup in previous 2 years are not shown because of small cell sizes. All values are no. (weighted % [95% CI]) unless otherwise indicated.

^bFor the continuous variable of age, *P* values were determined by linear regression. For categorical variables, the Rao–Scott χ^2 test was used to determine *P* values. *P* < .05 was considered significant.

^c“≥Some post–high school” includes mothers with some post–high school education and college graduates. “≤High school” includes high school graduates and mothers with <12 years of education.

^dData for uninsured and other health insurance categories are not shown because of small cell sizes.

^eData on annual family household income were missing for 8 people.

of a transcript from a recording of a single-session statewide HPV vaccination stakeholder meeting hosted by the American Cancer Society in Helena, Montana, in October 2018. The purpose of the half-day meeting was to convene stakeholders in adolescent HPV vaccine delivery in Montana to identify opportunities for enhanced and ongoing partnership and coordination. Two study team members (S.R.N. and E.C.) were both participants in and observers of this meeting. Ten additional meeting participants were representatives from the state health department, health insurance plans, medical provider groups, and nonprofit organizations working in HPV prevention. The meeting agenda included reviewing current data on HPV vaccination, ongoing challenges that had already been identified in the state, current activities supporting vaccine promotion, and opportunities to increase HPV vaccine coverage.

The second phase of qualitative data collection involved conducting one-on-one or small group interviews with key stakeholders, including medical providers. We interviewed a range of medical providers whose scope of practice included independent care of adolescent patients, including family medicine physicians, pediatricians, advanced practice nurses, and physician assistants, and public health nurses who provide immunizations at local health departments. We sought input from medical providers from eastern and western Montana, as

well as from both rural and more populated areas. Most medical providers in larger Montana cities care for rural patients who travel from surrounding counties. We identified medical providers from suggestions of participants in the October 2018 stakeholder meeting, from a statewide adolescent health meeting hosted by the state health department later that month, and from suggestions from interviewees.

We also interviewed other key stakeholders who were not direct medical providers, including members of the state public health department, rural health–focused nonprofit organizations, and health insurance plans. Some of these stakeholders also participated in the October 2018 meeting, and we conducted one-on-one interviews to solicit additional information. We contacted potential stakeholder interviewees by telephone or email, and we conducted interviews by telephone or in person. For the interviews, we developed a semi-structured tool with open-ended questions. Interviews of medical providers started with general questions about clinical processes and workflows for adolescent immunizations. Interviews of other stakeholders started by inquiring about organizational activities related to adolescent HPV vaccination. Then, both types of interviews included questions about stakeholders’ knowledge of and experiences with barriers to HPV vaccination in Montana, ideas for opportunities to increase vaccine uptake, and, if applicable, whether

Table 3. Factors associated with human papillomavirus (HPV) vaccine series initiation among adolescents aged 13-17, Montana, National Immunization Survey–Teen, 2017^a

Factor	Sample no.	Weighted % (95% CI)	PR (95% CI) for HPV vaccine series initiation	
			Unadjusted	Adjusted ^b
Adolescent received a Tdap vaccine after 11th birthday				
Yes	292	90.4 (86.5-94.3)	3.8 (1.8-8.0)	3.3 (1.4-8.1)
No	34	9.6 (5.7-13.5)	Reference	Reference
Parent/guardian received a medical provider's recommendation to vaccinate adolescent against HPV ^c				
Yes	245	78.9 (73.3-84.6)	2.4 (1.6-3.8)	2.3 (1.5-3.6)
No	63	21.1 (15.4-26.7)	Reference	Reference

Abbreviations: PR, prevalence ratio; Tdap, tetanus-diphtheria-acellular pertussis.

^aData source: Centers for Disease Control and Prevention.¹⁹

^bAdjusted for adolescent's age, sex, maternal education level, health insurance type, annual family household income, race/ethnicity, whether the child had a checkup in the previous 2 years, and the other factor listed in the table.

^cThirteen people answered that they did not know whether they had received a medical provider recommendation to vaccinate, and data were missing for 5 people; these 18 people were excluded from analysis.

and how other stakeholders had been included in their vaccination efforts. We approached 16 people for interviews and 13 agreed to participate, including 2 people who had also participated in the HPV vaccination stakeholder meeting. Interviews lasted 20 to 50 minutes and were conducted from October 2018 through June 2019. All interviews were one-on-one except for one with 4 public health nurses conducted as a small group session.

We audio-recorded and transcribed the HPV vaccination stakeholder meeting and stakeholder interviews. We used a directed content analysis approach, whereby we documented anticipated themes before analysis.²² These anticipated themes were based on previous research and knowledge of barriers to and facilitators of HPV vaccination that were identified in other settings.^{8,9} Two study team members (E.C. and T.S.) independently conducted line-by-line open coding of the transcribed meeting and interviews, assigning data to 19 codes (subthemes) within 7 broader coding categories (themes). The study team held regular meetings to review coding progress, identify emerging themes and subthemes, compare notes, and recode and organize data into more selective and focused categories.²³ This recoding process resulted in 6 themes and 13 subthemes. We tabulated these results with representative quotes from stakeholders.

We conducted qualitative analyses from January through August 2019 with NVivo version 12 software (QSR International).

Results

From 2013 to 2017, HPV vaccine series initiation rates among female and male Montana adolescents aged 13-17 increased in both rural and urban areas of Montana (Figure A). From 2016 to 2017, the rate increased from 55.3% to 65.5%; the large increase was partially due to increasing vaccination rates among adolescent boys in both urban areas (from 50.9% to 72.2%) and rural areas (from

38.4% to 64.6%). According to 2017 NIS-Teen data, 72.6% of adolescents in urban areas of Montana had initiated the series, whereas only 64.0% of adolescents in rural areas of Montana had initiated the series. Although HPV vaccination rates have been steadily increasing in Montana, missed opportunities occurred: by 2017, 90.4% of Montana adolescents had received a Tdap vaccine and 71.2% had received a meningococcal vaccine, whereas 65.5% had received at least 1 HPV vaccine dose.

In univariate analyses of NIS-Teen 2017 data (n = 326), we found no significant differences between adolescents who did and did not initiate the HPV vaccine series by age, sex, mother's education, type of health insurance, or annual family household income (Table 2). In multivariable modeling of NIS-Teen 2017 data, 2 variables were significantly associated with HPV vaccine initiation: adolescent receipt of Tdap vaccination (adjusted prevalence ratio [aPR] = 3.3; 95% CI, 1.4-8.1) and a parent or guardian reporting that a medical provider had recommended the HPV vaccine for the child (aPR = 2.3; 95% CI, 1.5-3.6) (Table 3).

Eleven medical providers and 10 public health stakeholders participated in the statewide HPV meeting or interviews. We found 6 main themes on barriers to and facilitators of adolescent HPV vaccination in Montana (Table 4). Two themes—medical providers' recommendation style and parental vaccine hesitancy—were the most commonly referenced. Medical providers' recommendation style emerged as a facilitator of HPV vaccination. Medical providers reported support of and confidence in the vaccine, and many discussed using a presumptive style of recommending the vaccine (ie, assuming the parent intends to vaccinate) and offering the HPV, meningococcal, and Tdap vaccines together. Several participants perceived that parents were more receptive to the HPV vaccine when it was discussed as a tool for cancer prevention rather than a tool for sexually transmitted infection prevention. Public health stakeholders shared information on previous and ongoing efforts to

Table 4. Themes, subthemes, and representative quotes on barriers to and facilitators of adolescent human papillomavirus (HPV) vaccination, identified from qualitative data collected from medical providers (n = 11) and public health stakeholders (n = 10), Montana, October 2018–June 2019

Theme	Subthemes	Barrier or facilitator	Representative quote(s)
Medical providers' recommendation style	<ul style="list-style-type: none"> • Cancer prevention messaging • Presumptive recommendation style 	Facilitator	<ul style="list-style-type: none"> • For me, I'm pretty basic. I don't ask them if they want it. I tell them it's due. I don't make them get it, obviously. I let them know it's their choice, but that it's recommended. It's cancer prevention and I definitely recommend it. [Public health nurse A] • I say, "We've got 3 immunizations due," and I assume that there's no issue. If they say, "We don't want to do immunizations," then I ask them what their concerns are or reasoning. If I need to . . . help them understand a little bit more, I try to. [Physician assistant A]
Parental vaccine hesitancy	<ul style="list-style-type: none"> • Vaccine safety concerns • Recommended age of vaccination concerns • Information from social media and internet • Provider challenges in addressing parents' concerns, including limited time for vaccine discussions • Greater need for information about the HPV vaccine relative to other adolescent vaccines 	Barrier	<ul style="list-style-type: none"> • It does seem . . . that HPV takes more discussion than other vaccinations. If we offer a flu shot or offer a tetanus shot, I don't feel like it's as often that my nurse has to come out and say, "They want to talk to you" or "They're not interested." [Physician A] • We get questions [about] if it's okay to give them many [vaccines] at one time and safety. Some people don't want to talk about it. They refuse it, and I don't really push those people." [Public health nurse A]
Adolescent engagement in vaccine discussions	<ul style="list-style-type: none"> • Engagement by medical providers • Parent–adolescent dynamics 	Both	People bargain with their kids . . . to get them in here, [and] say, "Well, you're only going to get one shot today." Somehow, educating them that there are 3 recommended vaccines . . . would be helpful. [Public health nurse B]
Policies and laws	<ul style="list-style-type: none"> • Vaccine requirements for school attendance • Adolescent consent laws 	Both	Teens can get birth control on their own, but they cannot get an HPV vaccine. That's a frustration . . . because they ask for it and we can't give it to them. [Public health nurse A]
Social determinants of health	<ul style="list-style-type: none"> • Health care access • Unique population needs (eg, adolescents in foster care) 	Barrier	We have providers all over the state that are VFC [Vaccines for Children] providers. However, . . . in some rural areas . . . they only have the public health department as their VFC provider. [Public health stakeholder A]
Irregular adolescent well care	Not applicable	Barrier	Adolescents do not seek care for well visits. . . [so] we have to do our vaccines on acute visits. That's when it has to be done because that's when they are there in your office. [Physician B]

educate health professionals in Montana about the HPV vaccine through in-person and online training. Analysis of NIS-Teen data supported the qualitative finding of provider support for and recommendation of the HPV vaccine: the percentage of Montana parents who reported receiving a recommendation from a medical provider to vaccinate their adolescent against HPV increased from 44.2% (95% CI,

37.6%-50.7%) in 2013 to 75.0% (95% CI, 69.1%-81.0%) in 2017 (Figure B).

Medical providers identified parental vaccine hesitancy as a barrier to vaccination (Table 4). Medical providers indicated that parents more often had questions about the HPV vaccine than about other vaccines recommended for adolescents. Medical providers reported that parents' concerns

ranged from questions about vaccine safety or the recommended age to initiate vaccination to concerns about vaccine misinformation (such as the vaccine causing infertility or sudden death) in social media. In 2017 NIS-Teen data, among parents of unvaccinated adolescents who did not intend to vaccinate within the next 12 months ($n = 71$), the top reason cited for nonintent to vaccinate was safety/side effect concerns (24.5%; 95% CI, 12.1%-36.9%).

Four additional themes were adolescent engagement in vaccine discussions, policies and laws, social determinants of health, and irregular adolescent well care (Table 4). Some medical providers talked about engaging adolescents in vaccine discussions, while others focused their conversation on parents or guardians. Interview participants also discussed how adolescents are engaged by parents, in particular how parent-adolescent dynamics affect vaccine decisions. Policies and laws were recognized as a facilitator of and barrier to vaccination. Requiring adolescents to have a Tdap vaccine for school attendance was seen as an opportunity for providing other vaccines. However, some stakeholders reported that the mandatory requirement sometimes led to perceptions among parents that the Tdap vaccine was more important than other adolescent vaccines, including HPV. In addition, laws limiting adolescent consent for vaccination were cited as a barrier. Social determinants of health, including barriers to access in extremely rural counties, were discussed, as were barriers among unique populations, such as adolescents in foster care. Finally, irregular adolescent well-care emerged as a barrier, with some stakeholders perceiving that adolescents do not come in as regularly as younger children for well-child visits.

Discussion

Adolescent HPV vaccination rates are rising in Montana, with 2017 HPV vaccine series initiation mirroring the national average of 65.5%.⁷ However, HPV vaccine uptake was higher in urban areas than in rural areas of Montana, and rates of HPV vaccination lagged behind rates of other adolescent vaccinations. We identified several opportunities to continue to increase HPV vaccine uptake in this large and primarily rural state.

Increasing medical provider recommendation for the HPV vaccine presumably contributed to Montana's increasing vaccination rates. In quantitative analyses, we observed an increase over time in the percentage of Montana parents of adolescents who reported receiving a medical provider recommendation to vaccinate against HPV. Consistent with other studies,^{9,24} our study found that receiving a medical provider recommendation was associated with adolescents initiating the HPV vaccine series. In qualitative analyses, public health and medical stakeholders communicated support of and confidence in the vaccine as a tool for cancer prevention. These findings align with evidence supporting

the importance of strong and consistent vaccine recommendations from medical providers,^{10,25} as well as the effectiveness of messaging that frames the HPV vaccine as a means of cancer prevention rather than prevention of sexually transmitted infection.²⁶

Many barriers to vaccination identified in this study are not unique to Montana. Parental vaccine hesitancy, including concerns about the vaccine's safety and necessity, was identified as a barrier in other national²⁷ and state investigations, including states with large rural populations, such as Alabama and South Carolina.^{28,29} However, some barriers identified by stakeholders in our study are unique to a large, rural state such as Montana, including access to health care in remote areas. Strategies to increase HPV vaccination rates may work differently in states with largely rural populations than in states with populations focused in urban centers. For example, public awareness campaigns may have less reach in rural areas than in urban areas. Determining which interventions work to increase HPV vaccine uptake in rural areas in the United States is a research priority of the American Cancer Society's National HPV Vaccination Roundtable.¹³ We encourage the development and testing of such interventions in states such as Montana.

From this study, we identified strategies to continue to support increasing HPV vaccination rates among adolescents in Montana. One strategy is to focus on reducing the number of missed vaccination opportunities. Montana state law requires Tdap vaccination before seventh grade, and efforts should continue to support offering all 3 recommended vaccines (Tdap, HPV, and meningococcal) when an adolescent is offered the Tdap vaccine. However, some stakeholders indicated that parents are not always aware that these 3 vaccines, along with annual influenza vaccination, are recommended for adolescents. Similar to ongoing work to educate parents about newborn immunizations before the birth of their child,³⁰ efforts to educate parents about adolescent vaccines before ages 11 or 12 should be explored. Moreover, our results point to the need for additional work in increasing public confidence in vaccines. For this, we encourage parental and patient input on when, where, and how they would like to receive information about HPV vaccination. Finally, continued education about HPV vaccination among health care and public health professionals in Montana should be sustained, including training on anticipating and responding to common parental concerns.

Limitations

Our study had several limitations. First, we did not obtain qualitative input from parents, guardians, or adolescents. These groups could provide additional insight into the barriers to and facilitators of HPV vaccination, and we have initiated work in western Montana to engage these stakeholder groups. Second, all medical providers who participated in the interviews supported use of the HPV vaccine; medical

providers less supportive of the vaccine may not have been interested in participating or were not referred to our study. Had we received input from medical providers who did not support HPV vaccination, our qualitative findings may have differed from those described here. Third, we focused on HPV vaccine series initiation; however, series completion is crucial for disease prevention. Reminder/recall programs can improve completion rates for adolescent immunizations,³¹ and research is needed to understand whether rural clinics are using these or other strategies for HPV vaccine series completion.

Conclusions

By integrating quantitative and qualitative methods, we identified facilitators of and barriers to HPV vaccination in Montana. Although HPV vaccination rates are on the rise in this large, rural state, sustained work is needed to continue to increase vaccine uptake. Future strategies should focus on reducing the number of missed opportunities to provide HPV vaccine, increasing public confidence in the vaccine, and training health care professionals to respond to common vaccine concerns.

Authors' Note

Preliminary findings from this work were presented at the 2019 American Public Health Association Annual Meeting, Philadelphia, Pennsylvania.

Disclaimer

All analyses, interpretations, and conclusions using the NIS-Teen public-use data source are those of the authors (recipient of the data source) and not of the Centers for Disease Control and Prevention, National Center for Immunization and Respiratory Diseases, which is responsible only for the initial data.

Declaration of Conflicting Interests

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