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Factors Associated with Increased HPV Vaccine Use in Rural-Frontier U.S. States

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Abstract

Objective—This study sought to examine sociodemographic factors surrounding human papillomavirus (HPV) vaccine initiation and three-dose completion rates in the Intermountain West (IW).

Design and Sample—Analysis of the Centers for Disease Control and Prevention's 2012 National Immunization Survey-Teen dataset was conducted with a survey-weighted Pearson chi-square test and multivariable Poisson regression to produce bivariate and multivariate analyses. Participants with daughters aged 13–17 with provider-verified immunization records were included. Dual-frame adjusted prevalence ratios (*PR*) and 95% confidence intervals (*CI*) were produced with provider-phase sampling weights.

Results—Older parental ages (45 years and above) showed lower prevalence of adolescent HPV vaccine initiation (*PR*=0.73, 95% *CI*=0.59–0.87, *p*=.003) and completion (*PR*=0.65, 95% *CI*=0.44–0.96, *p*=.031) compared with parents younger than 35. Seventeen year-old adolescents demonstrated highest prevalence of initiating (*PR*=1.88, 95% *CI*=1.47–2.39, *p*<.001) and completing (*PR*=2.92, 95% *CI*=1.97–4.33, *p*<.001) the vaccination series compared to 13 year-olds. Those who had received meningitis vaccinations had high prevalence of initiating (*PR*=1.93, 95% *CI*=1.50–2.48, *p*<.001) and completing the HPV vaccine (*PR*=2.52, 95% *CI*=1.64–3.86, *p*<.001).

Conclusion—This study highlights parental, adolescent, and healthcare characteristics related to use of the HPV vaccine. Future research to investigate specific barriers and strategies for addressing HPV vaccination use in the IW is recommended.

Keywords

vaccination; adolescent health; cancer; population-based nursing; prevention; public health systems

Background

Human papillomavirus (HPV) is the predominant cause of cervical cancer, which is estimated to affect over 12,000 women in the U.S. annually (Howlader et al., 2015). Approximately 80–90% of people will be infected with at least one strain of HPV in their lifetimes (Bosch et al., 2013). Those with persistent and recurrent infections are more likely to eventually develop cervical and other HPV-related cancers (Markowitz et al., 2014). Early stages and precursors of cervical cancers can be effectively treated with surgical procedures when detected early (Delgado et al., 1990; Zaino et al., 1992), but such treatments may pose significant physical, financial, and emotional burdens on patients, and may lead to complications such as sexual dysfunction and infertility (Herzog & Wright, 2007). Approximately \$6.5 billion is spent on cervical cancer screening and treatment annually (Chesson et al., 2012), yet the disease continues to claim over 4,000 lives every year in the U.S. (Howlader et al., 2015).

The three-dose HPV vaccine is recommended as a cancer prevention strategy for all adolescents by the Advisory Committee on Immunization Practices (ACIP) for the protection against cervical and other HPV-related cancers and genital warts (Markowitz et al., 2014). The burden of these conditions can largely be prevented by population-wide immunization with HPV vaccines; however, the rate of HPV vaccine utilization remains low despite HPV vaccines demonstrating high efficacy and safety (Howlader et al., 2015; Saraiya et al., 2015). The Healthy People 2020 goal for HPV vaccination in females is 80% (HealthyPeople.gov, 2015), yet nation-wide, only about a third of adolescent females have completed the series (Centers for Disease Control and Prevention (CDC), 2014a).

The Intermountain West (IW), also known as the Mountain West region, consists of Arizona (AZ), Colorado (CO), Idaho (ID), Montana (MO), Nevada (NV), New Mexico (NM), Utah (UT), and Wyoming (WY), and includes some of the least densely populated regions in the U.S. (United States Census Bureau (USCB), 2013). This eight-state region is served by only four National Cancer Institute (NCI)-designated cancer centers and comprehensive cancer centers—a majority of which are clustered in the southern region of the IW— and collectively represents a large geographical area consisting of several rural and underserved populations.

The IW was selected for this study as part of a needs assessment of the region to inform the actions of a HPV vaccination coalition comprising several Intermountain states. The IW region is predominantly non-Hispanic White; however, as a whole, has a higher proportion of Hispanic/Latino (20.5%), American Indian/Alaskan Native (3.9%) and Pacific Islander (0.4%) populations within the region compared to U.S. averages (17.1%; 1.2%; and 0.2%) (USCB, 2014a), as well as a large density of members of the Church of Jesus Christ of Latter Day Saints, also known as Mormons (Pew Research Center, 2013). Analyses of HPV immunization rates show lower rates of HPV immunizations in this region (Rahman, Islam,

& Berenson, 2015). IW states with particularly low completion rates of HPV vaccination in 2013 include Idaho (31.3%), Montana (28.3%), Nevada (27.4%), and Utah (20.5%) (CDC, 2014a). Most notably, Utah had the lowest HPV vaccination completion rate among females in the nation in 2013 (CDC, 2014a). Factors related to the low utilization rate of the HPV vaccine in parts of this region are understudied.

The low rates of HPV vaccination rates among adolescents in this region of the U.S. is a population health concern. A recent report from the President's Cancer Panel emphasized the urgency to improve the rate of HPV vaccinations in the U.S. (President's Cancer Panel, 2014). This call to action is especially pertinent for public health professionals engaged in the delivery of preventative services among those at risk. Prior studies of demographic factors related to HPV vaccination rates report disparities along racial and ethnic (Brewer & Fazekas, 2007; Cates, Brewer, Fazekas, Mitchell, & Smith, 2009; Niccolai, Mehta, & Hadler, 2011), and socioeconomic lines (Bednarczyk, Curran, Orenstein, & Omer, 2014). Studies also show access to health insurance predicted greater HPV vaccine utilization (Dorell, Yankey, Santibanez, & Markowitz, 2011; Kessels et al., 2012). These findings imply that lower HPV vaccination utilization in regions of the U.S. may be a systemic issue with associated with various sociodemographic factors. Little is known whether these factors impact low HPV vaccination rates in the IW.

This study seeks to investigate the sociodemographic factors of HPV vaccine utilization within the IW region, with the specific aims of identifying racial and ethnic, socioeconomic, insurance coverage, and healthcare utilization factors associated with higher prevalence of HPV vaccine initiation and completion. The public health goals of this study are to 1) inform the design of strategies for public health campaigns and initiatives to improve HPV vaccination in the IW, and 2) to inform the development of public health initiatives targeted at strengthening provider and parent education messages related to the HPV vaccine. To the best of our knowledge, no studies have yet examined the initiation and completion rates of the HPV vaccine in the IW.

Methods

Design and Sample

Data from the 2012 National Immunization Survey-Teen (NIS-Teen) dataset was used to assess sociodemographic factors in relation to HPV vaccine initiation and completion among age-eligible female adolescents in the IW region. The NIS-Teen is a national survey conducted by the CDC that consists of two sections; a random digit-dialing telephone survey of households with parent-reported immunization information of adolescents ages 13–17 years, and a provider-validated mailed survey to obtain validated vaccination records for the adolescent (CDC, 2013a). The 2012 NIS-Teen had a cellular-household response rate of 23.6% and a landline-household response rate of 55.1% (CDC, 2013b). The analysis of the 2012 NIS-Teen survey was conducted between February and May 2014. Analysis of publicly available data is considered exempt research by the University of Utah Institutional Review Board.

Data from female adolescents aged 13 to 17 years of age living in the eight IW states with provider-verified immunization records were included in the study ($N = 1291$). All participants were parents/legal guardians of age-eligible daughters.

Measures

Variables of interest were determined *a priori*, guided by an internal review of current literature of HPV vaccination in the U.S. Data from provider-verified vaccination records of female adolescents were used to analyze outcomes of interest, which included initiation (receipt of 1 dose) and completion (receipt of 3 doses) of the HPV vaccine. Independent variables related to mothers/parents included age, years of education, annual household income, and marital status. Independent variables related to adolescents included race and ethnicity, age, and recent receipt of other adolescent immunizations. Factors related to healthcare characteristics included source of health insurance, type of providers' practice, and providers' use of state or local health departments to obtain the HPV vaccine.

Outcomes of interest were HPV vaccine initiation and HPV vaccine completion. Vaccine initiation was defined as receiving one or more doses of the HPV vaccine; vaccine completion was defined as receiving three or more doses of the HPV vaccine.

Analytic Strategy

Provider-phase sampling weight for both landline and cell-phone sample interviews conducted in the U.S. was used to produce dual-frame point estimates and 95% confidence intervals (CI). Missing values of each variable were excluded. Frequency counts, weighted proportions, and 95% CI of the proportions were reported for the selected characteristics of the total sample and HPV vaccine initiation and completion subgroups. For all categorical variables, a survey-weighted Pearson chi-square test was used to compare distributions between those who had received at least one dose of the HPV vaccine, those who had completed the series, and the overall group. A survey-weighted multivariable Poisson regression was fitted to assess the impact of selected predictors and reported as an adjusted prevalence ratio (PR) with 95% CI. Results were considered significant at $p < .05$. All tests were two-sided comparisons in STATA version 13.1 (StataCorp, 2013).

Results

Sample Characteristics

There were $N = 1291$ eligible respondents living in the IW with a daughter aged 13–17 years old who had provider-verified vaccination records. Of these, 52.4% ($n = 677$) had initiated the HPV vaccine series, and 33.6% ($n = 434$) had completed the 3-dose series. Majority of parents were between the ages of 35 and 45 (49.9%, 95% CI = 45.6%–54.2%) and married (68.8%, 95% CI = 64.5%–72.9%). Adolescents aged 15 years old were the largest age group within the sample (24.4%, 95% CI = 20.7%–28.5%), followed by 13 year olds (21.7%, 95% CI = 18.3%–25.4%). Adolescents were mainly non-Hispanic white (56.3%, 95% CI = 51.9%–60.6%), and majority had private health insurance (55.0%, 95% CI = 50.6%–59.4%). Majority of the families were living above the poverty level and had an annual household income of \$75,000 and below (41.8%, 95% CI = 37.4%–46.2%).

Demographic Characteristics of Non-HPV Vaccinated Adolescents

Summary statistics (data not shown) showed that among adolescents who did not receive the HPV vaccine, the majority had parents who were above 35 years of age ($n = 578$, 94.9%), had more than 12 years of formal education ($n = 451$, 65.2%), and were married ($n = 486$, 70.7%). The majority of non-HPV vaccinated adolescents were between the ages of 13 to 15 years of age ($n = 404$, 69.1%), lived above poverty ($n = 517$, 79.0%), were Non-Hispanic White ($n = 459$, 61.8%), and had private health insurance ($n = 396$, 60.0%). Non-vaccinated adolescents primarily had healthcare providers who worked exclusively in private facilities ($n = 223$, 40.9%). A majority of the non-HPV vaccinated teens had received recent Tetanus, Diphtheria, and Pertussis (TDAP) (64.4%) immunizations and slightly over half had received recent meningitis vaccinations (56.7%). However, most of the non-HPV vaccinated teens did not receive a recent influenza vaccine (76.3%).

Parental Characteristics Related to HPV Vaccine Utilization

Bivariate analyses assessed whether parents' age, years of education, and poverty status were different among adolescents who had initiated the HPV vaccine, adolescents who had completed the vaccine, and the overall sample. A higher proportion of parents younger than 35 years of age was observed in the HPV vaccine initiation group (10.9%, 95% CI = 8.0–14.7, $p = .032$) compared to the overall sample (8.3%, 95% CI = 6.4–10.7) (see table 1).

A higher proportion of parents with 12 or less years of education was found in the HPV vaccine initiation group (23.0%, 95% CI = 17.7–29.3) compared to the overall sample (17.6%, 95% CI = 14.1–21.8, $p = .011$). Additionally, there was a higher proportion of parents with an annual household income below the poverty line in the initiation group compared to the overall sample (32.0%, 95% CI = 26.1–38.5, vs. 27.0%, 95% CI = 22.9–31.6, $p = .025$) (Table 1). This finding was not observed for HPV vaccine completion.

Multivariable analyses showed the only parental factor associated with HPV utilization was age. Female adolescents whose parent was aged 35 to 44 years old and greater than 45 years old had lower prevalence of receiving at least one dose of HPV vaccination compared with parents aged less than 34 years old, with PR 0.70 (95% CI = 0.57–0.87, $p = .001$) and 0.73 (95% CI = 0.59–0.90, $p = .003$) respectively (see Table 2). Adolescents whose parent was older than 45 years old had a lower prevalence of having HPV vaccination completion compared with parents aged less than 34 years old ($PR = 0.65$, 95% CI = 0.44–0.96, $p = .031$) (see Table 3).

Adolescent Characteristics Related to HPV Utilization

Our results suggest that older adolescent age was positively associated with HPV vaccine utilization at $p < .05$. Multivariate analyses demonstrated that prevalence of HPV vaccine use increased with adolescent age. Proportions of 17 year olds with at least one dose of the HPV vaccine (23.9%, 95% CI = 18.9–29.7%, $p = .011$) or three or more verified doses of the HPV vaccine (26.7%, 95% CI = 20.0–34.6, $p = .004$) were higher than the overall proportion of 17 year olds in the overall sample (18.6%, 95% CI = 15.5–22.6%). Multivariate analyses also confirmed that adolescents who were 15 years of age ($PR = 1.33$, 95% CI = 1.02–1.74, $p = .034$), 16 years of age ($PR = 1.66$, 95% CI = 1.28–2.15, $p < .001$),

and 17 years of age ($PR = 1.88$, 95% CI = 1.47–2.39, $p < .001$), had a higher prevalence of initiating the HPV vaccine compared to 13 year olds. Similarly, 15 year olds ($PR = 1.90$, 95% CI = 1.26–2.86, $p = .002$), 16 year olds ($PR = 2.40$, 95% CI = 1.60–3.60, $p < .001$), and 17 year olds ($PR = 2.92$, 95% CI = 1.97–4.33, $p < .001$) demonstrated higher prevalence of completing the HPV vaccine than 13 year olds in the sample.

Healthcare Characteristics Related to HPV Utilization

Healthcare factors that were related to HPV vaccine completion included up-to-date adolescent immunizations (receipt of a recent influenza, TDAP, or meningococcal vaccine) and adolescents' type of health insurance, all $p < .05$.

Receipt of either a TDAP, influenza, or meningitis vaccine was consistently associated with higher prevalence of HPV vaccine use compared to those who did not receive the vaccines. A greater proportion of teens who had influenza vaccinations within the past three years was observed among those who *initiated* the HPV vaccine (49.5%, 95% CI = 43.5%–55.5%, $p < .001$) compared to the overall sample (37.9%, 95% CI = 33.7–42.2); likewise, there was a greater proportion of influenza immunization among those who *completed* the HPV vaccine series compared to the entire group (52.6%, 95% CI = 44.9%–60.1%, $p < .001$). Compared to those who did not receive an influenza vaccination, teens who received a recent influenza vaccination had a higher prevalence of receiving a dose of the HPV vaccine ($PR = 1.51$, 95% CI = 1.29–1.76, $p < .001$) and completing the series ($PR = 1.76$, 95% CI = 1.40–2.21, $p < .001$).

Greater proportions of TDAP immunized teens were also found in HPV initiation group (77.7%, 95% CI = 71.9%–82.6%, $p = .002$) and HPV completion group (80.8%, 95% CI = 73.4%–86.6%, $p = .003$) compared to the overall sample (71.7%, 95% CI = 67.4%–75.6%). Multivariate analyses showed a higher prevalence of TDAP immunized teens had *initiated* the HPV vaccine ($PR = 1.32$, 95% CI = 1.06–1.65, $p = .015$) and *completed* it ($PR = 1.58$, 95% CI = 1.10–2.28, $p = .014$), compared to those who did not receive the TDAP vaccine.

Likewise, a greater percentage of teens immunized against meningitis was found among those who had at least one dose of the HPV vaccine (85.7%, 95% CI = 81.6%–89.0%, $p < .001$) and among those who completed the series (89.2%, 95% CI = 84.1%–92.8%, $p < .001$) compared to the overall sample (71.2%, 95% CI = 67.5%–74.7%). Multivariate analyses showed higher prevalence of HPV vaccine initiation ($PR = 1.93$, 95% CI = 1.50–2.48, $p < .001$) and completion ($PR = 2.52$, 95% CI = 1.64–3.86, $p < .001$) among those who had received at least one dose of meningitis vaccine compared to those who had not.

Adolescents' insurance type was associated with starting the HPV vaccination series in bivariate analysis only. A greater proportion of adolescents who *did not* have private insurance was found in the HPV initiation group (49.0%, 95% CI = 43.1%–55.0%) compared to the overall sample (45.0%, 95% CI = 40.6%–49.4%, $p = .044$); however, this was not reflected in the HPV completion group (see Table 1).

Discussion

This study investigated sociodemographic factors related to HPV initiation and three-dose completion in the IW to provide an initial assessment of the factors that may impact lower HPV utilization rates in this region. In addition to lower HPV vaccine utilization rates, the rates for papanicolaou (PAP) screening in five of the IW states are among the lowest in the nation (ID, NV, AZ, UT, & WY) (NCI, 2014), making an investigation of the risk factors of low HPV vaccination a priority in the region.

Parental characteristics

Parents, particularly mothers, are often responsible for making choices about their children's immunizations. This study found that a strong association between HPV utilization in the IW and a younger parental age. This finding is consistent with another study conducted in Canada which found that older parents were less inclined vaccinate their children against HPV (Ogilvie et al., 2007). Ogilvie et al. (2007) suggested that older generations of parents may have differing attitudes about the sexual health of their adolescent children compared to younger parents. It is possible that parental attitudes towards adolescent sexual activity may affect the low HPV utilization rates in the IW, a region with states that have a higher density of certain religious denominations with strong positions against sexual activities of youth. Another potential barrier among parents towards HPV vaccination may be the concern that the vaccine would promote promiscuity among adolescents (Waller, Marlow, & Wardle, 2006).

Adolescent Characteristics

Our multivariable analyses showed that neither race and ethnicity, or poverty level were significantly associated with increased HPV vaccination initiation or completion in the IW. Instead, we found that an older adolescent age was highly associated with HPV initiation and completion, a finding consistent with studies investigating patterns in HPV vaccination coverage in other states (McCave, 2010; Reiter et al., 2010). This suggests adolescents in the IW are less likely to be vaccinated at the recommended ages of 11 to 12 years of age. A recent study of vaccination registry data in Utah showed that high proportions of younger adolescents did not receive a dose of the HPV vaccine even though they had received another adolescent immunization at a physician visit (Kepka, Balch, Warner, & Spigarelli, 2015). Dempsey and colleagues found that parents were more willing to vaccinate older adolescents against HPV (Dempsey, Zimet, Davis, & Koutsky, 2006), which may support why older adolescents are more likely to use the HPV vaccine in the IW.

Healthcare characteristics

In addition, this study found that adolescents who had received other adolescent vaccinations, such as the TDAP, influenza, or meningococcal immunizations, showed higher prevalence of initiating and completing the HPV vaccine, with stronger associations for those who had received meningococcal immunizations. These findings suggest that annual well-child checks in which other vaccines are recommended are prime opportunities for providers and nurses to encourage the HPV vaccine or recommend it as a routine part of the vaccine schedule. Parental readiness to vaccinate, or the convenience of receiving the

vaccine together with other vaccines already scheduled at a well-child visit may be facilitators of HPV vaccination at this time. The CDC estimates that if female adolescents who received another immunization during a provider visit received the HPV vaccine as well, 93% of female adolescents in the U.S. would have received at least one dose of the HPV vaccine (CDC, 2013a).

Limitations

This study was limited by non-response among the NIS-Teen sample, with adequate provider-verified vaccination data available among only 56.4% of cellular and 62% of landline respondents. After weighting adjustments, bias from exclusion of households without phones and nonresponse might persist. Furthermore, states with smaller populations include NIS-Teen vaccination estimates with larger 95% confidence intervals due to smaller survey respondent sample sizes. In addition, the heterogeneity of the characteristics within sub regions of the IW is a limitation of this study. As such, variations within individual states or sub regions may cause effects to be underestimated.

Recommendations for Practice

Public health professionals may use findings from this study to guide the development of targeted interventions, community education programs, and advocate for increased efforts among local, state, and federal stakeholders in the improvement of HPV immunization efforts within the region. Public health nurses involved in the provision of preventative healthcare services such as vaccination administration, intervention planning, and patient and community education in the IW should be aware that adolescents with older parents may be less likely to receive the HPV vaccination, should be sensitive to possible parental barriers towards the HPV vaccine, and be knowledgeable about clinical evidence regarding the side effects, safety and efficacy of the HPV vaccine. One such concern would be the belief that the HPV vaccine may promote adolescent promiscuity (Waller, Marlow, & Wardle, 2006). Public health nurses should be aware that evidence shows adolescents who receive the vaccine are not more likely to engage in unsafe sex (Jena, Goldman, & Seabury, 2015). In interactions with patients and their families, public health nurses may choose to emphasize the cancer prevention benefit of the HPV vaccine and support parents' decision-making with information and education.

In addition to parental discomfort at vaccinating younger children against HPV, providers may also be less willing to vaccinate adolescents against HPV at these younger ages (Mays & Zimet, 2004; Zimet, 2005). Although HPV vaccines are effective in an older adolescent population, the HPV vaccine is recommended at 11 or 12 years of age for the stronger immune response to the vaccine, and the lower likelihood of sexual initiation among adolescents at these ages (Markowitz et al., 2014). As such, public health practitioners and nurses providing preventative healthcare to adolescents should be aware of the rationale for vaccinating children at the earlier ages and be sensitive to parental reluctance to vaccinate a younger adolescent who is eligible for the HPV vaccine.

In interactions with patients and their families, public health nurses may choose to emphasize the cancer prevention benefit of the HPV vaccine and support parents' decision-

making with information and education. In addition to a physician recommendation, school nurses may be in a prime position to advocate for the HPV vaccine within the education system (Bennett, 2008). Efforts to improve HPV vaccination rates should include strategies to enhance nurse knowledge of current HPV vaccination recommendations and optimize nurse-family conversations about the HPV vaccine to compliment providers' efforts in HPV vaccination promotion within the community. Cost of the HPV vaccine should not be a barrier as the large majority of insurance plans fully cover the cost of the HPV vaccine, and uninsured children below the age of 19 and American Indians or Alaskan Natives may receive it for free under the Vaccines for Children (VFC) program (CDC, 2014b). Children whose insurance plan does not cover the vaccine may be covered under the VFC program at qualified federal or rural health centers (CDC, 2014b).

Conclusions

As the healthcare system moves from a curative to preventative model (National Prevention Council, 2011), improving rates of HPV immunizations in the population has become an increased priority. This study provides additional insights to the risk factors surrounding low HPV vaccination utilization in the IW.

Public health nurses in the region engaged in in the delivery of preventative services may utilize findings from this study to guide their practice and interactions with patients and family members who are at risk for not being vaccinated against HPV. In addition, the findings from this study may also guide the development of community and state partnerships, policies, and programs targeted at improving the uptake of this important cancer prevention vaccine. Improving HPV vaccination utilization among adolescents in the IW is vital to preventing future cervical and HPV-associated cancers in this region, and is highly dependent on those who provide direct care to the populations at risk. This research highlights the sociodemographic factors correlated with of HPV vaccine uptake and completion the IW region. Findings from this research serves as an initial assessment of the IW region and will guide future research, intervention and policy development, and collaborative efforts among the IW states.

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Table 1
Bivariate Analysis of HPV Vaccine Initiation and Completion for the Intermountain West Region^a

Characteristic	Total (N = 1291)	% ^b (95% CI)	1 dose of HPV vaccine (n = 677)	HPV vaccine completion ^c (n = 434)
			n	% ^b (95% CI) p-value ^d
Age (Mother / Parent)				0.577
34 yrs	99	8.3 (6.4, 10.7)	63	34 9.7 (6.3, 14.6)
35 yrs < age 44 yrs	567	49.9 (45.6, 54.2)	282	185 47.4 (39.8, 55.1)
45 yrs	625	41.8 (37.7, 46.1)	332	215 42.9 (35.6, 50.5)
Education (Mother)				0.165
< 12 years	129	17.6 (14.1, 21.8)	84	41 16.5 (11.0, 23.9)
12 years	256	22.5 (18.9, 26.5)	138	90 25.1 (18.9, 32.5)
> 12 years (some college)	415	28.9 (25.3, 32.9)	202	125 23.1 (17.3, 30.2)
College graduate	491	31.0 (27.4, 34.8)	253	178 35.4 (28.8, 42.5)
Poverty status				0.556
Above poverty (> \$75k)	528	31.3 (27.7, 35.1)	275	186 34.0 (27.6, 41.1)
Above poverty (\$75k)	521	41.8 (37.4, 46.2)	257	170 38.7 (31.3, 46.6)
Below poverty	198	27.0 (22.9, 31.6)	124	68 27.3 (20.6, 35.3)
Missing, n (%)	44 (3.4)		21 (3.1)	10 (2.3)
Marital status of mother				0.425
Married	989	68.8 (64.5, 72.9)	503	330 71.1 (64.1, 77.3)
Other	302	31.2 (27.2, 35.5)	174	104 28.9 (22.7, 35.9)
Ethnicity/Race of teens				0.923
Hispanic	244	31.6 (27.3, 36.1)	148	84 33.1 (25.8, 41.3)
Non-Hispanic White only	905	56.3 (51.9, 60.6)	446	297 54.4 (46.6, 61.9)
Non-Hispanic Black only	17	2.4 (1.3, 4.4)	11	4 2.2 (0.7, 7.0)
Other	125	9.8 (7.6, 12.6)	72	49 10.3 (7.3, 14.4)
Age in years of selected teen				0.004
13 years old	263	21.7 (18.3, 25.4)	118	57 15.4 (10.8, 21.4)
14 years old	231	17.0 (14.1, 20.4)	112	60 13.8 (9.7, 19.4)
15 years old	291	24.4 (20.7, 28.5)	151	103 24.3 (17.9, 32.0)
16 years old	281	18.1 (15.3, 21.4)	156	117 19.9 (15.2, 25.5)

Characteristic	Total (N = 1291)	% ^b (95% CI)	1 dose of HPV vaccine (n = 677)	HPV vaccine completion ^c (n = 434)
			n	% ^b (95% CI) p-value ^d
17 years old	225	18.8 (15.5, 22.6)	140	26.7 (20.0, 34.6)
Source of health insurance for teens				
Provided through employment or union	802	55.0 (50.6, 59.4)	406	56.2 (48.3, 63.7)
Not Provided through employment or union	482	45.0 (40.6, 49.4)	268	43.9 (36.3, 51.7)
Missing, n (%)	7 (0.5)		3 (0.4)	2 (0.5)
Facility type for teen's providers				
All public facilities	239	21.6 (17.9, 25.8)	127	19.2 (13.7, 26.3)
All hospital facilities	68	5.1 (3.3, 8.0)	47	6.5 (3.9, 10.6)
All private facilities	476	40.8 (36.5, 45.2)	253	45.1 (37.3, 53.1)
Mixed / Other	465	32.5 (28.6, 36.6)	232	29.2 (22.9, 36.4)
Missing, n (%)	43 (3.3)		18 (2.7)	13 (3.0)
Do teen's providers order vaccination from states/local health department				
All providers	793	63.8 (59.6, 67.7)	478	66.4 (58.8, 73.1)
Some but possibly not all	281	20.3 (17.1, 23.8)	119	18.3 (13.2, 24.7)
No providers	104	7.5 (5.7, 9.7)	44	8.3 (4.8, 13.8)
Don't know	107	8.5 (6.5, 11.1)	36	7.1 (4.1, 12.2)
Missing, n (%)	6 (0.5)			
Receipt of Influenza vaccination^e				
Yes	460	37.9 (33.7, 42.2)	325	52.6 (44.9, 60.1)
No	831	62.2 (57.8, 66.3)	352	47.4 (39.9, 55.1)
Receipt of TDAP vaccination^f				
Yes	959	71.7 (67.4, 75.6)	546	80.8 (73.4, 86.6)
No	332	28.3 (24.4, 32.6)	131	19.2 (13.4, 26.6)
Receipt of Meningitis vaccination^g				
Yes	851	71.2 (67.5, 74.7)	557	89.2 (84.1, 92.8)
No	440	28.8 (25.3, 32.6)	120	10.8 (7.2, 15.9)

^aFemale adolescents with adequately complete provider-reported immunization records in the 2012 NIS-Teen survey were included in our analysis

^bWeighted percentages from Dual-Frame Sampling Weights

^cHPV completion includes those who had received at least 3 doses of the HPV vaccine

- ^d Chi-squared test was used for the comparison between subgroup and the total
- ^e Adolescent has taken at least one dose of seasonal influenza vaccination in the past three years
- ^f Adolescent has taken at least one dose of TDAP only vaccination since age 10 years old and before 13 years old
- ^g Adolescent has taken at least one dose of Meningitis vaccination

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Multivariable Analysis of Factors Associated with Receipt of 1 dose of HPV Vaccine among Female Adolescents in the Intermountain West (*N* = 1203)

Table 2

Characteristic	Adjusted vaccination coverage ^d % (95% CI)	Adjusted prevalence ratio (95% CI)	<i>p</i> -value
Age (Mother / Parent)			
34 yrs	74.5 (62.2, 86.7)	Reference	
35 yrs < age 44 yrs	52.5 (46.1, 58.9)	0.70 (0.57, 0.87)	0.001
45 yrs	54.1 (47.8, 60.5)	0.73 (0.59, 0.90)	0.003
Education (Mother)			
< 12 years	66.3 (52.6, 79.9)	Reference	
12 years	50.8 (41.4, 60.2)	0.77 (0.58, 1.02)	0.066
> 12 years (some college)	52.7 (45.1, 60.3)	0.80 (0.61, 1.04)	0.096
College graduate	52.9 (45.4, 60.3)	0.80 (0.61, 1.05)	0.108
Poverty status			
Above poverty (> \$75k)	54.2 (45.6, 62.7)	Reference	
Above poverty (\$75k)	53.6 (46.9, 60.3)	0.99 (0.82, 1.19)	0.915
Below poverty	57.1 (46.9, 67.3)	1.05 (0.80, 1.38)	0.703
Marital status of mother			
Married	54.7 (49.5, 59.9)	Reference	
Other	55.1 (45.7, 64.5)	1.01 (0.82, 1.23)	0.946
Ethnicity / Race of teens			
Hispanic	56.0 (46.9, 65.2)	Reference	
Non-Hispanic White only	55.0 (49.0, 61.0)	0.98 (0.80, 1.20)	0.856
Non-Hispanic Black only	46.7 (26.9, 66.5)	0.83 (0.52, 1.32)	0.438
Other	52.6 (41.8, 63.5)	0.94 (0.73, 1.21)	0.634
Age in years of selected teen			
13 years old	39.4 (31.3, 47.6)	Reference	
14 years old	49.1 (41.4, 56.9)	1.25 (0.98, 1.59)	0.074
15 years old	52.6 (42.7, 62.5)	1.33 (1.02, 1.74)	0.034
16 years old	65.3 (55.4, 75.2)	1.66 (1.28, 2.15)	<.001
17 years old	74.1 (64.1, 84.1)	1.88 (1.47, 2.39)	<.001
Source of health insurance for teens			

Characteristic	Adjusted vaccination coverage ^d % (95% CI)	Adjusted prevalence ratio (95% CI)	p-value
Provided through employment or union	51.2 (45.1, 57.4)	Reference	
Not Provided through employment or union	59.1 (52.7, 65.6)	1.15 (0.98, 1.36)	0.084
Facility type for teen's providers			
All public facilities	60.2 (49.7, 70.6)	Reference	
All hospital facilities	54.2 (33.7, 74.7)	0.90 (0.60, 1.35)	0.616
All private facilities	55.6 (48.6, 62.7)	0.93 (0.74, 1.15)	0.489
Mixed / Other	50.8 (43.8, 57.7)	0.84 (0.68, 1.05)	0.135
Do teen's providers order vaccination from states/local health department			
All providers	52.3 (47.2, 57.4)	Reference	
Some but possibly not all	62.6 (51.3, 73.8)	1.20 (0.98, 1.46)	0.075
No providers	60.6 (44.7, 76.4)	1.16 (0.88, 1.52)	0.290
Don't know	59.3 (42.5, 76.1)	1.13 (0.84, 1.53)	0.406
Receipt of Influenza vaccination^b			
Yes	69.0 (61.7, 76.3)	1.51 (1.29, 1.76)	<.001
No	45.8 (40.2, 51.4)	Reference	
Receipt of TDAP vaccination^c			
Yes	58.9 (53.8, 64.1)	1.32 (1.06, 1.65)	0.015
No	44.6 (35.4, 53.7)	Reference	
Receipt of Meningitis vaccination^d			
Yes	62.2 (56.9, 67.6)	1.93 (1.50, 2.48)	<.001
No	32.2 (24.7, 39.8)	Reference	

^aMultivariable Poisson regression

^bAdolescent has taken at least one dose of seasonal influenza vaccination in the past three years

^cAdolescent has taken at least one dose of TDAP only vaccination since age 10 years old and before 13 years old

^dAdolescent has taken at least one dose of Meningitis vaccination

Table 3Multivariable Analysis of Characteristics Associated with HPV Vaccine Completion among Female Adolescents in the Intermountain West (*N* = 1203)

Characteristic	Adjusted vaccination coverage ^d % (95% CI)	Adjusted prevalence ratio (95% CI)	<i>p</i> -value
Age (Mother / Parent)			
34 yrs	48.9 (32.3, 65.6)	Reference	
35 yrs < age 44 yrs	34.5 (28.2, 40.8)	0.71 (0.48, 1.04)	0.076
45 yrs	31.9 (26.3, 37.5)	0.65 (0.44, 0.96)	0.031
Education (Mother)			
< 12 years	30.0 (17.4, 42.5)	Reference	
12 years	36.8 (27.4, 46.1)	1.23 (0.74, 2.03)	0.427
> 12 years (some college)	29.3 (22.2, 36.4)	0.98 (0.59, 1.61)	0.927
College graduate	39.2 (31.3, 47.1)	1.31 (0.79, 2.16)	0.295
Poverty status			
Above poverty (> \$75k)	33.5 (25.8, 41.2)	Reference	
Above poverty (\$75k)	34.7 (27.9, 41.6)	1.04 (0.78, 1.37)	0.797
Below poverty	34.5 (24.1, 45.0)	1.03 (0.67, 1.58)	0.888
Marital status of mother			
Married	35.5 (30.2, 40.8)	Reference	
Other	31.3 (23.8, 38.9)	0.88 (0.66, 1.17)	0.393
Ethnicity/Race of teens			
Hispanic	37.7 (27.9, 47.5)	Reference	
Non-Hispanic White only	33.1 (27.9, 38.4)	0.89 (0.65, 1.19)	0.410
Non-Hispanic Black only	28.2 (13.1, 43.3)	0.75 (0.42, 1.34)	0.330
Other	32.8 (23.5, 42.1)	0.87 (0.60, 1.27)	0.466
Age in years of selected teen			
13 years old	18.6 (12.3, 25.0)	Reference	
14 years old	25.2 (17.7, 32.7)	1.35 (0.87, 2.11)	0.183
15 years old	35.4 (26.1, 44.7)	1.90 (1.26, 2.86)	0.002
16 years old	44.6 (34.8, 54.5)	2.40 (1.60, 3.60)	<.001
17 years old	54.4 (42.9, 65.8)	2.92 (1.97, 4.33)	<.001
Source of health insurance for teens			

Characteristic	Adjusted vaccination coverage ^d % (95% CI)	Adjusted prevalence ratio (95% CI)	p-value
Provided through employment or union	33.6 (27.6, 39.5)	Reference	
Not Provided through employment or union	35.1 (28.5, 41.8)	1.05 (0.80, 1.36)	0.739
Facility type for teen's providers			
All public facilities	36.6 (24.9, 48.3)	Reference	
All hospital facilities	44.8 (25.6, 63.9)	1.22 (0.73, 2.04)	0.440
All private facilities	35.6 (28.5, 42.6)	0.97 (0.66, 1.44)	0.885
Mixed / Other	29.8 (23.2, 36.4)	0.81 (0.54, 1.22)	0.321
Do teen's providers order vaccination from states/local health department			
All providers	33.5 (28.5, 38.4)	Reference	
Some but possibly not all	38.0 (27.1, 48.9)	1.14 (0.83, 1.55)	0.425
No providers	35.2 (20.7, 49.7)	1.05 (0.68, 1.62)	0.820
Don't know	31.9 (18.6, 45.3)	0.95 (0.62, 1.47)	0.828
Receipt of influenza vaccination^b			
Yes	46.6 (39.7, 53.6)	1.76 (1.40, 2.21)	<.001
No	26.5 (21.5, 31.5)	Reference	
Receipt of TDAP vaccination^c			
Yes	38.3 (33.0, 43.5)	1.58 (1.10, 2.28)	0.014
No	24.2 (16.0, 32.4)	Reference	
Receipt of Meningitis vaccination^d			
Yes	39.7 (34.4, 45.1)	2.52 (1.64, 3.86)	<.001
No	15.8 (9.4, 22.2)	Reference	

^aMultivariable Poisson regression

^bAdolescent has taken at least one dose of seasonal influenza vaccination in the past three years

^cAdolescent has taken at least one dose of TDAP only vaccination since age 10 years old and before 13 years old

^dAdolescent has taken at least one dose of Meningitis vaccination