



Short communication

Increasing human papillomavirus vaccination at the recommended age

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ABSTRACT

In the United States, human papillomavirus (HPV) vaccine has been recommended for females since 2006 and for males since 2011. However, national HPV vaccination coverage among adolescents is lower than national targets, and many adolescents initiate HPV vaccination later than the recommended age. We analyzed records for >2 million persons born during 1996–2000 who initiated HPV vaccination at age 9 through 16 years from six Immunization Information Systems Sentinel Sites, displayed the distribution of HPV vaccination initiation age, and calculated HPV vaccination coverage. More adolescents in recent cohorts initiated HPV vaccination at the recommended age of 11–12 years, the majority of whom received another recommended vaccine on the same day. However, >40% of all vaccinated adolescents did not initiate the HPV vaccination until age 13 years or later. Continued efforts are needed to increase HPV vaccination initiation at the recommended age.

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1. Introduction

In the United States, human papillomavirus (HPV) vaccine has been recommended for females since 2006 and for males since 2011. Adolescents are recommended to receive HPV vaccine at age 11–12 years, and can start at age 9 years; HPV vaccination is most effective when administered before exposure to HPV, and the vaccines are safe and immunogenic in this age group [1].

The currently available 9-valent HPV vaccine can prevent seven HPV types that may cause cervical cancer, other anogenital cancers, and oropharyngeal cancer in males and females, and two types that cause genital warts [1]. Although national HPV vaccination coverage among adolescents has been increasing in recent years it lags behind the coverage for other routinely recommended adolescent vaccines [2]. Many adolescents do not initiate HPV vaccination at the recommended age of 11–12 [2]. According to an analysis of National Immunization Survey-Teen (NIS-Teen) data, adolescents often did not receive HPV vaccine when they received another routinely recommended vaccine [3]. One study using NIS-Teen data has shown increasing trend in HPV vaccination initiation before age 13 among girls from 2008 to 2012 [4]. However, trends in boys and recent trend in girls have not been reported. Our objective was to assess changes in (1) HPV vaccination initiation age,

and (2) co-administration of HPV vaccine and another routinely recommended adolescent vaccine, among five birth cohorts of persons born during 1996–2000.

2. Methods

Immunization information systems (IISs) are “confidential, computerized, population-based systems that collect and consolidate vaccination data from vaccination providers that can be used in designing and sustaining effective immunization strategies” [5]. From 2013 to 2019, the Centers for Disease Control and Prevention funded six IIS Sentinel Sites (Michigan, Minnesota, New York City, North Dakota, six counties in Oregon, and Wisconsin) to monitor vaccine uptake, and evaluate vaccination coverage. The pediatric population in these sites is approximately 10% of the pediatric population nationwide.

We analyzed childhood immunization records for >2 million persons born during January 1, 1996 – December 31, 2000. We excluded persons reported as deceased or not residing in the jurisdiction. We grouped persons born in the same year as one birth cohort. To calculate the distribution of HPV vaccination initiation age, we divided the number of persons who initiated HPV vaccination at each age by the number of all persons who initiated HPV vaccination from age 9 through 16. We did this for each birth cohort, stratified by sex and co-administration of another routinely recommended vaccine: tetanus, diphtheria, and acellular pertussis vaccine (Tdap) or meningococcal conjugate vaccine (MenACWY). To calculate HPV vaccination coverage, we used U.S. Census

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Vintage 2016 estimates as denominators for each age group in each cohort, for each Sentinel Site. We used SAS® 9.4 (SAS Institute, Cary, NC) and Microsoft® Excel® 2016 (Microsoft, Redmond, WA) for all analyses.

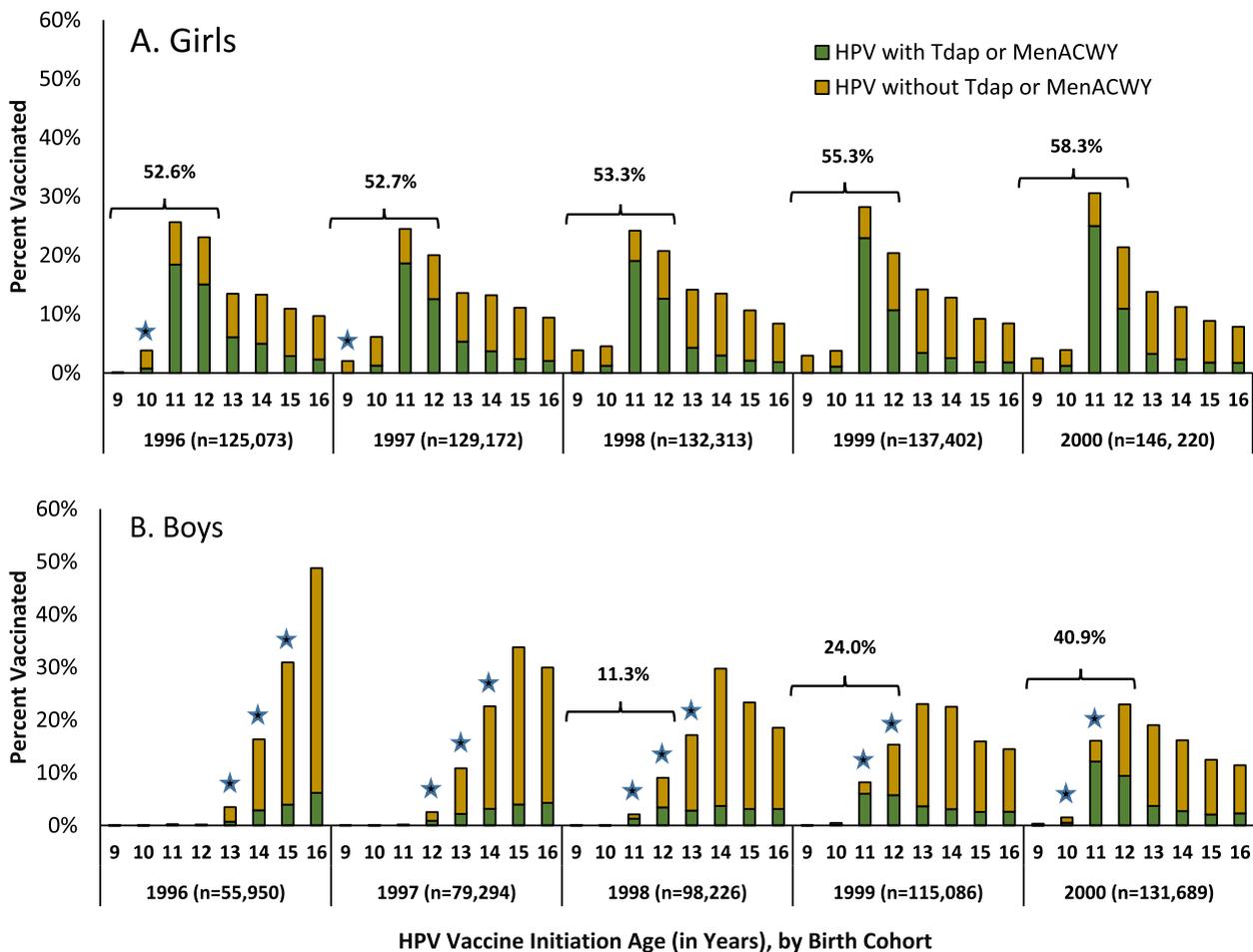
3. Results

We found 1,150,425 persons born during January 1, 1996 – December 31, 2000, who initiated HPV vaccination from age 9 through 16. Among girls who initiated the HPV vaccine series, the percentage who received at least one dose before age 13 increased each year, from 52.6% of the 1996 cohort to 58.3% of the 2000 cohort (Fig. 1a). Among boys who initiated HPV vaccination, the percentage receiving the first dose before age 13 increased from 11.3% of the 1998 cohort to 40.9% of the 2000 cohort (Fig. 1b).

For all cohorts of girls who initiated HPV vaccination at age 11–12, the majority received another routinely recommended vaccine, Tdap or MenACWY, on the same day (78.3% if at age 11 and 58.3% if at age 12); the percentage of girls who received HPV vaccine and Tdap/MenACWY on the same day remained largely unchanged among all five cohorts, ranging from 68.7% in the 1996 cohort to 70.5% in the 1998 cohort. The majority of girls who initiated HPV vaccination at age 13 or later did not receive Tdap or MenACWY on the same day (Fig. 1a). Among girls of the

most recent cohort (2000) who initiated HPV vaccination, 41.7% initiated at age 13 or later; of whom, 78.2% did not receive it on the same day as Tdap or MenACWY. Due to the more recent recommendation for boys than for girls, our data on HPV vaccination initiation at age 11 for boys born during 1996–1998 are limited. For boys born in 1999 and 2000 who initiated HPV vaccination at age 11, the majority also received Tdap or MenACWY on the same day. The majority of boys who initiated HPV vaccination at age 12 or later did not receive Tdap or MenACWY on the same day. (Fig. 1b). Among boys of the most recent cohort (2000) who initiated HPV vaccination, 59.1% initiated at age 13 or later; of whom, 81.8% did not receive it on the same day as Tdap or MenACWY.

We also analyzed 1 + dose HPV vaccination coverage in the population before age 17 in the five cohorts (Fig. 2). Among girls, receipt of at least one HPV vaccine dose before age 17 increased from 61.5% in the 1996 cohort to 72.3% in the 2000 cohort; and in boys from 26.2% in the 1996 cohort to 62.0% in the 2000 cohort. A larger percentage of girls in more recent cohorts initiated HPV vaccination at age 11–12: 33.1% of all girls in the 1999 cohort, and 37.6% of all girls in the 2000 cohort compared with 30.0% and 28.3% in 1996 and 1997 cohorts. For boys, the percentage of vaccine initiation at age 11–12 increased from 12.9% in the 1999 cohort to 24.2% in the 2000 cohort. Very low percentage of boys (1.2%) and girls (4.6%) initiated HPV vaccination at age 9–10 in



Star indicates vaccinations during the year of ACIP’s HPV vaccination recommendation: 2006 for women; 2011 for men. Percentage above brackets indicates total percentage of all persons in the birth cohort initiated HPV vaccine by age 13 years.

Fig. 1. Distribution of HPV vaccination initiation age among persons born during 1996–2000, by age group and gender – six Immunization Information Systems Sentinel Sites, United States.

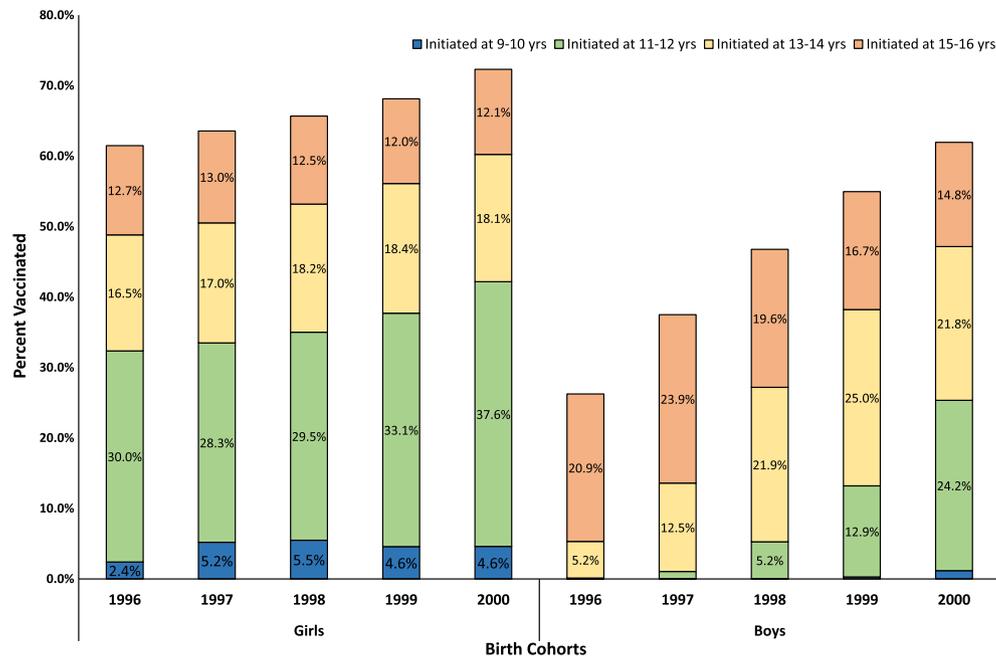


Fig. 2. Vaccination coverage with ≥ 1 dose of any HPV vaccine, by age at initiation and gender – six Immunization Information Systems Sentinel Sites, United States.

our most recent cohort, 2000. In contrast, a study that used data collected by Survey Sampling International revealed that 27.5% of 9–10-year-olds had initiated HPV vaccination in 2014 [6]. This could indicate a rapidly increasing trend of HPV vaccination initiated in this age group.

4. Discussion

In this analysis of IIS data, we found that a higher percentage of girls in recent cohorts initiated HPV vaccination at the recommended age of 11–12. However, even in the most recent cohort, among girls who initiated HPV vaccination, >40% did so older than the recommended age of 11–12. A systematic review found that providers are less likely to recommend HPV vaccine to adolescents aged 11–12 than to those aged 13–18, and parents tend to delay vaccination until age 13 or later [7]. Educational opportunities exist for both vaccine providers and parents to promote HPV vaccination initiation at the recommended ages.

In the United States, routine recommendation of HPV vaccine started in 2006 for girls and in 2011 for boys [1]. It is not surprising to see that some boys initiated HPV vaccination before 2011 because permissive recommendation was in place from 2009 [8]. Of note, the 2000 birth cohort of boys was the first to be vaccine eligible at the recommended age. The 2001 cohort of boys would be most comparable to the 1996 cohort of girls, in that each represents a cohort that reached age 16, 5 years after the routine recommendation for their sex. We do not have data for the 2001 cohort in this analysis but in the 2000 cohort of boys, 1+dose HPV vaccination coverage before age 17 was similar to that for the 1996 cohort of girls, 62.0% and 61.5%, respectively.

For both boys and girls who initiated HPV vaccination at age 11–12, the majority received another routinely recommended vaccine, Tdap or MenACWY, on the same day. Among girls who initiated HPV vaccination at age 11, receipt of Tdap or MenACWY on the same day increased by almost 10 percentage points from the 1996 to the 2000 cohort. While this suggests increased acceptability of HPV vaccination as well as co-administration with other vaccines, we cannot determine why many adolescents did not receive

HPV vaccine at the recommended age. Reasons could include objection to co-administration or lack of a provider recommendation for HPV vaccination. Provider recommendation has been strongly associated with HPV vaccine initiation [9]. According to a recent randomized trial [10], when providers recommend HPV vaccines on the same day as other vaccines, announcing all vaccines are due is more effective to increase HPV vaccine uptake than starting a conversation to discuss benefits of all due vaccines. Therefore, providers are encouraged to recommend HPV vaccine in the same way and on the same day as other vaccines.

The strength of this analysis includes the high quality population-based IIS Sentinel Site data and its timeliness. There are at least two limitations in this analysis. First, data from six Sentinel Sites do not necessarily represent the entire U.S. population. The distribution of age at HPV vaccination initiation may be different in the non-sentinel site areas. Second, IIS data may not have complete vaccination histories and therefore may underestimate vaccination coverage in the current analysis. The impact of this on our coverage analysis is likely small because previous analyses have demonstrated consistent HPV vaccination coverage in the Sentinel Site area compared with the NIS-Teen data for the same area [11].

In summary, more adolescents in recent cohorts initiated HPV vaccination at the recommended age; among those who did so, the majority received another routinely recommended vaccine on the same day. However, among adolescents who initiated HPV vaccination, many received it at age 13 or later. Efforts directed at both healthcare providers and parents are needed to improve HPV vaccination initiation at the recommended age to increase HPV vaccination coverage, and to protect men and women from HPV-related cancers and other adverse outcomes.

Disclaimer

The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Conflict of interest

All authors have disclosed no financial relationships relevant to this article.

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References

- [1] Markowitz LE, Dunne EF, Saraiya M, Chesson HW, Curtis CR, Gee J, et al. Human papillomavirus vaccination: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recomm Rep* 2014;63:1–30.
- [2] Walker TY, Elam-Evans LD, Singleton JA, Yankey D, Markowitz LE, Fredua B, et al. National, regional, state, and selected local area vaccination coverage among adolescents aged 13–17 years - United States, 2016. *MMWR Morb Mortal Wkly Rep* 2017;66:874–82.
- [3] Stokley S, Jeyarajah J, Yankey D, Cano M, Gee J, Roark J, et al. Human papillomavirus vaccination coverage among adolescents, 2007–2013, and postlicensure vaccine safety monitoring, 2006–2014—United States. *MMWR Morb Mortal Wkly Rep* 2014;63:620–4.
- [4] Rahman M, McGrath CJ, Hirth JM, Berenson AB. Age at HPV vaccine initiation and completion among US adolescent girls: trend from 2008 to 2012. *Vaccine* 2015;33:585–7.
- [5] Centers for Disease Control and Prevention. Progress in immunization information systems - United States, 2012. *MMWR Morb Mortal Wkly Rep* 2013;62:1005–8.
- [6] Donahue KL, Hendrix KS, Sturm LA, Zimet GD. Human papillomavirus vaccine initiation among 9–13-year-olds in the United States. *Prev Med Rep* 2015;2:892–8.
- [7] Rosen BL, Shepard A, Kahn JA. US health care clinicians' knowledge, attitudes, and practices regarding human papillomavirus vaccination: a qualitative systematic review. *Acad Pediatr* 2018;18:S53–65.
- [8] Centers for Disease Control and Prevention. FDA licensure of quadrivalent human papillomavirus vaccine (HPV4, Gardasil) for use in males and guidance from the Advisory Committee on Immunization Practices (ACIP). *MMWR Morb Mortal Wkly Rep* 2010;59:630–2.
- [9] Dorell CG, Yankey D, Santibanez TA, Markowitz LE. Human papillomavirus vaccination series initiation and completion, 2008–2009. *Pediatrics* 2011;128:830–9.
- [10] Brewer NT, Hall ME, Malo TL, Gilkey MB, Quinn B, Lathren C. Announcements versus conversations to improve HPV vaccination coverage: a randomized trial. *Pediatrics* 2017:139.
- [11] Lin X, Rodgers L, Zhu L, Stokley S, Meites E, Markowitz LE. Human papillomavirus vaccination coverage using two-dose or three-dose schedule criteria. *Vaccine* 2017;35:5759–61.

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