

Current Trends in HPV Vaccine Uptake: Wisconsin and United States, 2016-2019

Alexandria Cull Weatherer, MPH; Stephanie L. Pritzl, MD; Sarah Kerch, MPH; Zhanhai Li, PhD; Noelle K. LoConte, MD

ABSTRACT

Background: Human papillomavirus (HPV) is a recognized cause of cancer in both males and females. HPV vaccination prevents development of HPV-associated diseases.

Methods: Wisconsin HPV vaccination rates (2016-2019) were obtained from the Wisconsin Immunization Registry. Data was stratified by age, sex, Medicaid status, race/ethnicity, and ZIP code. Wisconsin vaccination rates were compared with national trends using data from the 2016, 2018, and 2019 National Immunization Survey-Teen.

Results: Wisconsin HPV vaccination rates remain consistently below national averages. HPV vaccination rates are improving—especially among males; however, vaccine coverage at the recommended age of 11-12 remains low. Rates of vaccine uptake differ by race/ethnicity, rurality/urbanicity, and Medicaid status.

Conclusion: Further initiatives are needed to increase awareness and acceptance of HPV vaccination for cancer prevention throughout Wisconsin.

new HPV infections and the development of HPV-associated diseases. The Advisory Committee on Immunization Practices (ACIP) recommends all individuals receive the HPV vaccine at 11 or 12 years of age.³ Vaccination can be given at age 9, and catch-up vaccination is recommended for all individuals not adequately vaccinated through age 26.³ In adults ages 27-45, shared clinical decision-making is recommended to determine which individuals may benefit.³ There is limited research comparing national HPV vaccination trends to those in Wisconsin. Here, we have identified and summarized national and statewide immunization rates from 2016 through 2019 and demographic variables that may result in

differences in HPV vaccine initiation and completion.

BACKGROUND

Persistent infection with high-risk human papillomavirus (HPV) genotypes is associated with cancer in men and women, including cervical, oropharyngeal, anal, vaginal, vulvar, and penile cancers.¹ Approximately 34,800 HPV-attributable cancers are diagnosed annually in the United States, with 600 reported each year in Wisconsin.² The HPV vaccine prevents

• • •

Author Affiliations: University of Wisconsin Carbone Cancer Center, Madison, Wis (Cull Weatherer, Kerch, LoConte); Department of Medicine, University of Wisconsin School of Medicine and Public Health, Madison, Wis (Pritzl, LoConte); Department of Biostatistics, University of Wisconsin, Madison, Wis (Li).

Corresponding Author: Alexandria Cull Weatherer, MPH, 610 N Walnut St, Room 370 WARE, Madison, WI 53726; phone 608.262.2774; email acull@wisc.edu.

METHODS

State and county-level HPV vaccination initiation and completion data was obtained from the Wisconsin Immunization Registry (WIR), a robust immunization information system. Data were stratified by sex at birth, age group (11-12 vs 13-17 years of age), Medicaid status (ever vs never), racial/ethnic group, and urbanicity. Urbanicity was determined by rural-urban commuting area (RUCA) codes by ZIP code, which classify census tracts using population density, urbanization, and daily commuting. RUCA codes 1 through 3 were defined as urban and 4 through 10 as rural.

Wisconsin vaccination rates were compared to data from the 2016, 2018, and 2019 National Immunization Survey-Teen (NIS-Teen), a survey that uses a representative sample to estimate

adolescent vaccination coverage.⁴ Data prior to 2016 was omitted given the HPV vaccine schedule change in 2015, making it difficult to ascertain if the change in vaccination coverage was due to HPV vaccine practice or the change in schedule.

RESULTS

HPV Vaccination Uptake: Wisconsin vs National Trends

Vaccine uptake at the recommended age of 11-12 from 2016 through 2019 has been slow. In 2016, 11% of Wisconsin adolescents ages 11-12 completed the HPV vaccine series. The completion rate increased to 15% as of 2019. All counties reported <30% vaccine completion rates for adolescents ages 11-12 in 2019 (Figure 1A). Despite the ACIP recommendation for HPV vaccine initiation and completion at ages 11-12, national HPV vaccination completion is reported for adolescents ages 13-17. As of 2019, Wisconsin falls short of its 80% coverage goal, and only 15 of 72 (21%) Wisconsin counties reported vaccine completion rates of at least 50% for adolescents ages 13-17 (Figure 1B).

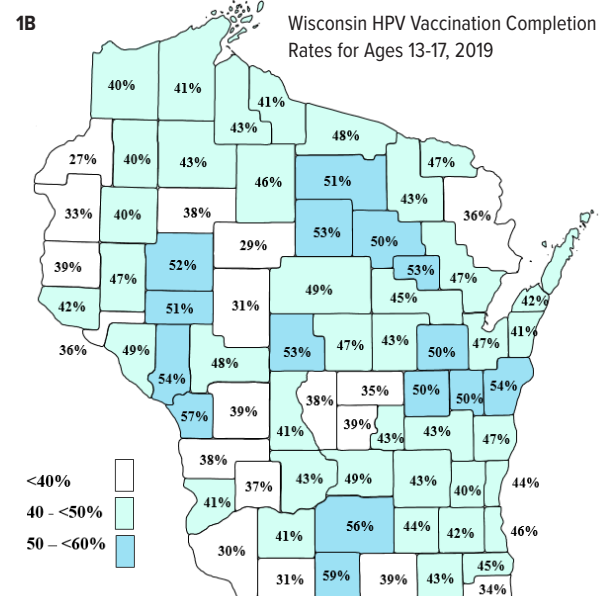
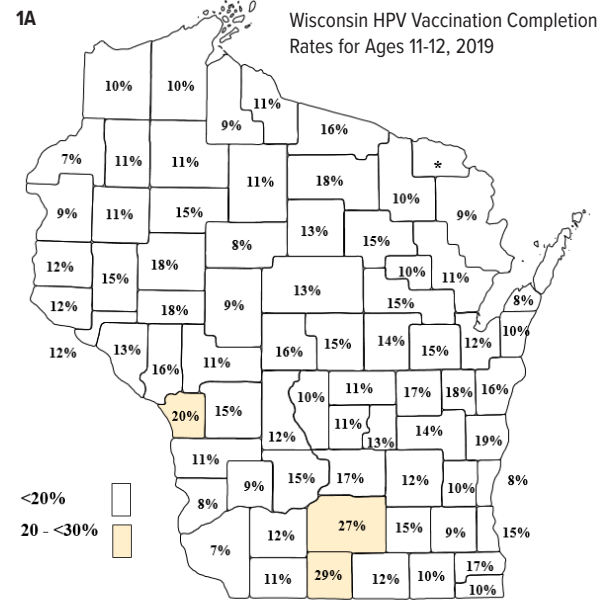
When comparing Wisconsin and national HPV vaccination rates, the state consistently remained below national rates (Figure 1C). In 2016, 34.0% of Wisconsin adolescents ages 13-17 completed the HPV vaccine series compared to national estimates of 43.4%.⁵ In 2019, 45.6% of Wisconsin adolescents were up-to-date with the HPV vaccine series compared to national estimates of 54.2%.⁶ Vaccination rates for males remain slightly below vaccination completion rates for females. However, HPV vaccination rates for males have improved consistently from 2016 through 2019, and this gender gap is beginning to close (Figure 1C).⁵⁻⁷

Differences in HPV Vaccination Rates: Rurality, Urbanicity, and Medicaid Status

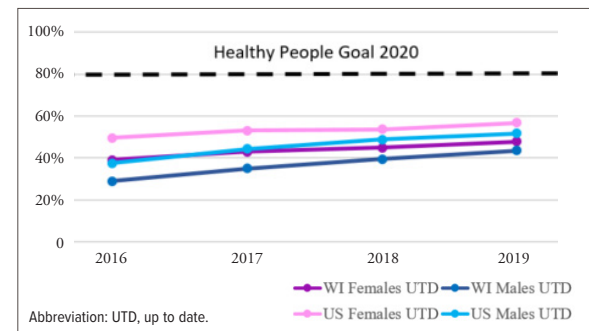
HPV vaccination initiation and completion rates vary throughout Wisconsin. RUCA codes were used to evaluate differences in HPV vaccination by ZIP code based on rurality and urbanicity. Wisconsin adolescents in urban areas have statistically significant higher HPV vaccination initiation/completion rates compared to their rural peers ($P < 0.0001$). In 2019, 46.8% of urban Wisconsin adolescents (ages 13-17) completed the HPV vaccine series compared to 42.7% of rural adolescents, and 60.4% of urban adolescents initiated the vaccine series versus 56.1% of rural adolescents (Figure 2A).

Similar trends are observed when reviewing national data. The NIS-Teen measures differences in vaccination status by rurality and urbanicity using metropolitan statistical areas (MSA). MSA status is defined by the US Census Bureau as having at least 1 urbanized area of at least 50,000 inhabitants. MSAs are grouped into 3 categories: MSA principal city (mostly urban areas), MSA non-principal city (mostly suburban areas), and non-MSA (mostly rural areas).⁶ In 2016, HPV vaccine coverage was 14.8% lower for adolescents living in a non-MSA

Figure 1. HPV Vaccination Completion Rates



1C. HPV Vaccination Completion Rates, 2016-2019, Ages 13-17: United States vs Wisconsin



and 6.1% lower among those living in MSA non-principal cities compared to those living in MSA principal cities.⁵ In 2019, HPV vaccine coverage was 9.8% lower for adolescents living in a non-MSA and 3.7% lower for adolescents living in MSA non-principal cities than those living in MSA principal cities (Figure 2B).⁶ As in previous years, HPV up-to-date vaccination status continues to be lower among adolescents in a non-MSA; however, geographic disparities were statistically significant only for adolescents at or above the poverty level in 2019.⁶

HPV vaccination rates in Wisconsin vary by Medicaid status. Wisconsin adolescents (ages 13-17) who were ever on Medicaid have statistically significant higher rates of HPV vaccination initiation and completion compared with those who were never on Medicaid ($P < .0001$) (Figure 2C). While Medicaid status was not included in national estimates until 2017, the NIS-Teen in previous years demonstrated that those living below the federal poverty level had higher HPV vaccination coverage for both males and females compared with their peers living at or above the poverty level.⁵ In 2019, US adolescents on Medicaid had statistically significant higher HPV vaccination coverage compared to those with private health insurance (4.4 and 6.0 percentage points higher for receipt of ≥ 1 dose and being up to date, respectively).⁶

Differences in HPV Vaccination Rates by Race and Ethnicity

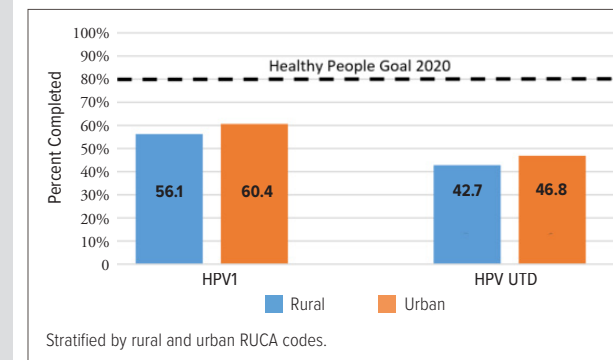
HPV vaccination rates differ by race and ethnicity. In Wisconsin, Hispanics and non-Hispanic Blacks (ages 13-17) have higher HPV vaccine completion rates when compared to non-Hispanic Whites from 2016 through 2019 (Table). However, this gap is closing. Nationwide, non-Hispanic Whites have the lowest rates of HPV vaccine initiation and completion compared to all other racial and ethnicity groups.⁵⁻⁷ In both 2016 and 2019, national HPV vaccine coverage was highest among Hispanic and Asian adolescents, both of which were statistically significant.⁵⁻⁶

DISCUSSION

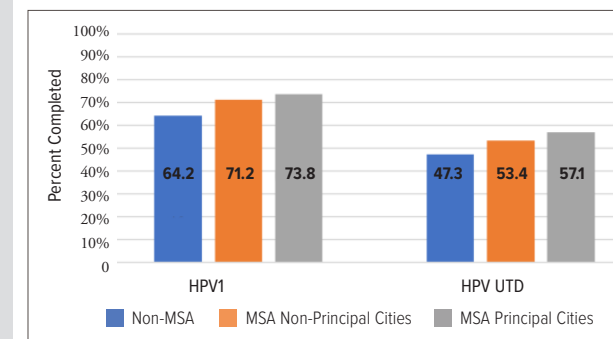
Despite strong evidence supporting safety of the HPV vaccine and efficacy in cancer prevention, vaccination rates in Wisconsin and throughout the United States remain low. Wisconsin falls drastically short of the Healthy People goal of 80% vaccination by 2020 and the Wisconsin Cancer Plan 2020-2030 goal of 50% HPV vaccine completion.⁸ Initiation and completion rates at the recommended age of 11-12 remain below targets. HPV vaccination at the recommended age is important for greater immunogenicity, administration before the onset of sexual activity and exposure to HPV, ability to bundle with other routine adolescent vaccines, and decreased dosing schedule (2 doses of HPV vaccine recommended if initiated before age 15 vs 3 doses if initiated at age 15 or later).^{3,9} Barriers to HPV vaccination include limited understanding of HPV-associated diseases, safety concerns, discomfort discussing sexual behavior, missed

Figure 2. Vaccination Rates for Adolescents Ages 13-17

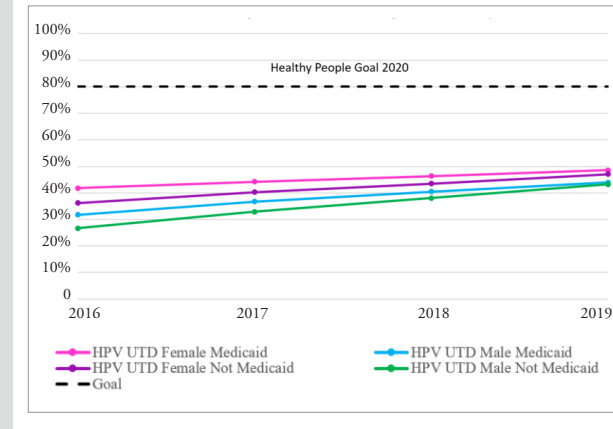
2A. 2019 HPV Vaccination Rates in Wisconsin: Rural vs Urban



2B. 2019 HPV Vaccination Rates in the United States: Metropolitan Statistical Areas



2C. Wisconsin HPV Vaccination Completion Rates Stratified by Medicaid Status



Abbreviation: UTD, up to date.

clinical opportunities, and lack of a universal strong recommendation from health care providers.⁹ While annual improvement in HPV vaccination initiation and completion have continued, the impact of COVID-19 will likely have an effect on routine vaccination uptake. Disease prevention measures, including routine vaccines and minimizing missed opportunities, are of utmost importance as the health care system continues to be burdened by the pandemic.

Barriers to HPV vaccination are multifactorial. A clear rec-

ommendation from health care providers is essential to increase HPV vaccine completion.⁹ The prevalence of parents reporting receiving a recommendation for adolescent HPV vaccination varies, especially in rural areas.⁷ A 2017 national survey found that the general public is now moderately aware of HPV, but awareness is higher among females and knowledge of noncervical HPV-related cancers remains low.¹⁰ Further education is needed to raise awareness of other HPV-associated cancers, especially as oropharyngeal cancer in males continues to rise.¹⁰

Initiatives to improve access to HPV vaccination include addressing associated costs. Individuals ≤ 18 years of age who are Medicaid-eligible, uninsured, underinsured, or American Indian/Alaska Native are eligible to receive vaccines through the Vaccines for Children (VFC) program.⁷ The VFC program reduces barriers for low-income individuals. Both state- and national-level data demonstrate that adolescents on Medicaid have slightly higher HPV vaccination rates than those on private insurance. Coverage of the HPV vaccine under Medicaid and VFC programs improves access to vaccination services and should be continued and expanded when possible.^{6,9} Socioeconomic status may be a moderating factor between HPV vaccination and rurality. Studies suggest that adolescents below the poverty level have higher HPV vaccination (possibly due to the VFC program), and those above the poverty level have lower HPV vaccination. More research is needed to explore this further. It is possible that lower HPV vaccine confidence in those above the poverty level may be a contributing factor, as these individuals have adequate insurance coverage to receive the vaccine.⁶

Limitations to our analysis include the use of 2 different data sources that are not directly comparable. National trends in HPV vaccination rates are measured for adolescents ages 13-17 rather than ages 11-12. Statewide data for the 11-12 age cohort help demonstrate the low rates of HPV vaccination completion. A small percentage of records are missing race/ethnicity data due to incomplete capture in the original electronic health record or incomplete file transfer.

CONCLUSION

While HPV vaccination rates continue to improve, further work is needed to promote HPV-attributable cancer prevention in males and females. A better understanding of how HPV vaccination coverage differs by age, race/ethnicity, rurality, and

Table. 2016-2019 HPV Vaccination Completion Rates in Wisconsin for Adolescents Ages 13-17 Stratified by Racial and Ethnic Group

| Racial/Ethnic Group | 2016 | P value | 2017 | P value | 2018 | P value | 2019 | P value |
|----------------------|--------------------|---------|--------------------|---------|--------------------|---------|--------------------|---------|
| Females | | | | | | | | |
| Hispanic | 47.5% ^a | <.0001 | 50.2% ^a | <.0001 | 52.0% ^a | 0.0002 | 54.9% | 0.0524 |
| Non-Hispanic Black | 47% ^a | <.0001 | 49.2% ^a | <.0001 | 51.1% | 0.2325 | 53.2% ^a | 0.0113 |
| Non-Hispanic White | 44.0% | | 47.7% | | 50.7% | | 54.2% | |
| Other ^b | 26.0% ^a | <.0001 | 28.0% ^a | <.0001 | 29.1% ^a | <.0001 | 31.0% ^a | <.0001 |
| Unknown ^c | 14.7% ^a | <.0001 | 16.0% ^a | <.0001 | 13.8% ^a | <.0001 | 14.9% ^a | <.0001 |
| Males | | | | | | | | |
| Hispanic | 40.6% ^a | <.0001 | 45.4% ^a | <.0001 | 48.3% ^a | <.0001 | 51.7% ^a | <.0001 |
| Non-Hispanic Black | 39.4% ^a | <.0001 | 43.9% ^a | <.0001 | 47.1% ^a | <.0001 | 50.2% ^a | 0.0024 |
| Non-Hispanic White | 31.8% | | 38.5% | | 43.7% | | 49.0% | |
| Other ^b | 18.9% ^a | <.0001 | 21.9% ^a | <.0001 | 24.8% ^a | <.0001 | 27.4% ^a | <.0001 |
| Unknown ^c | 10.8% ^a | <.0001 | 13.0% ^a | <.0001 | 12.6% ^a | <.0001 | 14.1% ^a | <.0001 |

^aStatistically significant difference (all $P < 0.05$) in estimated vaccination coverage by race/ethnicity; referent group was white, non-Hispanic adolescents.

^b"Other" includes adolescents who identify as either Asian, Native American and/or Multiracial.

^cUnknown= racial data not captured in the WIR.

Medicaid status may help to further inform and identify strategies for improvement. Medical providers should universally and strongly recommend the HPV vaccine to every adolescent ages 11-12 for optimal protection. Additionally, vaccination can be given as young as age 9 and catch-up vaccination is recommended for all individuals not adequately vaccinated through age 26.³ Vaccination status should be assessed at every medical encounter and offered when medically appropriate.

Acknowledgements: We are thankful for the input and data provided by the Wisconsin Department of Health Services, Wisconsin Immunization Program.

Funding/Support: Funding for this work was provided by the Centers for Disease Control and Prevention (grant 5 NU58DP006328-04-00), Wisconsin Department of Health Services (grant 435100-G20-503292-80, 44525), National Cancer Institute University of Wisconsin Carbone Cancer Center Support Grant (P30 CA014520).

Financial Disclosures: None declared.

REFERENCES

- Saraiya M, Unger ER, Thompson TD, et al. US assessment of HPV types in cancers: implications for current and 9-valent HPV vaccines. *J Natl Cancer Inst.* 2015;107(6):djv086. doi:10.1093/jnci/djv086
- Senkomago V, Henley SJ, Thomas CC, Mix JM, Markowitz LE, Saraiya M. Human Papillomavirus-Attributable Cancers - United States, 2012-2016. *MMWR Morb Mortal Wkly Rep.* 2019;68(33):724-728. Published 2019 Aug 23. doi:10.15585/mmwr.mm6833a3
- Meites E, Szilagyi PG, Chesson HW, Unger ER, Romero JR, Markowitz LE. Human Papillomavirus Vaccination for Adults: Updated Recommendations of the Advisory Committee on Immunization Practices. *MMWR Morb Mortal Wkly Rep.* 2019;68(32):698-702. doi:10.15585/mmwr.mm6832a3
- National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention. National Immunization Survey—Teen. Updated January 22, 2021. Accessed February 15, 2021. <https://www.cdc.gov/vaccines/imz-managers/nis/about.html>

5. Walker TY, Elam-Evans LD, Singleton JA, 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(33):874-882. doi:10.15585/mmwr.mm6633a2
6. Elam-Evans LD, Yankey D, Singleton JA, et al. National, Regional, State, and Selected Local Area Vaccination Coverage Among Adolescents Aged 13-17 Years - United States, 2019. *MMWR Morb Mortal Wkly Rep.* 2020;69(33):1109-1116. doi:10.15585/mmwr.mm6933a1
7. Walker TY, Elam-Evans LD, Yankey D, et al. National, Regional, State, and Selected Local Area Vaccination Coverage Among Adolescents Aged 13-17 Years - United States, 2018. *MMWR Morb Mortal Wkly Rep.* 2019;68(33):718-723. doi:10.15585/mmwr.mm6833a2
8. Office of Disease Prevention and Health Promotion. Healthy People 2020: immunization and infectious diseases. Updated 10/08/2020. Accessed June 17/17/2020. <https://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases/objectives>
9. Bailey HH, Chuang LT, duPont NC, et al. American Society of Clinical Oncology Statement: Human Papillomavirus Vaccination for Cancer Prevention. *J Clin Oncol.* 2016;34(15):1803-1812. doi:10.1200/JCO.2016.67.2014
10. Wheldon CW, Krakow M, Thompson EL, Moser RP. National Trends in Human Papillomavirus Awareness and Knowledge of Human Papillomavirus-Related Cancers. *Am J Prev Med.* 2019;56(4):e117-e123. doi:10.1016/j.amepre.2018.11.005