

Understanding the HPV-Associated Cancer Burden in West Virginia

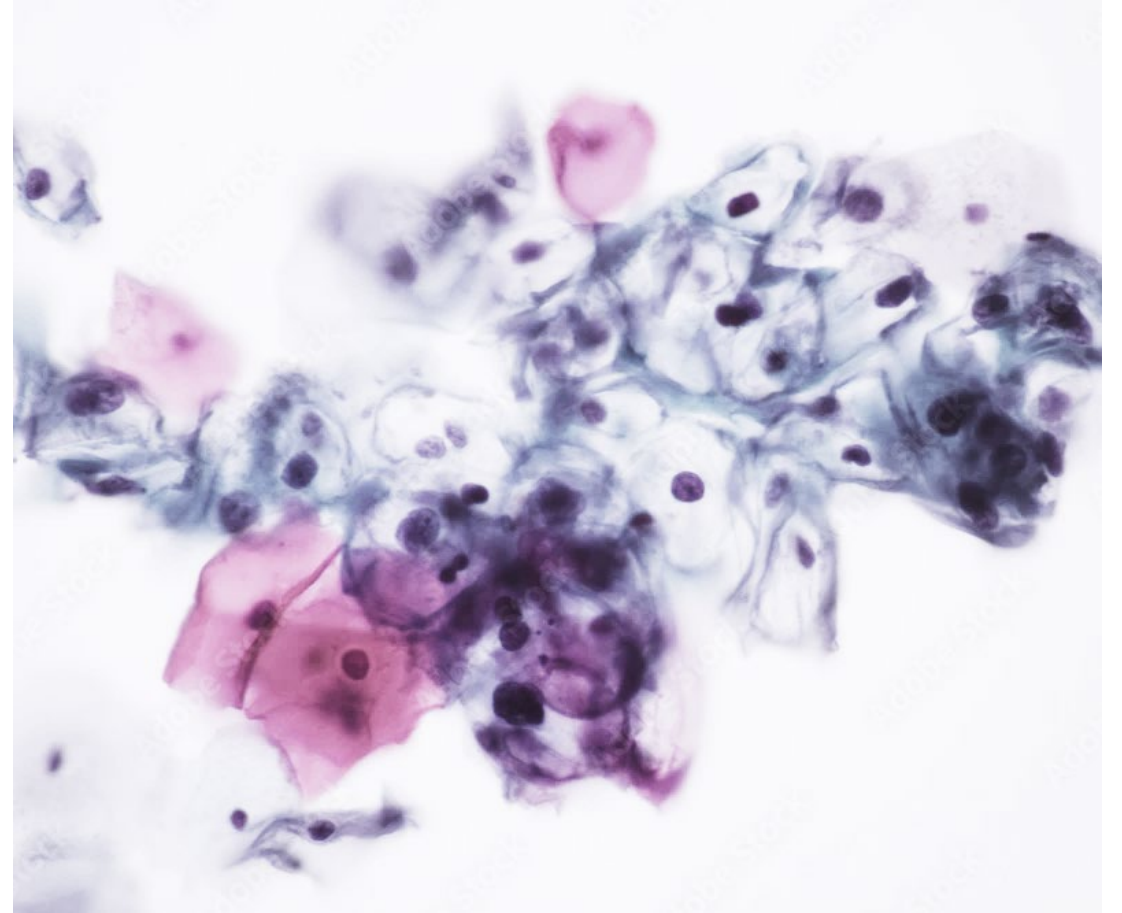
**Alana Hudson, PhD, MPH
Assistant Professor
Department of Cancer Prevention and Control
WVU Cancer Institute**

Cancers Attributable to Infections

- Several infectious agents (viral, bacterial, or parasitic pathogens) can cause cancer
- The International Agency for Research on Cancer (IARC) classifies 11 infectious agents as Group 1 carcinogens
- Worldwide, infections are linked to about 15% to 20% of cancers
- This percentage is lower in the United States and other developed countries
- Human papillomavirus (HPV) is by far the most common cause of infection-related cancers in the United States

What Is HPV

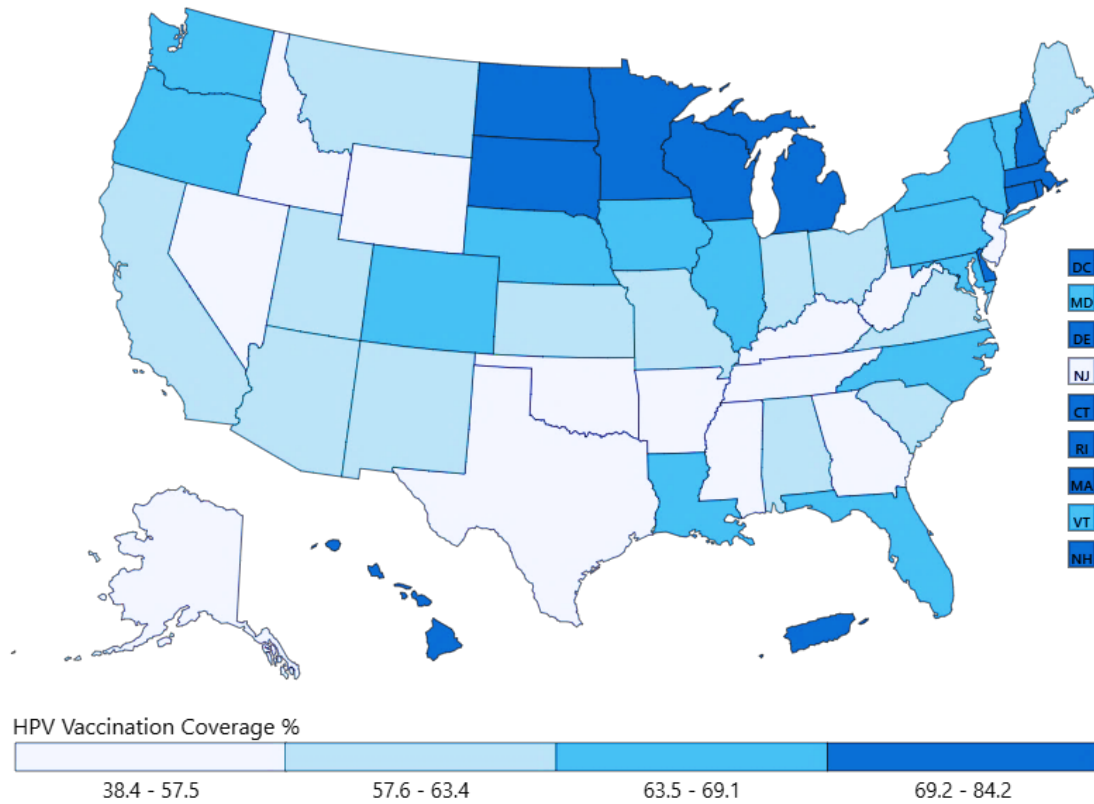
- HPV is very common and highly contagious
- There are more than 200 types of HPV
- High-risk types of HPV can cause cancer
- Persistent high-risk HPV infection can lead to abnormal cell changes
- HPV vaccination can prevent over 90% of cancers caused by HPV



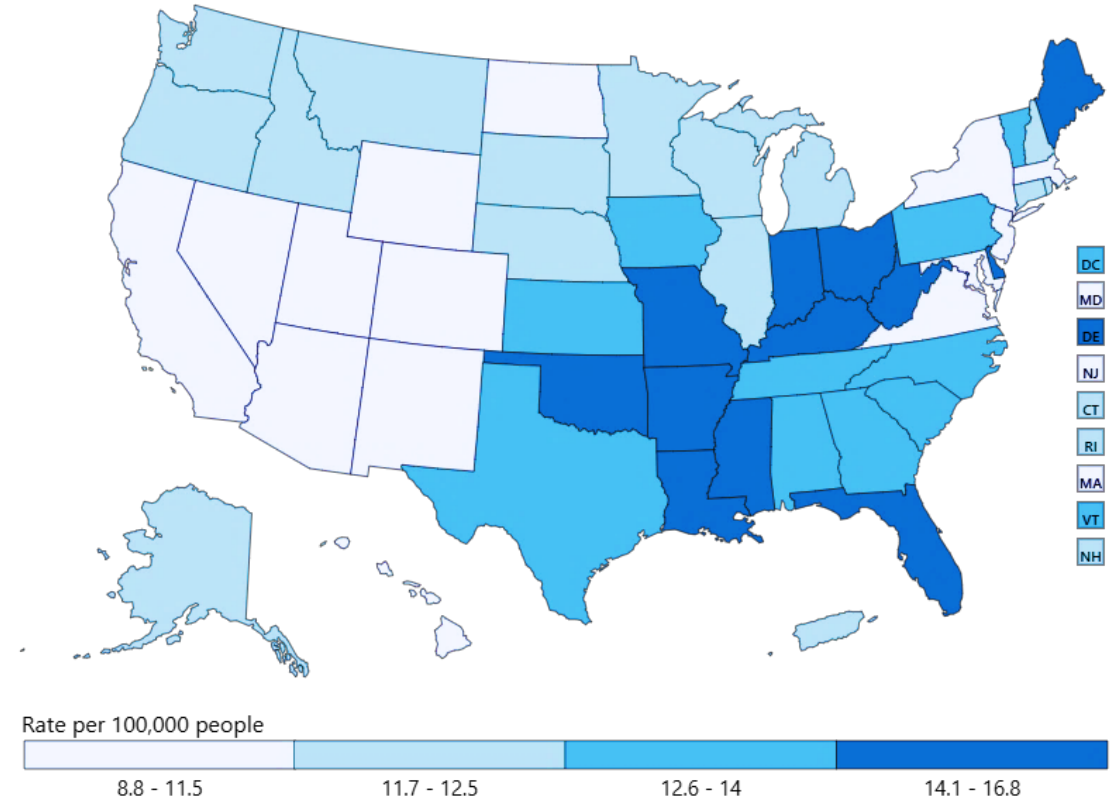
Pap smear image showing HPV-associated cellular changes.

Geographic Patterns of HPV Vaccination Coverage and HPV-Associated Cancers

Teens (%) Aged 13-17 Up-To-Date with HPV Vaccinations, NIS-Teen Survey 2023



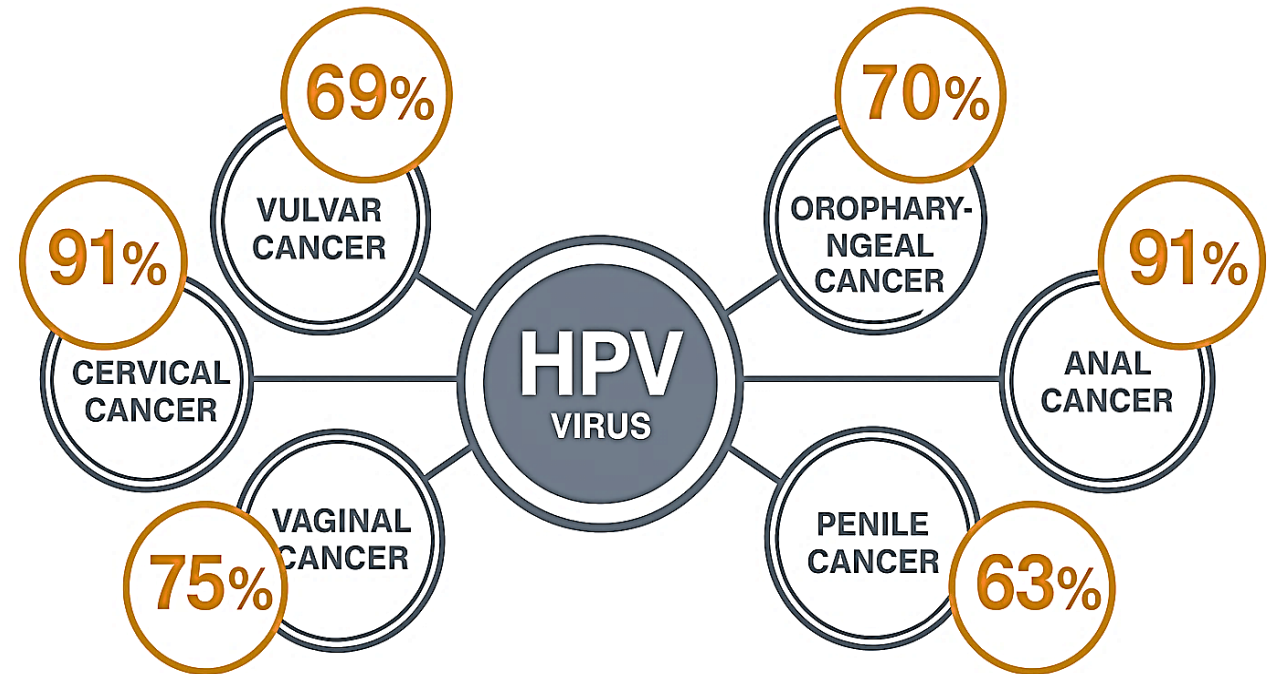
Age-Adjusted Incidence Rates of HPV-Associated Cancers, 2018-2022



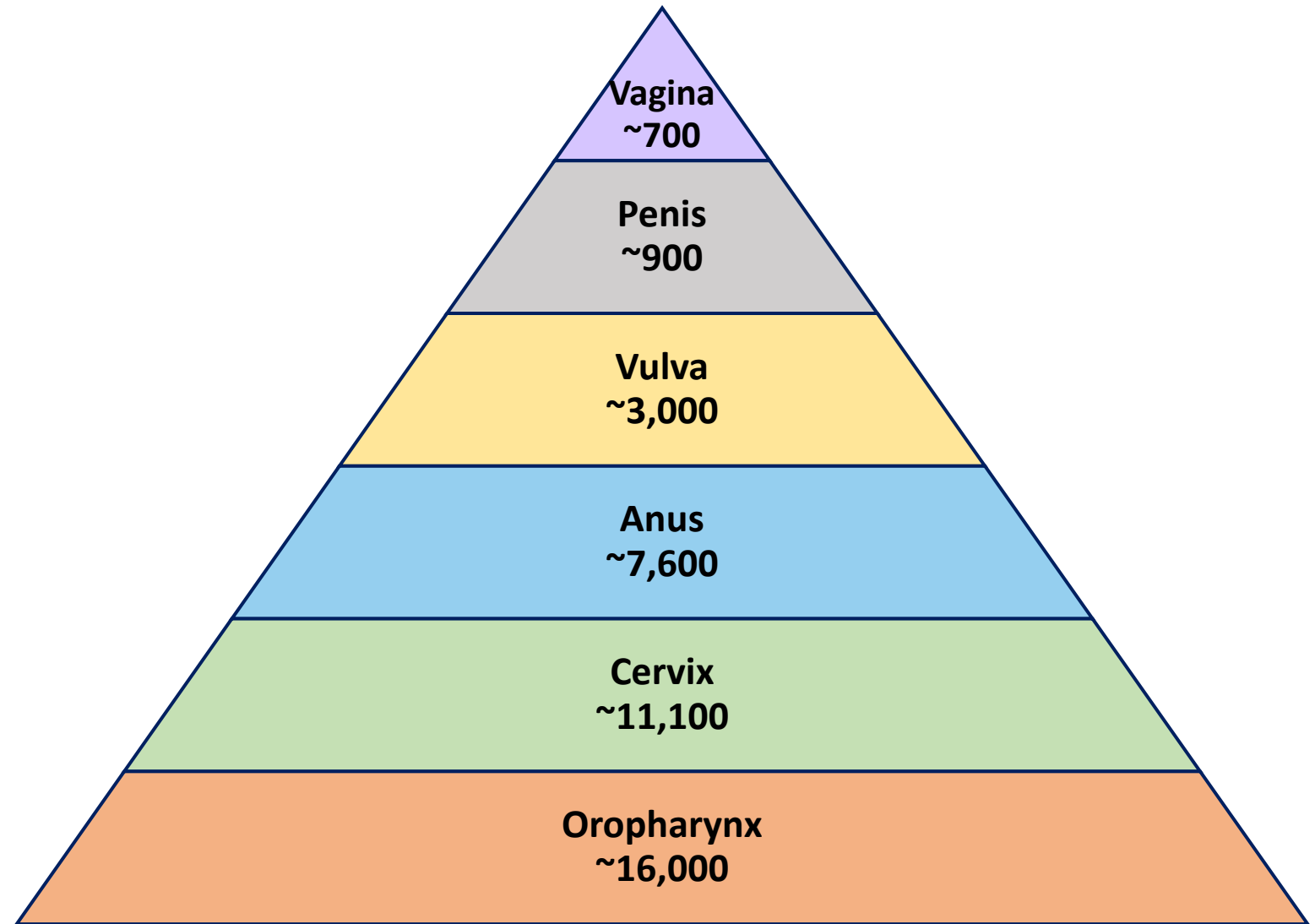
HPV-Associated Cancers

- HPV is responsible for cancers of the cervix, vagina, vulva, anus, penis and oropharynx
- The proportion attributable to HPV varies by anatomical site
- These sites form the basis for HPV-associated cancers

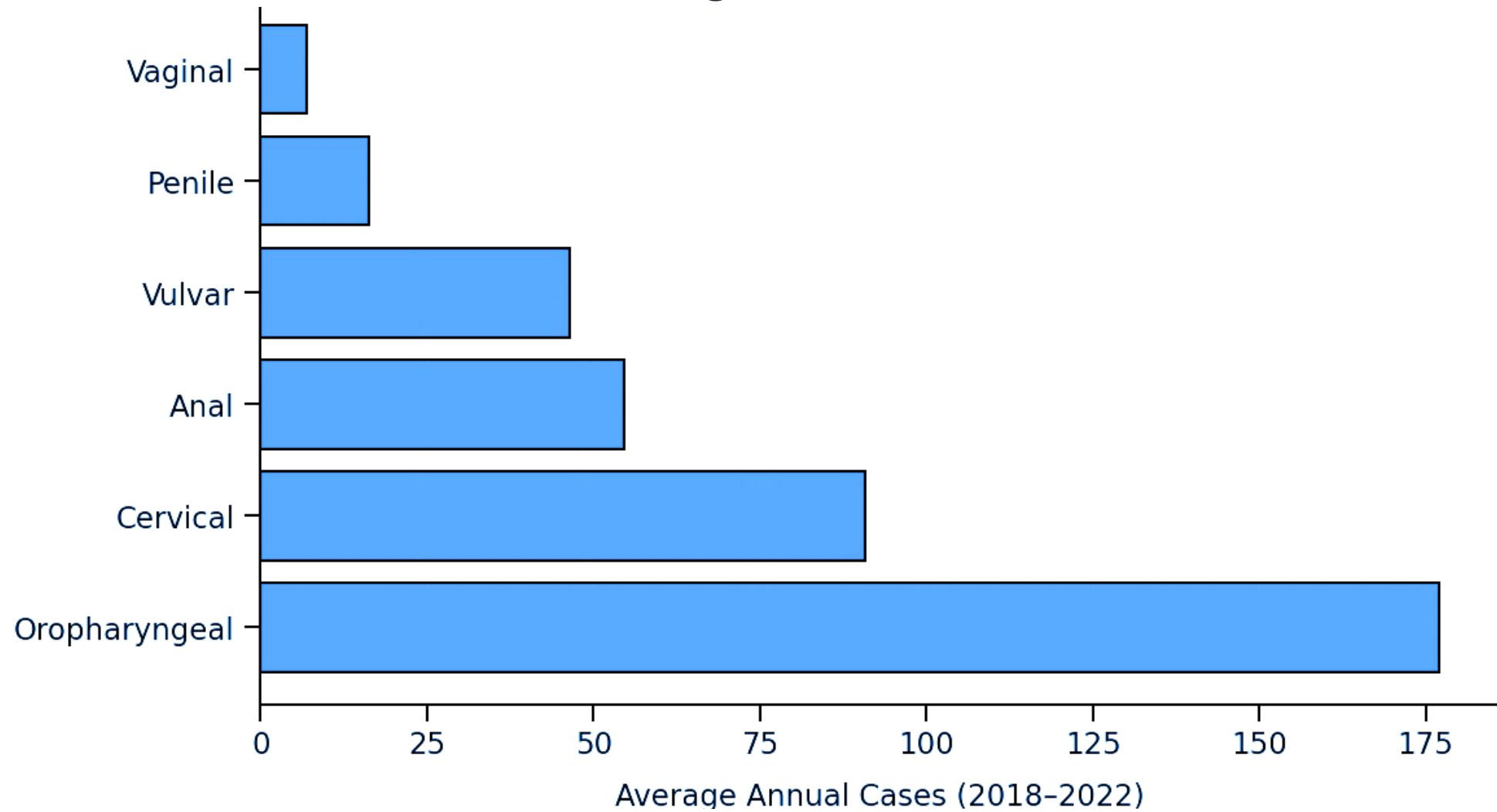
HPV CAUSES SIX TYPES OF CANCER



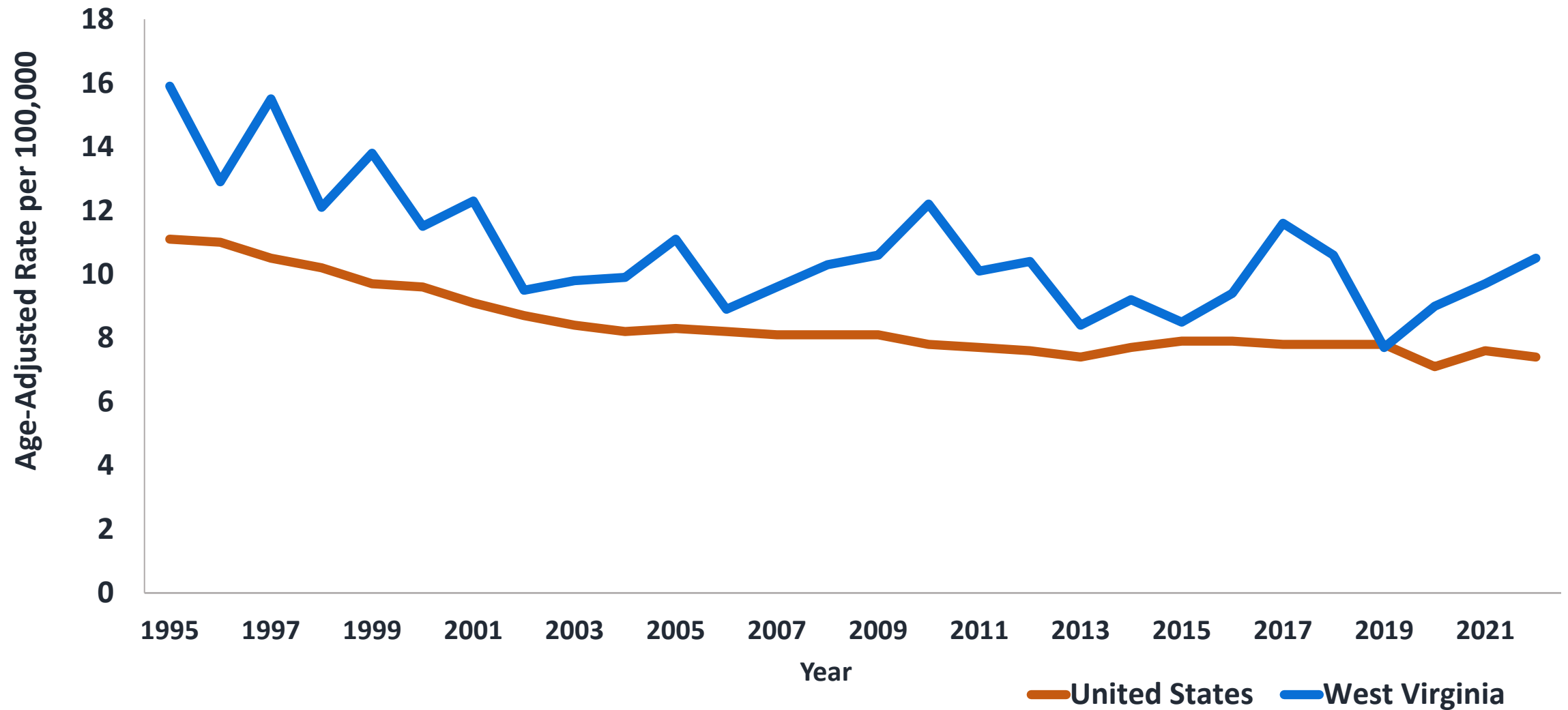
**Estimated
Number of
HPV-Attributable
Cancers
per Year in the
United States:
>39,000**



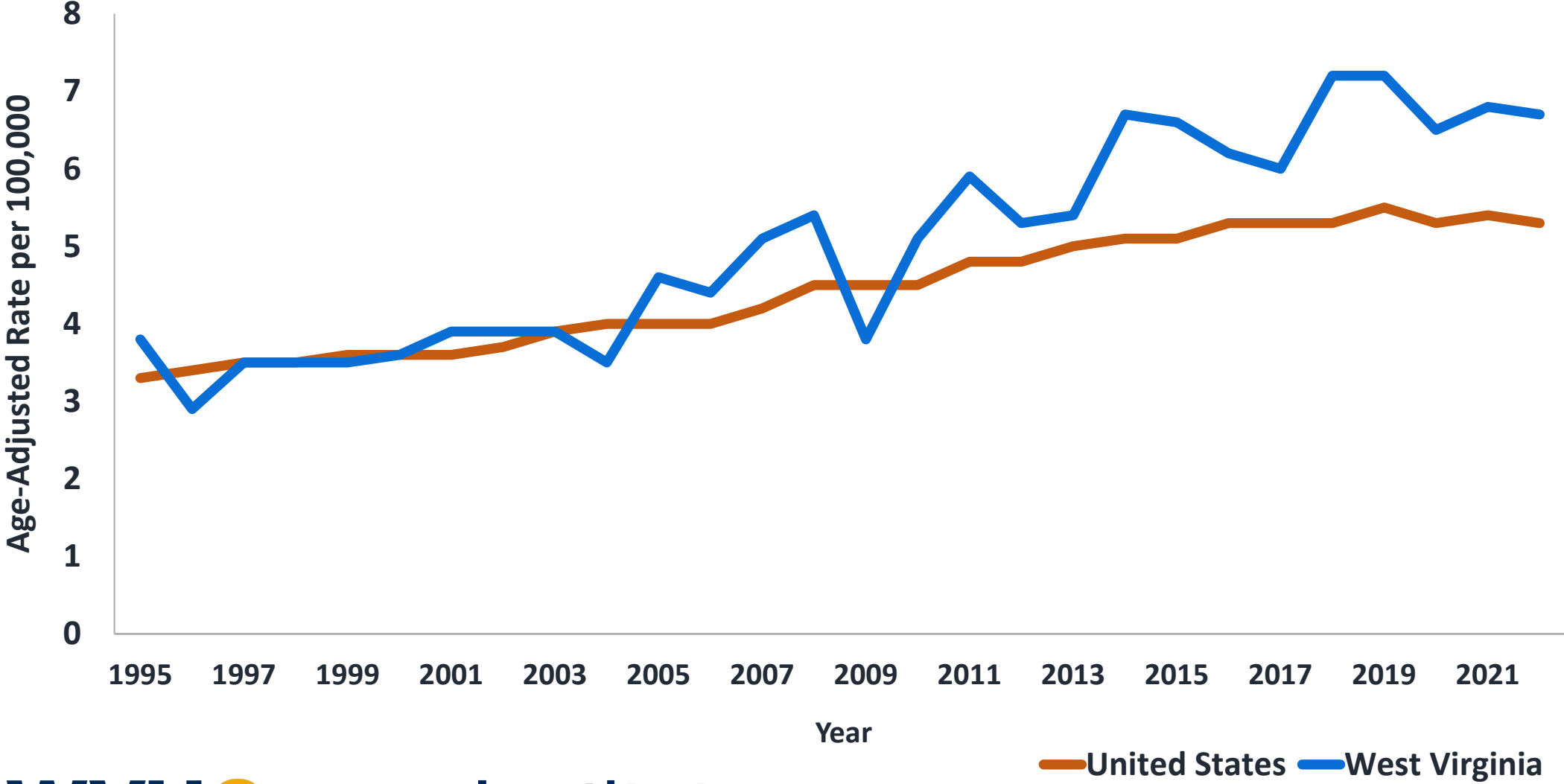
Average Annual HPV-Associated Cancer Cases, West Virginia, 2018-2022



Age-Adjusted Cervical Cancer Rates by Year of Diagnosis, United States and West Virginia, 1995-2022

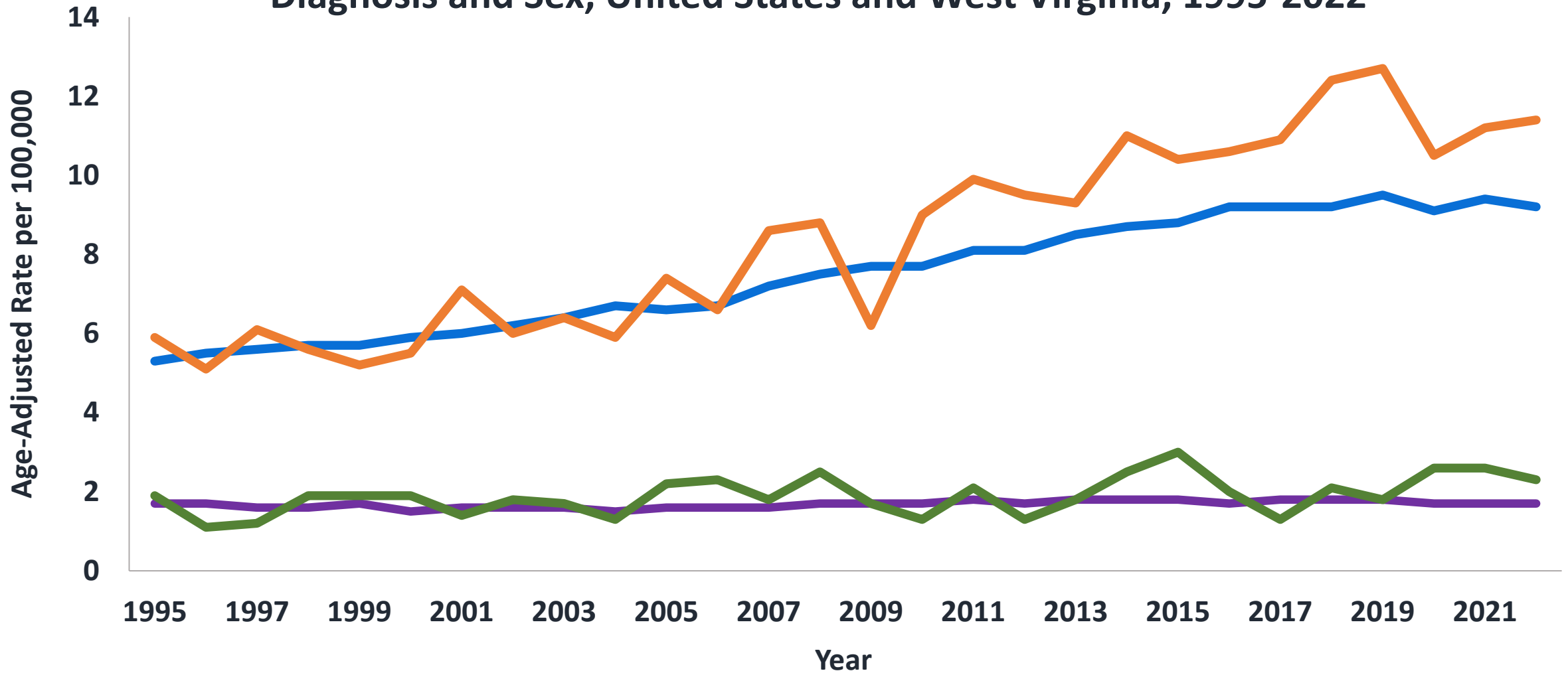


Age-Adjusted HPV-Associated Oropharyngeal Cancer* Rates by Year of Diagnosis, United States and West Virginia, 1995-2022



*Includes HPV-associated oropharyngeal cancer (OPC) only; not all OPC

Age-Adjusted HPV-Associated Oropharyngeal Cancer* Rates by Year of Diagnosis and Sex, United States and West Virginia, 1995-2022

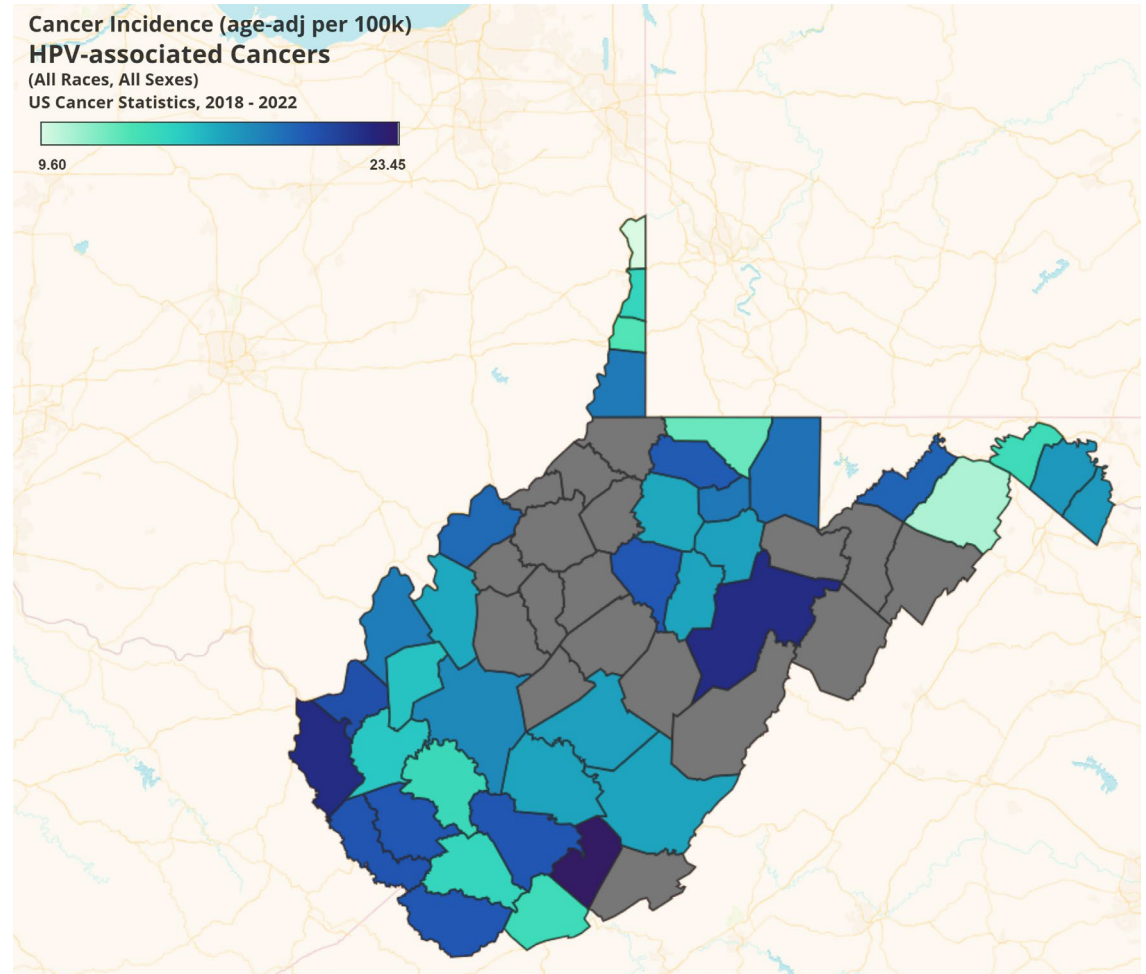


US Male WV Male US Female WV Female

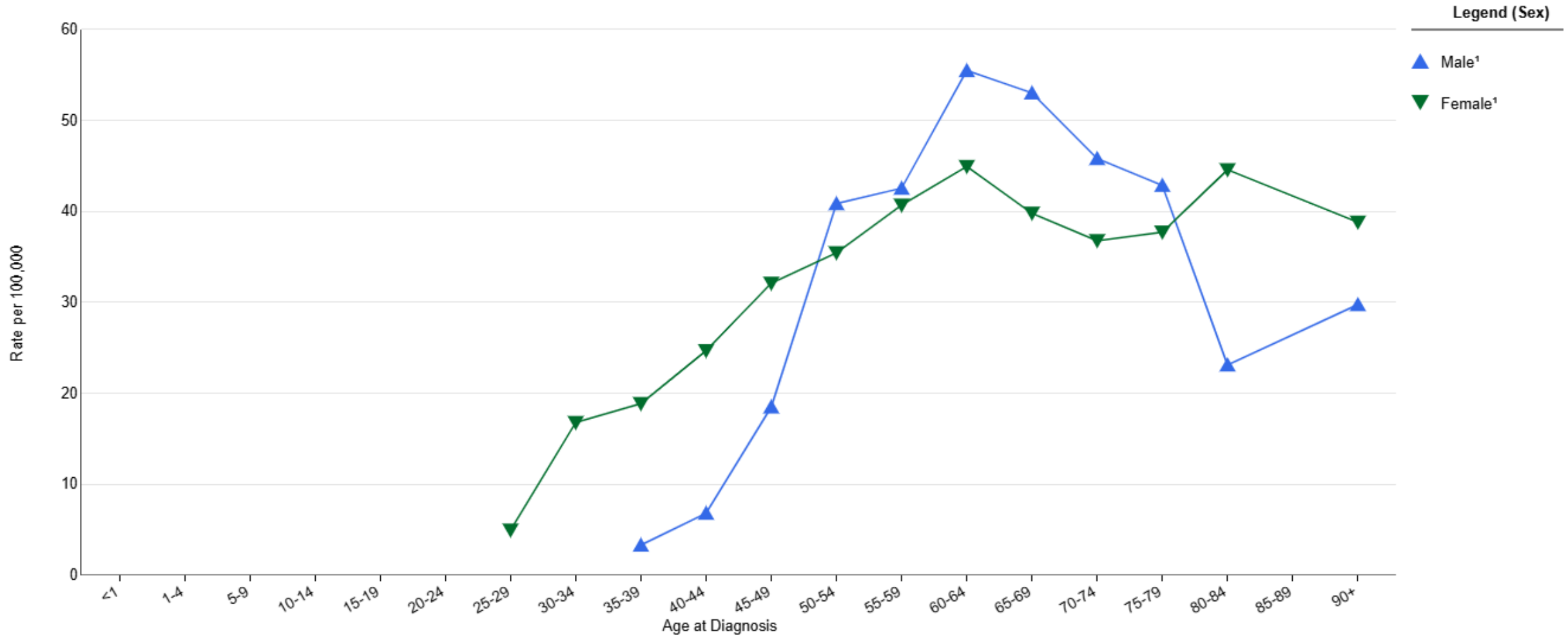
*Includes HPV-associated oropharyngeal cancer (OPC) only; not all OPC

Local Patterns

- County-level HPV-associated cancer incidence rates vary across the state
- Cancer burden observed across multiple regions, not isolated areas

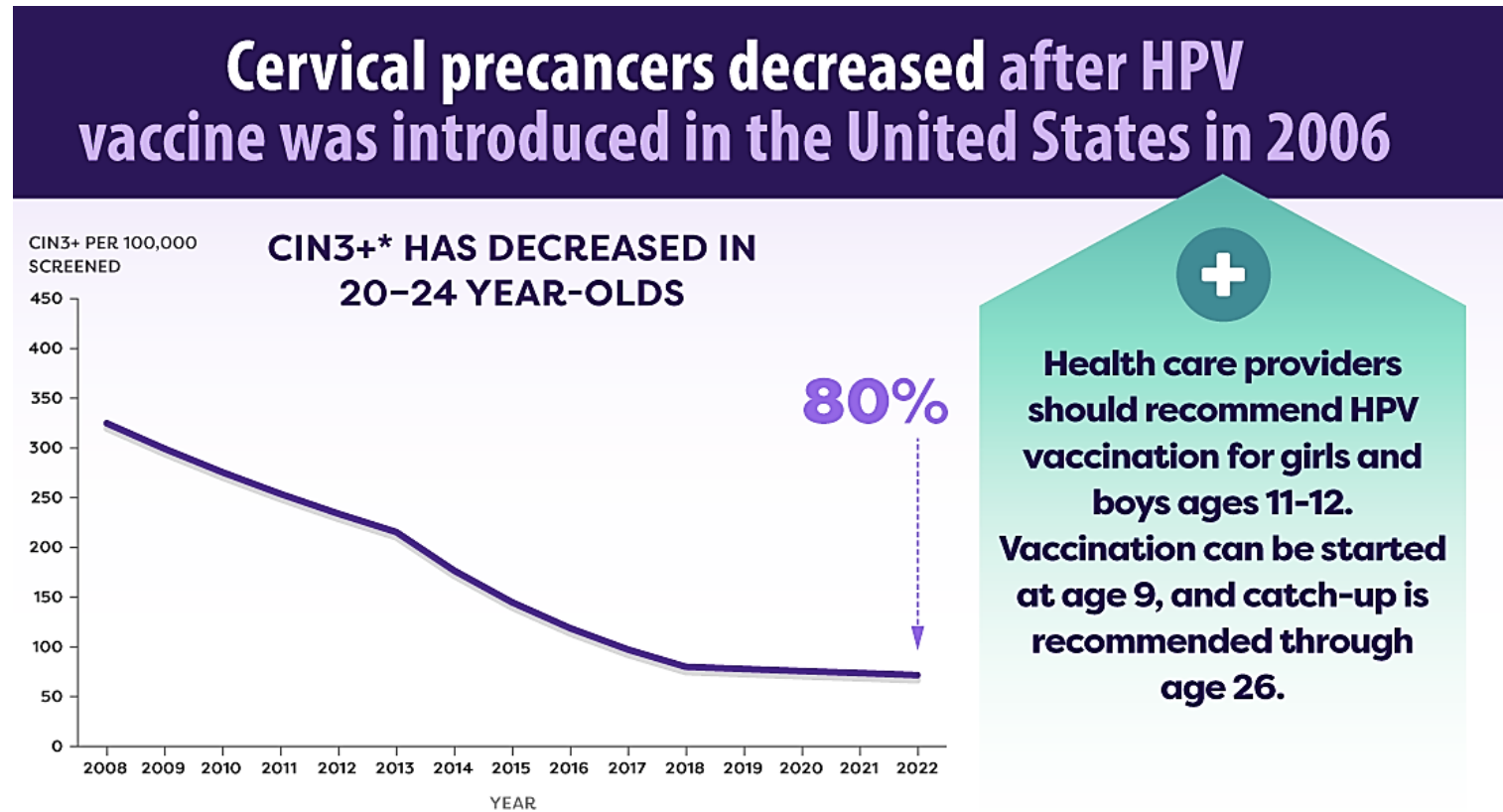


West Virginia
HPV Associated Sites
Incidence Rates by Age at Diagnosis, 2018-2022
By Sex, All Races



Real-World Evidence

- U.S. studies show oral HPV infections have declined among vaccinated males and females
- Cervical precancers decreased among U.S. women in their early 20s after HPV vaccine introduction



**For the first time,
there were no
cervical cancer
cases diagnosed
among women
under 25 in 2021**



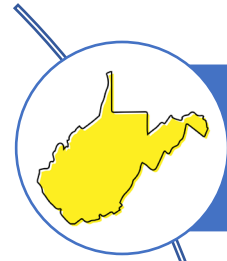
Heather Hazzan, SELF (Model(s) used for illustrative purposes only)

NEWSFEED

Australia on Track to Eliminate Cervical Cancer by 2035

Key Takeaways

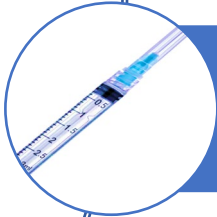
Because HPV-associated cancers reflect infections acquired many years earlier, the actions we take now will shape cancer burden decades to come.



West Virginia continues to experience a disproportionate burden of HPV-associated cancers



Cervical and oropharyngeal cancers remain the largest contributors to this burden



Most HPV-associated cancers are preventable with timely, complete vaccination



Improving coverage now is essential to reducing future cancer incidence and disparities

References

- U.S. Centers for Disease Control and Prevention (CDC). HPV-IMPACT Surveillance Data: Declines in Cervical Precancers Among Vaccinated Women Ages 20–24. Accessed March 2026. <https://www.cdc.gov/>
- U.S. Centers for Disease Control and Prevention (CDC). Trends in CIN2+ and CIN3+ Among U.S. Women Ages 20–24, 2008–2022. Accessed March 2026. <https://www.cdc.gov/>
- The University of Sydney. Australia Reports Zero Cervical Cancer Cases in Women Under 25 in 2021 Following Long-Term HPV Vaccination. Accessed March 2026. <https://www.sydney.edu.au/>
- London School of Hygiene & Tropical Medicine (LSHTM). Cervical Cancer Reduced by 80% in Women Under 30 After HPV Vaccination; England on Track for Elimination by 2040. Accessed March 2026. <https://www.lshtm.ac.uk/>
- American Cancer Society (ACS). HPV Vaccination and Reductions in Oral HPV Infection Among U.S. Males and Females. Accessed March 2026. <https://www.cancer.org/>
- International Agency for Research on Cancer (IARC). Agents Classified by the IARC Monographs, Volumes 1–140. Updated February 11, 2026. Accessed March 10, 2026. <https://monographs.iarc.who.int/agents-classified-by-the-iarc/>
- Centers for Disease Control and Prevention. U.S. Cancer Statistics Data Visualizations Tool. Updated 2024. Accessed December 10, 2025. <https://www.cdc.gov/cancer/dataviz>
- Centers for Disease Control and Prevention. Cancers Caused by HPV. Updated 2024. Accessed March 10, 2026. <https://www.cdc.gov/hpv/about/cancers-caused-by-hpv.html>
- Centers for Disease Control and Prevention. (n.d.). *Cancers linked with HPV each year*. U.S. Department of Health and Human Services. <https://www.cdc.gov/cancer/hpv/cases.html>
- North American Association of Central Cancer Registries (NAACCR). CiNA Public Use Dataset. Released 2024. Accessed March 10, 2026. <https://www.naacr.org>

Rural-Urban Differences in Knowledge of the HPV-Cancer Link and Awareness of the HPV Vaccine

Kelly D. Blake, ScD

Associate Director of Cancer Control and Population Science

West Virginia University Cancer Institute

Assistant Professor

Department Cancer Prevention and Control

West Virginia University School of Medicine

Rachel Wattick, PhD, RD

Department Cancer Prevention and Control

West Virginia University School of Medicine

West Virginia Immunization Network

Infectious Disease and Immunization Summit

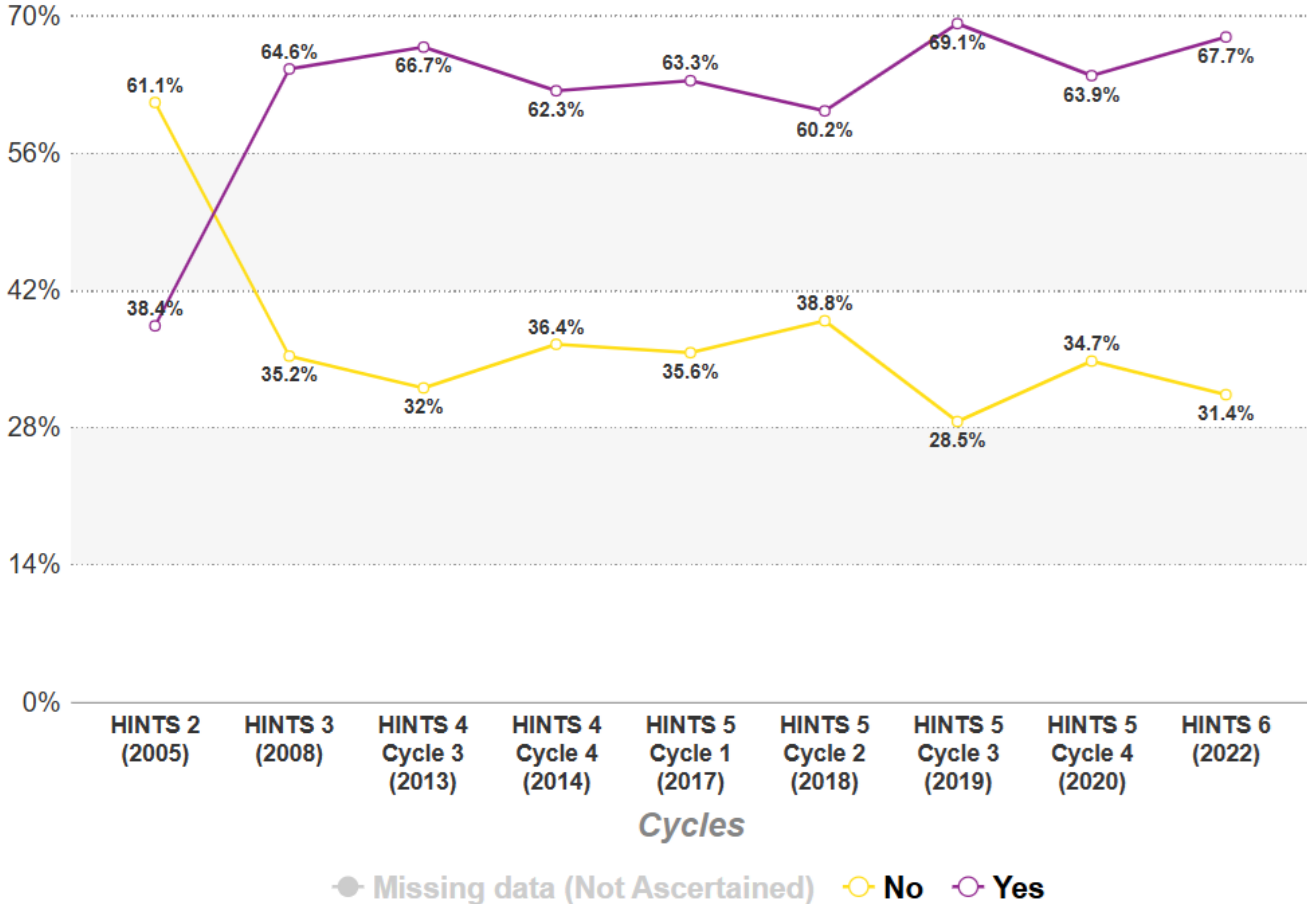
May 14, 2026

Today

- National trends in awareness of the HPV-cancer link
- National trends in awareness of the HPV vaccine
- Current sociodemographic predictors of:
 - Hearing of HPV
 - Hearing of the HPV vaccine
 - Knowledge that HPV causes cervical cancer

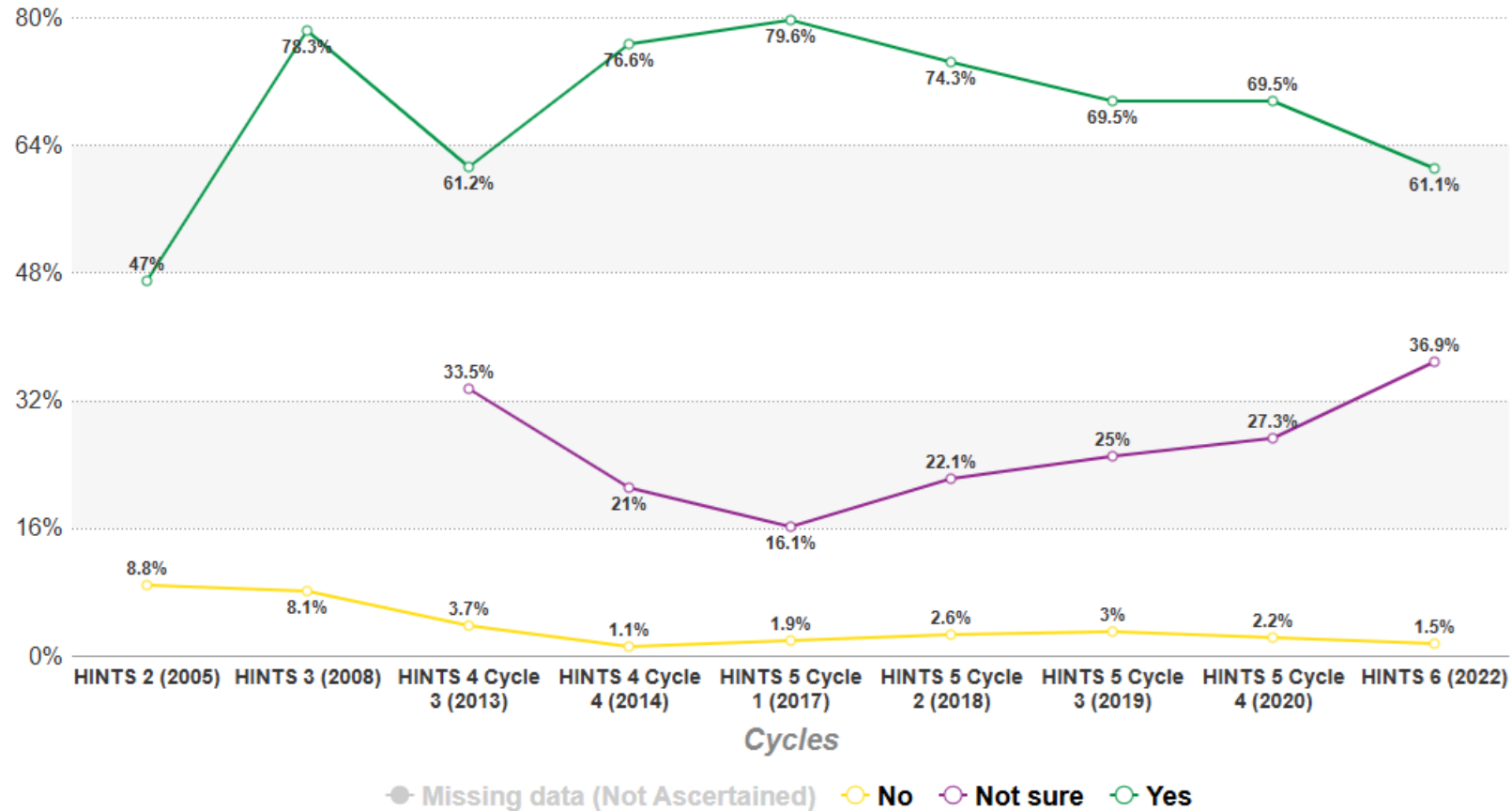
Have you ever heard of HPV? HPV stands for Human Papillomavirus. It is not HIV, HSV, or herpes

U.S. Adults 2005-2022



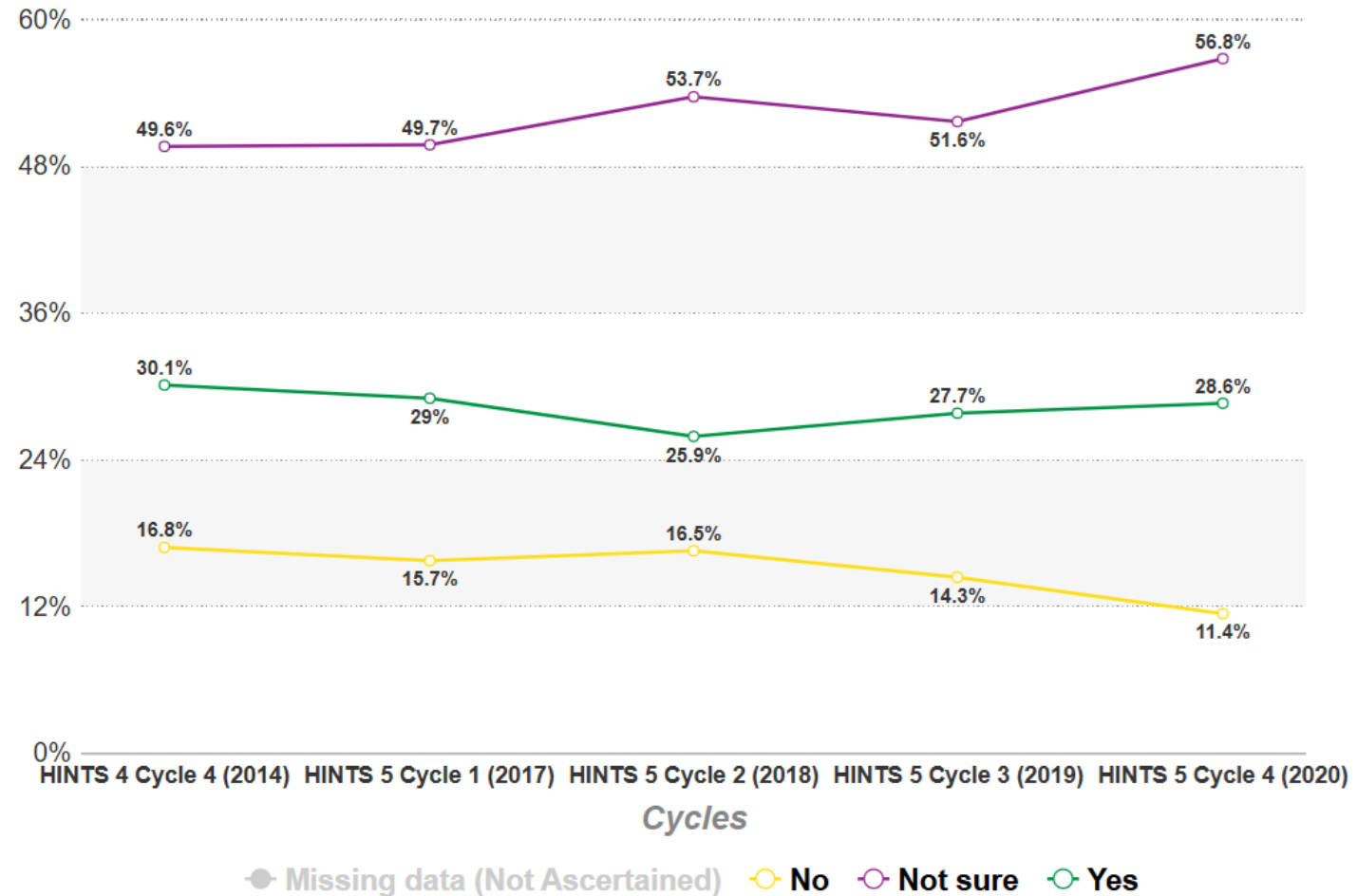
Do you think HPV can cause cervical cancer?

U.S. Adults 2005-2022



Do you think HPV can cause oral cancer?

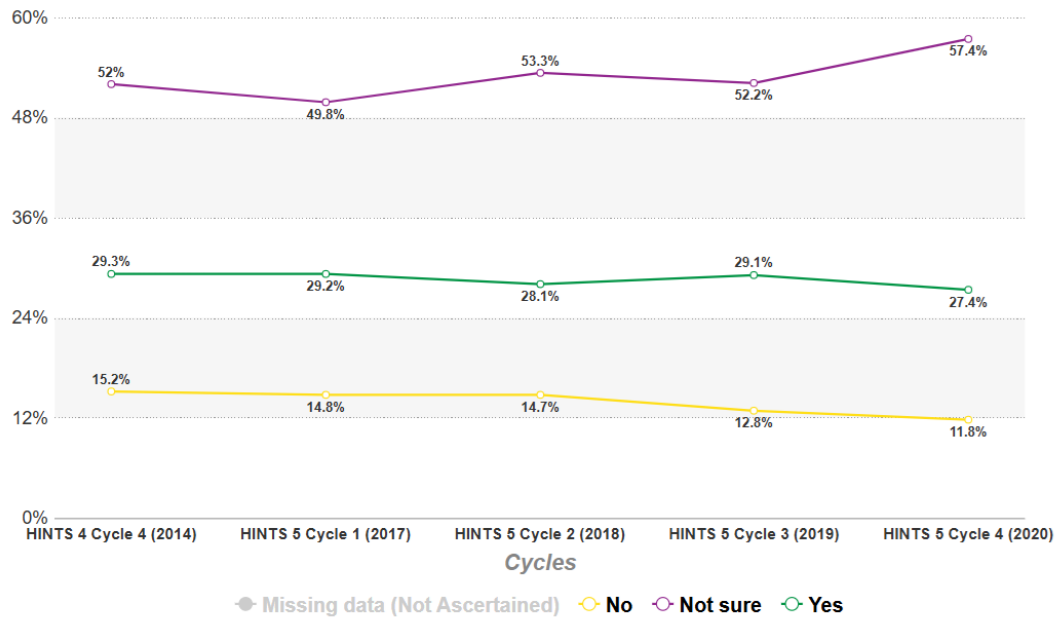
U.S. Adults 2014-2020



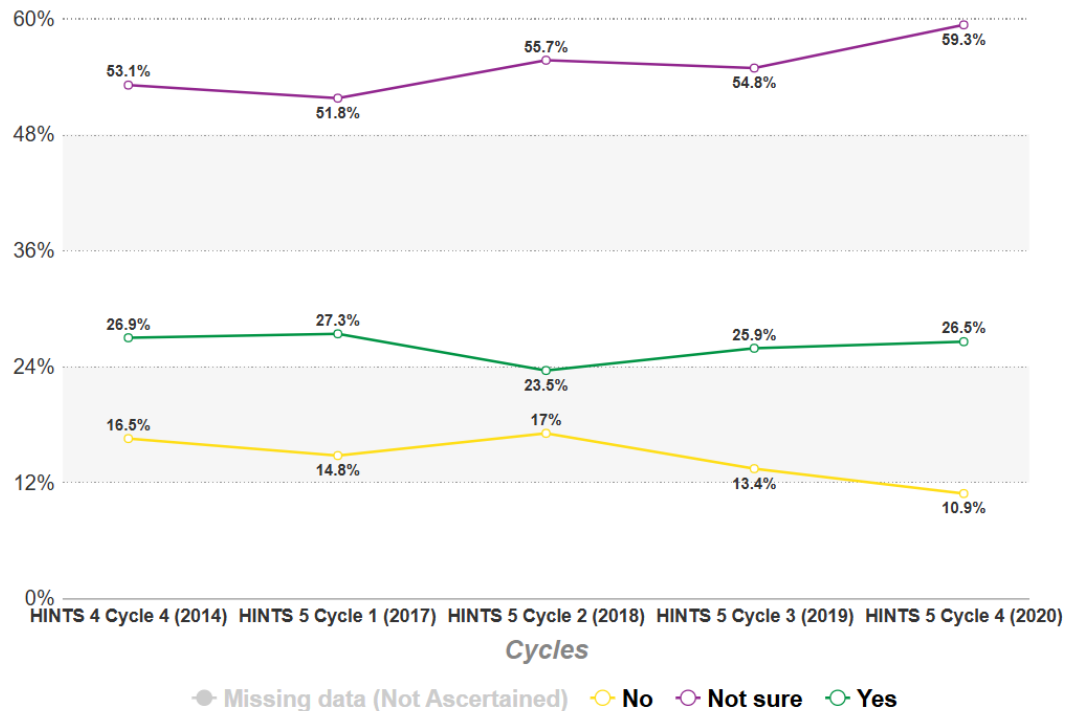
Do you think HPV can cause...

U.S. Adults 2014-2020

Penile Cancer

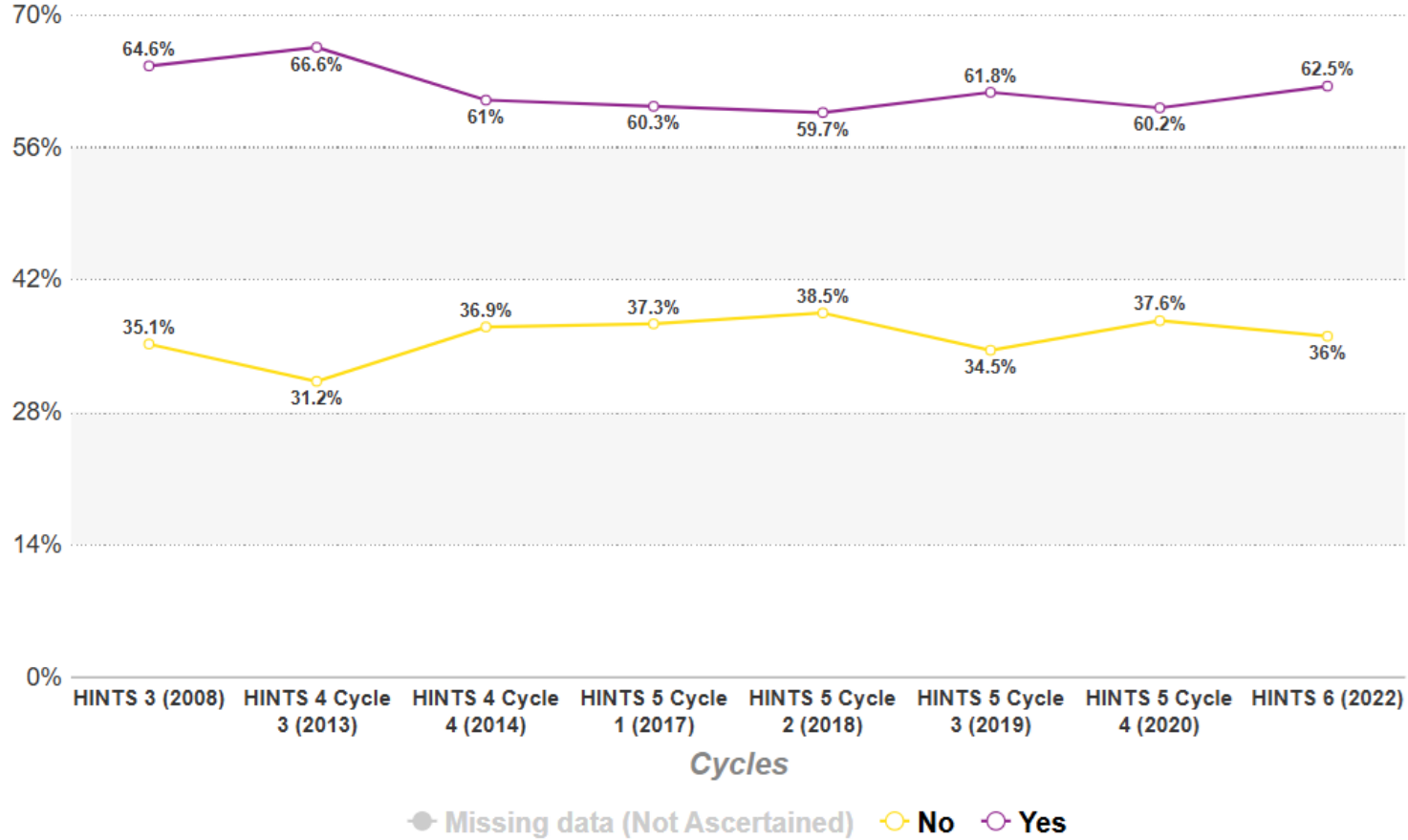


Anal Cancer



A vaccine to prevent HPV infection is available and is called the cervical cancer vaccine or HPV shot. Before today, have you ever heard of the cervical cancer vaccine or HPV shot?

U.S. Adults 2008-2022



***What are the current sociodemographic predictors of hearing of HPV, knowing that HPV causes cervical cancer, and hearing of the HPV vaccine?
And does knowledge and awareness vary by rurality or Appalachian residence?***

Methods

- Health Information National Trends Survey (HINTS) 2022 (N=6,252)
 - Cross-sectional, probability-based postal survey of U.S. addresses
 - Oversample of rural zip codes
- Analyses were conducted using SAS and accounted for the complex sampling design of HINTS.
- Frequencies and weighted, unadjusted proportions were calculated to estimate awareness of the 3 questions under study.
- Weighted, fully adjusted multivariable logistic regression models were used to examine sociodemographic predictors of awareness for each question under study.
- Tests of significance conducted at $p < 0.05$ level.

Survey Questions

- “Have you ever heard of HPV? HPV stands for Human Papillomavirus. It is not HIV, HSV, or herpes.”
 - Yes/No
- “Do you think HPV can cause cervical cancer?”
 - Yes/No/Not Sure
- “A vaccine to prevent HPV infection is available and is called the cervical cancer vaccine or HPV shot. Before today, have you ever heard of the cervical cancer vaccine or HPV shot?”
 - Yes/No

Sample Characteristics (N=6252)

	Unweighted N	Weighted %
Male	2307	49.23
Female	3535	50.76
Urban	5411	87.75
Rural	811	12.24
Non-Appalachian	5932	93.28
Appalachian	320	6.71
Children in household	1312	29.79
No children in household	4419	70.20
Less than high school education	387	6.85
High school degree	1068	21.61
Some college	1672	38.89
Bachelor's degree or higher	2721	32.63
Health Insurance	5605	89.28
No Health Insurance	521	10.71

Sample Characteristics (Cont.)







	Unweighted N	Weighted %
Age 18-34	939	25.91
Age 35-49	1240	25.25
Age 50-64	1772	27.26
Age 65-74	1356	12.99
Age 75+	847	8.57
Non-Hispanic White	3203	61.20
Non-Hispanic Black	889	10.98
Hispanic	1001	17.04
Non-Hispanic Asian	288	5.71
Non-Hispanic Other Race	184	5.04
Ever Cancer Diagnosis	900	10.12
Never Cancer Diagnosis	4982	89.87
Income <\$50K	2420	37.34
Income >\$50K	3100	62.64

Bivariate Analysis Results

	Yes (%)	No (%)	Not Sure (%)
Heard of HPV?	68.27	31.72	--
Can HPV cause cervical cancer?	61.41	1.48	37.09
Heard of HPV vaccine?	63.47	36.52	--

Adjusted Results

- Rural residents were no more or less likely than urban residents to have HPV awareness and knowledge.
- Appalachian residents were no more or less likely than non-Appalachian residents to have HPV awareness and knowledge.

Heard of HPV	HPV Causes Cervical Cancer	Heard of HPV Vaccine
Age Sex Education Race/Ethnicity Trust in Government for Cancer Info 	Age Sex Education Race/Ethnicity Cancer History 	Age Sex Education Race/Ethnicity Income Cancer History 
Rural Appalachian Income Health Insurance Cancer History Children in Household Trust in Doctor for Cancer Info 	Rural Appalachian Income Health Insurance Children in Household Trust in Doctor for Cancer Info Trust in Government for Cancer Info 	Rural Appalachian Health Insurance Children in Household Trust in Doctor for Cancer Info Trust in Government for Cancer Info 

Implications

- While cervical cancer incidence and mortality rates in Appalachia are significantly higher and rising compared to the rest of the U.S., our region is not less likely to have heard of HPV, have knowledge of the HPV-cervical cancer link, or be less aware of the HPV vaccine.
 - Differential awareness and knowledge is driven more by age, sex, and educational attainment.
- Everyone could benefit from being educated about the causal link between HPV and cervical, oropharyngeal, anal, vulvar, vaginal, and penile cancers – and the ability of the vaccine to prevent these infections and cancers.
- Education and policy efforts focused on access to care, screening adherence, and vaccine uptake are needed.



kelly.blake1@hsc.wvu.edu

HPV Vaccine Recommendations

Heather N. Owens, PhD, MPH

Assistant Professor

WVU School of Pharmacy

WVU Cancer Institute

Agenda

HPV vaccine timeline

Current HPV vaccine recommendations

How to improve HPV vaccine uptake

Other opportunities for HPV vaccination

HPV Vaccine Timeline

2009

Quadrivalent vaccine **approved** for boys 9-26 years old

2014

FDA approves Gardasil 9 and includes in recommendations

2020

FDA approves Gardasil 9 for prevention of oropharyngeal cancer

2006

Quadrivalent vaccine recommended for girls 9-26 years old

2011

Routine vaccination **recommended** for boys 11-12

2019

Approval extended to 27-45 years old

Current HPV Vaccine Recommendations

proposed CDC

- 1 dose at 11-12 years old

American
Academy of
Pediatrics
(AAP)

- Start series between 9 and 12 years old
- Catch up vaccination through age 18
- Starting age for dosage
 - 9-14: 2 doses
 - 15 and over: 3 doses

Science of 1 Dose

Costa Rica

- 20,330 girls 12-16 years old
- Exploring 1 and 2 doses of bivalent or 9 valent
- One dose was not inferior to 2 doses in preventing HPV infection
- Vaccine effectiveness was at least 97% in each group

Kenya

- 2,275 women 15-20 years old
- 1 dose of bivalent or 9 valent
- Vaccine efficacy was 97.5% for both vaccines

India

- 4,949 girls 10-18 years old
- Vaccine efficacy of 1 dose against types 16 and 18 was 95.4%

Limitations of the Science of 1 Dose



Limited follow up (no studies past 12 years after vaccination)



Did not include boys of any age

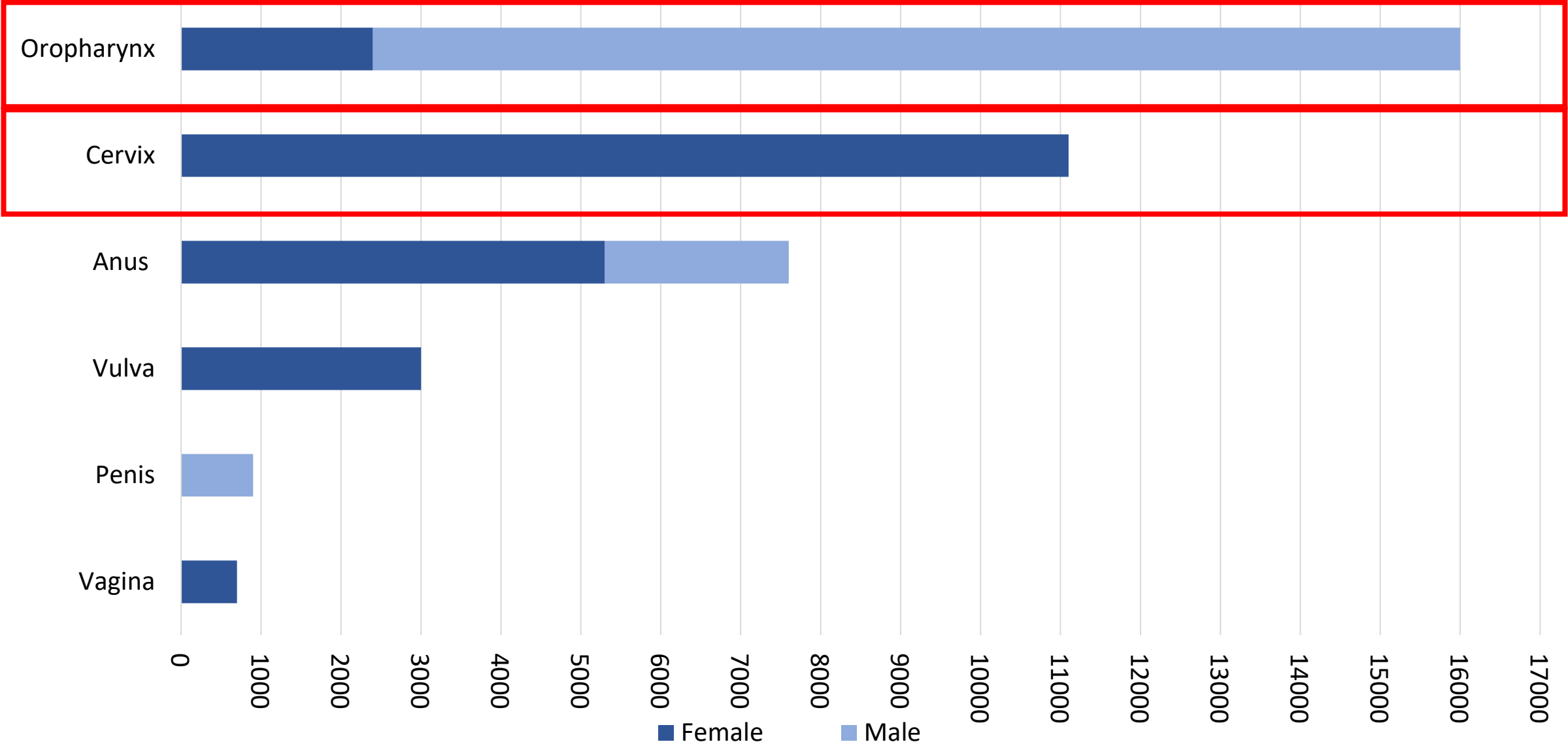


Did not confirm effectiveness for other HPV-related cancers

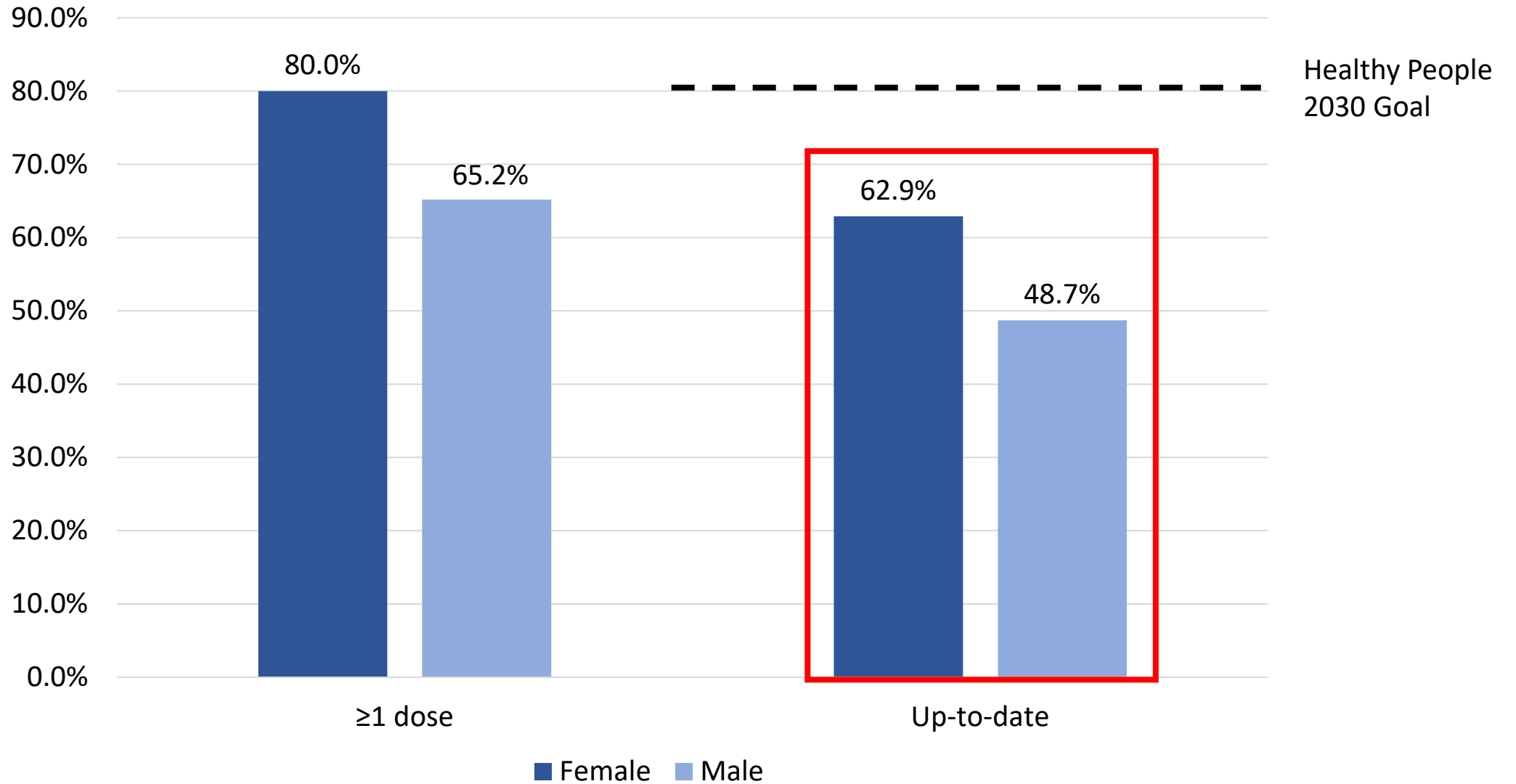


Gardasil 9 does not have FDA approval for 1 dose

Number of HPV-associated Cancers per Year



HPV Vaccination among Adolescents 13-17 in West Virginia, 2024



How can we improve HPV vaccine uptake?

Starting at Age 9

- HPV vaccine is most effective when given before exposure
- Advantages
 - More flexibility in introducing and discussing the vaccine
 - More time to complete the vaccine series
 - Separates from others given at 11-12 years old (Tdap, meningococcal)



**The strongest predictor of
vaccine uptake is
provider recommendation**

Provider Recommendation

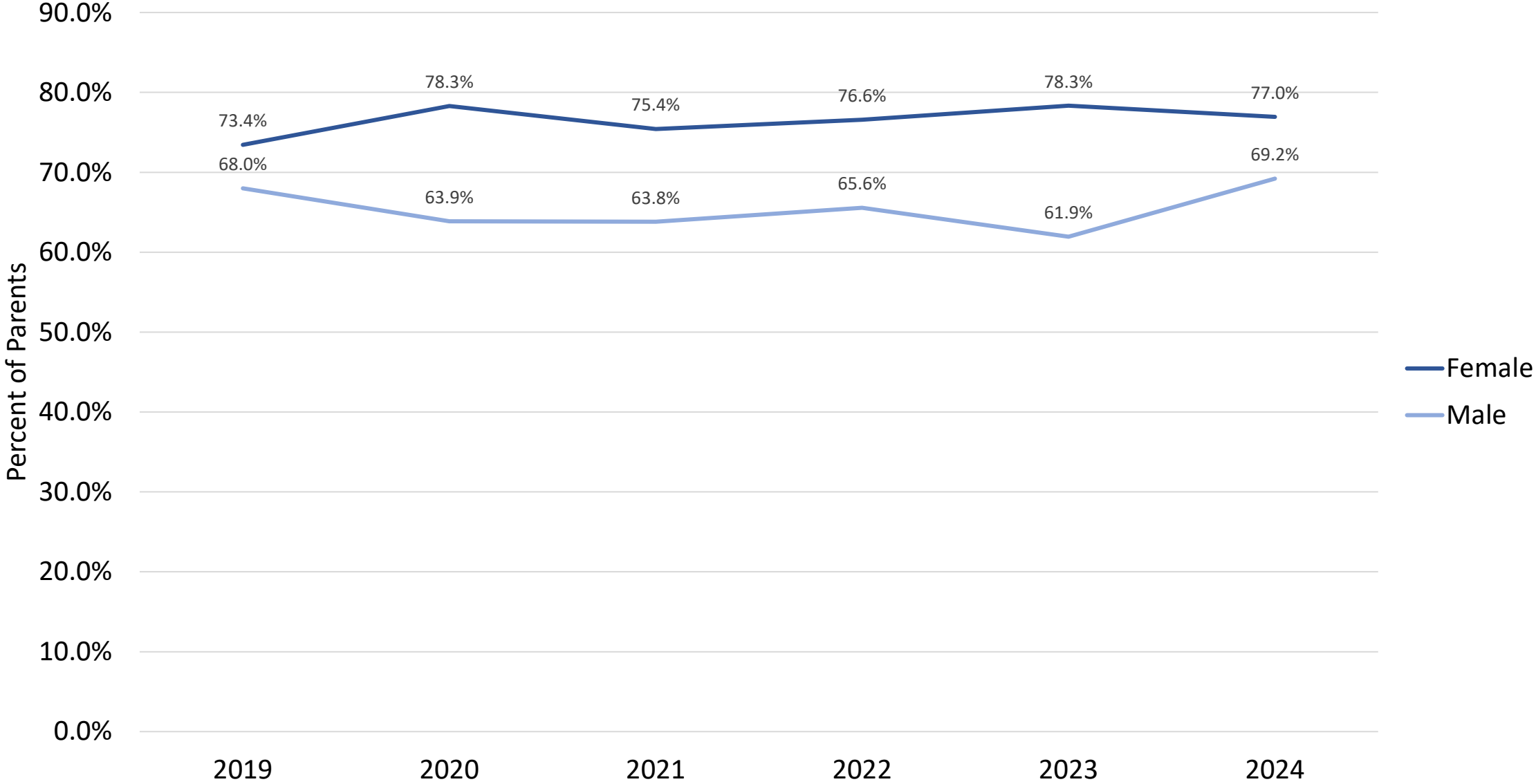
Increased initiation

- 10x higher among those who received a recommendation
- 12x higher among those who discussed the vaccine with a provider
- 60% of adolescents who received a recommendation initiated

Fewer recommendations

- Fewer males compared to females
- Lowest in the Southern US
- Lower in rural areas compared to urban

Percent of WV Parents Who Reported Receiving a Provider Recommendation



Resources for Providers

Materials

- Mountains of Hope – WV Cancer Coalition
- ACS Rural Learning Community Sessions
- ACS National HPV Vaccination Roundtable
- HPV Vaccination Roundtable of the Southeast

How to improve recommendations

- Announcement Approach Training
- 3 C's – confident, concise, and consistent
- Ask, Tell, Ask Model

Address missed opportunities for educating, discussing, and recommending the vaccine

Dentists

- 80% of WV 1-17 years old had a preventive dental visit in 2022-2023
- Educate, discuss, recommend
- Patients are comfortable discussing the HPV vaccine with a dental provider

Pharmacists

- 47.6% of rural communities have 1 pharmacy and 34.6% have 3+
- Longer operating hours, short wait times, and walk-in vaccination
- Can order and administer in WV

School-based Clinics

- Many counties in WV have school-based health centers
- At-school vaccination has shown to increase vaccine uptake
- Educate and vaccinate at back-to-school events

HPV-associated cancer rates are high in West Virginia

HPV vaccine uptake is low in West Virginia

HPV Vaccine Takeaways

Importance of improving knowledge of HPV

Opportunities to improve uptake

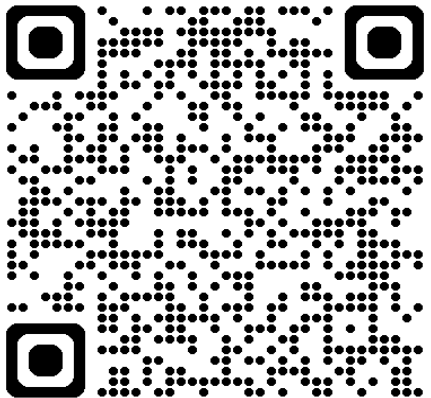
Thank you!

heather.owens1@hsc.wvu.edu

Thursday, May 14



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PRESENTERS:

Kelly Blake, ScD, WVU Cancer Control and Population Sciences

Alana Hudson, PhD, MPH, WVU Cancer Institute Research Programs

Heather Owens, PhD, MPH, WVU Pharmaceutical Systems & Policy

