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HPV Vaccine Market in US

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Objectives

Analyze current HPV vaccine immunization rates across different demographics and regions in the United States.

Evaluate adherence to recommended HPV vaccination schedules and their effectiveness in preventing HPV infections.

Propose strategies to enhance HPV vaccine uptake and address identified gaps in vaccination coverage and public awareness.

Research Methodology

- **Research Approach**

Research Approach: A mixed-methods approach combining qualitative and quantitative analysis of secondary data will be employed to comprehensively analyze HPV vaccine market trends in the US. This approach allows for both statistical analysis of market data and qualitative insights from existing literature and reports.

- **Data Collection Methods**

- **Literature Review:** - Systematic review of academic literature using databases such as PubMed, Google Scholar, and specialized health databases (e.g., JAMA Network, NEJM).

- Keywords: "HPV vaccine market trends", "HPV vaccine coverage", "HPV vaccine efficacy", "HPV vaccine safety", "barriers to HPV vaccination", "HPV vaccine hesitancy".

- Review of industry reports and market analyses from reputable sources such as IMS Health, IQVIA, and CDC.

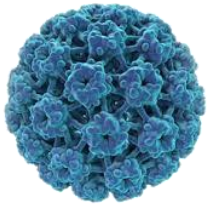
- **Sources:** CDC (https://www.cdc.gov), American Cancer Society (https://www.cancer.org), ASCO (https://www.asco.org).

- **Data Analysis Techniques**

Quantitative Analysis: - Statistical analysis of market data to examine trends in HPV vaccine uptake, market size, growth rates, and market share of different vaccine brands.

Qualitative Analysis: - Thematic analysis of qualitative data from literature, focusing on factors influencing HPV vaccine adoption, stakeholder perspectives, and barriers to vaccination. This adjusted methodology focuses solely on secondary research methods, utilizing existing literature and data sources to provide a thorough analysis of HPV vaccine market trends in the US.

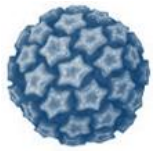
Human Papilloma Virus Overview



OVERVIEW

- **HPV**, comprising a diverse group of small, double-stranded DNA viruses, primarily targets epithelial cells and is classified into over 200 types based on genomic variations.
- While most types affect skin epithelium, leading to common warts, roughly 40 mucosal types are associated with cervical cancer..

Risk Factors



HPV infection

Immune System Deficiency

Multiple pregnancies

Smoking

Long term use of Oral Contraceptives

Sexual history

Chlamydia

Socio-economic Factors

TYPES OF HPV INFECTION

Mucosal /Genital infection site

High risk HPV types (16,18,31,33,45,52,58, and others)

- High or low-grade lesions of genital tract
- Cervical,anal,penile, vaginal,vulvar, and oropharyngeal cancers

Low-risk HPV types (6,11, and others)

- Low grade lesions of genital tract.
- Anogenital warts
- Recurrent respiratory papillomatosis

Nonmucosal/Cutaneous infection site

Low-risk HPV types (6,11, and others)

- Planar warts
- Palmar warts
- Other skin warts

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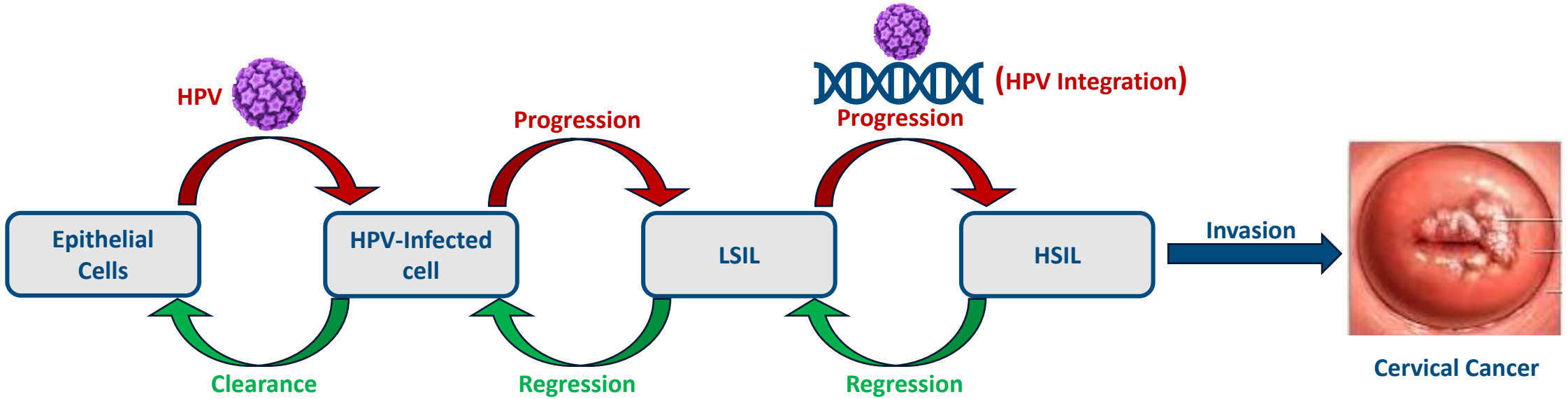
HPV Induced Cervical Cancer- Pathophysiology

Cervical cancer begins when healthy cells on the surface of the cervix change or become infected **with human papillomavirus (HPV)** and grow out of control, forming a mass called a tumor.

Cells in the transformation zone do not suddenly change into cancer. Instead, the normal cells of the cervix first gradually develop abnormal changes that can turn into cancer. Doctors use several terms to describe these cell changes, including **cervical intraepithelial neoplasia (CIN), squamous intraepithelial lesion (SIL), and dysplasia.**

Pathophysiology



LSIL-Low-grade intraepithelial lesion (CIN1);HSIL-High-grade intraepithelial lesion(CIN2&CIN3)

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HPV-Linked Cancer Rates: Yearly Averages

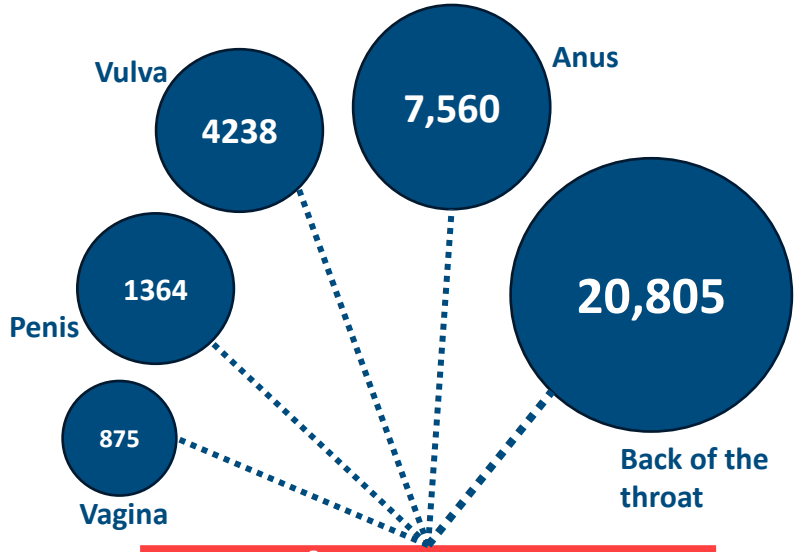
- HPV Vaccination is the best protection against certain cancer cases caused by HPV.

Cervical Cancer

Cervical cancer is the only type of cancer caused by HPV that has recommended screening test to detect it at an early stage.

Cervical Pre-cancers

While screening can detect precancers before they turn into cancer , treatment for these precancers can lead to problems getting pregnant and problems during pregnancy.



Other Cancers caused by HPV

There are no recommended screening tests for these 5 cancers , so they may not be detected until they cause serious health problems.

Understanding Cervical cancer: Prevention and Symptoms

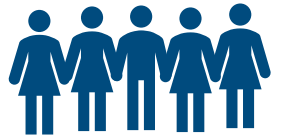
➢ **Important measures one can take to prevent cervical cancer are :**

The **Pap test** (or Pap smear) and the **HPV test** are specific tests used during screening for cervical cancer.

Condoms provide **some protection** against HPV, but they don't completely prevent infection.

Not smoking is another important way to reduce the risk of cervical pre-cancer and cancer.

HPV vaccines only work to prevent HPV infection ,they will not treat an infection that is already there.



Limiting the number of **sex partners** may lower your risk of exposure to HPV.

➢ **Women with early cervical cancers and pre-cancers usually have no symptoms. Symptoms often do not begin until the cancer becomes larger and grows into nearby tissue. When this happens, the most common symptoms are:**

Pelvic pain

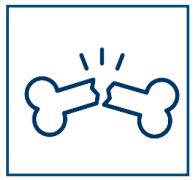
Weight Loss

Vaginal Bleeding

Leg Pain

Increased vaginal discharge

Fatigue



Bone fractures

Back pain

Leg Swelling

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Screening Tests for Cervical Cancer

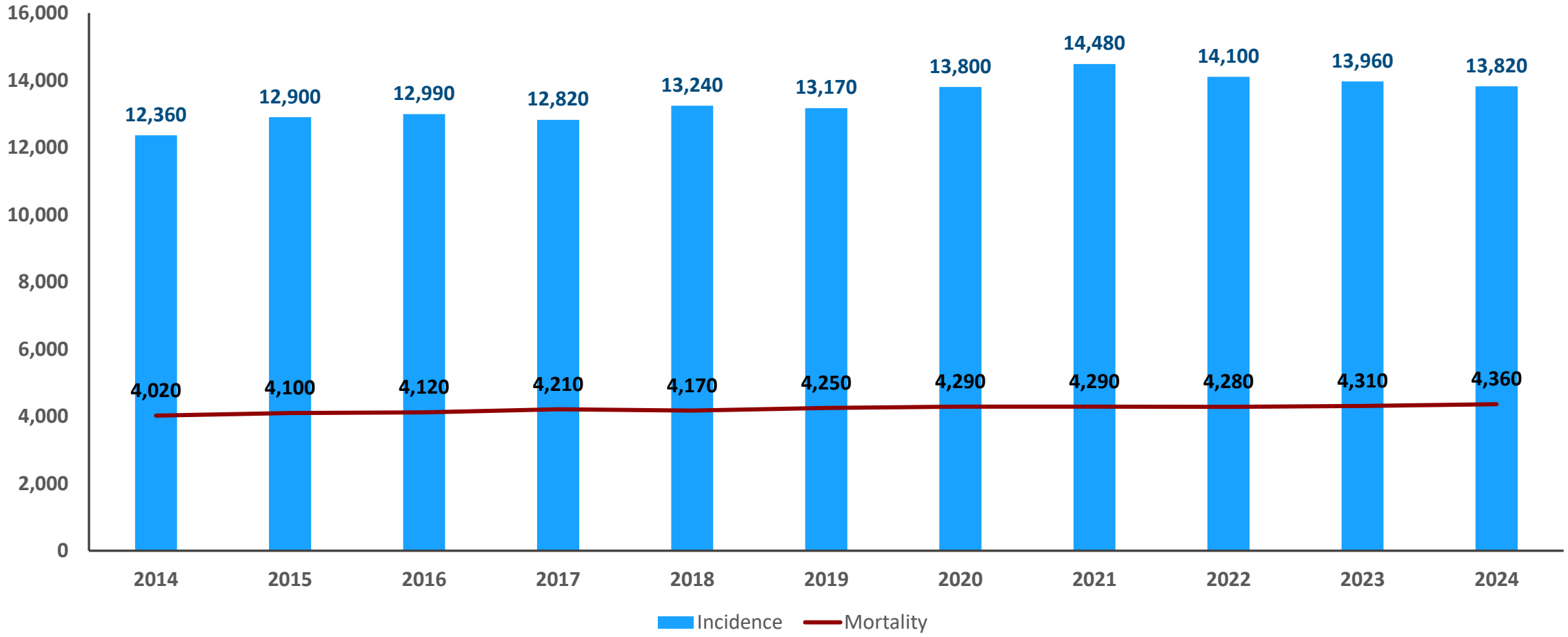
Human papillomavirus (HPV) test. This test is done on a sample of cells removed from the cervix. This sample is tested for the strains of HPV most commonly linked to cervical cancer .This test may also be done on a sample of cells collected from the vagina, which a person can collect on their own.

Pap test (Pap Smear). The Pap test has been the most common test for early changes in cells (Pre-cancers) that can lead to cervical cancer. A Pap test involves gathering a sample of cells from the cervix. It is often done at the same time as a bimanual pelvic exam as part of a gynecologic checkup.

Some HPV tests are approved only as part of a **co-test**, when the HPV test and the Pap test are done at the same time to screen for cervical cancer.

POPULATION	RECOMMENDATION
Aged less than 21 years	No screening
Aged 21-29 years	Cytology (Pap test) alone every 3 years
Aged 30-65 years	Any one of the following – Cytology alone every 3 years. FDA-Approved primary hrHPV testing alone every 5 years. Cotesting (hrHPV testing and cytology)every 5 years.
Greater than 65 years	No screening after adequate negative prior screening results
Hysterectomy with removal of the cervix	No screening in individuals who do not have a history of high-grade cervical precancerous lesions or cervical cancer

Approximately 33% Mortality Rate vs Incidence each year for HPV Induced Cervical Cancers



HPV Vaccine: Quick Overview

- The HPV vaccine protects against **genital warts** and most cases of **cervical cancer**. It protects against cancer of the **vagina, vulva, penis or anus** caused by HPV. The HPV vaccine also protects **against mouth, throat, head and neck cancers** caused by HPV.
- Three HPV vaccines—9-valent HPV **vaccine (Gardasil 9, 9vHPV),** quadrivalent HPV vaccine **(Gardasil, 4vHPV)**, and bivalent HPV vaccine **(Cervarix, 2vHPV)**—have been licensed by the USFDA. All three HPV vaccines protect against HPV types 16 and 18 that cause most HPV cancers.
- Since late **2016**, only Gardasil-9 (9vHPV) is distributed in the United States. This vaccine protects against nine HPV types (6, 11, 16, 18, 31, 33, 45, 52, and 58).

Reasons to get HPV Vaccine

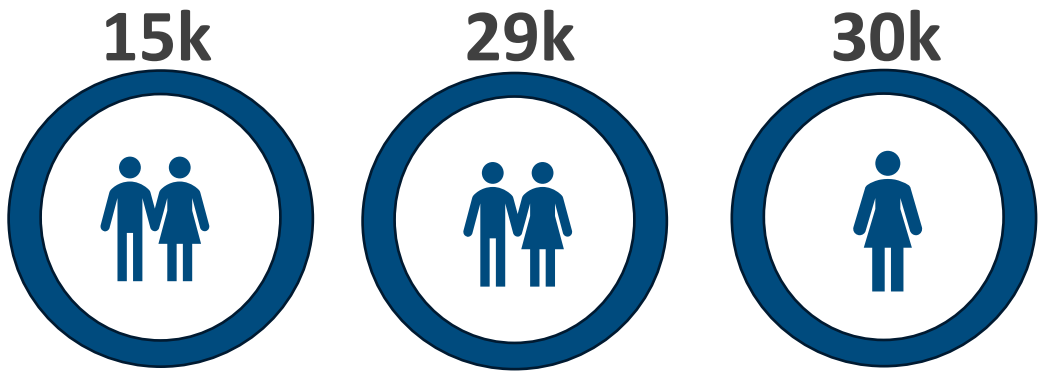
85% of people will get an HPV infection in their lifetime .About 13 million Americans ,including teens ,become infected each year.

HPV infections, genital warts, and cervical precancers (abnormal cells on the cervix that can lead to cancer) have dropped since the vaccine has been in use in the United States..

HPV vaccination is **cancer prevention** and Preventing cancer is better than treating it.

Most children only need two doses of HPV vaccine when vaccinated before age 15 years. Early protection works best.

HPV Vaccination is Safe and Effective



Gardasil® 9 was studied in clinical trials with more than 15,000 females and males.

Gardasil® was studied in clinical trials with more than 29,000 females and males.

Cervarix® was studied in clinical trials with more than 30,000 females.

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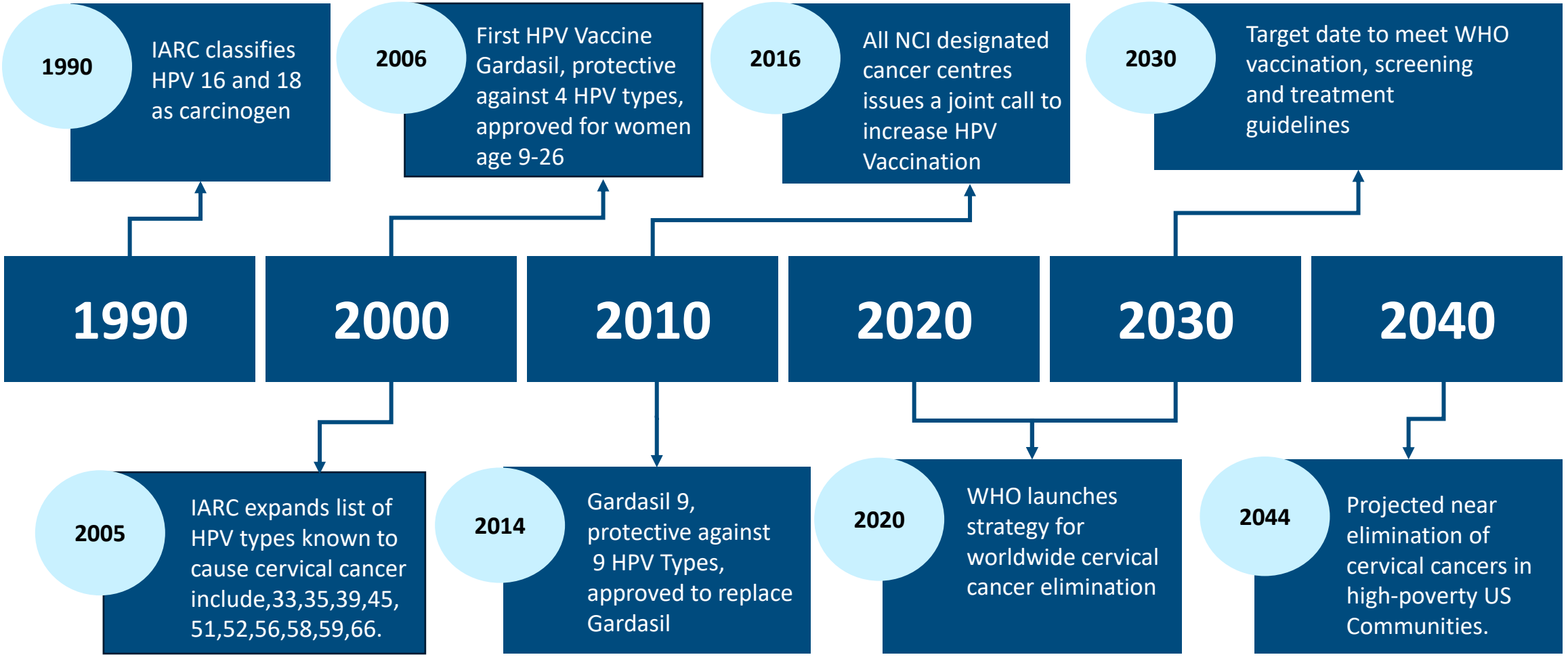
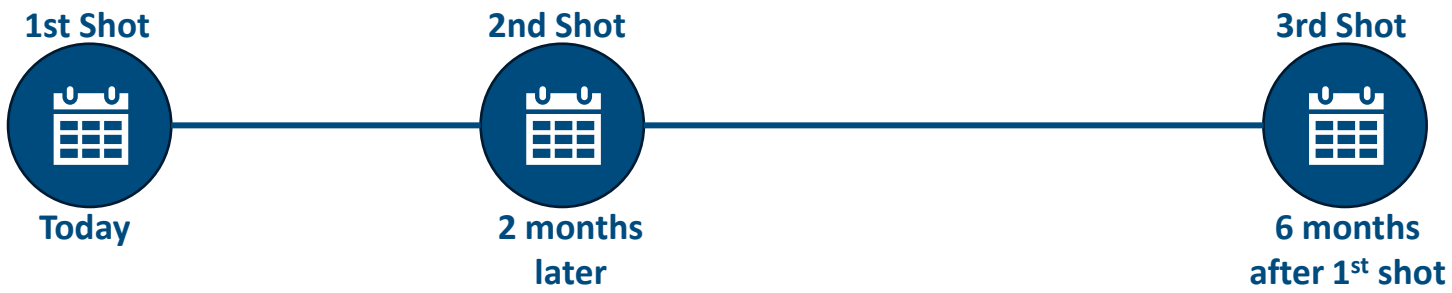
From Discovery to Impact: A Journey Through the History of HPV Vaccines



Immunization Schedule for HPV Vaccine in US

Routine Vaccination	**Age 11-12 years:** Can be started at age 9 years
Catch-up Vaccination	**Age 13-26 years:** If not completely vaccinated
Shared clinical decision making	**Some adults age 27-45 years:** If not adequately vaccinated

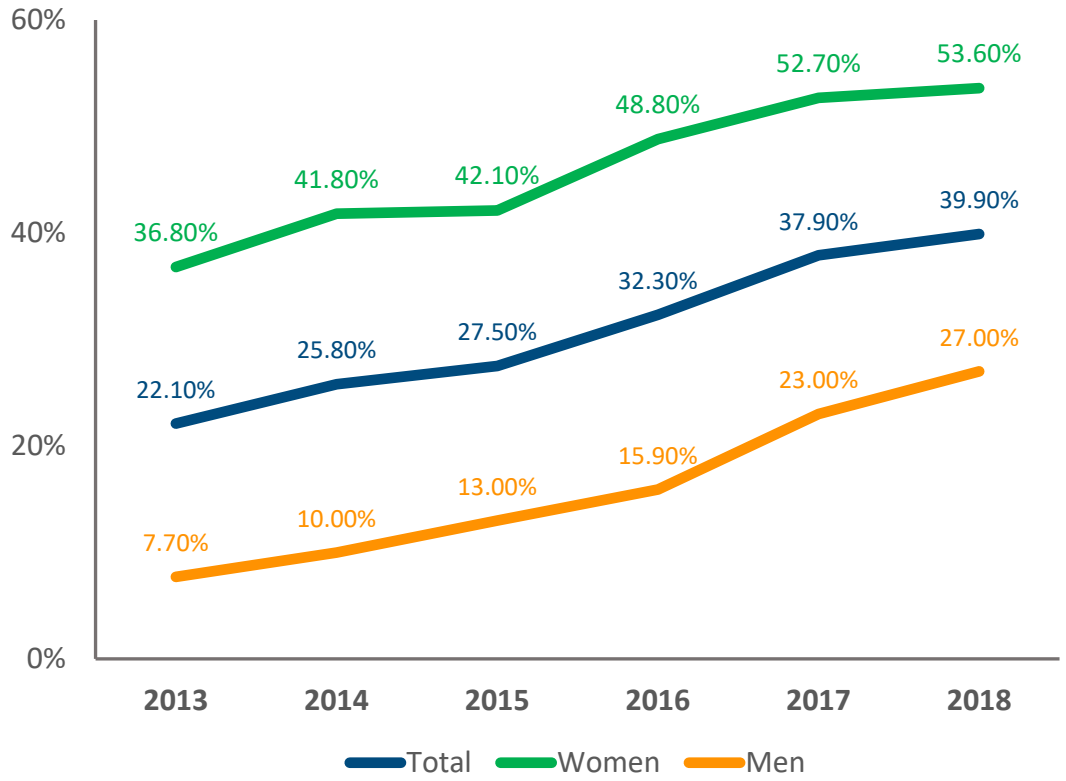
For those under 15, a two-dose schedule is recommended, with a minimum 5-month gap between doses.



For those receiving their first dose at or after age 15 or with certain immunocompromising conditions, a three-dose schedule is advised.

HPV Vaccination Coverage among Adults Aged 18-26: United States, 2018 (1/2)

Percentage of adults aged 18–26 who ever received one or more doses of human papillomavirus vaccine, by year and sex: United States, 2013–2018



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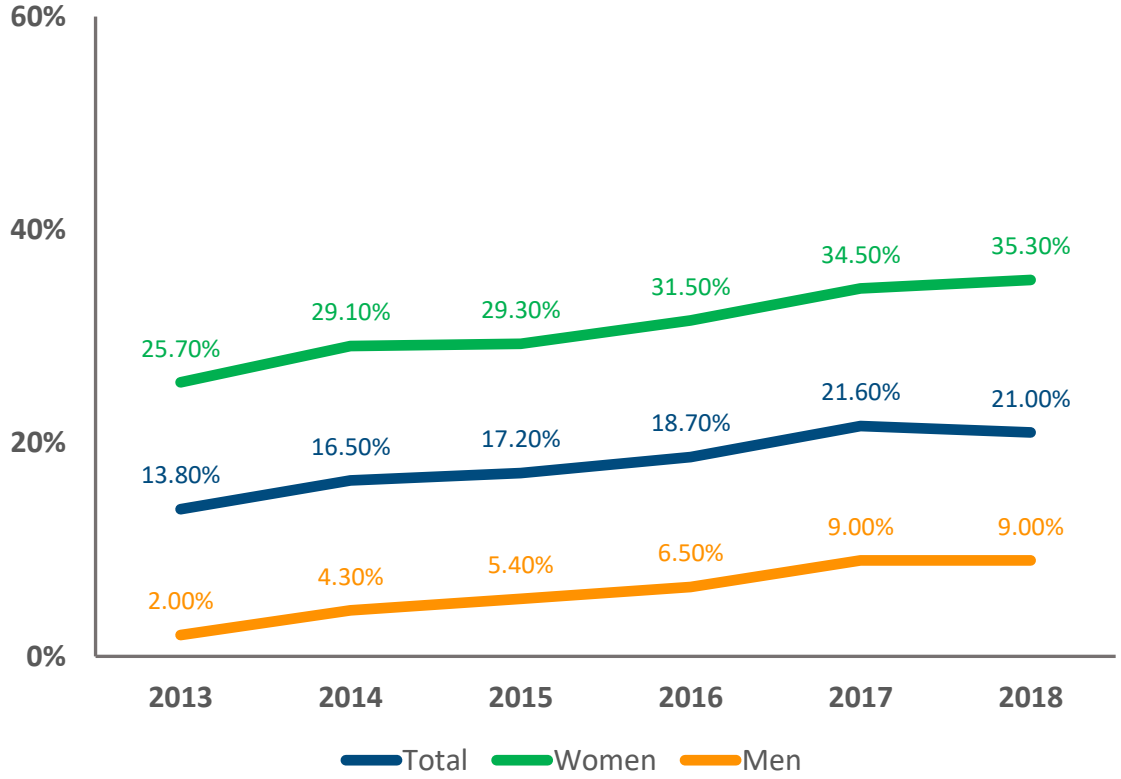

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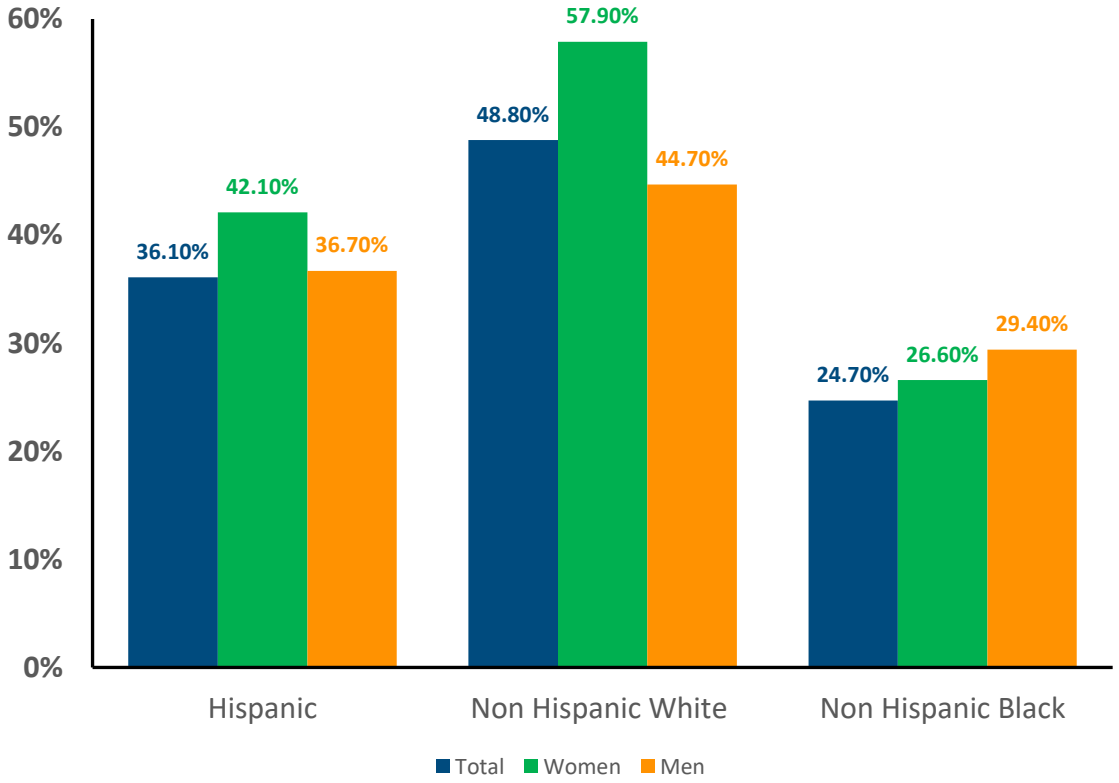
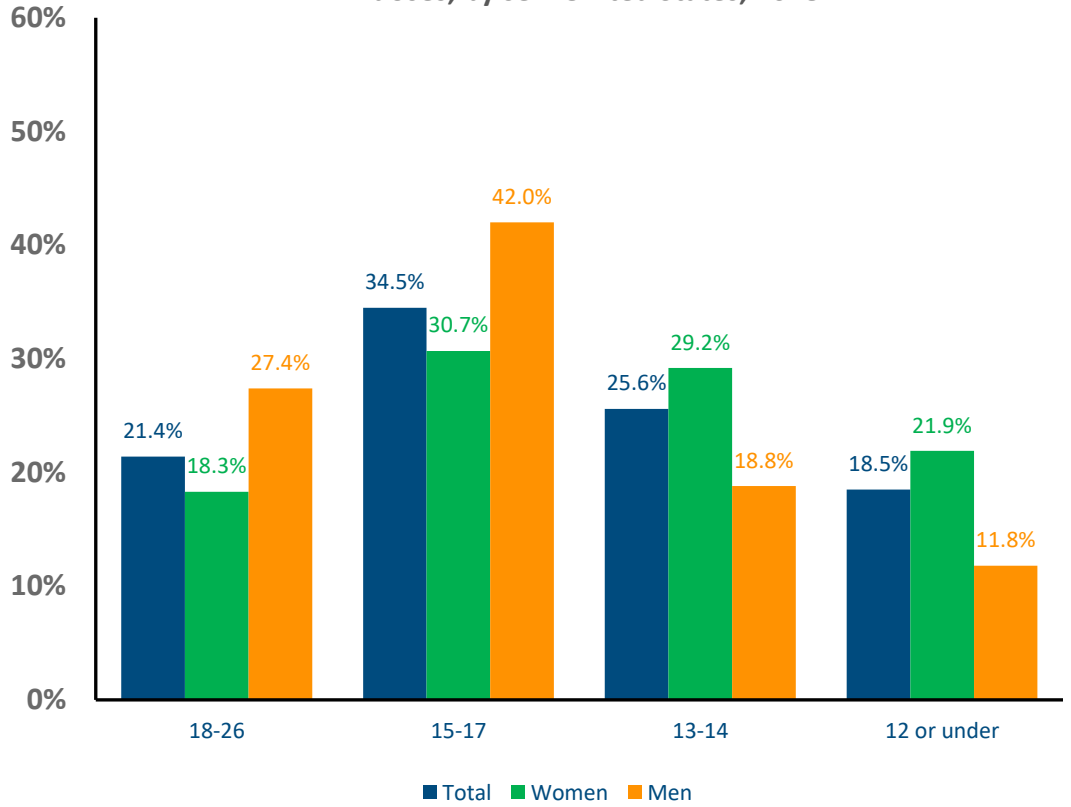
HPV Vaccination Coverage among Adults Aged 18–26: United States, 2018 (2/2)

Percentage of adults aged 18–26 who ever received one or more doses of human papillomavirus vaccine, by sex and race and ethnicity: United States, 2018

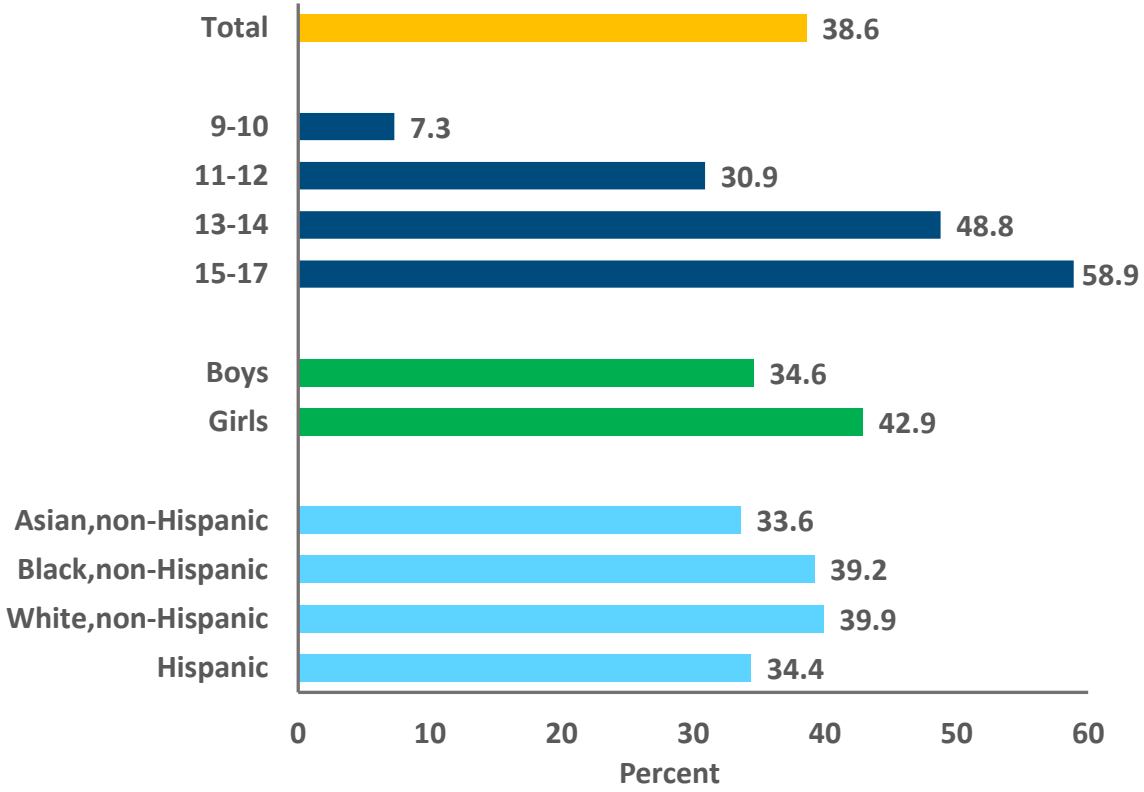


Percent distribution of age at first human papillomavirus vaccine dose among adults aged 18–26 who ever received one or more doses, by sex: United States, 2018

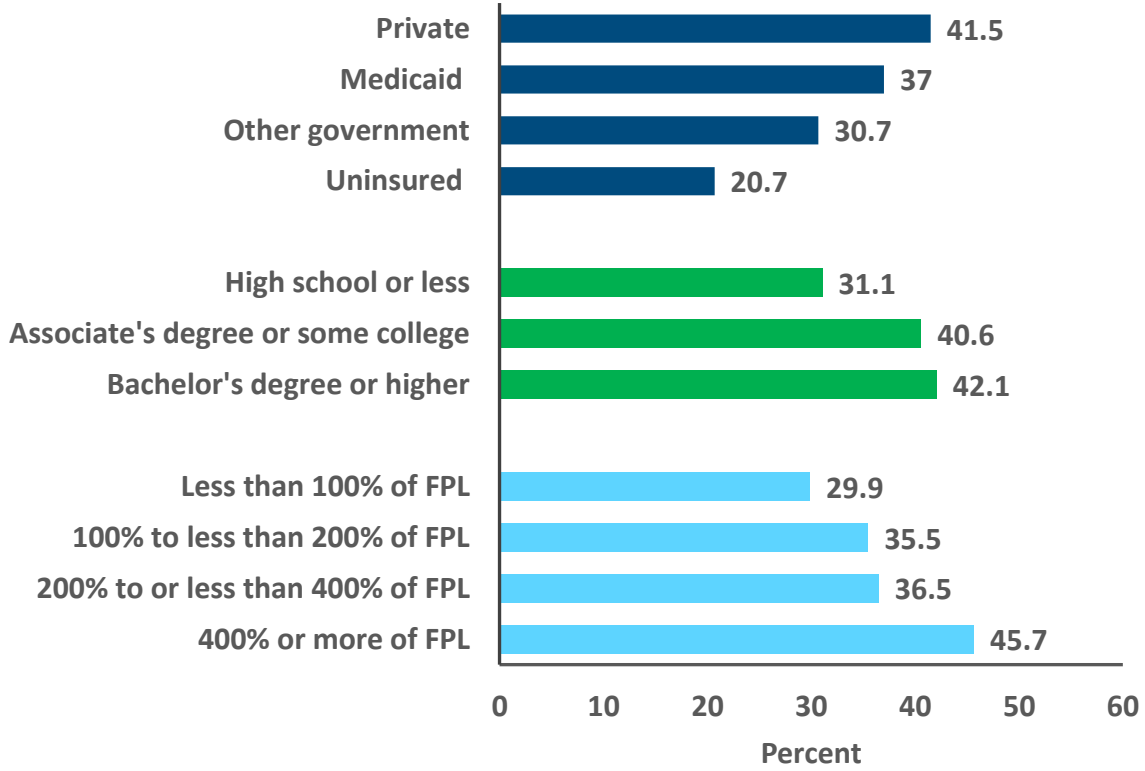


Insights into HPV Vaccination Coverage among Children Aged 9–17: United States, 2022

HPV Vaccination Coverage Among Children Ages 9–17 in the United States, 2022: Analyzing by Age Group, Gender, and Race/Ethnicity



HPV Vaccination Rates in Children Ages 9–17 in the United States, 2022: Analysis by Child's Health Insurance Coverage, Parental Education Level, and Family Income



FPL- Federal Poverty Level. It is a measure of income issued every year by the U.S. Department of Health and Human Services (HHS).

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ACIP(Advisory Committee on Immunization Practices) Recommendations for HPV Vaccination

ACIP Recommendation Changes over the years:

2007

ACIP advises routine vaccination of females aged 11–12 with three doses of quadrivalent HPV vaccine, starting at age 9). For females aged 13–26 who haven't been vaccinated or completed the series, vaccination is also recommended.

2011

ACIP advises routine HPV4 vaccination for males aged 11 or 12, starting at age 9, and recommends it for males aged 13–21 who haven't completed the 3 dose series. Males aged 22–26 may also receive the vaccine, with administration and precautions remaining unchanged.

2016

ACIP advises routine HPV vaccination at ages 11 or 12, starting from 9 years old. Vaccination is also recommended for females up to 26 years and males up to 21 years if previously inadequately vaccinated. Males aged 22–26 may also receive vaccination.

2019[1]

- **Children and adults aged 9 through 26 years.** HPV vaccination is suggested from age 9, routinely at 11-12, with catch-up vaccination up to age 26 for those not adequately vaccinated**.**
- **Administration**. Dosing schedules remain unchanged. No pre-vaccination testing (e.g., Pap or HPV testing) is advised.
- **Cervical cancer Screening**. Cervical cancer screening guidelines and recommendations should be followed.
- **Adults aged >26 years.** Catch-up HPV vaccination isn't for adults over 26. Shared clinical decision-making suggested for some aged 27-45. HPV vaccines not approved over 45.
- **Special populations and medical conditions**. The recommendations apply to everyone regardless of risk factors. Delay HPV vaccination during pregnancy, but no need for pregnancy testing before vaccination. Breastfeeding individuals can still get vaccinated.

Gardasil & Cervarix Discontinuation: Understanding the Shift to Gardasil 9

- Merck had been in the process of developing Gardasil 9 while Gardasil was being launched. As GSK voluntarily stopped producing Cervarix and Merck phased out Gardasil, Gardasil 9 ultimately became the exclusive vaccine for HPV prevention.

Vaccines	Initial U.S. Approval	Vaccine Indication	HPV types
Gardasil	**2006**	**GARDASIL 9 is a vaccine indicated in females and males 9 through 26 years of age.**	**HPV Quadrivalent (Types 6, 11, 16, and 18)**
CERVARIX	**2009**	**CERVARIX is approved for use in females 9 through 25 years of age.**	**HPV Bivalent (Types 16,18)**
GARDASIL®9	**2014**	**GARDASIL 9 is a vaccine indicated in females and males 9 through 45 years of age.**	**HPV 9-valent Vaccine(Types 6, 11, 16, 18, 31, 33, 45, 52,58)**

- Launching three years post Gardasil's debut in 2009, Cervarix struggled to secure **substantial market presence** due to its **belated entry** and a **less favorable label.**
- This label **lacked a genital wart indication,** limited approval **solely for females**, narrower strain coverage, and lacked cross-protection data, which GSK deemed pivotal.
- Unlike Gardasil, Cervarix's lifecycle management failed to adjust to evolving market needs, like the increasing demand for male vaccination. Consequently, Cervarix was voluntarily withdrawn from the market in 2016.

Gardasil 9:Advancing HPV Prevention and Protection

GARDASIL 9
Human Papillomavirus
9-valent Vaccine, Recombinant

Indications

"GARDASIL 9 is a vaccine indicated in **females** and **males** 9 through 45 years of age for the prevention of cervical, vulvar, vaginal, anal, oropharyngeal and other head and neck cancers caused by HPV Types 16, 18, 31, 33, 45, 52, and 58; precancerous or dysplastic lesions caused by HPV Types 6, 11, 16, 18, 31, 33, 45, 52, and 58; and genital warts caused by HPV Types 6 and 11.

Dosing Schedule

	Regimen	Schedule
Patient 9-14 years	2-dose	0,6,12 ,months
	3-dose	0,2,6,months

	Regimen	Schedule
Patient 15-45 years	3-dose	0,2,6,months

Adverse drug reactions

- The most common (≥10%) local and systemic adverse reactions in females were **injection-site pain, swelling, erythema, and headache.**
- The most common (≥10%) local and systemic reactions in males were injection-site pain, swelling, and erythema.

Contraindications

Hypersensitivity, including severe allergic reactions to yeast (a vaccine component), or after a previous dose of GARDASIL 9 or GARDASIL®

.

Dosage Forms and Strengths

0.5-mL suspension for injection as a single-dose vial and prefilled syringe.

Addressing Unmet Needs in HPV Vaccine Accessibility and Uptake

❑ Stigma and Cultural Considerations in HPV Vaccination Advocacy

- HPV vaccination faces stigma and cultural barriers, especially regarding early sexual activity. Women, often primary healthcare decision-makers, must navigate societal norms and faith-based beliefs.
- To boost vaccine uptake, addressing stigma and cultural factors is crucial, requiring sensitive messaging and education.

❑ Expanding HPV Vaccination Awareness Beyond Cervical Cancer

- Though HPV vaccination's benefits against cervical cancer are acknowledged, awareness should broaden to include other anogenital cancers.
- Educational materials should embrace gender diversity to promote participation in preventive measures, as men are also at risk for HPV-related cancers.
- These efforts address inequitable care and gender biases, crucial for achieving herd immunity.

❑ Health Care Provider Influence on HPV Vaccine Acceptance

- Healthcare providers endorsement or hesitancy significantly impacts patient acceptance of the HPV vaccine. Consistency in discussing risks, benefits, and sexual health during appointments is crucial.
- However, lack of preparedness among providers is a barrier.
- Training opportunities are desired, including web-based training options.

HPV Treatment Landscape: Competitive Insights and Future Prospects

PHASE-2	PHASE-3	Marketed
Monalizumab+Cetuximab+Anti-PD(L)1 Innate Pharma	9vHPV Vaccine+mRNA-1273 Vaccine Merck Sharp & Dohme LLC	Gardasill-9 Merck Sharp & Dohme LLC
VGX-3100+Imiquimod 5% Cream Inovio Pharmaceuticals	9vHPV Vaccine Merck Sharp & Dohme LLC	Gardasil* Merck Sharp & Dohme LLC
TG4001+Avelumab Transgene	VGX-3100 Inovio Pharmaceuticals	Cervarix** GlaxoSmithKline (GSK)
VB10.16 Nykode Therapeutics ASA	Ficlatuzumab + Cetuximab AVEO Pharmaceuticals, Inc.	
VGX-3100 Inovio Pharmaceuticals	9vHPV Vaccine Merck Sharp & Dohme LLC	
PRGN-2009+Pembrolizumab Precigen, Inc	VGX-3100 Inovio Pharmaceuticals	
BNT113+Pembrolizumab BioNTech SE	Pembrolizumab+ Cisplatin+ (AFX) Radiotherapy +(SFX) Radiotherapy Merck Sharp & Dohme LLC	
Cemiplimab+ISA101b BioNTech SE		
Nivolumab+Ipilimumab Bristol-Myers Squibb		

MOA- ***Immunostimulants ; Antibody-dependent cell cytotoxicity+Programmed cell inhibitor; Immunostimulants+Antibody-dependent cell cytotoxicity Antigen presenting cell modulators; Antibody-dependent cell cytotoxicity+Hepatocyte growth factor inhibitors ; Antibody-dependent cell cytotoxicity***

Gardasil- Marketing Status : Discontinued (Replaced by Gardasil 9); Cervarix**- Its was withdrawn from US market due to low demand.*

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Gardasil-9 Forward: Merck's Vision and Strategy

- **Merck**, being the manufacturer of Gardasil 9 (sole HPV Vaccine accessible in USA), revealed during the **EUROGIN 2024 HPV Congress** its intention to begin clinical trials for a **novel multi-valent HPV vaccine**. This vaccine aims to offer enhanced protection against various types of HPV infections.

- Additionally, Merck intends to conduct clinical studies in both women and men to assess the effectiveness and safety of a **one-dose schedule** of GARDASIL®9 (Human Papillomavirus 9-valent, recombinant), in comparison to the currently approved three-dose regimen.

- The newest addition to the company's pipeline utilizes its own virus-like particle (VLP) technology to integrate extra VLPs, broadening coverage against various HPV types. This encompasses strains that are particularly significant in African and Asian populations. Initial human trials (Phase 1) are slated to commence in the **final quarter of 2024**.

- Since 2019, the company has undertaken to enhance its **manufacturing capacity** by scaling up production in current facilities and erecting new ones. From 2017 to 2020, this effort nearly **doubled the supply**, and subsequently, it has doubled once more from 2020 to 2024.

- Merck anticipates providing ample quantities of HPV vaccines to fulfill expected **demand for 2025** and intends to further bolster its supply capacity in the years ahead.

Findings

- Vaccination rates for HPV are highest among preteens and adolescents but decline notably in the **18-26 age group.**
- Females exhibit higher vaccination rates compared to males, although efforts are underway to close this gender gap. Ethnic minorities, particularly Hispanic and African American communities, show lower vaccination rates, highlighting disparities in healthcare access.
- Gardasil, produced by Merck & Co., dominates the HPV vaccine market in the USA due to its efficacy against multiple HPV strains and comprehensive disease prevention. Cervarix holds a smaller market share in comparison. Gardasil's market position is reinforced by strong public health endorsements and initiatives.
- Challenges persist in increasing HPV vaccination rates among underserved populations such as rural residents, low-income groups, and certain ethnic minorities. Overcoming vaccine hesitancy through education and awareness campaigns, improving healthcare infrastructure, and implementing outreach programs are crucial steps toward achieving equitable vaccine distribution.
- Higher HPV vaccination rates correlate with reduced HPV-related illnesses, underscoring the vaccine's effectiveness in public health. Universal vaccination recommendations across genders aim to boost vaccination rates and improve health outcomes. Policy interventions like discounted vaccinations are pivotal for enhancing accessibility, particularly among marginalized communities.
- VGX3100, an emerging therapeutic vaccine, shows promise in treating existing HPV infections, representing a significant advancement in HPV therapy. Research efforts are focused on broadening vaccine coverage to protect against a wider array of HPV strains, potentially enhancing overall vaccine effectiveness and public health impact.

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Thank you!