

Accessing and Utilizing HPV Vaccination Data to Protect California from HPV-Attributed Illnesses and Cancers:

Report of Findings of the California HPV Vaccination Roundtable

2025 Update

Released October 2025

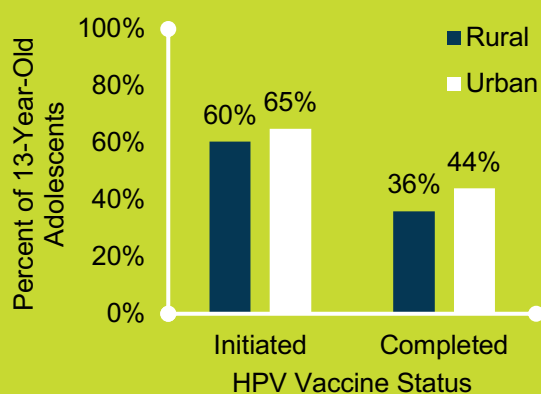


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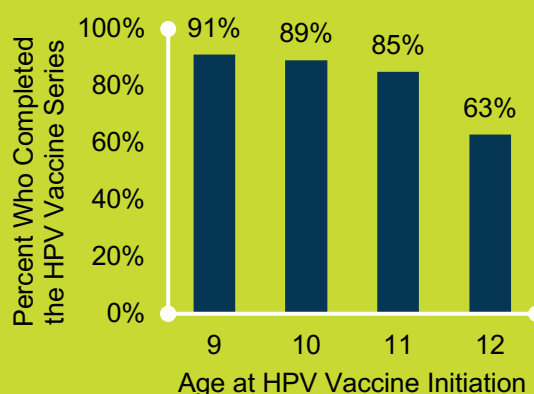
Highlights from the 2025 Update

HPV and cancer	HPV vaccine
- An estimated 3,665 HPV-attributable cancer cases occurred annually in California during 2017–2021. - Top HPV-attributable cancer sites were cervical (1,283 cases), oropharyngeal (1,229 cases), and anal (747 cases). - The five years' combined estimated HPV-attributable cancer rate during 2017–2021 was 8.4 cases per 100,000 population, a decrease from 8.6 cases per 100,000 population during 2012–2016.	- In 2023, 64% of 13-year-olds in California initiated the HPV vaccine and 43% completed the series. - HPV vaccine series completion rates among 13-year-olds were similar by gender in 2023: 44% of females and 42% of males. - HPV vaccine initiation among 13-year-olds was highest among Latino (73%) and Asian (69%) adolescents, and lowest among White (57%) adolescents and those with unknown race/ethnicity (39%).

In 2023, 13-year-olds in rural California counties had lower HPV vaccine initiation and series completion rates than 13-year-olds in urban counties.



In 2023, California adolescents who initiated the HPV vaccine at 9 years old had higher series completion rates than those who initiated at older ages.



Suggested Citation

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Acronyms and Initialisms

AA	African American
AB	Assembly Bill
AAP	American Academy of Pediatrics
ACIP	Advisory Committee on Immunization Practices
ACOG	American College of Obstetricians and Gynecologists
AI/AN	American Indian/Alaska Native
CAIR	California Immunization Registry
CCR	California Cancer Registry
CDC	Centers for Disease Control and Prevention
CDOC	California Dialogue on Cancer
CDPH	California Department of Public Health
COVID-19	Coronavirus Disease 2019
DOI	Digital Object Identifier
EHR	Electronic Health Records
ERS	Economic Research Service
FDA	U.S. Food and Drug Administration
HPV	Human Papillomavirus
ICD-O	International Classification of Diseases for Oncology
IIS	Immunization Information System
MMWR	Morbidity and Mortality Weekly Report
NCI	National Cancer Institute
NFID	National Foundation for Infectious Diseases
NH/OPI	Native Hawaiian/Other Pacific Islander
NIS	National Immunization Survey
RIDE	Regional Immunization Data Exchange
RUCA	Rural-Urban Commuting Area
SDIR	San Diego Immunization Registry
SEER	Surveillance, Epidemiology, and End Results
Tdap	Tetanus, diphtheria, and pertussis
U.S.	United States
USDA	U.S. Department of Agriculture
ZIP	Zone Improvement Plan

Tables and Figures

Tables

Table 1	RUCA Code Label by California County (Data Source: USDA ERS).
Table 2	Five Years' Combined Estimated HPV-Attributable Cancer Cases and Rates per 100,000 Population by County, California, 2017–2021 (Data Source: CCR).
Table 3	Percent of 13–17-Year-Olds Who Completed the HPV Vaccine Series by Data Source (CAIR and NIS-Teen), California and U.S., 2019–2023.
Table 4	Number of 13-Year-Olds Who Initiated the HPV Vaccine and Completed the HPV Vaccine Series by Select Demographics, California, 2023 (Data Source: CAIR).
Table 5	Number of Adolescents Ages 13–17 Years Old (as of December 31, 2024) Who Completed the HPV Vaccine Series by Age in Years at HPV Vaccine Initiation, California, 2023 (Data Source: CAIR).

Figures

Figure 1	Estimated Annual HPV-Attributable Cancer Cases by Anatomic Site, California, 2017–2021 (Data Source: CCR).
Figure 2	Five Years' Combined Age-Adjusted Estimated HPV-Attributable Cancer Rate per 100,000 Population Ranked by County, California, 2017–2021 (Data Source: CCR).
Figure 3	Percent of 13-Year-Olds Who Initiated the HPV Vaccine and Completed the HPV Vaccine Series, California, 2019–2023 (Data Source: CAIR).
Figure 4	Percent of 13-Year-Olds Who Initiated the HPV Vaccine Ranked by County, California, 2022 and 2023 (Data Source: CAIR).
Figure 5	Percent of 13-Year-Olds Who Completed the HPV Vaccine Series Ranked by County, California, 2022 and 2023 (Data Source: CAIR).
Figure 6	Percent of 13-Year-Olds Who Initiated the HPV Vaccine and Completed the HPV Vaccine Series by Urbanicity, California, 2019–2023 (Data Source: CAIR).

Appendices

- Figure 1 Percent of 13-Year-Olds Who Initiated the HPV Vaccine by County, California, 2023 (Data Source: CAIR).
- Figure 2 Percent of 13-Year-Olds Who Completed the HPV Vaccine Series by County, California, 2023 (Data Source: CAIR).

Introduction

The California Human Papillomavirus (HPV) Vaccination Roundtable (cahpvroundtable.org) was formed in October 2018. Its mission is to mobilize health care providers and the public to take collective action against HPV-related illnesses and cancers by improving HPV vaccine series completion across the state.

The Using and Improving HPV Vaccination Data Workgroup (referred to as the Data Workgroup), a committee of the Roundtable, compiles detailed statewide registry data on HPV vaccine series completion among people living in California. These data complement data available through the National Immunization Survey (NIS). The Data Workgroup's goal is to identify under-vaccinated populations and promote collaborative, coordinated efforts to improve HPV vaccine series completion and reduce HPV-attributable illnesses and cancers.

The Roundtable published its first statewide analysis of HPV vaccination rates in May 2020, based on immunization registries and cancer data reported to the California Department of Public Health (CDPH). Addendums to this report were released in October 2021 and July 2023. This updated report uses a new methodology for estimating HPV vaccination rates from the California Immunization Registry (CAIR). Because of the revised methodology, readers should not directly compare vaccination data in this report to data in earlier reports.

HPV and Cancer

In the United States (U.S.), approximately 13 million people are newly infected with HPV each year.¹ While most infections resolve within one to two years, an estimated 42 million people are currently infected with one or more HPV types—more than the entire population of California. HPV is so widespread that approximately 85% of people will acquire at least one of the over 200 identified HPV types during their lifetime.²

Of the 40 HPV types that infect mucosal and related tissues, 25 are classified as high-risk. Twelve of these—HPV 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, and 59—are strongly associated with cancer.^{3,4} In contrast, HPV types 6 and 11 are low-risk and primarily cause genital warts.

Persistent HPV infection can lead to six types of cancer, often developing years or decades after initial exposure. These include cervical, vaginal, and vulvar cancers in women; penile cancer in men; and anal and oropharyngeal cancers in both men and women.¹ High-risk HPV types are also present in pre-cancers of the anus, cervix, penis, vagina, and vulva.^{3,4} According to the U.S. Centers for Disease Control and Prevention (CDC), HPV causes about 91% of anal (including rectal) and cervical cancers, 70% of oropharyngeal cancers, 75% of vaginal cancers, 69% of vulvar cancers, and 63% of penile cancers.^{3,5,6}

HPV Vaccine

A vaccine can prevent more than 90% of cancers caused by HPV.⁷ Although three HPV vaccines have been approved since 2006, only one—Gardasil 9 (9-valent HPV vaccine, recombinant)—is currently available in the U.S.⁸ Manufactured by Merck Sharp & Dohme LLC (Merck), Gardasil 9 protects against nine HPV types: 6, 11, 16, 18, 31, 33, 45, 52, and 58. Seven of these are among the 12 high-risk types associated with cancer.⁹

The U.S. Food and Drug Administration (FDA), the Advisory Committee on Immunization Practices (ACIP), and the CDC recommend routine HPV vaccination at ages 11–12 years, with the option to begin as early as nine.¹⁰ The American Cancer Society (ACS) and the American Academy of Pediatrics (AAP) recommend routine vaccination during ages 9–12 years.^{11,12} Although the CDC recommendation has always included nine-year-olds, it has historically recommended HPV vaccination during ages 11–12 to align with other routine adolescent vaccines, such as tetanus, diphtheria, and pertussis (Tdap), and the meningococcal (meningitis) vaccine.

If the first dose of the HPV vaccine is given during ages 9–14 years, two doses are needed to complete the series.³ The second dose is recommended 6–12 months after the first. Importantly, even if the second dose is given more than 12 months later, only two total doses are required—if the vaccine series was initiated before age 15. For individuals who begin the series at age 15 years or older, three doses are recommended: the second dose should be given 1–2 months after the first, and the third dose 6 months after the first.

More than 135 million doses of HPV vaccine have been distributed in the U.S. since 2021.^{13,14} Vaccine safety has been well studied, and it has consistently been found that the cancer-prevention benefits of the HPV vaccine significantly outweigh any potential side effects.¹⁵ The most common side effects are mild, such as redness, swelling, or pain at the injection site; other side effects include fever, headache, tiredness, nausea, or muscle or joint pain.⁵

New data confirm the cancer prevention effectiveness of the HPV vaccine. In 2021, researchers documented a decline in vaccine-preventable HPV infections.¹⁶ Because HPV-related cancers often take 10–20 years to develop, these infection trends are an early sign of progress. In February 2025, the Morbidity and Mortality Weekly Report (MMWR) published a study showing a 79% drop in cervical pre-cancer and an 80% drop in higher-grade cervical pre-cancer between 2008 and 2022 among screened women ages 20–24 years—the age group most likely to be vaccinated.¹⁷ In 2024, ACS reported a 65% decrease in cervical cancer incidence from 2012 to 2019 in the U.S.¹⁸ Last year, researchers in Scotland found zero cases of cervical cancer among women vaccinated at ages 12–13.¹⁹ The researchers concluded the vaccine is highly effective at preventing cervical cancer. As we enter the third decade of the HPV vaccine, further evidence will likely continue to demonstrate its critical role in cancer prevention.

Methods

HPV and Cancer

We used data from the California Cancer Registry (CCR) to obtain five-year combined (2017–2021) incidence counts of HPV-associated cancer cases by county and five-year age group (1–4 years, 5–9 years, 10–14 years, 15–19 years, 20–24 years, etc.). Based on ACIP recommendations to determine cancer that is most likely attributed to HPV, the following International Classification of Diseases for Oncology (ICD-O) were used for cancer site and morphology:²⁰

- Cervical cancer: histologic types 8010–8761 and 8940–8941
- Anal, penile, rectal, vaginal, and vulvar cancers: histologic types 8050–8084 and 8120–8131
- Oropharyngeal cancer: histologic types 8050–8084 and 8120–8131, with primary sites 19, 24, 28, 51–52, 90–91, 98–104, 108–109, 140–142, and 148²¹

We estimated HPV-attributable cancers by multiplying the number of HPV-associated cancer cases in California by the national average annual percentage attributable to HPV types 16, 18, 31, 33, 45, 52, and 58^{20,22}

To address data suppression issues in counties with fewer than 10 cases, we used CCR's standard county groupings. The following counties were combined:

- Alpine, Amador, and Calaveras
- Colusa, Glenn, and Tehama
- Del Norte and Humboldt
- Inyo and Mono
- Lassen, Modoc, and Plumas
- Mariposa and Tuolumne
- Sierra and Yuba
- Siskiyou and Trinity

We calculated age-adjusted rates of HPV-attributable cancer using methodology from the Surveillance, Epidemiology, and End Results (SEER) Program of the National Cancer Institute (NCI). Rates were standardized to the age distribution of the 2000 U.S.

standard population.²³ Five-year population estimates from SEER served as denominators for each age group in each county.

HPV Vaccine

We calculated HPV vaccine initiation and series completion rates among 13-year-olds in 2022 and 2023, disaggregated by county, race/ethnicity, and gender identity. To assess trends over time, we also analyzed 13-year-old cohorts from 2019–2023.

Urbanicity status was determined using the U.S. Department of Agriculture (USDA) Economic Research Service (ERS) 2010 Rural-Urban Commuting Area (RUCA) codes (Table 1).²⁴ Zone Improvement Plan (ZIP) codes with RUCA values of 1–3 were classified as urban (36 of California’s 58 counties; 62%), and 4–10 as rural (22 of California’s 58 counties; 38%).

Table 1. RUCA Code Label by California County (Data Source: USDA ERS).

County	RUCA	County	RUCA	County	RUCA
Alameda	Urban	Marin	Urban	San Mateo	Urban
Alpine	Rural	Mariposa	Rural	Santa Barbara	Urban
Amador	Rural	Mendocino	Rural	Santa Clara	Urban
Butte	Urban	Merced	Urban	Santa Cruz	Urban
Calaveras	Rural	Modoc	Rural	Shasta	Urban
Colusa	Rural	Mono	Rural	Sierra	Rural
Contra Costa	Urban	Monterey	Urban	Siskiyou	Rural
Del Norte	Rural	Napa	Urban	Solano	Urban
El Dorado	Urban	Nevada	Rural	Sonoma	Urban
Fresno	Urban	Orange	Urban	Stanislaus	Urban
Glenn	Rural	Placer	Urban	Sutter	Urban
Humboldt	Rural	Plumas	Rural	Tehama	Rural
Imperial	Urban	Riverside	Urban	Trinity	Rural
Inyo	Rural	Sacramento	Urban	Tulare	Urban
Kern	Urban	San Benito	Rural	Tuolumne	Rural
Kings	Urban	San Bernardino	Urban	Ventura	Urban
Lake	Rural	San Diego	Urban	Yolo	Urban
Lassen	Rural	San Francisco	Urban	Yuba	Urban
Los Angeles	Urban	San Joaquin	Urban	—	—
Madera	Urban	San Luis Obispo	Urban	—	—

HPV vaccination series completion rates were assessed using data from CAIR and NIS-Teen. CAIR is a centralized, secure, web-accessible statewide Immunization

Information System (IIS) operated by CDPH.²⁵ NIS-Teen is a CDC-run survey that estimates vaccine coverage in 13–17-year-olds across the U.S., including California, using random-digit-dialed phone surveys followed by provider verification of immunization records.²⁶

Health care providers in 50 of California's 58 counties report immunizations directly to CAIR. The San Diego Immunization Registry (SDIR) was fully integrated into CAIR in early 2022. Providers in the remaining counties report to the Regional Immunization Data Exchange (RIDE)/Healthy Futures IIS, which shares data with CAIR. California Assembly Bill (AB) 1797 took effect on January 1, 2023, requiring all health care providers to report administered immunizations and patient race/ethnicity to CAIR or RIDE/Healthy Futures.^{27,28} Before AB 1797, only pharmacists were required to submit immunization records to the statewide system.

HPV vaccine initiation and series completion were defined as follows:

- HPV vaccine initiation: For persons born 2006–2010 (i.e., 13 years old during 2019–2023), initiation was defined as receiving at least one dose of any HPV vaccine before their 13th birthday
- HPV vaccine series completion: For the same cohorts, completion was defined as receiving at least one dose before age 13, and at least two total doses at time intervals consistent with ACIP recommendations

To be included in the denominator, individuals had to:

- Be born during 2006–2010 (13 years old in 2019–2023)
- Reside in California
- Have at least one vaccination (HPV or non-HPV) recorded in CAIR

Past reports defined the eligible population using three criteria: age range, a California address, and receipt of at least two doses of a non-Coronavirus Disease 2019 (COVID-19) vaccine. This method depended heavily on the completeness of CAIR records and assumed that individuals remained in the same location over time.

To improve the accuracy of denominator estimates and address potential record fragmentation or outdated entries, we implemented a logarithmic weighting algorithm in this updated report. Each individual in CAIR received a weight between zero and one, based on how recently their most recent immunization (HPV or non-HPV) was recorded. Records older than 10 years were assigned a weight of zero; more recent records received progressively higher weights, approaching one.

This process replaces the prior minimum-dose exclusion criterion and allows for more accurate rate estimates by reflecting the likelihood that a person remains part of the

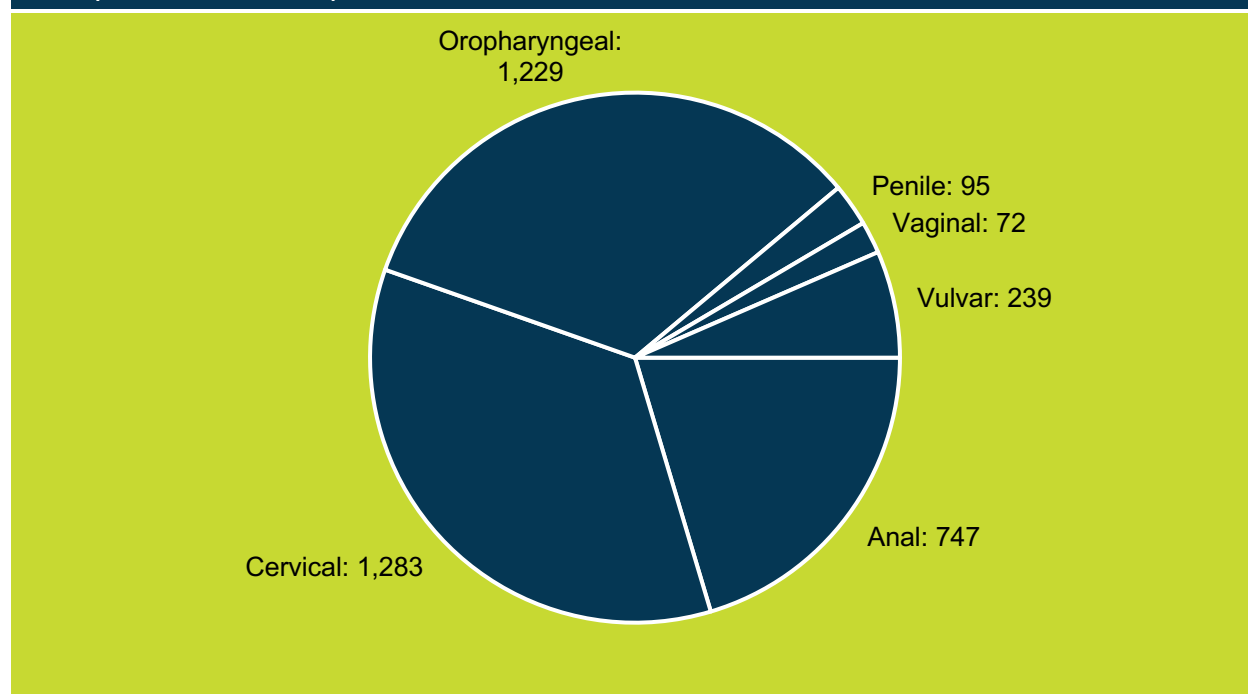
active population. In the context of IIS, this technique helps correct for mobility and incomplete data, yielding a more realistic denominator for immunization coverage rates.

Findings

HPV and Cancer

An HPV-associated cancer is a specific type of cancer found in areas where HPV is commonly detected—such as the anus, cervix, oropharynx, penis, vagina, and vulva. An HPV-attributable cancer is a cancer probably caused by HPV.²⁹ These are estimated by multiplying the total number of HPV-associated cancers by the proportion attributable to HPV. National data from 2008–2012 show high HPV attribution rates for these cancers: 91.1% of anal, 90.6% of cervical, 70.1% of oropharyngeal, 63.3% of penile, 75.0% of vaginal, and 68.8% of vulvar cancers.²² Based on these percentages, we calculate an estimated 3,665 annual cancer cases in California from 2017 to 2021 that were attributable to high-risk HPV types 16, 18, 31, 33, 45, 52, and 58 (Figure 1): 747 anal (including rectal), 1,283 cervical, 1,229 oropharyngeal, 95 penile, 72 vaginal, and 239 vulvar cancer cases.

Figure 1. Estimated Annual HPV-Attributable Cancer Cases by Anatomic Site, California, 2017–2021 (Data Source: CCR).



**Based on the national average annual percentage attributable to HPV types 16, 18, 31, 33, 45, 52, and 58.²⁰*

Note: An HPV-attributable cancer is a cancer probably caused by HPV.²⁹

Statewide, the age-adjusted rate of HPV-attributable cancer ranged by county from 5.0 to 13.8 cases per 100,000 population (Table 2 and Figure 2). The highest rate was observed in Lake County (13.8 cases per 100,000 population).

Geographically, the distribution of counties with HPV-attributable cancer rates greater than the overall state is in the northern regions (e.g., Del Norte and Humboldt) and eastern regions (e.g., Mariposa and Tuolumne). Notably there were also larger counties that yielded high rates, including San Diego, San Francisco, Riverside (Table 2 and Figure 2).

Table 2. Five Years' Combined Estimated HPV-Attributable Cancer Cases and Rates per 100,000 Population by County, California, 2017–2021 (Data Source: CCR).

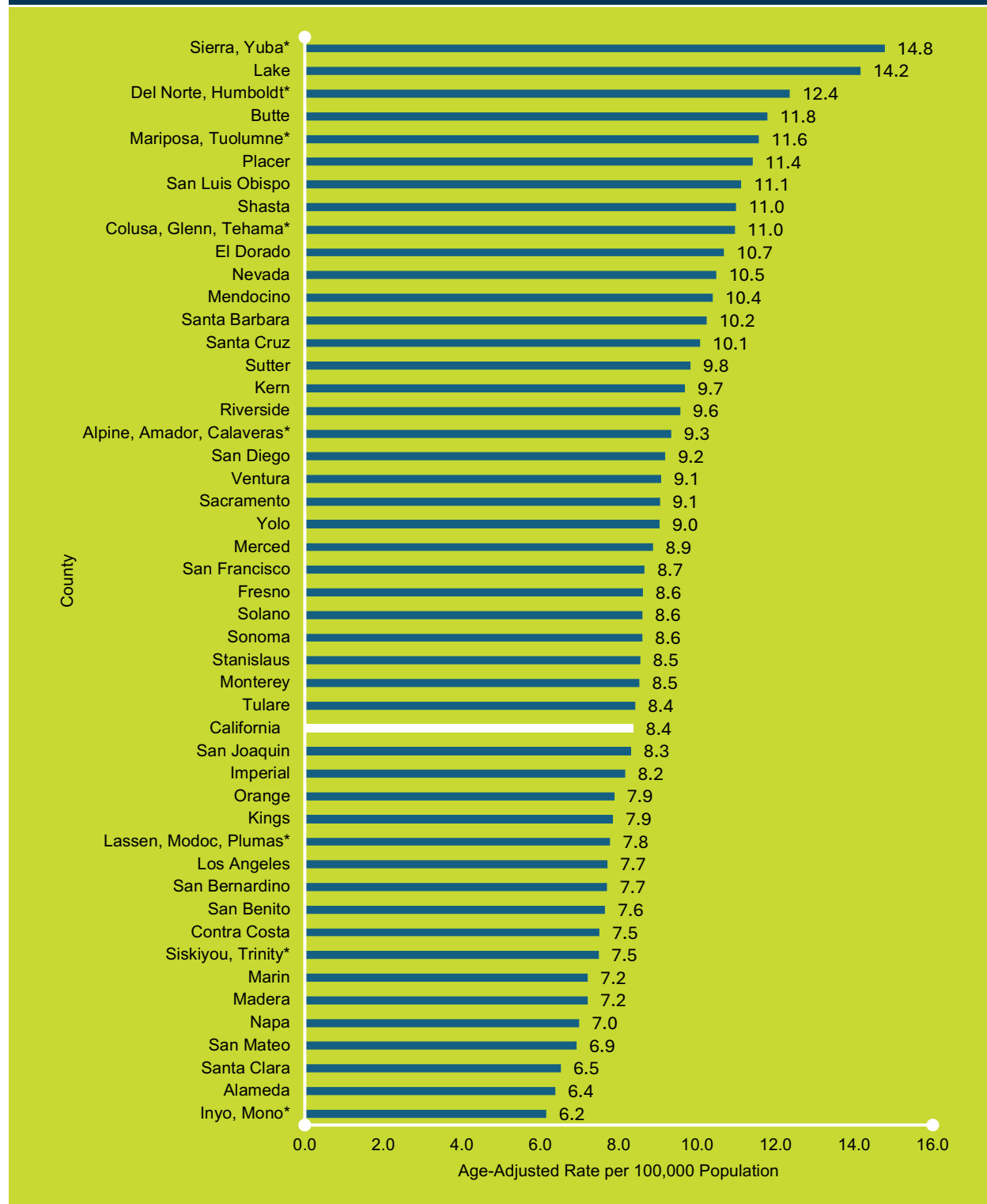
County	Five Years' Combined Population	Five Years' Combined Cases	Age-Adjusted Rate
Alameda	8,360,006	602	6.4
Alpine, Amador, Calaveras*	433,208	60	9.3
Butte	1,086,797	137	11.8
Colusa, Glenn, Tehama*	579,032	75	11.0
Contra Costa	5,809,398	522	7.5
Del Norte, Humboldt*	820,957	121	12.4
El Dorado	953,097	142	10.7
Fresno	5,014,911	415	8.6
Imperial	899,701	71	8.2
Inyo, Mono*	160,352	14	6.2
Kern	4,517,172	406	9.7
Kings	758,191	53	7.9
Lake	338,784	64	14.2
Lassen, Modoc, Plumas*	304,812	31	7.8
Los Angeles	50,079,290	4,236	7.7
Madera	780,044	74	7.2
Marin	1,310,617	145	7.2
Mariposa, Tuolumne*	361,777	68	11.6
Mendocino	457,720	65	10.4
Merced	1,393,384	113	8.9
Monterey	2,193,958	195	8.5
Napa	693,541	63	7.0
Nevada	510,652	84	10.5
Orange	15,906,327	1,450	7.9
Placer	2,001,834	228	11.4

Riverside	12,033,653	1,253	9.6
Sacramento	7,858,243	787	9.1
San Benito	316,665	24	7.6
San Bernardino	10,852,943	970	7.7
San Diego	16,463,401	1,672	9.2
San Francisco	4,326,078	447	8.7
San Joaquin	3,855,624	333	8.3
San Luis Obispo	1,409,311	205	11.1
San Mateo	3,812,790	317	6.9
Santa Barbara	2,228,607	248	10.2
Santa Clara	9,661,333	690	6.5
Santa Cruz	1,352,718	166	10.1
Shasta	909,860	136	11.0
Sierra, Yuba*	418,400	64	14.8
Siskiyou, Trinity*	300,092	36	7.5
Solano	2,255,067	225	8.6
Sonoma	2,459,780	297	8.6
Stanislaus	2,754,222	239	8.5
Sutter	495,515	56	9.8
Tulare	2,354,775	182	8.4
Ventura	4,225,338	451	9.1
Yolo	1,078,989	90	9.0
California	197,148,966	18,322	8.4

*Counties were combined into groups of two or three.

Note: An HPV-attributable cancer is a cancer probably caused by HPV.²⁹

Figure 2. Five Years' Combined Age-Adjusted Estimated HPV-Attributable Cancer Rate per 100,000 Population Ranked by County, California, 2017–2021 (Data Source: CCR).



*Counties were combined into groups of two or three.

Note: An HPV-attributable cancer is a cancer probably caused by HPV.²⁹

HPV Vaccine

This analysis focused on HPV vaccine initiation and series completion by age 13, consistent with ACIP guidelines. To provide a broader picture and allow for comparison with other states, it also examined coverage among adolescents aged 13–17 using data from CAIR and NIS-Teen.

California consistently reported higher series completion rates than the national average from 2019 to 2021 according to NIS-Teen: 56% in 2019, 62% in 2020, and 69% in 2021, compared to national estimates of 54%, 59%, and 62%, respectively (Table 3). However, California fell slightly below the national average in subsequent years, with a 61% completion rate in 2022 compared to 63% nationally, and 58% in 2023 compared to 61% nationally. CAIR data, which draw on a larger and more stable sample, showed relatively consistent statewide series completion rates: 50% in 2019, 52% in 2020, 47% in 2021, 50% in 2022, and 53% in 2023.

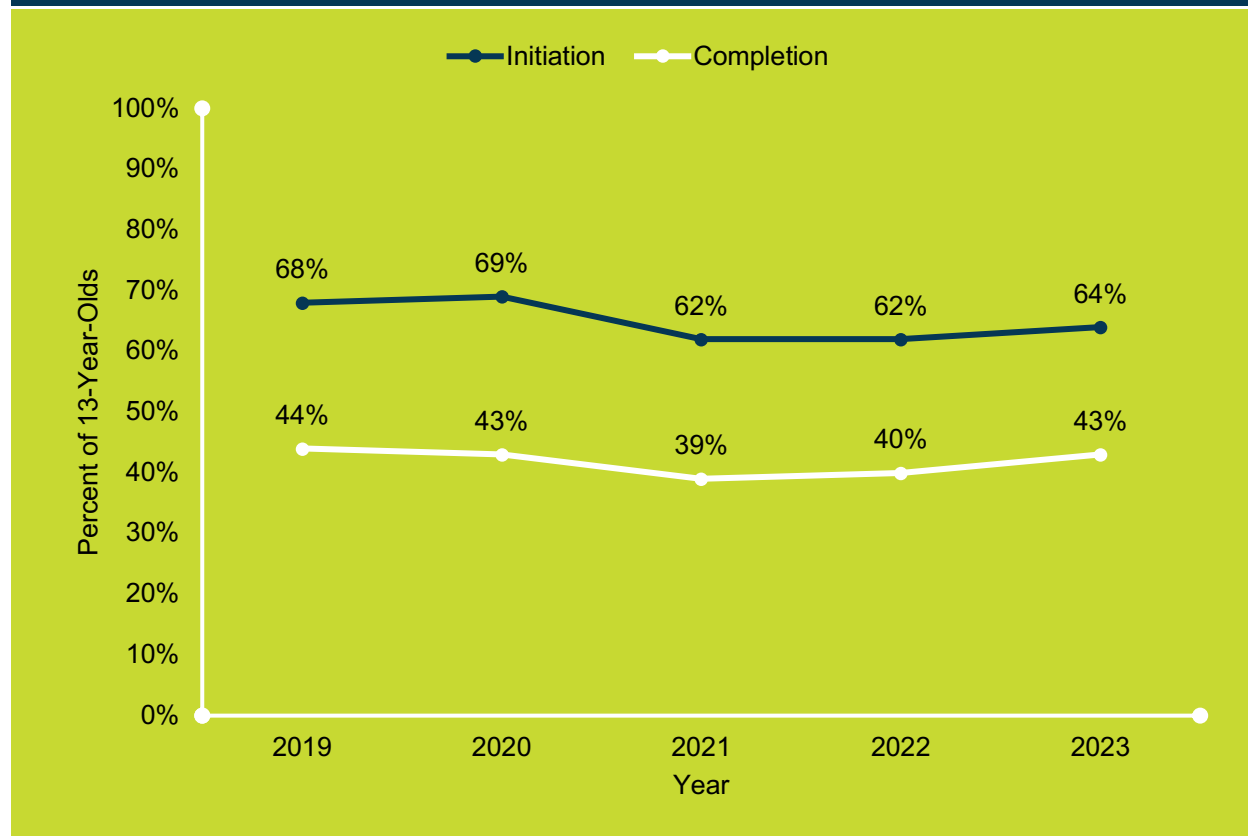
Table 3. Percent of 13–17-Year-Olds Who Completed the HPV Vaccine Series by Data Source (CAIR and NIS-Teen), California and U.S., 2019–2023.

Year	CAIR	NIS-Teen: California (95% Confidence Interval)	NIS-Teen: U.S. (95% Confidence Interval)
2019	50%	56% (47%–65%)	54% (53%–56%)
2020	52%	62% (55%–69%)	59% (57%–60%)
2021	47%	69% (61%–76%)	62% (60%–63%)
2022	50%	61% (53%–67%)	63% (61%–64%)
2023	53%	58% (49%–65%)	61% (60%–63%)

It is important to interpret NIS-Teen data for California with caution due to small sample sizes—for example, just 266 respondents in 2023—leading to wide confidence intervals.²⁶ In contrast, CAIR data use a weighted denominator and provide more stable and comprehensive estimates, making direct comparisons between CAIR and NIS-Teen challenging.

Among 13-year-olds specifically, both HPV vaccine initiation and series completion declined slightly from 2019 to 2023 (Figure 3). In 2019, 68% of 13-year-olds initiated the vaccine and 44% completed the series. By 2023, initiation declined to 64% and completion to 43%.

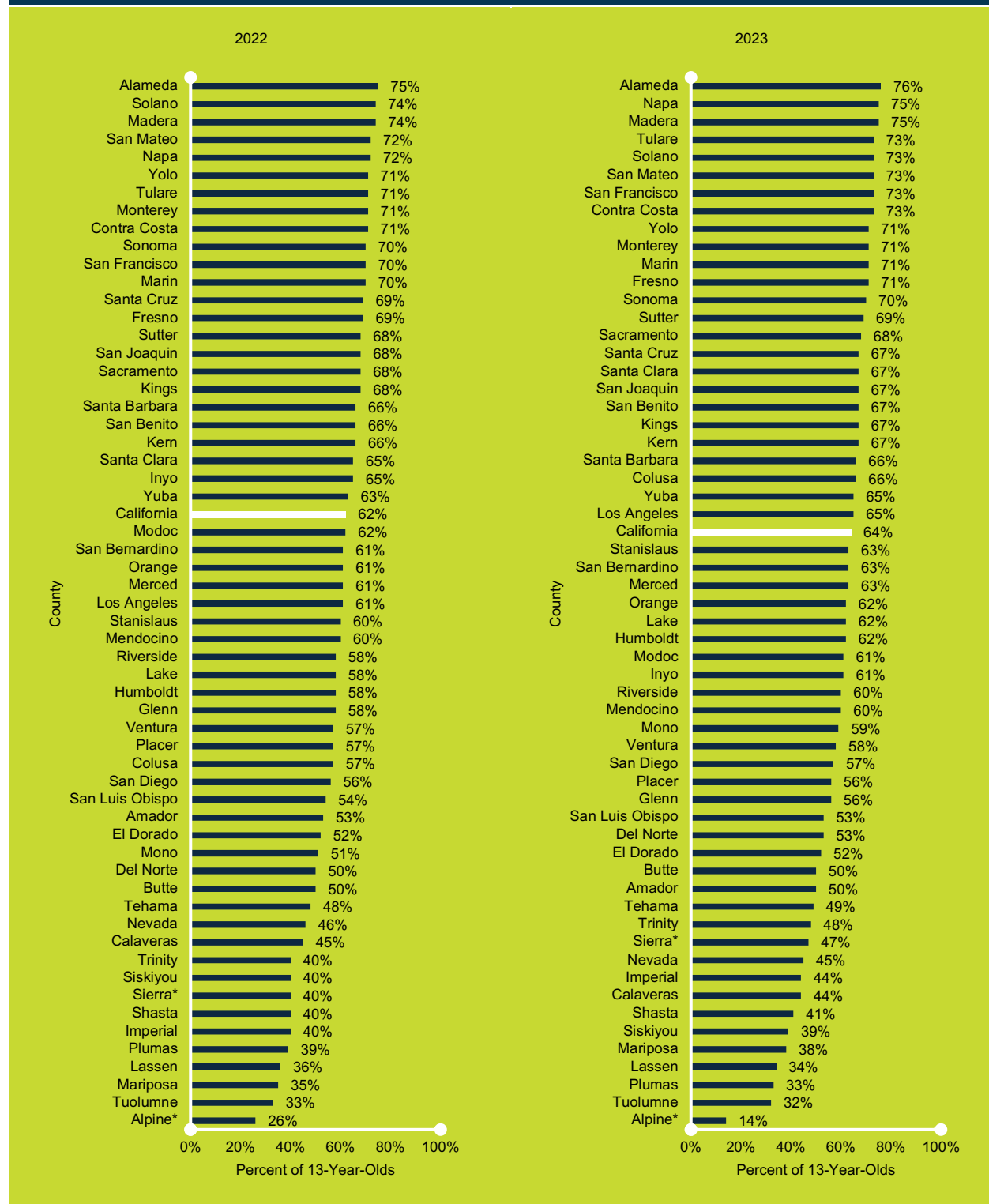
Figure 3. Percent of 13-Year-Olds Who Initiated the HPV Vaccine and Completed the HPV Vaccine Series, California, 2019–2023 (Data Source: CAIR).



At the county level, HPV vaccine initiation among 13-year-olds showed variation between 2022 and 2023 (Figures 4 and 5). Four counties—Alpine, Amador, Inyo, and Plumas—experienced declines of more than two percentage points in initiation rates. In contrast, 13 counties—Colusa, Del Norte, Humboldt, Imperial, Lake, Los Angeles, Mariposa, Mono, Napa, San Francisco, Sierra, Stanislaus, and Trinity—saw initiation rates increase by more than two percentage points during the same period. A similar pattern was observed in HPV vaccine series completion: four counties—Alpine, Lassen, Modoc, and Plumas—experienced notable decreases, while 22 counties reported increases in completion rates exceeding two percentage points. These included Colusa, Del Norte, Humboldt, Imperial, Inyo, Kern, Lake, Los Angeles, Merced, Mono, Monterey, Napa, Nevada, Riverside, San Benito, San Bernardino, Santa Clara, Stanislaus, Trinity, Tulare, Ventura, and Yolo.

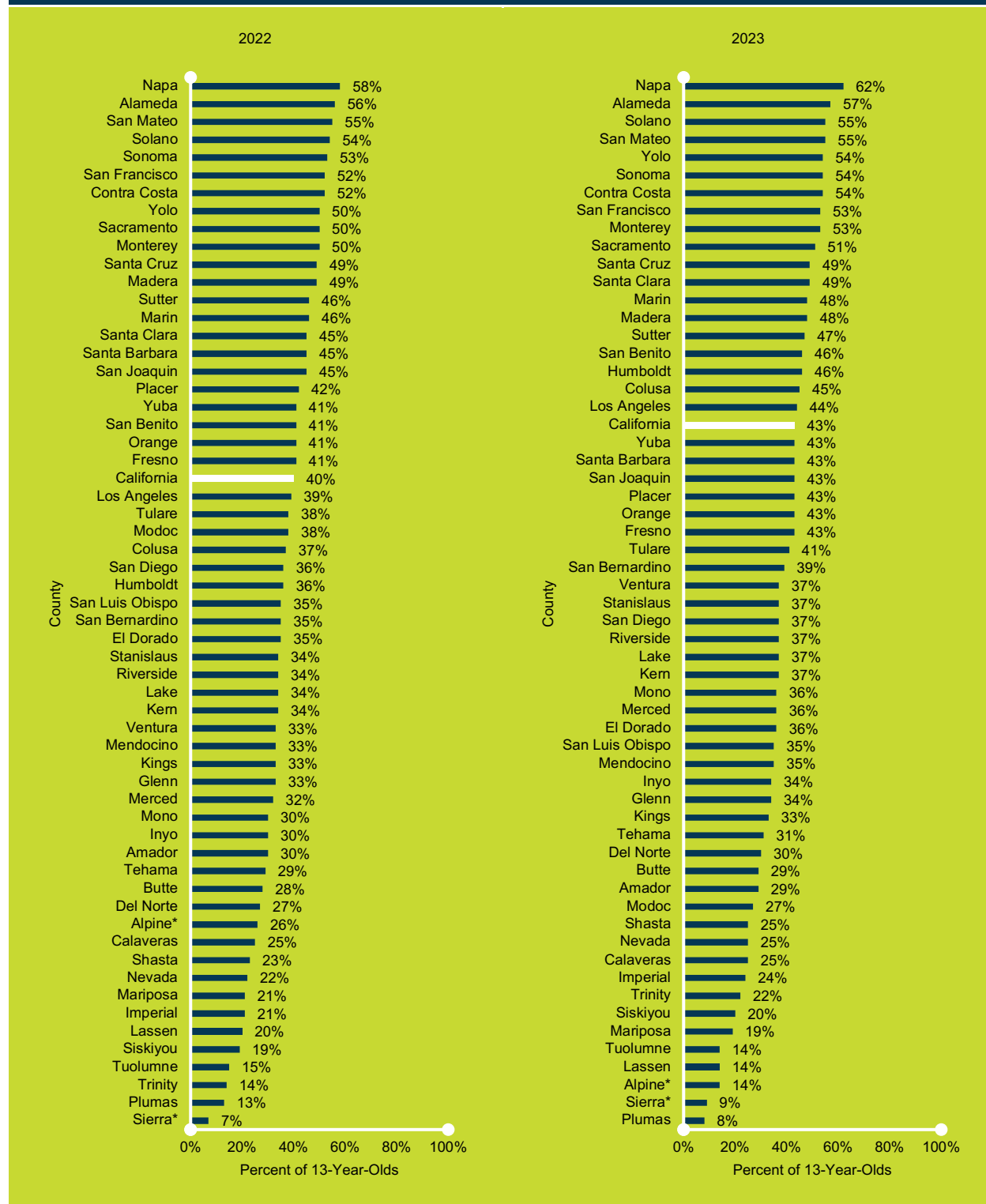
The lowest HPV vaccine initiation rates occurred in the Rural North, parts of the Greater Sierra Sacramento, and some of Central California. HPV vaccine series completion was lowest among the Rural North, Central California, Greater Sierra Sacramento, Southern California, and Los Angeles. (See Appendices for a state map visualization of HPV vaccine initiation and series completion percentages in 2023 by county.)

Figure 4. Percent of 13-Year-Olds Who Initiated the HPV Vaccine Ranked by County, California, 2022 and 2023 (Data Source: CAIR).



**Percentages were calculated using a population estimate because the county has fewer than 50 13-year-olds.*

Figure 5. Percent of 13-Year-Olds Who Completed the HPV Vaccine Series Ranked by County, California, 2022 and 2023 (Data Source: CAIR).



**Percentages were calculated using a population estimate because the county has fewer than 50 13-year-olds.*

In 2023, CAIR identified 499,869 13-year-olds statewide. Of these, 320,802 (64%) had initiated the HPV vaccine, and 214,668 (43%) had completed the series (Table 4). Initiation and completion rates were similar between males and females. Sixty-five percent of females and 63% of males initiated the vaccine series, while 44% of females and 42% of males completed it. Notably, the historical gender gap in HPV vaccine uptake had largely disappeared by 2023.

Table 4. Number of 13-Year-Olds Who Initiated the HPV Vaccine and Completed the HPV Vaccine Series by Select Demographics, California, 2023 (Data Source: CAIR).

Demographics	Total Number of 13-Year-Olds (Column Percent)	Number of HPV Vaccine Initiations (Row Percent)	Number of HPV Vaccine Series Completions (Row Percent)
Gender Identity			
Female	244,884 (49%)	159,102 (65%)	107,115 (44%)
Male	254,694 (51%)	161,589 (63%)	107,501 (42%)
Non-Binary	21 (<1%)	14 (67%)	11 (52%)
Unknown	270 (<1%)	97 (36%)	41 (15%)
Race/Ethnicity			
AI/AN*	2,125 (<1%)	1,299 (61%)	832 (39%)
Asian	51,268 (10%)	35,514 (69%)	27,108 (53%)
Black/AA**	22,506 (5%)	15,101 (67%)	9,410 (42%)
Latino	195,320 (39%)	141,754 (73%)	93,262 (48%)
NH/OPI***	2,268 (<1%)	1,511 (67%)	1,022 (45%)
White	108,675 (22%)	61,408 (57%)	41,065 (38%)
Multiracial	8,277 (2%)	5,894 (71%)	4,314 (52%)
Other Race	53,095 (11%)	32,618 (61%)	22,612 (43%)
Unknown	56,335 (11%)	25,703 (46%)	15,043 (27%)
Urbanicity			
Rural	27,331 (6%)	16,502 (60%)	9,739 (36%)
Urban	464,738 (93%)	301,221 (65%)	203,405 (44%)
Unknown	7,800 (2%)	3,079 (40%)	1,524 (20%)
Total	499,869 (100%)	320,802 (64%)	214,668 (43%)

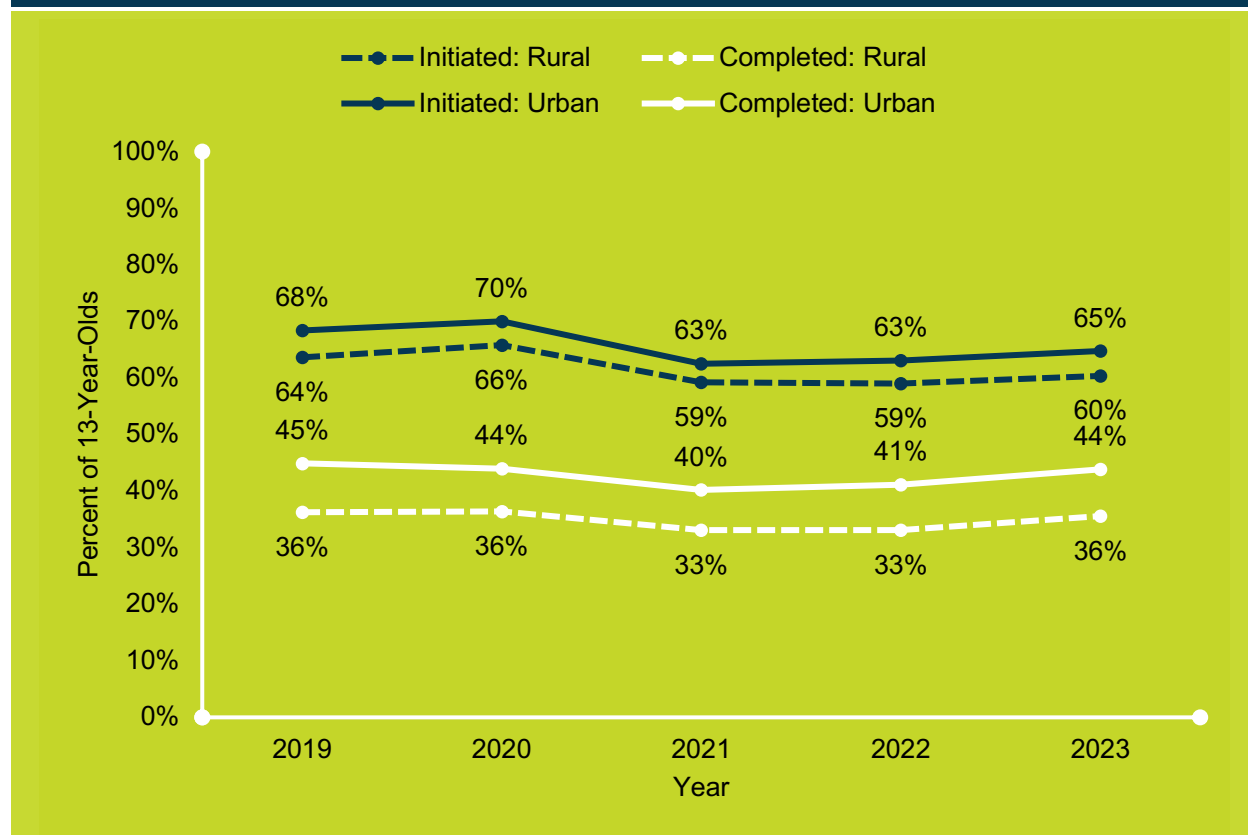
*American Indian/Alaska Native; **African American; ***Native Hawaiian/Other Pacific Islander.

CAIR allows self-reporting of gender identity, but some contributing electronic health records (EHR) do not yet support gender identity categories beyond male and female. As a result, data for individuals with non-binary or unknown gender identity should be interpreted with caution.

Vaccination rates also varied by race and ethnicity. All groups except those who identified as White and those with unknown race/ethnicity reported HPV vaccine initiation rates of at least 60%. Initiation was highest among 13-year-olds who identified as Latino (73%), followed by Multiracial (71%), Asian (69%), and Black/African American (67%). In contrast, only 57% of 13-year-olds who identified as White and 39% of those with unknown race/ethnicity initiated the vaccine. Series completion followed a similar pattern: 13-year-olds who identified as Asian (53%) and Multiracial (52%) had the highest completion rates, followed by those who identified as Latino (48%), Native Hawaiian/Other Pacific Islander (45%), and those who identified as Other Race (43%). Those who identified as White (38%) and those with unknown race/ethnicity (23%) had the lowest completion rates. These disparities may reflect underlying issues related to access to care, negative experiences within the health care system, and vaccine hesitancy.^{30,31}

Differences by urbanicity were also observed. Among the 36 urban counties, 65% of 13-year-olds initiated the vaccine and 44% completed the series. In comparison, in the 22 rural counties, 60% initiated the vaccine and 36% completed the series. This urban-rural gap has been consistent across the past five years (2019–2023), although both groups saw improvements in 2022–2023 following declines during the COVID-19 pandemic (Figure 6).

Figure 6. Percent of 13-Year-Olds Who Initiated the HPV Vaccine and Completed the HPV Vaccine Series by Urbanicity, California, 2019–2023 (Data Source: CAIR).



The AAP recommends that children initiate the HPV vaccine series between ages 9–12. Data from a 2023 cohort of adolescents aged 13–17 clearly show that earlier initiation leads to higher completion rates (Table 5). Among those who began the vaccine at age nine, 91% completed the series. This dropped slightly to 89% among those who initiated at age 10, and to 85% for those who began at age 11. However, completion declined sharply to just 63% among those who initiated at age 12. This steep attrition by age underscores the importance of timely HPV vaccination during the recommended age window and the benefits of initiating HPV vaccination at nine years of age.³²

Table 5. Number of Adolescents Ages 13–17 Years Old (as of December 31, 2024) Who Completed the HPV Vaccine Series by Age in Years at HPV Vaccine Initiation, California, 2023 (Data Source: CAIR).

Age in Years at HPV Vaccine Initiation	Number of HPV Vaccine Initiations	Number of HPV Vaccine Series Completions (Row Percent)
9	66,304	60,486 (91%)
10	132,734	118,626 (89%)
11	1,198,518	1,012,831 (85%)
12	556,059	349,770 (63%)

Limitations

The Data Workgroup encourages readers to consider the limitations of available data sources when reviewing this report and planning HPV-related interventions.

CCR Data

CCR collects information on nearly all cancer cases diagnosed in the state, providing a robust foundation for understanding cancer burden, including HPV-attributable cancers. However, several limitations should be noted. The CCR does not collect data on carcinoma in situ of the cervix (also known as stage 0 cervical cancer or precancer), which limits the ability to capture the full spectrum of HPV-related cervical disease. It can also be difficult to distinguish between cervical and endometrial primary cancers, occasionally leading to misclassification in cancer registries. Additionally, CCR data do not include case-level information on other relevant risk factors—such as smoking or high parity—that may influence the development of HPV-attributable cancers. Furthermore, the migration of patients into and out of SEER registry areas may result in missed diagnoses of second primary malignancies, leading to potential undercounts.

CAIR and NIS-Teen Data

While CAIR is a valuable tool for monitoring vaccine coverage, there are several limitations when using it to estimate HPV vaccine series completion. Some health care providers have not yet enrolled in CAIR despite requirements, and those that are

enrolled are encouraged—but not mandated—to report historical doses. As a result, immunization records may be incomplete or fragmented, particularly for patients who have moved or changed health care providers. The completeness of CAIR records may vary based on patient age, provider reporting practices, vaccine type, geographic region, demographic characteristics, and population mobility. These gaps can affect both the numerators and denominators used to calculate HPV vaccine initiation and series completion, potentially resulting in either underestimates or overestimates.

CAIR data allow for county-level analysis, but this granularity should be interpreted with caution. Fragmented records or duplicate entries across jurisdictions may distort local estimates. Additionally, counties with smaller populations are more susceptible to fluctuation in rates, where even small changes in cases can have a large effect on rates. It is also important to note that county-level analyses are based on where people live, and not necessarily where they receive health care.

The passage of AB 1797, which expanded provider reporting requirements to CAIR, resulted in a large influx of new immunization records. This influx increased the denominator used to calculate HPV vaccine coverage, potentially contributing to observed declines in initiation and series completion rates. These apparent declines may also reflect missed vaccination opportunities during the COVID-19 pandemic, particularly in 2020–2021, when many pediatric health care visits were deferred.

NIS-Teen is administered using a standardized national methodology that includes provider verification of vaccination records. It provides a means to compare California's vaccine coverage with other states. However, California's NIS-Teen estimates are based on a small statewide sample, which results in wide confidence intervals and unstable estimates. This small sample size reduces the ability to detect meaningful year-to-year changes and precludes subgroup comparisons by factors such as urbanicity or insurance status. Nevertheless, NIS-Teen data remain valuable for cross-state and regional comparisons in the broader context of national HPV vaccination trends.

Conclusions

HPV and Cancer

In our report published May 2020, the state's five years' combined estimated HPV-attributable cancer rate for 2012–2016 was 8.6 per 100,000.³³ This report illustrates a slight reduction at 8.4 per 100,000 population for 2017–2021.

Seven counties and county groupings reported a decrease by two percentage points or more in estimated HPV-attributable cancer rates from 2012–2016 to 2017–2021 include:

- Inyo and Mono, from 9.2 to 6.2 per 100,000 population

- Lassen, Modoc, and Plumas, from 10.2 to 7.8 per 100,000 population
- Marin, from 10.4 to 7.2 per 100,000 population
- Napa, from 10.3 to 7.0 per 100,000 population
- San Benito, from 9.6 to 7.6 per 100,000 population
- Siskiyou and Trinity, from 10.0 to 7.5 per 100,000 population
- Tulare, from 10.4 to 8.4 per 100,000 population

Conversely, four counties and county groupings reported an increase by two percentage points or more in estimated HPV-attributable cancer rates from 2012–2016 to 2017–2021 include:

- Lake, from 11.5 to 14.2 per 100,000 population
- Nevada, from 7.8 to 10.5 per 100,000 population
- San Luis Obispo, from 9.0 to 11.1 per 100,000 population
- Sierra and Yuba, from 8.9 to 14.8 per 100,000 population

It is encouraging to observe even modest declines in HPV-attributed cancers across California. These reductions likely reflect early signs of cancer prevention from HPV vaccination, as well as continued efforts in the early detection of cervical cancer—the only HPV-related cancer for which routine screening is currently recommended. While anal cytology, referred to as the anal Papanicolaou (Pap) test, may be offered to high-risk populations (such as gay, bisexual, and other men who have sex with men) for early detection of anal cancer, they are not routinely recommended. Research is ongoing to develop effective screening methods for other HPV-attributed cancers.³⁴ Because HPV-related cancers often take 10–20 years to develop, we expect rates to continue declining as vaccinated cohorts age.

Future analyses of cancer registry data are needed to examine disparities in HPV-attributable cancers across race/ethnicity, gender identity, sex, sexual orientation, geography, age, and other factors. Identifying and addressing barriers to cancer screening—especially in historically underserved communities that bear a disproportionate cancer burden—will be critical to reducing incidence and promoting health equity throughout the state. Given the evolving health insurance landscape, it will also be important to consider variations in insurance coverage and access to care moving forward.

The Roundtable is closely aligned with the California Dialogue on Cancer (CDOC), the state's comprehensive cancer coalition. CDOC is responsible for developing California's

cancer plan and supporting its implementation and evaluation. The 2026–2035 Comprehensive Cancer Control Plan sets ambitious goals for improving HPV vaccine coverage, including increasing series completion rates from 10% to 50% among 9–12-year-olds and from 54% to 85% among 13–17-year-olds by 2035. These targets encompass all gender identities, with particular emphasis on rural and racially marginalized populations. The plan also outlines activities to advance cervical cancer screening and calls on stakeholders to develop a comprehensive action plan to eliminate HPV-related cancers, beginning with cervical cancer. Achieving this will require sustained increases in HPV vaccination and cervical cancer screening, along with efforts to reduce disparities in access to treatment. The Roundtable looks forward to supporting data analyses that track progress toward these goals.

HPV Vaccine

As with many preventive health care services, HPV vaccination rates declined during the COVID-19 pandemic. Encouragingly, data in this report suggest a positive trajectory of recovery, with increasing vaccination uptake from 2022 to 2023. Notably, HPV vaccine initiation and series completion are relatively high among historically marginalized racial/ethnic communities. California also stands out nationally for achieving near-equal vaccination rates among males and females, in contrast to lower rates among males nationwide.

Significant geographic disparities persist, however, with rural counties reporting the lowest vaccination rates, particularly in the northeast. Caution is warranted when interpreting estimates from the state's least populous counties due to small sample sizes. Nonetheless, closing these gaps will require tailored strategies that address the unique needs of rural communities while sustaining successful efforts in urban areas.

In 2023, California passed AB 659, the Cancer Prevention Act, which recommends that students entering 8th grade complete the HPV vaccine series.³⁵ Starting in 2024, students and their caregivers receive notification of this recommendation when they enter 6th grade. Given the proven effectiveness of reminders and trusted messengers in increasing vaccine uptake, public health advocates are hopeful that AB 659 will support increased HPV vaccination rates across the state.

As public health leaders across California and the U.S. continue working to increase HPV vaccine uptake, there is a growing need for access to timely, reliable county-level data. Such data can guide health care systems, policymakers, and community-based organizations to prioritize HPV vaccinations and prevent illnesses and cancers in their communities.

The Roundtable's Data Workgroup recommends implementing a range of evidence-based interventions to improve HPV vaccination. These include:

- Encourage HPV vaccine initiation at age 9 to increase series completion by age 13.

- Establish a recall process to ensure that follow-up HPV vaccine doses are administered after the minimum five months.
- Train health care providers and staff on HPV vaccine recommendations and effective patient communication. Community meetings, in-service training, guest speakers, and social media can be used to educate providers and staff.
- Collaborate with health insurance plans to develop incentives that reward primary care practices for on-time HPV vaccine initiation and series completion.
- Collaborate with health insurance plans to leverage available data to inform member- and provider-directed interventions.
- Encourage health care organizations to place patient education resources in exam rooms, such as multi-language flyers, letters, and pamphlets; set up video education in the waiting room; and email reminders to patients, providers, and caregivers to initiate and complete the HPV vaccine series. Emphasize HPV vaccination as cancer prevention.
- Support health care organizations in creating reminders in EHR to notify providers and staff when a patient is due for the HPV vaccine. Send physical reminders and use automated phone calls to notify patients when a patient is due or overdue for the HPV vaccine.
- Partner with clinics to train health care staff—physicians, pharmacists, physician assistants, nurse practitioners, nurses, medical assistants, and every other frontline staff—about the importance of the HPV vaccine to prevent cancer.
- Prioritize HPV vaccination along with other scheduled vaccinations.
- Avoid missed opportunities to vaccinate. Use all encounters, including acute care encounters, to provide the HPV vaccine.
- Offer walk-in or vaccine-only appointments to increase access to the HPV vaccine.
- Compare HPV vaccination rates to rates of other vaccines. Use year-over-year data to report on the success rate of HPV vaccinations at the health care organization, clinic, or practitioner level.
- Use provider-focused and family-focused decision support.
- Incorporate standing orders into clinic procedures to ensure frontline health care staff provide the HPV vaccine.

- Partner with local health care organizations by establishing strong partnerships between local health care facilities and health insurance plans and embed HPV vaccination efforts within larger cancer prevention efforts.
- Develop HPV vaccination resources to disseminate for the public and providers.
- Continue to use CCR and CAIR data to support HPV vaccine interventions.
- Support improved access to HPV vaccination through school-based clinics, pharmacies, local health departments, and other vaccination clinics.

Resources

Community

The following resources are recommended for public health advocates, researchers, and providers when engaging with patients and the public:

- Fact sheet with basics about the HPV vaccine (ACS):
<https://www.cancer.org/content/dam/cancer-org/online-documents/en/pdf/flyers/hpv-prevention-matters.pdf>
- Fact sheet for parents about common HPV vaccine myths (ACS):
<https://www.cancer.org/content/dam/cancer-org/online-documents/en/pdf/flyers/hpv-vaccination-just-the-facts-for-parents.pdf>
- Infographic with four key points about the HPV vaccine (ACS):
<https://www.cancer.org/content/dam/cancer-org/online-documents/en/pdf/flyers/protecting-our-children-from-hpv-cancers.pdf>
- Infographic about initiating the HPV vaccine at ages 9–12 years (ACS):
<https://www.cancer.org/content/dam/cancer-org/online-documents/en/pdf/flyers/hpv-dont-wait-to-vaccinate.pdf>
- Flyer (8.5" × 11") and poster (18" × 24") recommending HPV vaccines for pre-teens and teenagers (National HPV Vaccination Roundtable):
Flyer: <https://hpvroundtable.org/wp-content/uploads/2023/05/Co-brand-HPV-Roundtable-2022-Flier-8-5x11-PRINT-v1.pdf>
Poster: <https://hpvroundtable.org/wp-content/uploads/2022/06/Co-Brand-HPV-Roundtable-2022-poster18x24-WEB-v1.pdf>
- Recommended immunizations for children ages 7–18 years (CDC):
<https://www.cdc.gov/vaccines/imz-schedules/downloads/parent-version-schedule-7-18yrs.pdf>

- Local health departments can request access to state- and county-level vaccination data available on the CDPH vaccine dashboards by emailing CDPHVaccineDataTeam@cdph.ca.gov and providing your full name, local health department email address, health department, role, and request to access the vaccine dashboards.

Providers

The following resources are recommended for health care providers:

- Six-part education virtual series for providers on the latest information about HPV vaccination guidelines, implementation guidelines to increase vaccination rates, and more (ACS, National HPV Vaccination Roundtable, and the Indiana Immunization Coalition):
<https://hpvroundtable.org/provider-education-series-videos/>
- Guide sheet for providers to recommend the HPV vaccine and address concerns using the announcement approach (HPV IQ at the University of North Carolina Gillings School of Global Public Health):
<https://hpvroundtable.org/wp-content/uploads/2023/10/Updated-AAT-flyer.pdf>
- Fact sheet for providers about the HPV vaccine (ACS):
<https://www.cancer.org/content/dam/cancer-org/online-documents/en/pdf/flyers/hpv-vacs-just-the-facts-for-providers.pdf>
- Fact sheet for providers about how to talk to parents about the HPV vaccine (CDC):
https://www.cdc.gov/hpv/media/pdfs/2024/07/talking_to_parents_hpv.pdf
- HPV Vaccination Promising Practices Series (ACS):
<https://hpvroundtable.org/initiatives-and-campaigns/hpv-best-practices-education-series/>

Systems

The following resources are recommended for public health advocates, researchers, and providers to support system-level changes:

- Action guides to increase HPV vaccination at the system level (National HPV Vaccination Roundtable):
<https://hpvroundtable.org/cancer-prevention-through-hpv-vaccination-action-guides/>
- Resources to support initiating HPV vaccination at age nine years (National HPV Vaccination Roundtable):
<https://hpvroundtable.org/start-hpv-vaccination-at-age-9/>

- An HPV standing order template (ACS):
<https://brandcentral.cancer.org/dam/contentitems/e198c0f001454d61afdab27901355761>
- HPV Communication Toolkit (ACS):
<https://brandcentral.cancer.org/dam/contentitems/91c48690375144f78649b28000ff048b>

Organizations

The following organizations are recommended for further HPV vaccine information and resources:

- AAP:
<https://www.aap.org/en/patient-care/immunizations/adolescent-immunization-discussion-guides/>
- ACS:
<https://www.cancer.org/health-care-professionals/hpv-vaccination-information-for-health-professionals/hpv-vaccination-resources-for-health-professionals.html>
- American College of Obstetricians and Gynecologists (ACOG):
<https://www.acog.org/womens-health/faqs/hpv-vaccination>
- CDPH:
<https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/HPV.aspx>
- CDC:
<https://www.cdc.gov/hpv/hcp/educational-resources/>
- Immunize.org (formerly Immunization Action Coalition):
<https://www.immunize.org/clinical/a-z/>
- NCI:
<https://www.cancer.gov/about-cancer/causes-prevention/risk/infectious-agents/hpv-vaccine-fact-sheet>
- National Foundation for Infectious Diseases (NFID):
<https://www.nfid.org/resource/facts-about-hpv/>
- National HPV Vaccination Roundtable:
<https://hpvroundtable.org/resource-center/>

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Appendices

Figure 1. Percent of 13-Year-Olds Who Initiated the HPV Vaccine by County, California, 2023 (Data Source: CAIR).



Figure 2. Percent of 13-Year-Olds Who Completed the HPV Vaccine Series by County, California, 2023 (Data Source: CAIR).



