BURDEN OF HPV-ASSOCIATED CANCERS IN CALIFORNIA, 1988-2019

ACKNOWLEDGEMENTS AND DISCLAIMER

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EXECUTIVE SUMMARY

- ❖ High-risk strains of Human Papillomavirus (HPV) can cause several different cancers including squamous cell carcinoma (SCC) of the vulva, vagina, anus, penis, oropharynx, and carcinoma of the cervix.
- ❖ Vaccines approved by the U.S. Food and Drug Administration protect against infections of the high-risk HPV strains that can cause cancer. An HPV vaccine was approved for use in females in 2006 and in males in 2009.
- ❖ The Centers for Disease Control and Prevention (CDC) Advisory Committee on Immunization Practices (ACIP) recommends HPV vaccination at 11 or 12 years of age, but vaccination can start as early as age nine. Catch-up vaccination is recommended for everyone through 26 years of age.
- ❖ The 2019 National Immunization Teen Survey (NIS) of 13-17 year-olds found 61.5 percent of female adolescents were up to date on the HPV vaccine compared to 51.4 percent of males in California. Up-to-date vaccination percentages were 54.1 percent in Hispanic/Latino adolescents compared to 47.1 percent of non-Hispanic/Latino Whites (Whites) and 39.8 percent of Black/African Americans. By health insurance coverage, 54.1 percent of adolescents covered by Medicaid were up to date on the HPV vaccine compared to 50.3 percent who were covered by private insurance and 39.6 percent who were uninsured.
- ❖ Between 1988 and 2019, 119,552 HPV-associated cancers were diagnosed among California residents. Cervical cancer was the most common (40.7 percent), followed by oropharyngeal (33.5 percent), anal (14.0 percent), vulvar (6.8 percent), penile (2.9 percent), and vaginal (2.1 percent) cancers.
- ❖ Statewide, the five-year (2015-2019) age-adjusted incidence rate of all HPV-associated cancers combined was 10.7 per 100,000. However, incidence varied by county. Counties with the highest incidence of HPV-associated cancers were Humboldt, Trinity, Plumas, Sierra, Yuba, Colusa, Lake, Alpine, Tuolumne and Inyo counties.
- ❖ Females had higher age-adjusted incidence of anal cancer compared to males (2.2 per 100,000 versus 1.4 per 100,000).
- ❖ During the post-vaccine period (after 2006 for females and 2009 for males), anal cancer incidence increased among females by an average of 2.1 percent per year, Black/African Americans by an average of 1.8 percent per year, Hispanic/Latinos by an average of 1.3 percent per year, Whites by an average of 1.7 percent per year, and among persons aged 65 years and older by an average of 2.4 percent per year. Persons aged 35 to 64

years experienced an average decrease in anal cancer incidence of 1.4 percent per year (Table ES1).

- Anal cancer mortality increased during the post-vaccine period among males by an average of 1.3 percent per year, females by an average of 1.2 percent per year, Black/African Americans by an average of 2.2 percent per year, Whites by an average of 1.9 percent per year, and persons aged 65 years and older by an average of 1.6 percent per year (Table ES1).
- Compared to patients diagnosed with other HPV-associated cancers, cervical cancer patients were more often diagnosed at 20 to 34 years of age (15.7 percent), were Hispanic/Latino (36 percent), had Medicaid/public health insurance (25.6 percent), and resided in the lowest socioeconomic status (SES) neighborhoods (41.8 percent).
- During the post-vaccine period, cervical cancer incidence decreased for most women except for Native Americans who experienced an average increase of 1.5 percent per year (Table ES1).
- During the post-vaccine period, cervical cancer mortality decreased among Black/African Americans by an average of 2.8 percent per year, Hispanic/Latinas by an average of 2.3 percent per year, females aged 20 to 34 years by an average of 1.6 percent per year, and females aged 35 to 64 years by an average of 1.6 percent per year (Table ES1).
- Oropharyngeal cancer patients were more often male (78.1 percent). Incidence of oropharyngeal cancer was highest in Whites, but mortality was highest in Black/African Americans.
- During the post-vaccine period, incidence of oropharyngeal cancer decreased among females by an average of 1.1 percent per year, Black/African Americans by an average of 1.3 percent per year, and persons aged 35 to 64 years by an average of 1.9 percent per year. However, incidence increased among Hispanic/Latinos by an average of 1.9 percent per year (Table ES1).
- During the post-vaccine period, oropharyngeal cancer mortality increased among males by an average of 2.1 percent per year, Whites by an average of 3.3 percent per year, persons aged 35 to 64 years by an average of 2.1 percent per year, and persons aged 65 years and older by an average of 1.2 percent per year (Table ES1).
- During the post-vaccine period, penile cancer incidence and mortality rates were stable, except incidence decreased among Black/African Americans by an average of 2.4 percent per year and among Whites by an average of 0.7 percent per year.

- During the post-vaccine period, incidence of vaginal cancer decreased by an average of 0.8 percent per year among women aged 65 years and older, as did mortality among females aged 35 to 64 years by an average of 1.1 percent per year.
- Vulvar cancer incidence increased during the post-vaccine period among Whites by an average of 1.0 percent per year and females aged 65 years and older by an average of 0.5 percent per year. Vulvar cancer mortality increased among Whites by an average of 1.8 percent per year and females aged 35 years to 64 years by an average of 2.3 percent per year, but decreased among Hispanic/Latinas by an average of 1.1 percent per year.
- Native Americans had the highest incidence and mortality of anal, cervical, and penile (tied with Hispanic/Latinos) cancers, the second highest incidence of oropharyngeal cancer, and the highest mortality from vulvar cancer.
- Black/African Americans had the highest incidence and mortality of vaginal cancer (incidence same at Hispanic/Latinas), the second highest incidence of vulvar cancer, and the highest mortality from vaginal cancer.
- Hispanic/Latinos had the highest incidence of vaginal cancer (incidence same as Black/African Americans) and highest incidence and mortality of penile cancer.
- Of the HPV-associated cancers, oropharyngeal cancer had the largest percentage of cases diagnosed late stage (80 percent), followed by vaginal (52 percent), cervical (46 percent), anal (42 percent), vulvar (38 percent), and penile (37 percent) cancers.
- Californians with Medicaid/public health insurance had a higher percent of all HPV-related cancers diagnosed at a late stage.
- Persons residing in low SES neighborhoods had a higher percent of anal, cervical, penile, and vulvar cancers diagnosed at a late stage.
- Hispanic/Latinos had a higher percent of oropharyngeal, penile, and vulvar cancers diagnosed at a late stage and Black/African Americans had a higher percent of cervical, penile, and vaginal cancers diagnosed at a late stage.

BETWEEN 1988 AND 2019

119,552

HPV-ASSOCIATED CANCERS WERE DIAGNOSED AMONG CALIFORNIA RESIDENTS

Table ES1: Summary of Trend Analyses, Average Annual Percent Change (AAPC) in Incidence and Mortality During the Study Period (SP) and Post-Vaccine Period (PVP)* by Cancer Type, 1988-2019

Population	Anal				Cervical				Oropharyngeal				Penile				Vaginal				Vulvar			
	Incidence		Mortality		Incidence		Mortality		Incidence		Mortality		Incidence		Mortality		Incidence		Mortality		Incidence		Mortality	
	AAPC SP	AAPC PVP	AAPC SP	AAPC PVP	AAPC SP	AAPC PVP	AAPC SP	AAPC PVP	AAPC SP	AAPC PVP	AAPC SP	AAPC PVP	AAPC SP	AAPC PVP	AAPC SP	AAPC PVP	AAPC SP	AAPC PVP	AAPC SP	AAPC PVP	AAPC SP	AAPC PVP	AAPC SP	AAPC PVP
Male & Female	**1.2**	0.3	**1.2**	**1.2**	^	^	^	^	0.1	-0.5	0.03	**1.5**	^	^	^	^	^	^	^	^	^	^	^	^
Male	**1.2**	-0.8	**1.3**	**1.3**	^	^	^	^	**0.8**	-0.1	0.5	**2.1**	-0.1	-0.1	0.9	0.9	^	^	^	^	^	^	^	^
Female	**1.5**	**2.1**	**1.2**	**1.2**	**-1.6**	-0.7	**-1.4**	-0.4	**-1.9**	**-1.1**	-0.1	-0.1	^	^	^	^	**-0.8**	**-0.8**	-0.5	-0.5	0.2	0.2	**0.9**	**0.9**
Asian/ Pacific Islander	0.5	0.5	^	^	**-2.8**	**-2.1**	**-2.6**	-1.0	-0.4	-0.4	^	^	^	^	^	^	-1.6	-1.6	^	^	-1.1	-1.1	^	^
Black/ African American	**1.8**	**1.8**	**2.2**	**2.2**	**-2.9**	**-0.9**	**-2.8**	**-2.8**	**-1.3**	**-1.3**	0.9	0.9	**-2.4**	**-2.4**	^	^	-0.6	-0.6	-1.7	-1.7	2.9	-0.4	^	^
Hispanic/ Latino	**1.3**	**1.3**	0.9	0.9	**-2.4**	**-2.0**	**-2.3**	**-2.3**	0.6	**1.9**	0.9	0.9	0.6	0.6	^	^	-0.8	-0.8	0.4	0.4	-0.3	-0.3	**-1.1**	**-1.1**
Native American	^	^	^	^	**1.5**	**1.5**	^	^	1.8	2.2	^	^	^	^	^	^	^	^	^	^	^	^	^	^
Non-Hispanic/ Latino White	**2.0**	**1.7**	**1.9**	**1.9**	**-1.3**	**-1.3**	**-1.5**	-0.1	**1.1**	0.2	1.1	**3.3**	**-0.7**	**-0.7**	0.2	0.2	-0.6	-0.6	0.1	0.1	**1.0**	**1.0**	**1.8**	**1.8**
Aged 0-19 Years	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^
Aged 20-34 years	-1.1	-1.1	^	^	**-1.7**	**-1.7**	**-1.6**	**-1.6**	-0.4	-0.4	^	^	^	^	^	^	^	^	^	^	^	^	^	^
Aged 35-64 years	**1.0**	**-1.4**	0.7	0.7	**-1.4**	-0.9	**-1.6**	**-1.6**	-0.01	**-1.9**	-0.8	**2.1**	0.7	0.7	1.4	1.4	-0.8	-0.8	**-1.1**	**-1.1**	0.4	-0.1	**2.3**	**2.3**
65+ years	**1.4**	**2.4**	**1.6**	**1.6**	**-2.6**	**-2.6**	**-1.7**	0.2	0.3	1.3	**1.2**	**1.2**	-0.4	-0.4	0.9	0.9	**-0.8**	**-0.8**	-0.4	-0.4	**0.5**	**0.5**	0.6	0.6

*Study Period defined as 1988-2019. Post-Vaccine Period defined as 2006-2019 for females and 2009-2019 for males. ^Statistic not calculated for this group.

Statistically significant increase; Statistically significant decrease. Source of data: California Cancer Registry, California Department of Public Health.

INTRODUCTION

HPV is a group of more than 200 related viruses that infect epithelial cells (outer layer) of the skin and oral and genital mucosa (mucus membranes).[1,2] HPV strains are classified as either low-risk or high-risk in nature. Low-risk strains typically do not cause disease. However, high-risk strains can cause several different types of cancer including cervical, vulvar, vaginal, anal, penile and oropharyngeal.[1] Currently, 14 high-risk HPV strains have been identified and two of these, HPV16 and HPV18, are most often detected in the cancers noted above.[3]

HPV is transmitted via vaginal, anal, and oral sex and skin-to-skin contact. HPV infections are very common and nearly all sexually active people will acquire HPV at some point during their lives. According to the CDC, nearly 42 million people in the United States (U.S.) currently have an HPV infection and approximately 13 million people become infected with HPV each year.[4] In most cases, HPV infections are asymptomatic and cleared by the immune system within six months to two years.[1,5] In a small number of cases, HPV infection persists leading to cellular changes and potentially cancer.

Three vaccines licensed for use in the U.S. provide protection against infection of high-risk HPV strains. First generation Gardasil was approved by the U.S. Food and Drug Administration (FDA) for use in females in 2006 and in males in 2009.[4] Gardasil protects against HPV strains 6, 11, 16, and 18. HPV strains 6 and 11 are not linked to cancer but cause 90 percent of genital wart cases. Second generation Gardasil, Gardasil9, was approved for use by the FDA in females and males in December 2014 and protects against HPV strains 6, 11, 16, 18, 31, 33, 45, 52, and 58. HPV strains 31, 33, 45, 52, and 58 are linked to cervical cancer. A third vaccine, Cervarix, was approved for use in females by the FDA in 2009 and protects against HPV strains 16 and 18. Since 2016, Gardasil9 is the only HPV vaccine administered in the U.S.[6]

HPV VACCINE: A HISTORY

2006

First generation Gardasil was approved by the U.S. Food and Drug Administration (FDA) for use in females and protects against HPV strains 6, 11, 16, and 18

2009

- First generation Gardasil was approved by the FDA for use in males
- Cervarix was approved for use in females by the FDA and protects against HPV strains 16 and 18

2014

Second generation Gardasil, Gardasil 9, was approved for use by the FDA in females and males and protects against HPV strains 6, 11, 16, 18, 31, 33, 45, 52, and 58

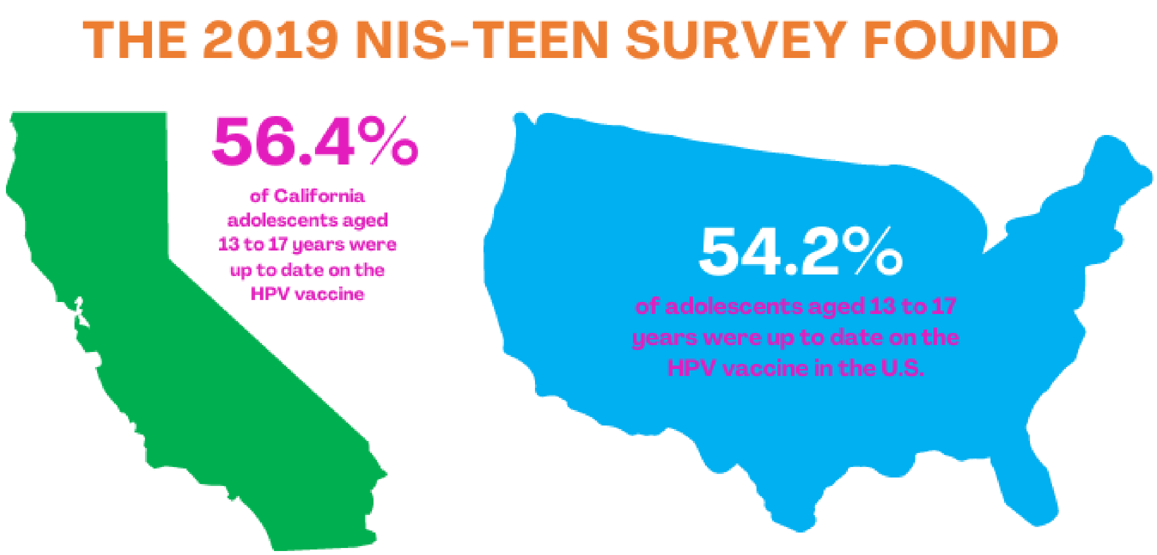
2016

Since 2016, Gardasil 9 is the only HPV vaccine administered in the United States

The CDC's ACIP recommends HPV vaccination at 11 or 12 years of age, but vaccination can start as early as age nine. Catch-up vaccination is recommended for everyone through 26 years of age. Vaccination is not recommended for those older than 26 years of age. However, adults aged 27 through 45 years can discuss with their healthcare provider whether they would benefit from vaccination.[7]

The 2019 NIS found 56.4 percent of California adolescents aged 13 to 17 years were up to date on the HPV vaccine compared to 54.2 percent nationally. In California, 61.5 percent of females and 51.4 percent of males were up to date, compared to 56.8 percent of females and 51.8 percent of males nationally. Additional differences in HPV-vaccine coverage estimates in California were observed by poverty level, race/ethnicity, and insurance coverage. From 2015 through 2019, 50.8 percent of adolescents living at or above the poverty level were up to date, compared to 53.5 percent of adolescents living below the poverty level. Approximately 54.1 percent of Hispanic/Latino adolescents were up to date on the HPV vaccine compared to 47.1 percent of non-Hispanic/Latino Whites (Whites) and 39.8 percent of Black/African Americans. By health insurance coverage, 54.1 percent of adolescents covered by Medicaid were up to date, compared to 50.3 percent of adolescents covered by private insurance, and 39.6 percent of adolescents who are uninsured.[8]

The objective of this report is to evaluate the burden of HPV-associated cancers among Californians, particularly during the post-HPV vaccine period, defined as after 2006 for females and after 2009 for males.



METHODS

Incidence

This report includes incident cases of HPV-associated cancers diagnosed among California residents between January 1, 1988 and December 31, 2019. HPV-associated cancers include SCC of the oropharynx, anus/rectum, vulva, vagina, and penis, as well as carcinoma of the cervix.[5] Tumors were classified based on primary site and histology according to the International Classification of Diseases for Oncology, third edition (Appendix A).[9] All tumors were microscopically confirmed, and only invasive tumors were included in this report. These data were obtained from the California Cancer Registry (CCR). CCR is California's, population-based, cancer surveillance system and has been collecting data on cancer diagnoses statewide since 1988. Since 2012, the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, within the University of California Davis Comprehensive Cancer Center, has partnered with the California Department of Public Health (CDPH) in managing the day-to-day operations of the CCR.

Mortality

Computerized files containing information on cancer-related deaths were obtained from CDPH, Center for Health Statistics. From 1988 through 1998, cause of death was coded according to the International Classification of Diseases, Ninth Edition (ICD-9).[10] Beginning in 1999, cause of death was coded according to the International Classification of Diseases, Tenth Edition (ICD-10).[11] This report includes deaths due to malignant neoplasms of the oropharynx, anus/rectum, vulva, vagina, cervix, and penis. Mortality data does not include histology information so we could not limit deaths to those specifically caused by SCC of the oropharynx, anus/rectum, vulva, vagina, and penis. All deaths occurred among California residents between January 1, 1988 and December 31, 2019. All mortality analyses presented in this report are the responsibility of the authors and were not reviewed or endorsed by the Center for Health Statistics prior to publication.

Age-Adjusted Rates

Rates were calculated as the number of new cases (incidence) or deaths (mortality) in specific age groups per 100,000 persons each year and were age-adjusted to the 2000 U.S. standard population. Age-adjusted rates are weighted averages of age-specific rates, where the weights represent the age distribution of a standard population. Such adjustment eliminates differences in rates due to changes in the age of a population over time or differences in the age distribution between population groups. Rates in this report were calculated using SEER*Stat software.[12]

Trends in Cancer Incidence and Mortality

Joinpoint linear regression was used to determine trends in cancer incidence and mortality. In this analysis, a statistical algorithm detects joinpoints, or points in time where the slope of the regression line significantly changes. Thus, the model describes trends during different time segments, with the annual percent change (APC) estimated for each segment. The average annual percent change (AAPC) is a summary measure of a trend over a pre-specified fixed interval. It allows for the use of a single number to describe the average APCs over a period of multiple years. It is valid even if the joinpoint model indicates that there were changes in trends during those years. It is computed as a weighted average of the APCs from the joinpoint model, with the weights equal to the length of the APC interval. Trends were calculated for the entire study period (1988 through 2019) and a post-vaccine period. The post-vaccine period for female-specific cancers was 2006-2019 and the post-vaccine period for male-specific and non-sex-specific cancers was 2009-2019. Joinpoint version 4.7.0.0 software was used for all trend analyses in this report.[13]

Variable Definitions

Stage at Diagnosis

Stage at diagnosis was defined according to the Surveillance, Epidemiology, and End Results (SEER) Program's Summary Stage classification scheme.[14] In this scheme, tumors are classified as *in situ*, localized, regional, distant, or unstaged. *In situ* tumors are non-invasive and do not penetrate the basement membrane. Localized tumors are confined entirely to the organ of origin. Regional tumors extend into surrounding organs, tissues, or regional lymph nodes. Distant tumors have metastasized to other parts of the body. *In situ* tumors were excluded from all analyses. Analyses on late-stage tumors included both regional and distant stage tumors.

Type of Health Insurance

Patients' health insurance information was obtained from the latest report received by the CCR regarding the patient's tumor. Health insurance was categorized as either private/government, Medicare with no supplement, Medicaid/public, uninsured, or unknown. The private/government category included private managed care, HMO, PPO, and fee-for-service plans, as well as Medicare with private supplement, TRICARE, Military, and Veterans Affairs (VA). The Medicaid/public category included Medicaid, Medicare with Medicaid, Indian/Public Health Service plans, and county funded plans.[15]

Neighborhood SES

A neighborhood-level SES measure was utilized in this report. This SES measure is a composite score created using principal component analysis and incorporates census tract-level measures of employment, income, housing characteristics, and education. A SES score was calculated for each census tract in California. A patient's SES is based on the census tract in which they resided at the time of their cancer diagnosis. The SES score for all cancer patients was divided into tertiles representing low-, middle-, and high-neighborhood SES.[16,17]

Limitations

There are some limitations to consider when interpreting these data. Small counts can lead to unstable rates and trends that are not statistically significant. When the number of cases or deaths was zero for any year in the evaluation period, the trend could not be calculated. This is particularly problematic for Native Americans because Native Americans are often misclassified in cancer registry data making it difficult to understand their true cancer burden.[29] In addition, histology information is not available in mortality data. Thus, we could not limit deaths from anal, oropharyngeal, penile, vaginal, and vulvar cancer to those specifically caused by SCC. This could explain why some mortality trends did not align with the corresponding incidence trend. Furthermore, persons who died during the study period were not necessarily diagnosed during the study period. Additionally, the cancer registry does not contain information about individual HPV vaccination status.

RESULTS

Characteristics of HPV-Associated Cancer Cases

Between January 1, 1988 and December 31, 2019, 119,552 microscopically confirmed, HPV-associated cancers were diagnosed among California residents. HPV-associated cancers include SCC of the oropharynx (hereafter called oropharyngeal cancer), SCC of the anus/rectum (hereafter called anal cancer), SCC of the vulva (hereafter called vulvar cancer), SCC of the vagina (hereafter called vaginal cancer), SCC of the penis (hereafter called penile cancer), and carcinoma of the cervix (hereafter called cervical cancer). Cervical cancer was the most common HPV-associated cancer diagnosed among California residents (n=48,664, 40.7 percent), followed by oropharyngeal (n=40,091, 33.5 percent), anal (n=16,680, 14.0 percent), vulvar (n=8,120, 6.8 percent), penile (n=3,447, 2.9 percent), and vaginal (n=2,550, 2.1 percent) cancer (Table 1).

Of the HPV-associated cancers, oropharyngeal and anal cancers are diagnosed in males and females whereas the other cancers are sex specific. Oropharyngeal cancer patients were more often male (78.1 percent) and anal cancer patients were more often female (62.3 percent) (Table 1). A small number of patients (n=37) were neither male nor female sex or sex was unknown. These cases were excluded from all rate analyses.

The majority of oropharyngeal (77.3 percent), anal (76.9 percent), and vulvar (74.2 percent) cancer patients were non-Hispanic/Latino White (White) (Table 1). Cervical, vaginal, and penile cancer patients varied more by race/ethnicity. Forty-two percent of cervical cancer patients were White, 36 percent were Hispanic/Latina, 13 percent were Asian/Pacific Islander, seven percent were Black/African American, and nearly one percent were Native American. Among penile and vaginal cancers, Hispanic/Latinos accounted for 32 and 22 percent of cases, respectively.

Greater than 90 percent of oropharyngeal, anal, vulvar, vaginal, and penile cancers were diagnosed among persons aged 35 years and older (Table 1). More cervical cancers were diagnosed among patients aged 20 to 34 years (15.7 percent) than other HPV-associated cancers. Very few HPV-associated cancers were diagnosed among patients aged 19 years or younger.

The majority of vulvar and penile cancers (57.1 percent and 57.6 percent, respectively) were diagnosed localized stage and nearly half of all cervical and anal cancers (48.8 percent and 46.8 percent, respectively) were diagnosed localized stage (Table 1). Vaginal and oropharyngeal cancers had the lowest proportion of cases diagnosed localized stage (36.7 percent and 14.9 percent, respectively).

More than half of oropharyngeal (56.3 percent) and anal (53.7 percent) cancer patients had private/government health insurance (Table 1). More cervical cancer patients (25.6 percent) had Medicaid/public health insurance compared to patients with other HPV-associated cancers. Similarly, more cervical cancer patients resided in the lowest SES neighborhoods (41.8 percent) followed by penile cancer patients (40.0 percent).

MOST COMMON HPV-ASSOCIATED CANCERS

1. **CERVICAL (40.7%)**
2. **OROPHARYNGEAL (33.5%)**
3. **ANAL (14.0%)**
4. **VULVAR (6.8%)**
5. **PENILE (2.9%)**
6. **VAGINAL (2.1%)**

Table 1. Demographic and Tumor Characteristics of HPV-Associated Cancer Cases in California, 1988-2019 (N=119,552)

	Cancer Type											
	Oropharyngeal		Anal		Cervical		Vulvar		Vaginal		Penile	
Characteristic	N	%	N	%	N	%	N	%	N	%	N	%
All Patients	40,091	33.5	16,680	14.0	48,664	40.7	8,120	6.8	2,550	2.1	3,447	2.9
Sex												
Male	31,326	78.1	6,264	37.6	-	-	-	-	-	-	3,446	100.0
Female	8,753	21.8	10,398	62.3	48,662	100.0	8,119	100.0	2,547	99.9	-	-
Other	12	<0.1	18	0.1	2	<0.1	1	<0.1	3	0.1	1	<0.1
Race/Ethnicity												
Asian/Pacific Islander	1,658	4.1	438	2.6	6,443	13.2	294	3.6	208	8.2	205	6.0
Black/African American	2,742	6.8	1,081	6.5	3,263	6.7	471	5.8	197	7.7	185	5.4
Hispanic/Latino	4,200	10.5	2,050	12.3	17,502	36.0	1,201	14.8	569	22.3	1,105	32.1
Native American	236	0.6	101	0.6	342	0.7	40	0.5	8	0.3	20	0.6
Non-Hispanic/Latino White	30,991	77.3	12,831	76.9	20,635	42.4	6,025	74.2	1,549	60.8	1,899	55.1
Other/Unknown	264	0.7	179	1.1	479	1.0	89	1.1	19	0.8	33	1.0
Age at Diagnosis (years)												
0-19	4	<0.1	5	<0.1	32	<0.1	1	<0.1	1	<0.1	2	<0.1
20-34	214	0.5	201	1.2	7,630	15.7	138	1.7	37	1.5	86	2.5
35-64	23,407	58.4	9,212	55.2	31,687	65.1	3,075	37.9	1,014	39.8	1,359	39.4
65+	16,466	41.1	7,262	43.5	9,315	19.1	4,906	60.4	1,498	58.8	2,000	58.0
Stage at Diagnosis												
Localized	5,981	14.9	7,812	46.8	23,742	48.8	4,638	57.1	936	36.7	1,985	57.6
Regional	26,438	65.9	5,065	30.4	16,853	34.6	2,634	32.4	917	36.0	1,125	32.6
Distant	5,737	14.3	1,941	11.6	5,762	11.8	457	5.6	408	16.0	156	4.5
Unknown	1,935	4.8	1,862	11.2	2,307	4.7	391	4.8	289	11.3	181	5.3
Health Insurance												
Private/Government	22,554	56.3	8,949	53.7	19,180	39.4	3,936	48.5	1,126	44.2	1,546	44.9
Medicare, No Supplement	3,430	8.6	1,669	10.0	2,068	4.3	1,014	12.5	294	11.5	405	11.8
Medicaid/Public	6,103	15.2	3,101	18.6	12,459	25.6	1,489	18.3	469	18.4	704	20.4
Uninsured	733	1.8	268	1.6	1,736	3.6	104	1.3	37	1.5	103	3.0
Unknown	7,271	18.1	2,693	16.2	13,221	27.2	1,577	19.4	624	24.5	689	20.0

Table 1. Demographic and Tumor Characteristics of HPV-Associated Cancer Cases in California, 1988-2019 (N=119,552), continued

Neighborhood Socioeconomic Status												
Low	10,640	26.5	4,513	27.1	20,317	41.8	2,545	31.3	832	32.6	1,379	40.0
Medium	14,617	36.5	6,091	36.5	16,299	33.5	3,069	37.8	980	38.4	1,172	34.0
High	14,834	37.0	6,076	36.4	12,048	24.8	2,506	30.9	738	28.9	896	26.0

Source of data: California Cancer Registry, California Department of Public Health.

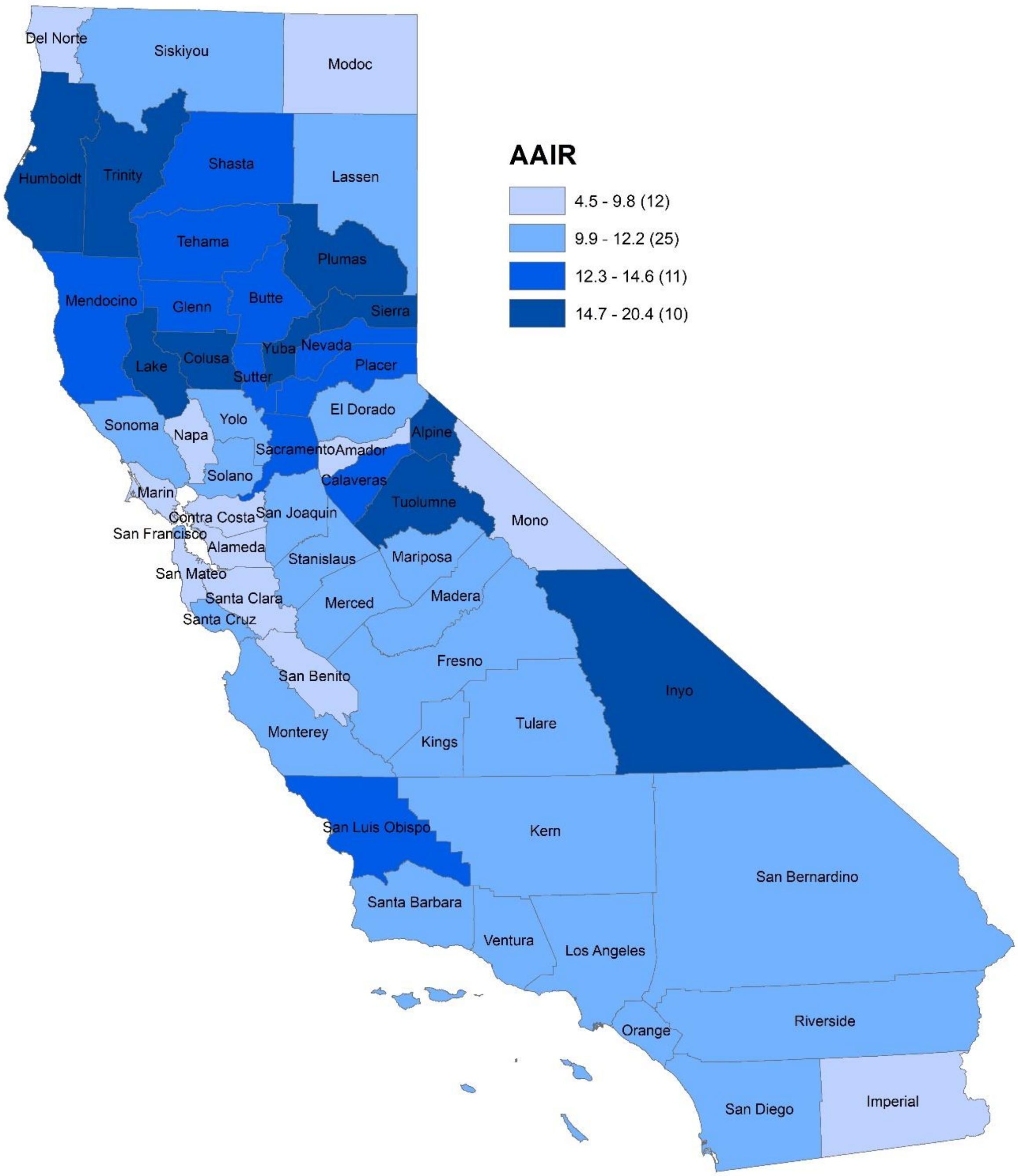
Incidence of HPV-Associated Cancers by California County

Statewide, the five-year (2015-2019) age-adjusted incidence rate of all HPV-associated cancers combined was 10.7 per 100,000. However, incidence varied by county. Counties with the lowest incidence of HPV-related cancers were Del Norte and Modoc counties located in the northernmost part of the state, several Bay Area counties including Napa, Marin, Contra Costa, Alameda, San Mateo, Santa Clara, and San Benito, Amador County located in the foothills of the Sierra Nevada Mountains, Mono County located on the eastern border of the state, and Imperial County located in the southernmost part of the state (Figure 1a). Counties with the highest incidence of HPV-associated cancers were mostly located in the northern part of the state and included Humboldt, Trinity, Plumas, Sierra, Yuba, Colusa, Lake, Alpine, and Tuolumne counties. Inyo County, located on the eastern border of the state, also had among the highest incidence rates.

COUNTIES WITH THE **HIGHEST** FIVE-YEAR AGE-ADJUSTED INCIDENCE RATE OF HPV-ASSOCIATED CANCERS

- **Humboldt**
- **Trinity**
- **Plumas**
- **Sierra**
- **Yuba**
- **Colusa**
- **Lake**
- **Alpine**
- **Tuolumne**
- **Inyo**

Figure 1a. Age-Adjusted Incidence Rate (AAIR) of HPV-Associated Cancers by California County, 2015-2019

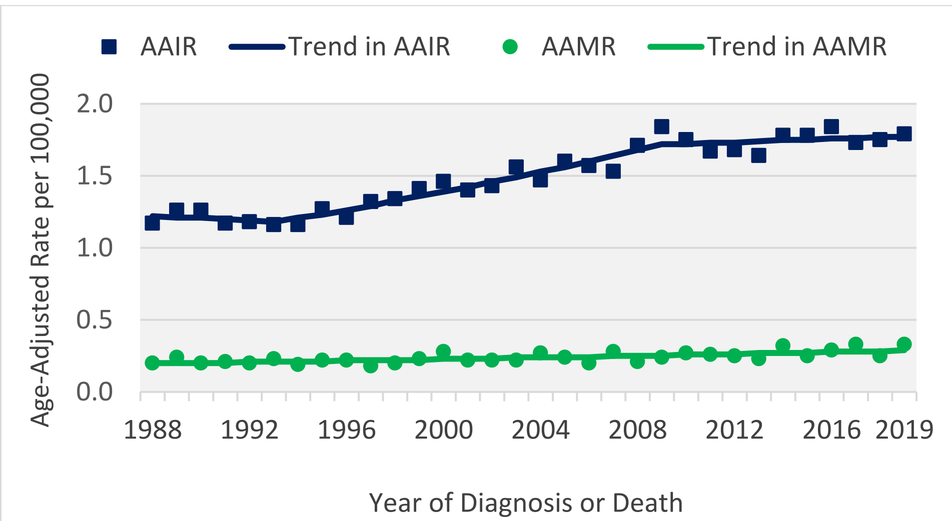


Rates are per 100,000 and age-adjusted to the 2000 U.S. standard population
Source of data: California Cancer Registry, California Department of Public Health

Anal Cancer

HPV is the probable cause of 91 percent of anal cancers.[18] Each year, approximately 800 Californians are diagnosed with anal cancer and 130 die of the disease. Of the HPV-associated cancers, anal cancer is the third most common with a five-year (2015 to 2019) age-adjusted incidence rate (AAIR) of 1.8 per 100,000 and an age-adjusted mortality rate (AAMR) of 0.3 per 100,000. From 1993 to 2009, anal cancer incidence significantly increased by an average of 2.4 percent per year but was stable during the post-vaccine period (Figure 1 and Table 2). Mortality from anal cancer increased significantly by an average of 1.2 percent per year during the study period.

Figure 1. Trend in the Age-Adjusted Incidence (AAIR) and Mortality (AAMR) Rate of Anal Cancer, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

Table 2. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence and Mortality Trend of Anal Cancer, California, 1988-2019

Trend	Joinpoint Analyses (1988-2019)									
	Trend 1		Trend 2		Trend 3		Overall Trend		Post-Vaccine Trend†	
	Time Period	APC	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
Incidence	1988-1993	-0.8	1993-2009	2.4*	2009-2019	0.3	1988-2019	1.2*	2009-2019	0.3
Mortality	1988-2019	1.2*					1988-2019	1.2*	2009-2019	1.2*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†Since the HPV-vaccine was available for both females and males in 2009, the post-vaccine trend for females and males combined was calculated from 2009-2019.
Source of data: California Cancer Registry, California Department of Public Health.

During the most recent five-year period (2015-2019), incidence of anal cancer among females (AAIR=2.2 per 100,000) was significantly higher than among males (AAIR=1.4 per 100,000) (Table 3). Mortality of anal cancer did not differ between females (AAMR=0.3 per 100,000) and males (AAMR=0.3 per 100,000).

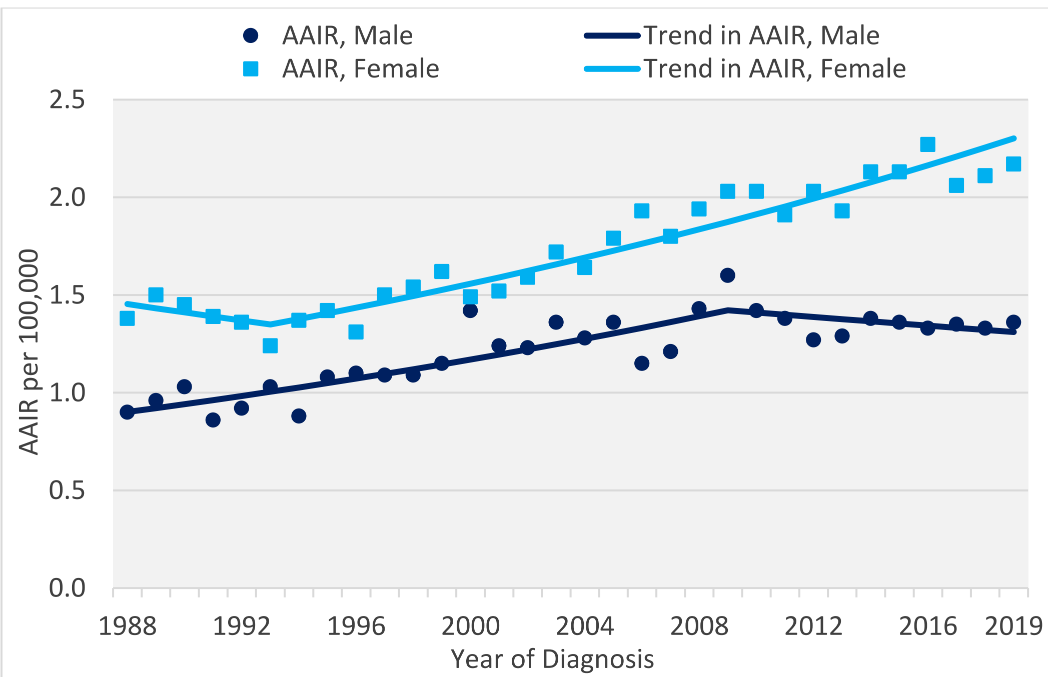
Table 3. Five-Year Age-Adjusted Incidence and Mortality Rates and Rate Ratios of Anal Cancer by Sex, California, 2015-2019

Rate	Female	Male	Rate Ratio Male/Female	P Value
Age-Adjusted Incidence Rate	2.2	1.4	0.6	<0.001
Age-Adjusted Mortality Rate	0.3	0.3	0.9	0.3

Source of data: California Cancer Registry, California Department of Public Health.

From 1993 to 2019, anal cancer incidence increased significantly among females by an average of 2.1 percent per year (Figure 2 and Table 4). Among males, incidence increased significantly from 1988 to 2009 by an average of 2.2 percent per year but was stable during the post-vaccine period.

Figure 2. Trend in the Age-Adjusted Incidence Rate (AAIR) of Anal Cancer by Sex, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

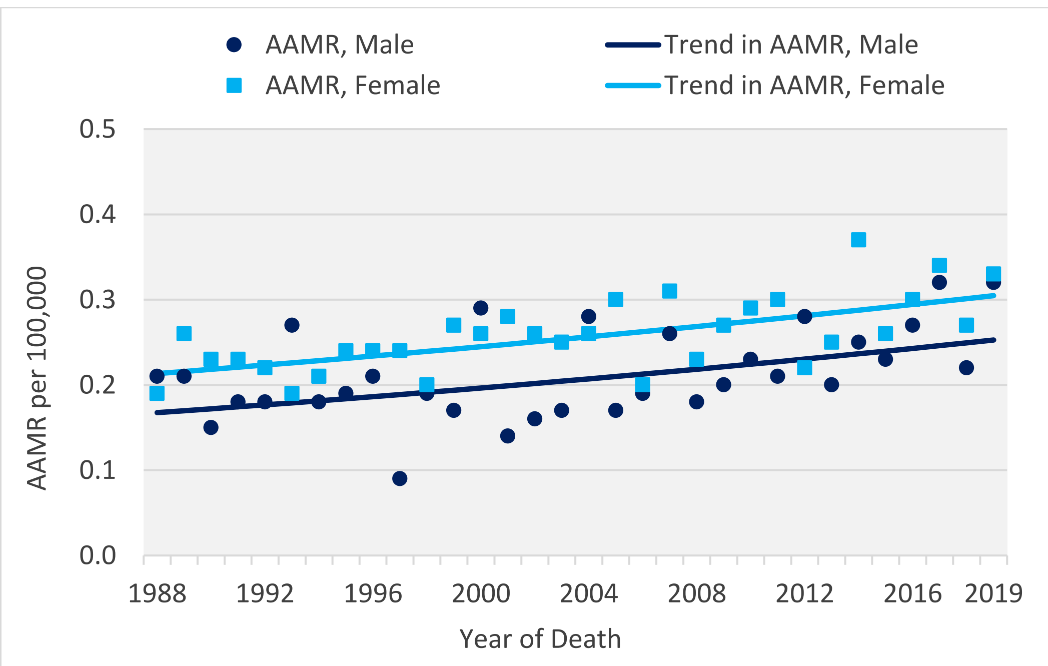
Table 4. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence Trend of Anal Cancer by Sex, California, 1988-2019

Sex	Joinpoint Analyses (1988-2019)							
	Trend 1		Trend 2		Overall Trend		Post-Vaccine Trend†	
	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
Male	1988-2009	2.2*	2009-2019	-0.8	1988-2019	1.2*	2009-2019	-0.8
Female	1988-1993	-1.5	1993-2019	2.1*	1988-2019	1.5*	2006-2019	2.1*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019 and the post-vaccine trend for males was calculated from 2009-2019.
Source of data: California Cancer Registry, California Department of Public Health.

Mortality of anal cancer among females and males increased significantly during the study period by an average of 1.2 and 1.3 percent per year, respectively (Figure 3 and Table 5).

Figure 3. Trend in the Age-Adjusted Mortality Rate (AAMR) of Anal Cancer by Sex, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

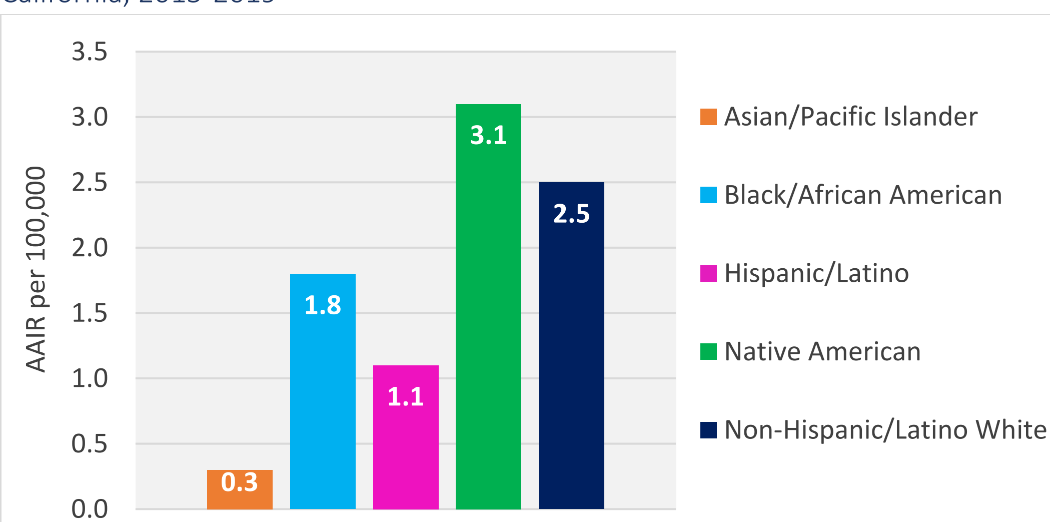
Table 5. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Mortality Trend of Anal Cancer by Sex, California, 1988-2019

	Joinpoint Analyses (1988-2019)			
	Trend 1/Overall Trend		Post-Vaccine Trend†	
Sex	Time Period	APC/AAPC	Time Period	AAPC
Male	1988-2019	1.3*	2009-2019	1.3*
Female	1988-2019	1.2*	2006-2019	1.2*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019 and the post-vaccine trend for males was calculated from 2009-2019.
Source of data: California Cancer Registry, California Department of Public Health.

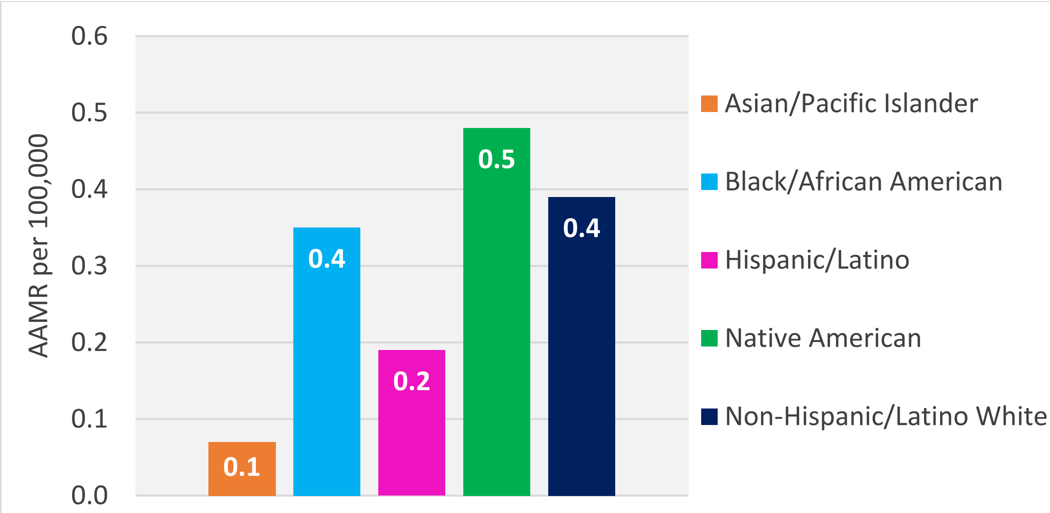
Native Americans had the highest five-year (2015 to 2019) age-adjusted incidence rate of anal cancer (AAIR=3.1 per 100,000) followed by Whites (AAIR=2.5 per 100,000), Black/African Americans (AAIR=1.8 per 100,000), Hispanic/Latinos (AAIR=1.1 per 100,000), and Asian/Pacific Islanders (AAIR=0.3 per 100,000) (Figure 4). Native Americans also had the highest five-year (2015 to 2019) age-adjusted mortality rate of anal cancer (AAMR=0.5 per 100,000), followed by Whites and Black/African Americans who had the same rate (AAMR=0.4 per 100,000), Hispanic/Latinos (AAMR=0.2 per 10,000), and Asian/Pacific Islanders (AAMR=0.1 per 100,000) (Figure 5).

Figure 4. Five-Year, Age-Adjusted Incidence Rate (AAIR) of Anal Cancer by Race/Ethnicity, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

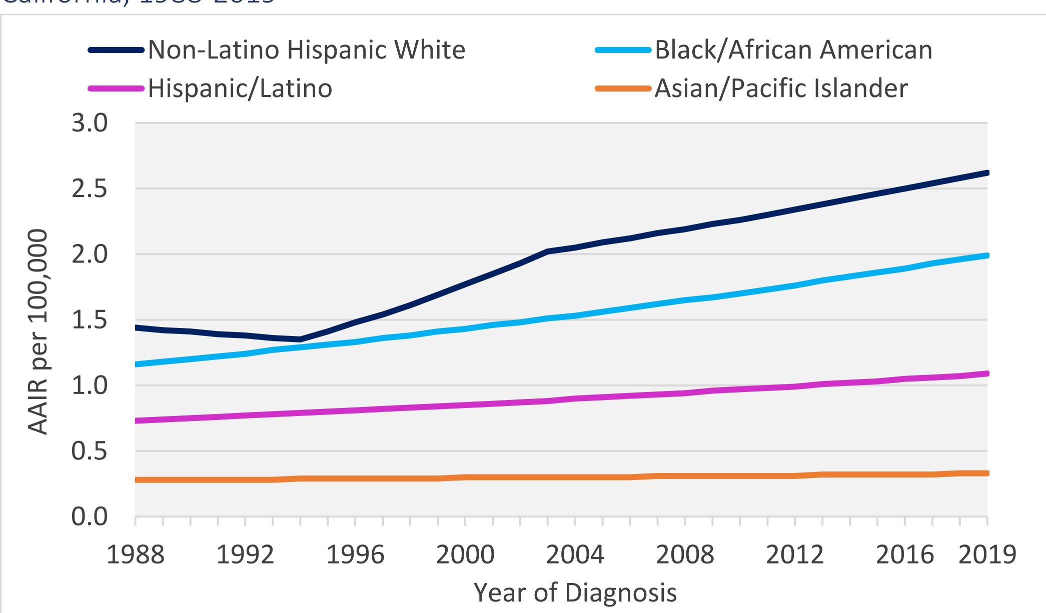
Figure 5. Five-Year, Age-Adjusted Mortality Rate (AAMR) of Anal Cancer by Race/Ethnicity, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

During the study period, incidence of anal cancer significantly increased among Black/African Americans by an average of 1.8 percent per year and among Hispanic/Latinos by an average of 1.3 percent per year (Figure 6 and Table 6). Incidence among Whites significantly increased from 1994 to 2003 by an average of 4.6 percent per year and from 2003 to 2019 by an average of 1.7 percent per year. Incidence among Asian/Pacific Islanders was stable. The incidence trend for Native Americans could not be calculated because no cases of anal cancer were reported in this population in one or more years.

Figure 6. Trend in the Age-Adjusted Incidence Rate (AAIR) of Anal Cancer by Race/Ethnicity, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

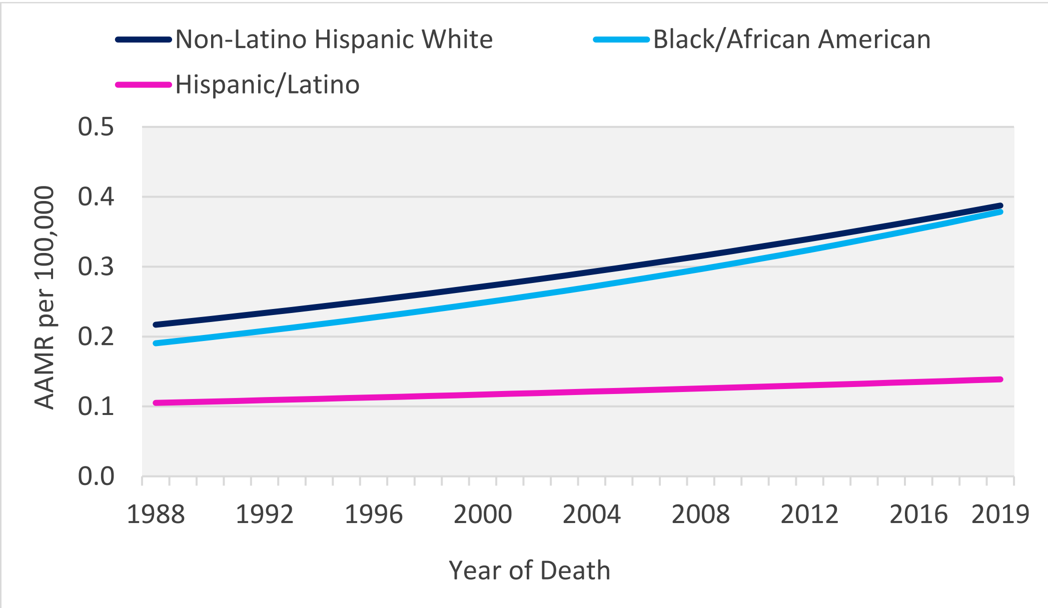
Table 6. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence Trend of Anal Cancer by Race/Ethnicity, California, 1988-2019

	Joinpoint Analyses (1988-2019)									
	Trend 1		Trend 2		Trend 3		Overall Trend		Post-Vaccine Trend†	
Race/Ethnicity	Time Period	APC	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
Asian/Pacific Islander	1988-2019	0.5					1988-2019	0.5	2009-2019	0.5
Black/African American	1988-2019	1.8*					1988-2019	1.8*	2009-2019	1.8*
Hispanic/Latino	1988-2019	1.3*					1988-2019	1.3*	2009-2019	1.3*
Native American	^	^	^	^	^	^	^	^	^	^
Non-Hispanic/Latino White	1988-1994	-1.0	1994-2003	4.6*	2003-2019	1.7*	1988-2019	2.0*	2009-2019	1.7*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†Since the HPV-vaccine was available for both females and males in 2009, the post-vaccine trend for females and males combined was calculated from 2009-2019.
^Trend could not be calculated because at least one year had zero cases reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

During the study period, anal cancer mortality increased significantly among Black/African Americans by an average of 2.2 percent per year and among Whites by an average of 1.9 percent per year (Figure 7 and Table 7). Among Hispanic/Latinos, mortality was stable. Mortality trends could not be calculated for Asian/Pacific Islanders or Native Americans because no deaths from anal cancer were reported in these populations in one or more years.

Figure 7. Trend in the Age-Adjusted Mortality Rate (AAMR) of Anal Cancer by Race/Ethnicity, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

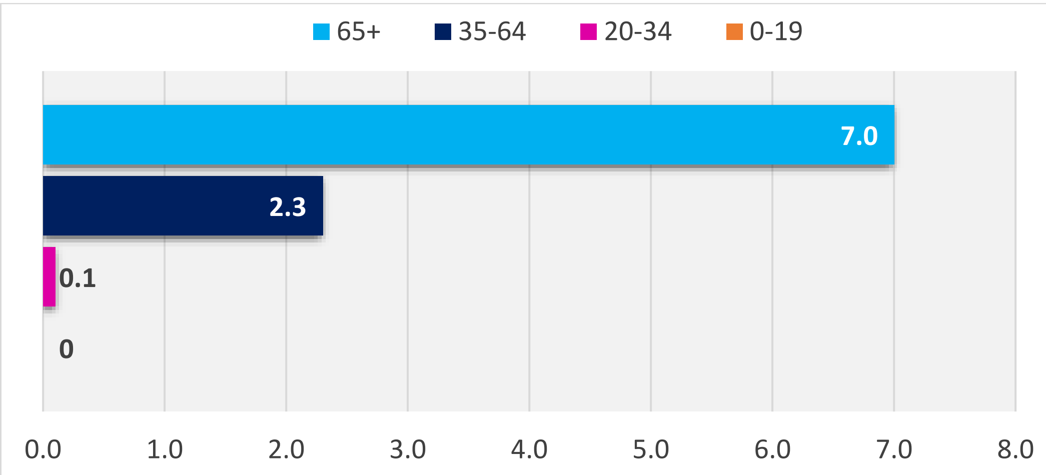
Table 7. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Mortality Trend of Anal Cancer by Race/Ethnicity, California, 1988-2019

Race/Ethnicity	Joinpoint Analyses (1988-2019)			
	Trend 1/Overall Trend		Post-Vaccine Trend†	
	Time Period	APC/AAPC	Time Period	AAPC
Asian/Pacific Islander	^	^	^	^
Black/African American	1988-2019	2.2*	2009-2019	2.2*
Hispanic/Latino	1988-2019	0.9	2009-2019	0.9
Native American	^	^	^	^
Non-Hispanic/Latino White	1988-2019	1.9*	2009-2019	1.9*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†Since the HPV-vaccine was available for both females and males in 2009, the post-vaccine trend for females and males combined was calculated from 2009-2019.
^Trend could not be calculated because at least one year had zero deaths from the disease reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

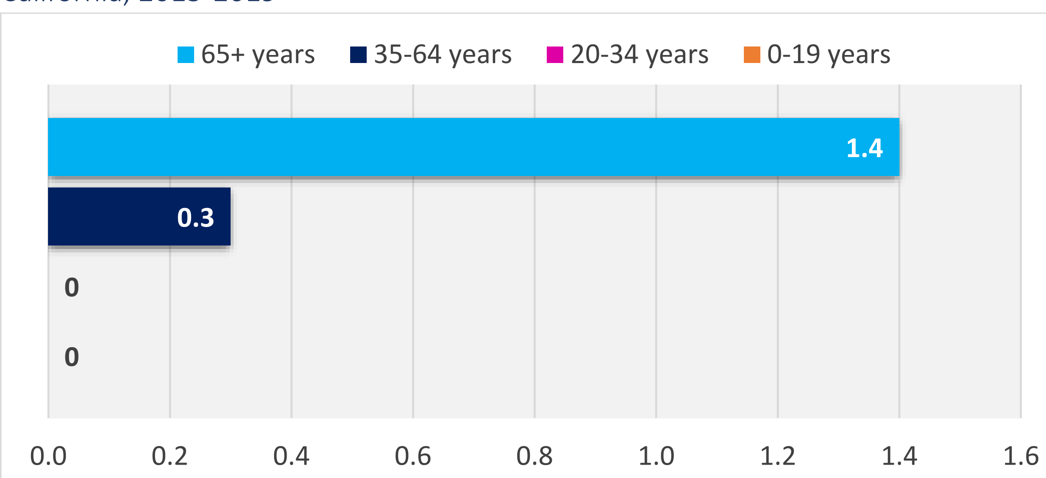
During the most recent five-year period (2015 to 2019), incidence and mortality of anal cancer was highest among individuals aged 65 years and older (AAIR=7.0 per 100,000; AAMR=1.4 per 100,000) compared to those aged 35 to 64 years (AAIR=2.3 per 100,000; AAMR=0.3 per 100,000), and those aged 20 to 34 years (AAIR=0.1 per 100,000; AAMR=0) (Figures 8 and 9). There were no cases of anal cancer or deaths among persons aged 19 years or younger during this time period.

Figure 8. Five-Year Age-Adjusted Incidence Rate (AAIR) of Anal Cancer by Age at Diagnosis, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

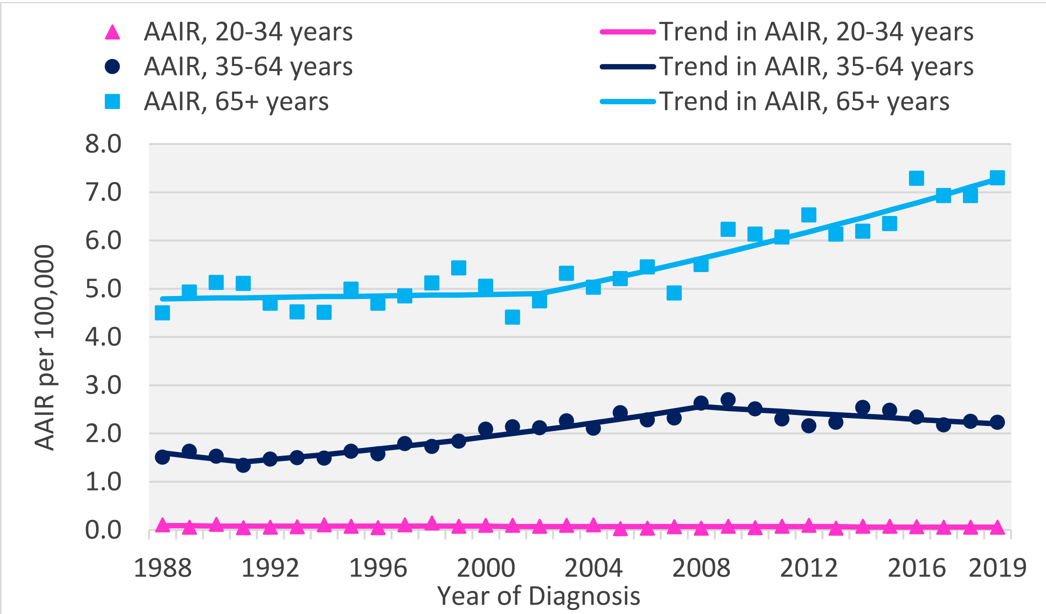
Figure 9. Five-Year Age-Adjusted Mortality Rate (AAMR) of Anal Cancer by Age at Death, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

From 2002 to 2019, anal cancer incidence significantly increased among persons aged 65 years and older by an average of 2.4 percent per year (Figure 10 and Table 8). Among persons aged 35 to 64 years, the incidence of anal cancer decreased significantly by an average of 1.4 percent per year from 2008 to 2019. Anal cancer incidence among persons aged 20 to 34 years was stable. The incidence trend for those aged 19 years and younger could not be calculated because no cases of anal cancer were reported in this population in one or more years.

Figure 10. Trend in the Age-Adjusted Incidence Rate (AAIR) of Anal Cancer by Age at Diagnosis, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

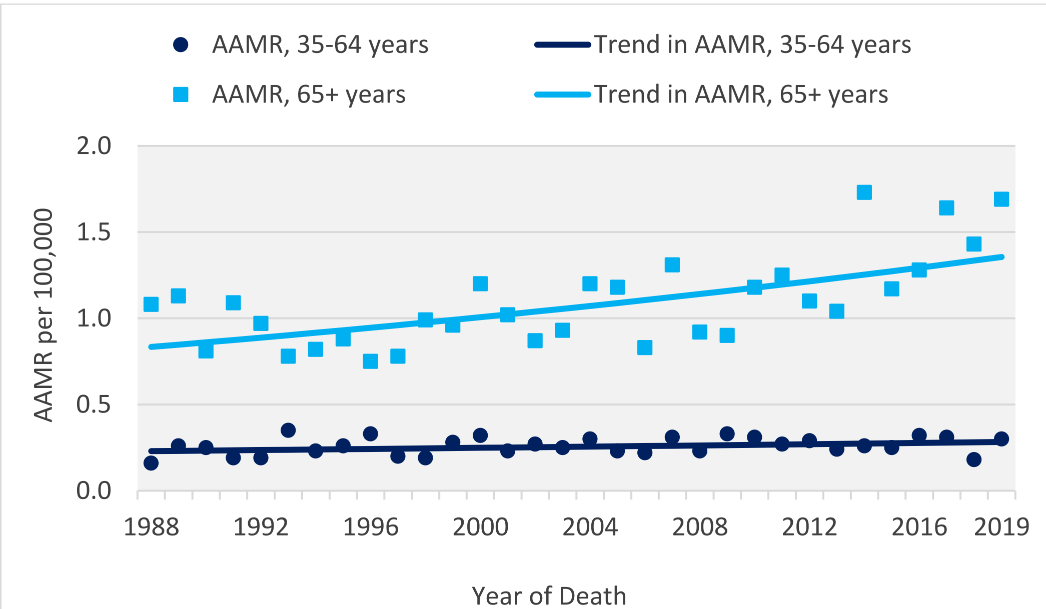
Table 8. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence Trend of Anal Cancer by Age at Diagnosis, California, 1988-2019

Age Group (years)	Joinpoint Analyses (1988-2019)									
	Trend 1		Trend 2		Trend 3		Overall Trend		Post-Vaccine Trend†	
	Time Period	APC	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
0-19	^	^	^	^	^	^	^	^	^	^
20-34	1988-2019	-1.1					1988-2019	-1.1	2009-2019	-1.1
35-64	1988-1991	-4.2	1991-2008	3.6*	2008-2019	-1.4*	1988-2019	1.0*	2009-2019	-1.4*
65+	1988-2002	0.2	2002-2019	2.4*			1988-2019	1.4*	2009-2019	2.4*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†Since the HPV-vaccine was available for both females and males in 2009, the post-vaccine trend for females and males combined was calculated from 2009-2019.
^Trend could not be calculated because at least one year had zero cases reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

During the study period, anal cancer mortality increased significantly among persons aged 65 years and older by an average of 1.6 percent per year (Figure 11 and Table 9). Among persons aged 35 to 64 years, mortality was stable. Mortality trends could not be calculated for those aged 19 years or younger or those aged 20 to 34 years because no deaths from anal cancer were reported in these populations in one or more years.

Figure 11. Trend in the Age-Adjusted Mortality Rate (AAMR) of Anal Cancer by Age at Death, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

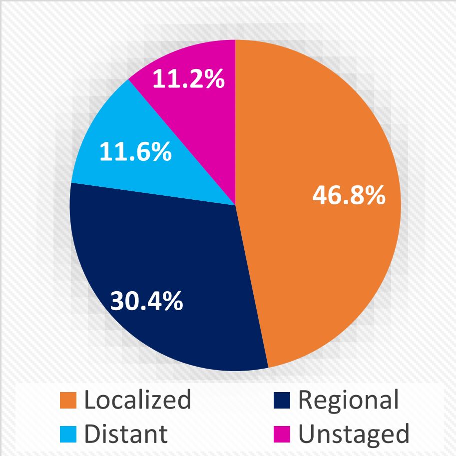
Table 9. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Mortality Trend of Anal Cancer by Age at Death, California, 1988-2019

Age Group (years)	Joinpoint Analyses (1988-2019)			
	Trend 1/Overall Trend		Post-Vaccine Trend†	
	Time Period	APC/AAPC	Time Period	AAPC
0-19	^	^	^	^
20-34	^	^	^	^
35-64	1988-2019	0.7	2009-2019	0.7
65+	1988-2019	1.6*	2009-2019	1.6*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†Since the HPV-vaccine was available for both females and males in 2009, the post-vaccine trend for females and males combined was calculated from 2009-2019.
^Trend could not be calculated because at least one year had zero deaths from the disease reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

From 2015 to 2019, 42 percent of anal cancers were diagnosed late stage (30.4 percent regional stage and 11.6 percent distant stage) (Figure 12).

Figure 12. Distribution of Anal Cancer by Stage at Diagnosis, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

A higher percent of late-stage anal cancers was diagnosed among Native Americans (51.5 percent), persons with no health insurance (47.4 percent), persons with Medicaid/public health insurance (46.9 percent), and among individuals residing in low SES neighborhoods (43.7 percent) (Table 10).

Table 10. Associations of Late-Stage Diagnosis with Race/Ethnicity, Health Insurance Type, and Neighborhood Socioeconomic Status among Anal Cancer Patients, California, 1988-2019 (N=16,680)

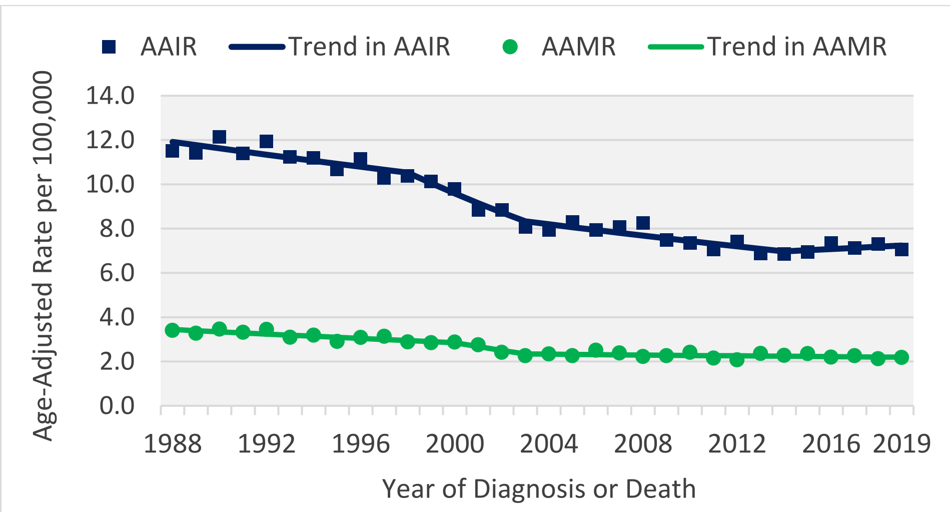
	Late-Stage Diagnoses		
Characteristic	**N**	**Percent (%)**	**P Value**
Race/Ethnicity			
Asian/Pacific Islander	197	45.0%	<0.001
Black/African American	477	44.1%	
Hispanic/Latino	895	43.7%	
Native American	52	51.5%	
Non-Hispanic/Latino White	5,354	41.7%	
Other/Unknown	31	17.3%	
Health Insurance			
Private/ Government	3,831	42.8%	<0.001
Medicare/ No Supplement	686	41.1%	
Medicaid/ Public	1,455	46.9%	
Uninsured	127	47.4%	
Unknown	907	33.7%	
Neighborhood Socioeconomic Status			
Low	1,974	43.7%	0.002
Medium	2,582	42.4%	
High	2,450	40.3%	

Source of data: California Cancer Registry, California Department of Public Health.

Cervical Cancer

Of HPV-associated cancers, cervical cancer is the most common. HPV is the probable cause of 91 percent of cervical cancers.[18] Each year, approximately 1,450 Californians are diagnosed with cervical cancer and 485 die of the disease. From 2015 to 2019, the five-year age-adjusted incidence rate and age-adjusted mortality rate were 7.2 per 100,000 and 2.2 per 100,000, respectively. Cervical cancer incidence decreased significantly from 1988 to 2014 but was stable during the post-vaccine period (Figure 13 and Table 11). Cervical cancer mortality decreased significantly by an average of 1.6 percent per year from 1988 to 2000 but was stable during the post-vaccine period.

Figure 13. Trend in the Age-Adjusted Incidence (AAIR) and Mortality (AAMR) Rate of Cervical Cancer, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

Table 11. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence and Mortality Trend of Cervical Cancer, California, 1988-2019

	Joinpoint Analyses (1988-2019)											
	Trend 1		Trend 2		Trend 3		Trend 4		Overall Trend		Post-Vaccine Trend†	
Trend	**Time Period**	**APC**	**Time Period**	**APC**	**Time Period**	**APC**	**Time Period**	**APC**	**Time Period**	**AAPC**	**Time Period**	**AAPC**
Incidence	1988-1998	-1.2*	1998-2003	-4.6*	2003-2014	-1.6*	2014-2019	0.8	1988-2019	-1.6*	2006-2019	-0.7
Mortality	1988-2000	-1.6*	2000-2003	-6.5	2003-2019	-0.4			1988-2019	-1.4*	2006-2019	-0.4

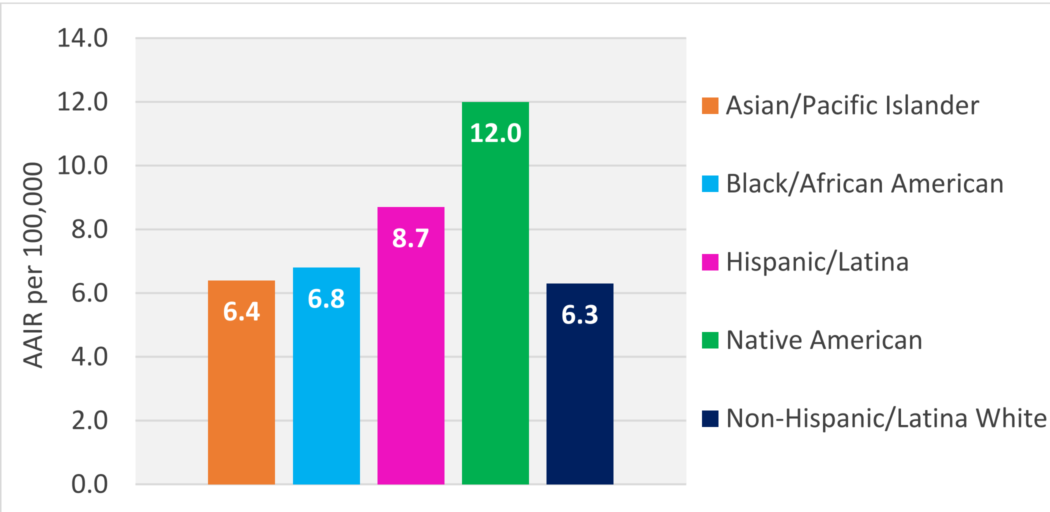
*The APC and/or AAPC is significantly different from zero at alpha=0.05.

†The post-vaccine trend for females was calculated from 2006-2019.

Source of data: California Cancer Registry, California Department of Public Health.

From 2015 to 2019, the five-year age-adjusted incidence rate of cervical cancer was highest among Native Americans (AAIR=12.0 per 100,000), followed by Hispanic/Latinas (AAIR=8.7 per 100,000), Black/African Americans (AAIR=6.8 per 100,000), Asian/Pacific Islanders (AAIR=6.4 per 100,000), and Whites (AAIR=6.3 per 100,000) (Figure 14).

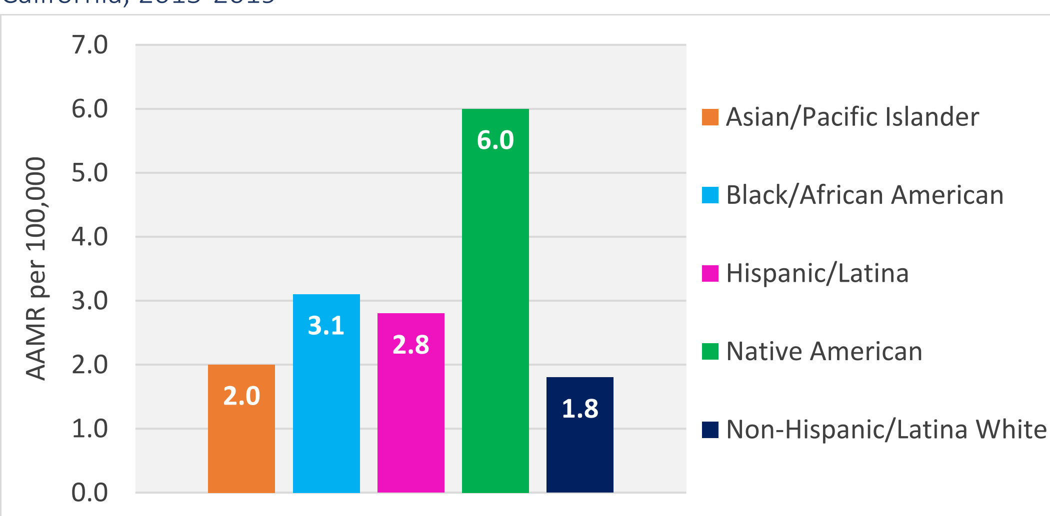
Figure 14. Five-Year, Age-Adjusted Incidence Rate (AAIR) of Cervical Cancer by Race/Ethnicity, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

The five-year age-adjusted mortality rate of cervical cancer from 2015 to 2019 was also highest for Native Americans (AAMR=6.0 per 100,000), followed by Black/African Americans (AAMR=3.1 per 100,000), Hispanic/Latinas (AAMR=2.8 per 100,000), Asian/Pacific Islanders (AAMR=2.0 per 100,000), and Whites (AAMR=1.8 per 100,000) (Figure 15).

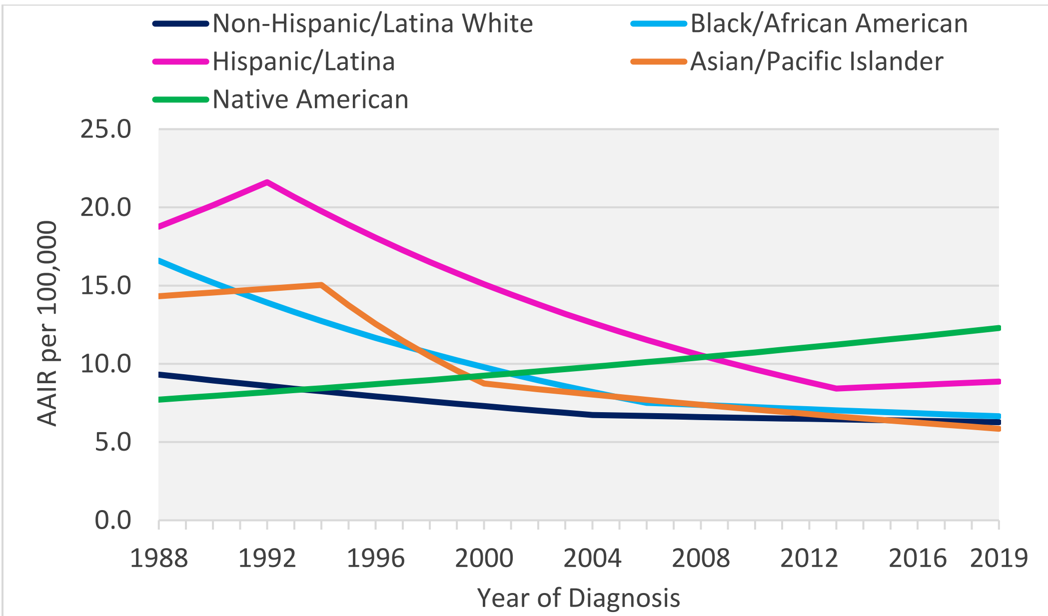
Figure 15. Five-Year, Age-Adjusted Mortality Rate (AAMR) of Cervical Cancer by Race/Ethnicity, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

During the post-vaccine period, incidence of cervical cancer decreased significantly for most race/ethnicities except Native Americans who experienced a significant increase of 1.5 percent per year (Figure 16 and Table 12). Incidence significantly decreased among Asian/Pacific Islanders by an average of 2.1 percent per year, among Hispanic/Latinas by an average of 2.0 percent per year, and among Whites by an average of 1.3 percent per year. Incidence among Black/African Americans was stable.

Figure 16. Trend in the Age-Adjusted Incidence Rate (AAIR) of Cervical Cancer by Race/Ethnicity, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

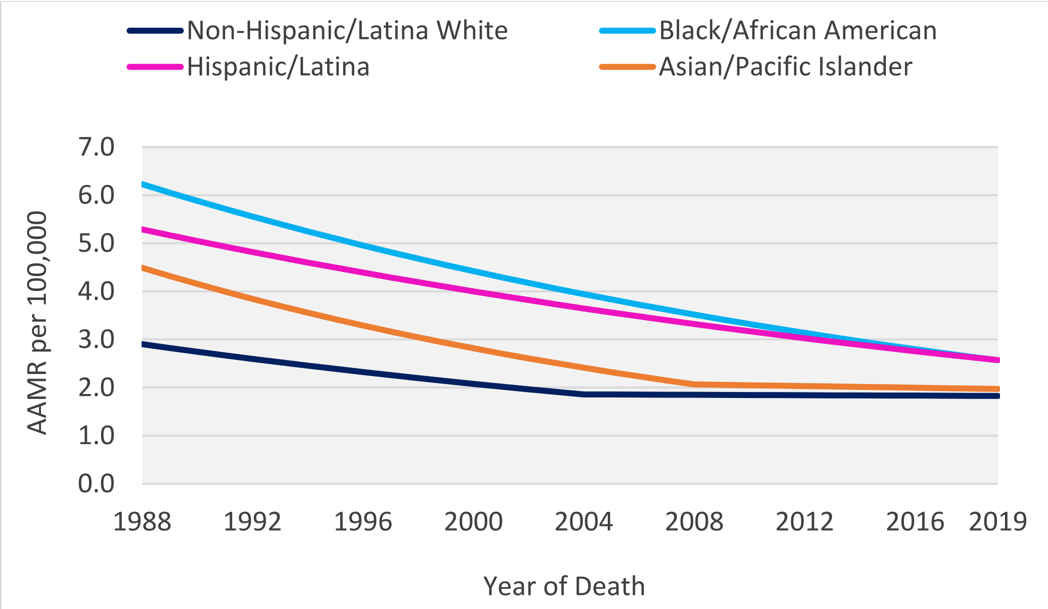
Table 12. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence Trend of Cervical Cancer by Race/Ethnicity, California, 1988-2019

	Joinpoint Analyses (1988-2019)									
	Trend 1		Trend 2		Trend 3		Overall Trend		Post-Vaccine Trend†	
Race/Ethnicity	Time Period	APC	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
Asian/Pacific Islander	1988-1994	0.8	1994-2000	-8.6*	2000-2019	-2.1*	1988-2019	-2.8*	2006-2019	-2.1*
Black/African American	1988-2006	-4.3*	2006-2019	-0.9			1988-2019	-2.9*	2006-2019	-0.9
Hispanic/Latina	1988-1992	3.6	1992-2013	-4.4*	2013-2019	0.9	1988-2019	-2.4*	2006-2019	-2.0*
Native American	1988-2019	1.5*					1988-2019	1.5*	2006-2019	1.5*
Non-Hispanic Latina White	1988-2004	-2.0*	2004-2019	-0.5			1988-2019	-1.3*	2006-2019	-1.3*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019.
Source of data: California Cancer Registry, California Department of Public Health.

During the study period, cervical cancer mortality decreased significantly among Black/African Americans by an average of 2.8 percent per year and Hispanic/Latinas by an average of 2.3 percent per year (Figure 17 and Table 13). Cervical cancer mortality was stable during the post-vaccine period for Asian/Pacific Islanders and Whites. The trend in cervical cancer mortality could not be calculated for Native Americans because there were no deaths from cervical cancer reported in this population in one or more years.

Figure 17. Trend in the Age-Adjusted Mortality Rate (AAMR) of Cervical Cancer by Race/Ethnicity, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health

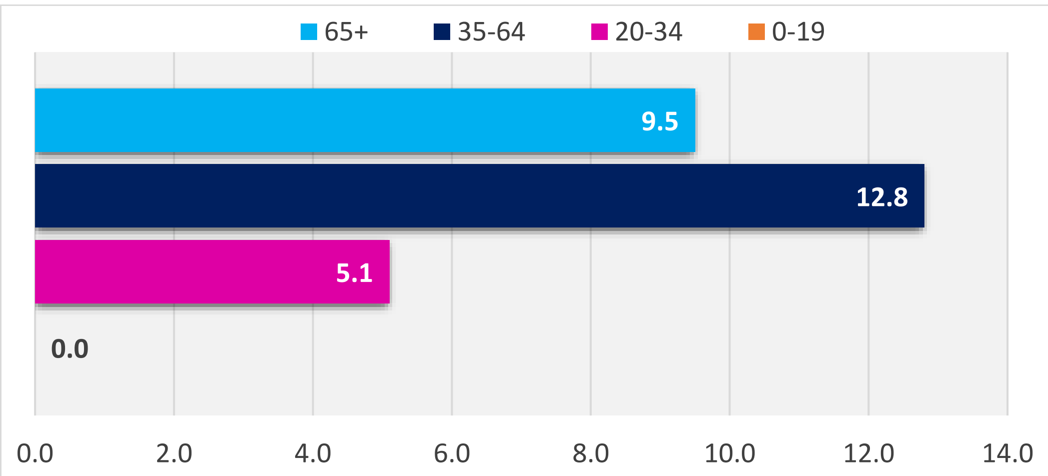
Table 13. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Mortality Trend of Cervical Cancer by Race/Ethnicity, California, 1988-2019

Race/Ethnicity	Joinpoint Analyses (1988-2019)							
	Trend 1		Trend 2		Overall Trend		Post-Vaccine Trend†	
	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
Asian/Pacific Islander	1988-2008	-3.8*	2008-2019	-0.4	1988-2019	-2.6*	2006-2019	-1.0
Black/African American	1988-2019	-2.8*			1988-2019	-2.8*	2006-2019	-2.8*
Hispanic/Latina	1988-2019	-2.3*			1988-2019	-2.3*	2006-2019	-2.3*
Native American	^	^	^	^	^	^	^	^
Non-Hispanic/Latina White	1988-2004	-2.8*	2004-2019	-0.1	1988-2019	-1.5*	2006-2019	-0.1

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019.
^Trend could not be calculated because at least one year had zero deaths from the disease reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

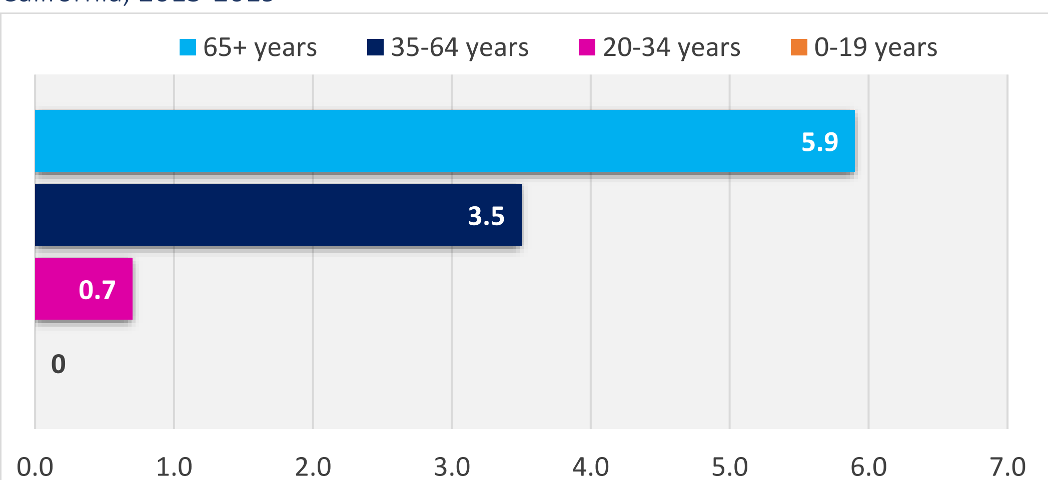
From 2015 to 2019, incidence of cervical cancer was highest among those aged 35 to 64 years (AAIR=12.8 per 100,000), followed by those aged 65 years and older (AAIR=9.5 per 100,000), and those aged 20 to 34 years (AAIR=5.1 per 100,000) (Figure 18). Mortality was highest among those aged 65 years and older (AAMR=5.9), followed by those aged 35 to 64 years (AAMR=3.5 per 100,000), and those aged 20 to 34 years (AAMR=0.7 per 100,000) (Figure 19). Incidence and mortality rates were not calculated for persons aged 19 years and younger because there were less than five cases of cervical cancer and zero deaths due to cervical cancer reported in this population from 2015 to 2019.

Figure 18. Five-year Age-Adjusted Incidence Rate (AAIR) of Cervical Cancer by Age of Diagnosis, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

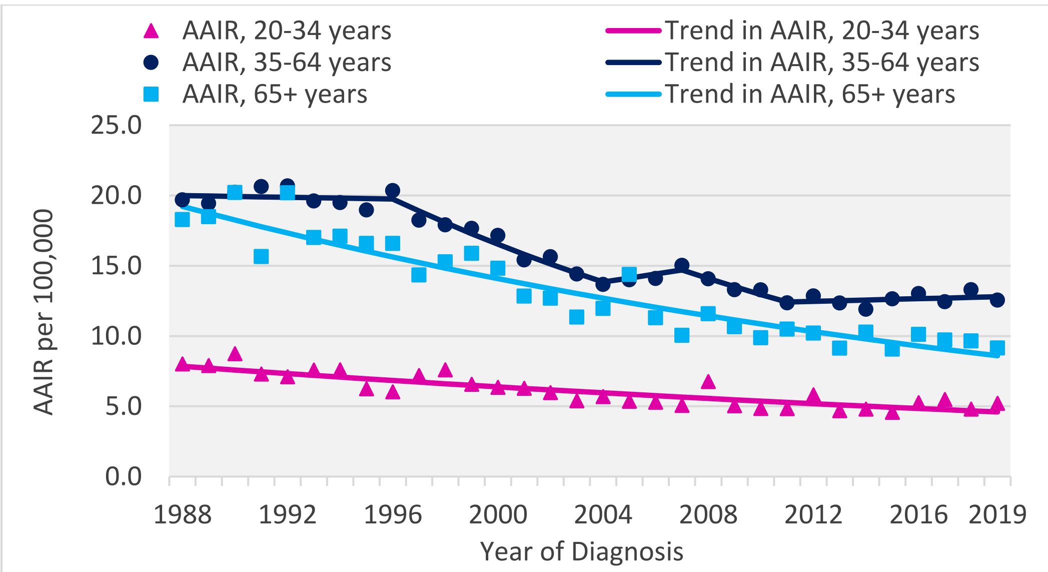
Figure 19. Five-year Age-Adjusted Mortality Rate (AAMR) of Cervical Cancer by Age at Death, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

During the study period, cervical cancer incidence decreased significantly among those aged 20 to 34 years by an average of 1.7 percent per year and those aged 65 years and older by an average of 2.6 percent per year (Figure 20 and Table 14). Among those aged 35 to 64 years, incidence was stable during the post-vaccine period. The trend in cervical cancer incidence could not be calculated for those aged 19 years and younger because no cases of cervical cancer were reported in this population in one or more years.

Figure 20. Trend in the Age-Adjusted Incidence Rate (AAIR) of Cervical Cancer by Age at Diagnosis, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

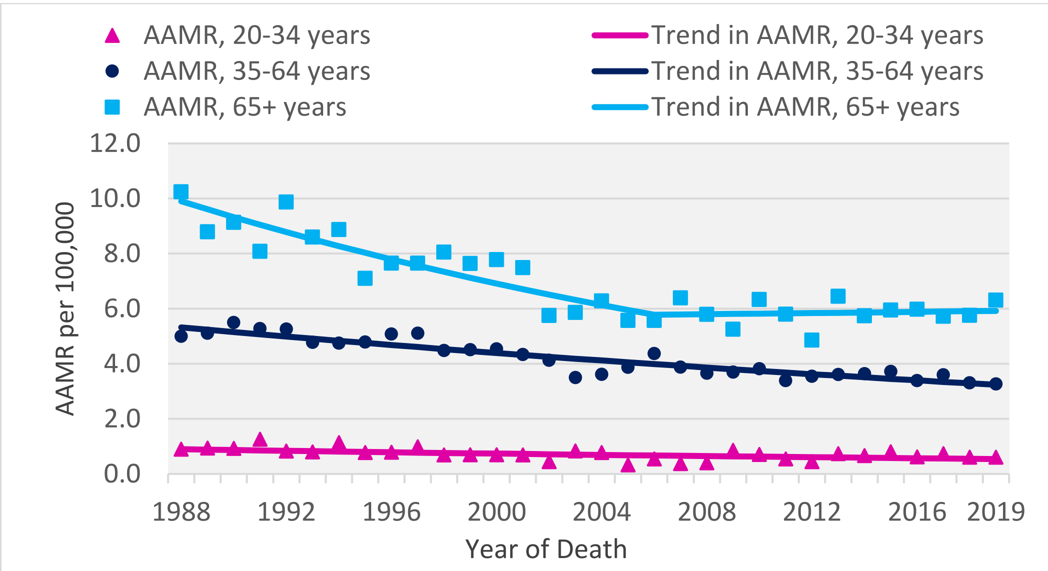
Table 14. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence Trend of Cervical Cancer by Age at Diagnosis, California, 1988-2019

Age Group (years)	Joinpoint Analyses (1988-2019)													
	Trend 1		Trend 2		Trend 3		Trend 4		Trend 5		Overall Trend		Post-Vaccine Trend†	
	Time Period	APC	Time Period	APC	Time Period	APC	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
0-19	^	^	^	^	^	^	^	^	^	^	^	^	^	^
20-34	1988-2019	-1.7*									1988-2019	-1.7*	2006-2019	-1.7*
35-64	1988-1996	-0.2	1996-2004	-4.4*	2004-2007	2.0	2007-2011	-4.1	2011-2019	0.4	1988-2019	-1.4*	2006-2019	-0.9
65+	1988-2019	-2.6*									1988-2019	-2.6*	2006-2019	-2.6*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019.
^Trend could not be calculated because at least one year had zero cases reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

During the study period, cervical cancer mortality decreased significantly among patients aged 20 to 34 years and those aged 35 to 64 years similarly by an average of 1.6 percent per year (Figure 21 and Table 15). Mortality was stable among those aged 65 years and older during the post-vaccine period. The trend in cervical cancer mortality could not be calculated for those aged 19 years and younger because no deaths from cervical cancer were reported in this population in one or more years.

Figure 21. Trend in the Age-Adjusted Mortality Rate (AAMR) of Cervical Cancer by Age at Death, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

Table 15. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Mortality Trend of Cervical Cancer by Age at Death, California, 1988-2019

Age Group (years)	Joinpoint Analyses (1988-2019)							
	Trend 1		Trend 2		Overall Trend		Post-Vaccine Trend†	
	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
0-19	^	^	^	^	^	^	^	^
20-34	1988-2019	-1.6*			1988-2019	-1.6*	2006-2019	-1.6*
35-64	1988-2019	-1.6*			1988-2019	-1.6*	2006-2019	-1.6*
65+	1988-2006	-3.0*	2006-2019	0.2	1988-2019	-1.7*	2006-2019	0.2

*The APC and/or AAPC is significantly different from zero at alpha=0.05.

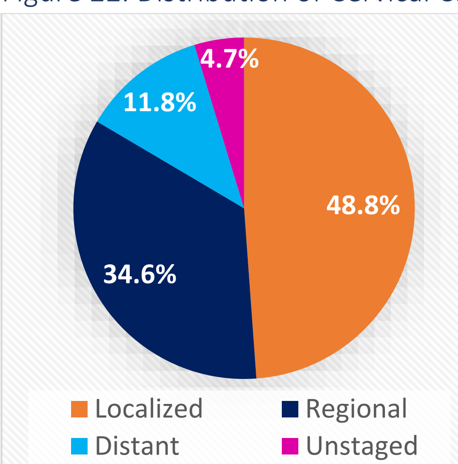
†The post-vaccine trend for females was calculated from 2006-2019.

^Trend could not be calculated because at least one year had zero deaths from the disease reported in the population.

Source of data: California Cancer Registry, California Department of Public Health.

From 2015 to 2019, 46.4 percent of cervical cancers were diagnosed late stage (34.6 percent regional stage and 11.8 percent distant stage) (Figure 22).

Figure 22. Distribution of Cervical Cancer by Stage at Diagnosis, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

A higher percent of late-stage cervical cancers was diagnosed among Black/African Americans (51.8 percent), Asian/Pacific Islanders (49.8 percent), persons with Medicare (no supplement) (62.7 percent) and Medicaid/public health insurance (56.6 percent), and individuals residing in low SES neighborhoods (49.6 percent) (Table 16).

Table 16. Associations of Late-Stage Diagnosis with Race/Ethnicity, Health Insurance Type, and Neighborhood Socioeconomic Status among Cervical Cancer Patients, California, 1988-2019 (N=48,664)

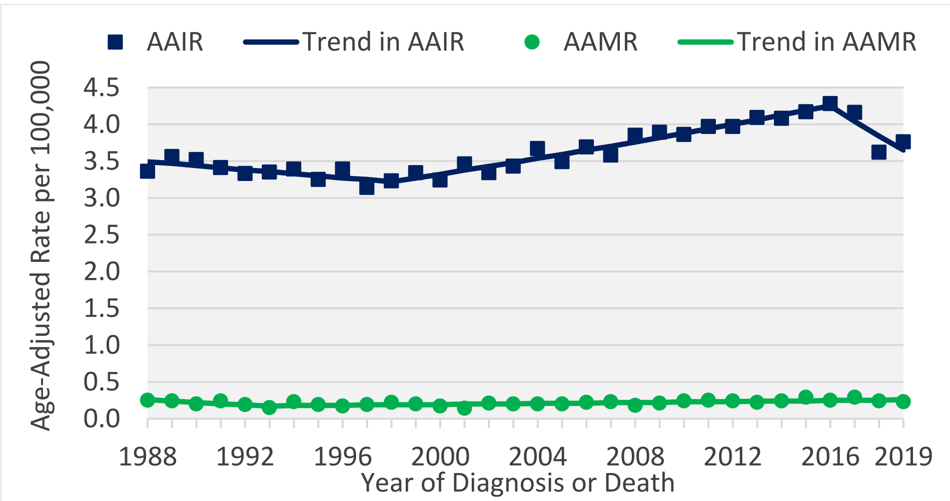
Characteristic	Late-Stage Diagnoses N	Late-Stage Diagnoses Percent (%)	P Value
Race/Ethnicity			
Asian/Pacific Islander	3,210	49.8%	<0.001
Black/African American	1,689	51.8%	
Hispanic/Latina	8,190	46.8%	
Native American	160	46.8%	
Non-Hispanic/Latina White	9,325	45.2%	
Other/Unknown	41	8.6%	
Health Insurance			
Private/ Government	7,981	41.6%	<0.001
Medicare/ No Supplement	1,296	62.7%	
Medicaid/ Public	7,051	56.6%	
Uninsured	852	49.1%	
Unknown	5,435	41.1%	
Neighborhood Socioeconomic Status			
Low	10,082	49.6%	<0.001
Medium	7,507	46.1%	
High	5,026	41.7%	

Source of data: California Cancer Registry, California Department of Public Health.

Oropharyngeal Cancer

HPV is the probable cause of 70 percent of oropharyngeal cancers.[18] Each year, approximately 1,800 Californians are diagnosed with oropharyngeal cancer and 116 die of the disease. Of the HPV-associated cancers, oropharyngeal cancer is the second most common with a five-year (2015 to 2019) age-adjusted incidence rate of 4.0 per 100,000 and an age-adjusted mortality rate of 0.3 per 100,000. During the post-vaccine period, incidence of oropharyngeal cancer was stable (Figure 23 and Table 17). However, a significant decrease of 5.0 percent per year on average was observed from 2016 to 2019. Mortality from oropharyngeal cancer significantly increased by an average of 1.5 percent per year from 1993 to 2019.

Figure 23. Trend in the Age-Adjusted Incidence (AAIR) and Mortality (AAMR) Rate of Oropharyngeal Cancer, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

Table 17. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence and Mortality Trend of Oropharyngeal Cancer, California, 1988-2019

	Joinpoint Analyses (1988-2019)									
	Trend 1		Trend 2		Trend 3		Overall Trend		Post-Vaccine Trend†	
Trend	Time Period	APC	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
Incidence	1988-1998	-0.8*	1998-2016	1.6*	2016-2019	-5.0*	1988-2019	0.1	2009-2019	-0.5
Mortality	1988-1993	-7.3	1993-2019	1.5*			1988-2019	0.03	2009-2019	1.5*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†Since the HPV-vaccine was available for both females and males in 2009, the post-vaccine trend for females and males combined was calculated from 2009-2019.
Source of data: California Cancer Registry, California Department of Public Health.

Incidence of oropharyngeal cancer among males (AAIR=7.1 per 100,000) is more than five times higher than among females (AAIR=1.3 per 100,000) and mortality among males (AAMR=0.4 per 100,000) is more than three times higher than among females (AAMR=0.1 per 100,000) (Table 18).

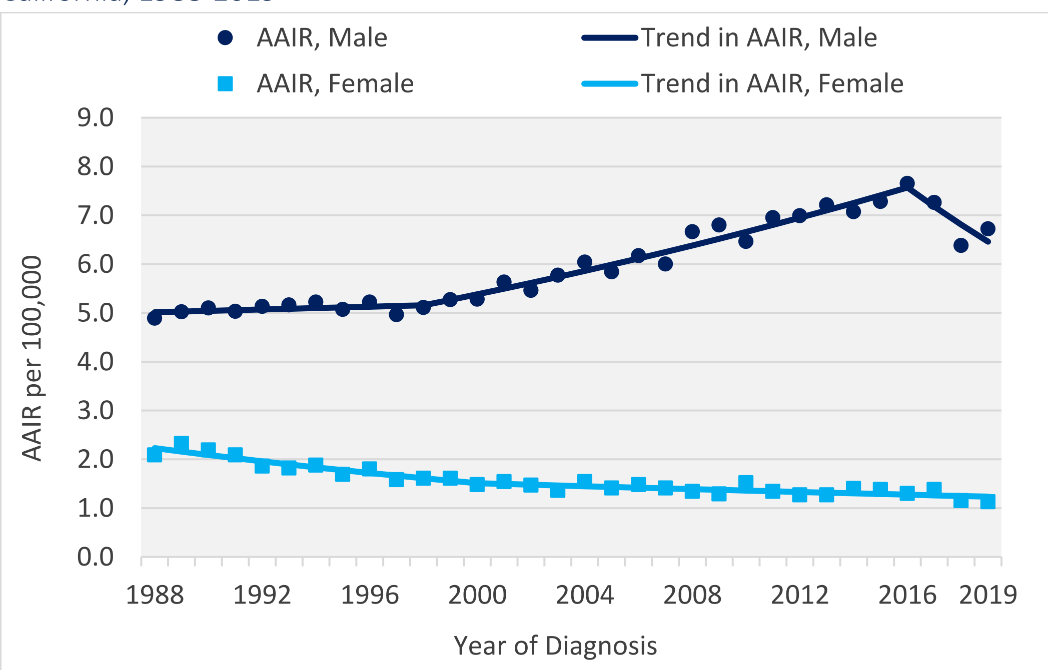
Table 18. Five-Year Age-Adjusted Incidence and Mortality Rates and Rate Ratios of Oropharyngeal Cancer by Sex, California, 2015-2019

Rate	Female	Male	Rate Ratio Male/Female	P Value
Age-Adjusted Incidence Rate	1.3	7.1	5.6	<0.001
Age-Adjusted Mortality Rate	0.1	0.4	3.3	<0.001

Source of data: California Cancer Registry, California Department of Public Health.

During the post-vaccine period, the incidence of oropharyngeal cancer among males was stable (Figure 24 and Table 19). However, a significant decrease of 5.2 percent per year was observed from 2016 to 2019. Among females, incidence decreased significantly during the post-vaccine period by an average of 1.1 percent per year.

Figure 24. Trend in the Age-Adjusted Incidence Rate (AAIR) of Oropharyngeal Cancer by Sex, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

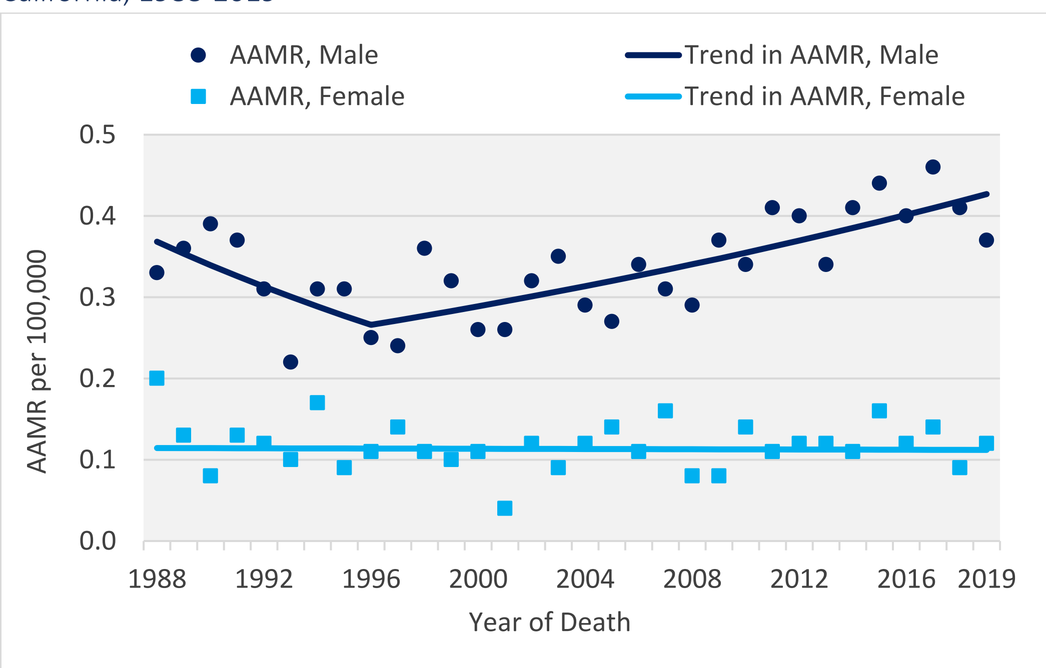
Table 19. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence Trend of Oropharyngeal Cancer by Sex, California, 1988-2019

Sex	Joinpoint Analyses (1988-2019)									
	Trend 1		Trend 2		Trend 3		Overall Trend		Post-Vaccine Trend†	
	Time Period	APC	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
Male	1988-1998	0.3	1998-2016	2.2*	2016-2019	-5.2*	1988-2019	0.8*	2009-2019	-0.1
Female	1988-2000	-3.2*	2000-2019	-1.1*			1988-2019	-1.9*	2006-2019	-1.1*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019 and the post-vaccine trend for males was calculated from 2009-2019.
Source of data: California Cancer Registry, California Department of Public Health.

Mortality of oropharyngeal cancer among males increased significantly by an average of 2.1 percent per year from 1996 to 2019 (Figure 25 and Table 20). Mortality among females was stable.

Figure 25. Trend in the Age-Adjusted Mortality Rate (AAMR) of Oropharyngeal Cancer by Sex, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

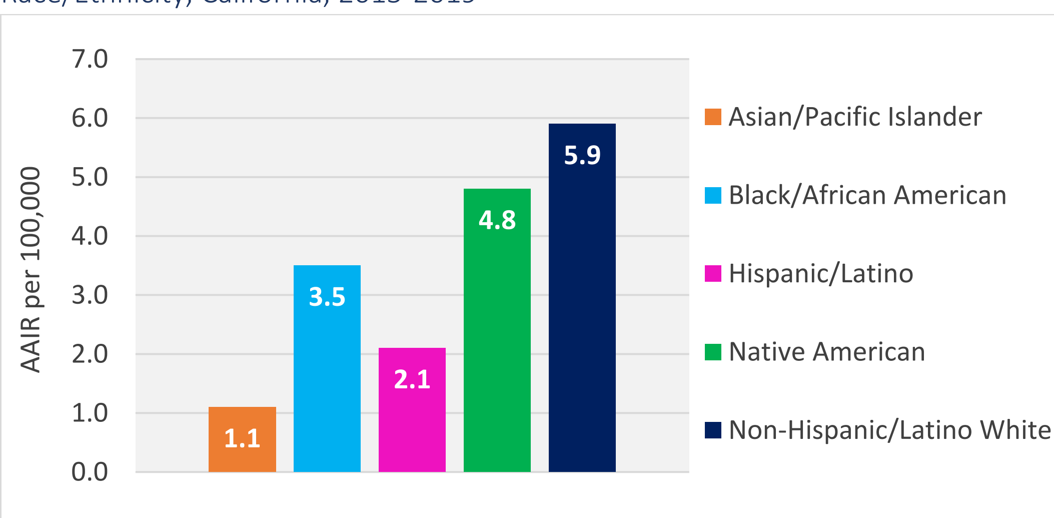
Table 20. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Mortality Trend of Oropharyngeal Cancer by Sex, California, 1988-2019

Sex	Joinpoint Analyses (1988-2019)							
	Trend 1		Trend 2		Overall Trend		Post-Vaccine Trend†	
	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
Male	1988-1996	-4.0	1996-2019	2.1*	1988-2019	0.5	2009-2019	2.1*
Female	1988-2019	-0.1			1988-2019	-0.1	2006-2019	-0.1

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019 and the post-vaccine trend for males was calculated from 2009-2019.
Source of data: California Cancer Registry, California Department of Public Health.

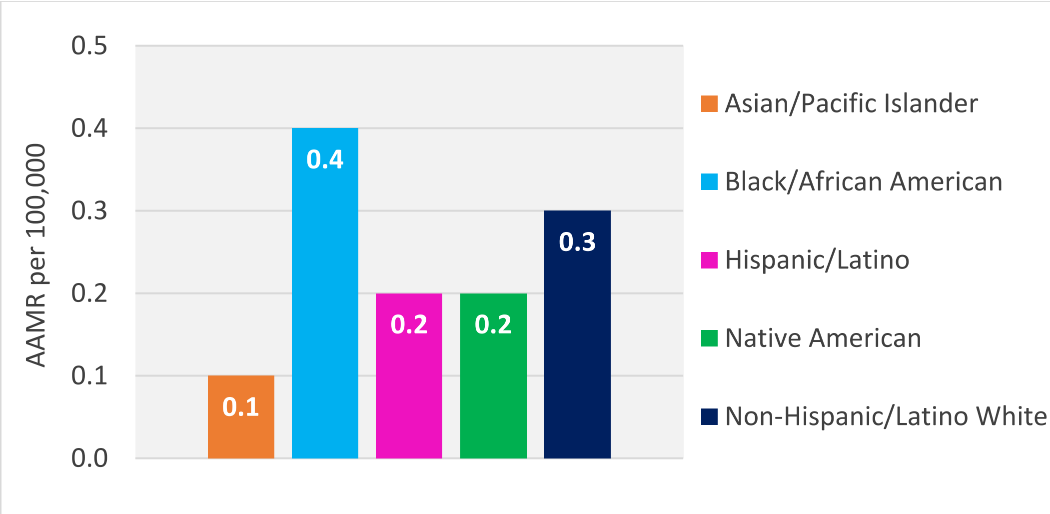
Whites had the highest five-year (2015 to 2019) age-adjusted incidence rate of oropharyngeal cancer (AAIR=5.9 per 100,000) followed by Native Americans (AAIR=4.8 per 100,000), Black/African Americans (AAIR=3.5 per 100,000), Hispanic/Latinos (AAIR=2.1 per 100,000) and Asian/Pacific Islanders (AAIR=1.1 per 100,000) (Figure 26). Black/African Americans had the highest five-year (2015 to 2019) age-adjusted mortality rate of oropharyngeal cancer (AAMR=0.4 per 100,000), followed by Whites (AAMR=0.3 per 100,000), Hispanic/Latinos and Native Americans who had the same rate (AAMR=0.2 per 100,000), and Asian/Pacific Islanders (AAMR=0.1 per 100,000) (Figure 27).

Figure 26. Five-Year Age-Adjusted Incidence Rate (AAIR) of Oropharyngeal Cancer by Race/Ethnicity, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

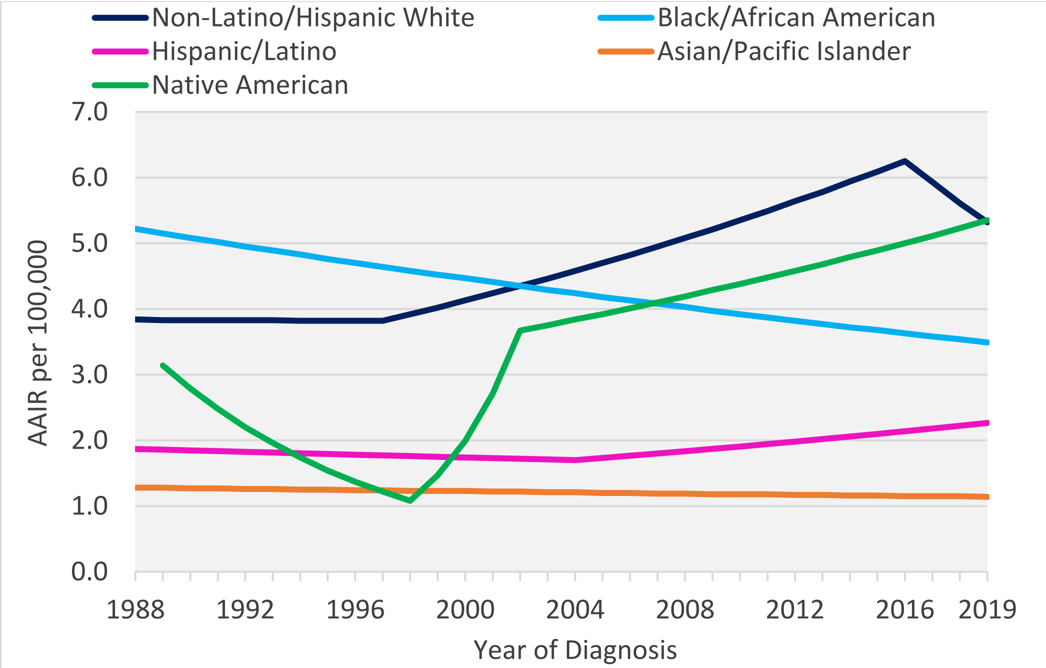
Figure 27. Five-Year Age-Adjusted Mortality Rate (AAMR) of Oropharyngeal Cancer by Race/Ethnicity, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

From 2004 to 2019, the incidence of oropharyngeal cancer among Hispanic/Latinos increased significantly by an average of 1.9 percent per year (Figure 28 and Table 21). Among Black/African Americans, incidence significantly decreased during the study period by an average of 1.3 percent per year. Incidence among Whites was stable during the post-vaccine period but a significant decrease of 5.3 percent per year was observed from 2016 to 2019. Incidence was stable among Asian/Pacific Islanders. Overall, few cases of oropharyngeal cancer were diagnosed among Native Americans resulting in unstable rates. There were no cases of oropharyngeal cancer diagnosed among Native Americans in 1988 therefore the trend was calculated from 1989 to 2019. During the study period and post-vaccine period, incidence appeared to increase but these increases were not statistically significant.

Figure 28. Trend in the Age-Adjusted Incidence Rate (AAIR) of Oropharyngeal Cancer by Race/Ethnicity, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

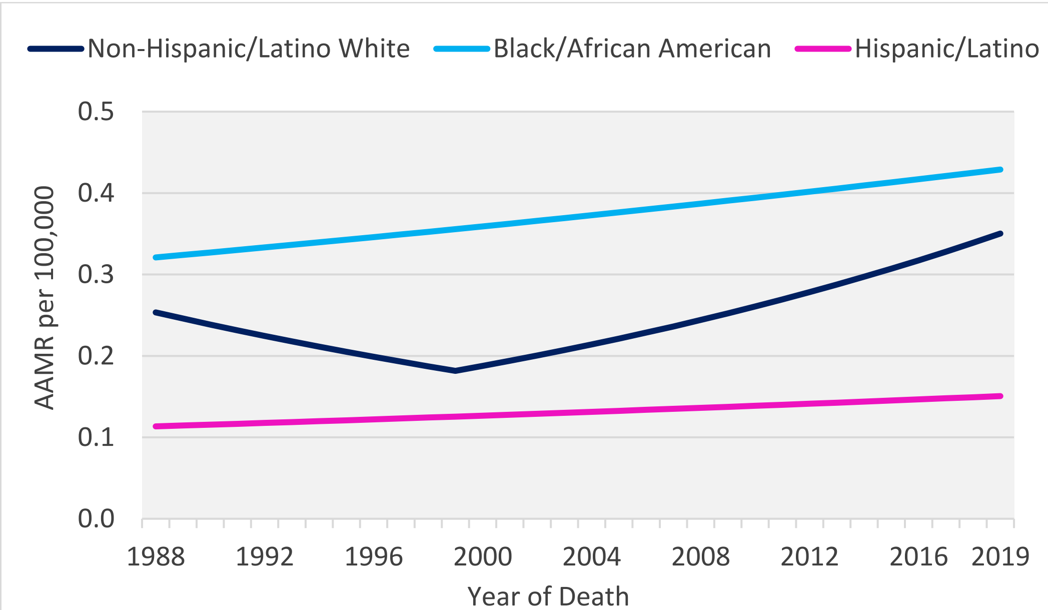
Table 21. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence Trend of Oropharyngeal Cancer by Race/Ethnicity, California, 1988-2019

	Joinpoint Analyses (1988-2019)									
	Trend 1		**Trend 2**		**Trend 3**		**Overall Trend**		**Post-Vaccine Trend†**	
Race/Ethnicity	**Time Period**	**APC**	**Time Period**	**APC**	**Time Period**	**APC**	**Time Period**	**AAPC**	**Time Period**	**AAPC**
Asian/Pacific Islander	1988-2019	-0.4					1988-2019	-0.4	2009-2019	-0.4
Black/African American	1988-2019	-1.3*					1988-2019	-1.3*	2009-2019	-1.3*
Hispanic/Latino	1988-2004	-0.6	2004-2019	1.9*			1988-2019	0.6	2009-2019	1.9*
Native American	1989-1998	-11.2*	1998-2002	35.7	2002-2019	2.2	1989-2019	1.8	2009-2019	2.2
Non-Hispanic/Latino White	1988-1997	-0.1	1997-2016	2.6*	2016-2019	-5.3*	1988-2019	1.1*	2009-2019	0.2

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†Since the HPV-vaccine was available for both females and males in 2009, the post-vaccine trend for females and males combined was calculated from 2009-2019.
Source of data: California Cancer Registry, California Department of Public Health.

During the study period, mortality of oropharyngeal cancer was stable among Black/African Americans and Hispanic/Latinos (Figure 29 and Table 22). From 1999 to 2019, mortality increased significantly among Whites by an average of 3.3 percent per year. Mortality trends could not be calculated for Asian/Pacific Islanders or Native Americans because no deaths from anal cancer were reported in these populations in one or more years.

Figure 29. Trend in the Age-Adjusted Mortality Rate (AAMR) of Oropharyngeal Cancer by Race/Ethnicity, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

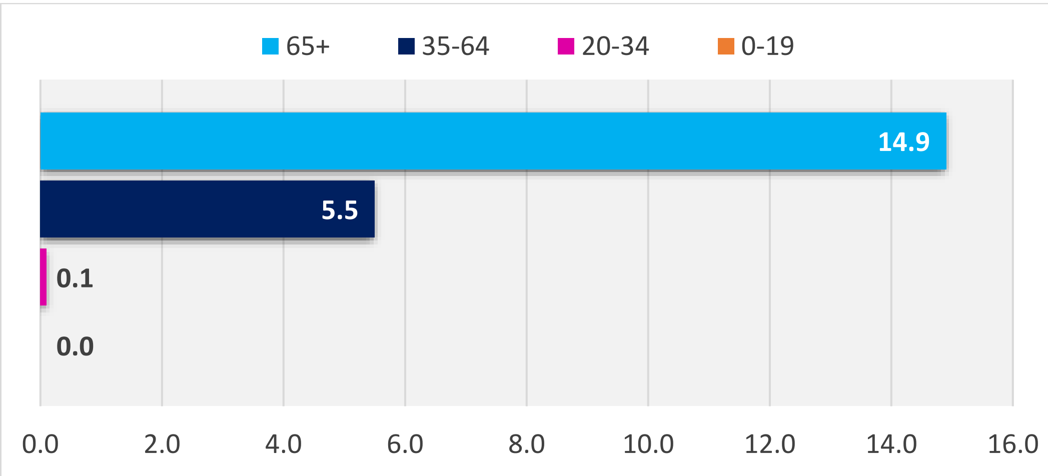
Table 22. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Mortality Trend of Oropharyngeal Cancer by Race/Ethnicity, California, 1988-2019

	Joinpoint Analyses (1988-2019)							
	Trend 1		Trend 2		Overall Trend		Post-Vaccine Trend†	
Race/Ethnicity	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
Asian/Pacific Islander	^	^	^	^	^	^	^	^
Black/African American	1988-2019	0.9			1988-2019	0.9	2009-2019	0.9
Hispanic/Latino	1988-2019	0.9			1988-2019	0.9	2009-2019	0.9
Native American	^	^	^	^	^	^	^	^
Non-Hispanic Latino White	1988-1999	-3.0*	1999-2019	3.3*	1988-2019	1.1	2009-2019	3.3*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†Since the HPV-vaccine was available for both females and males in 2009, the post-vaccine trend for females and males combined was calculated from 2009-2019.
^Trend could not be calculated because at least one year had zero deaths from the disease reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

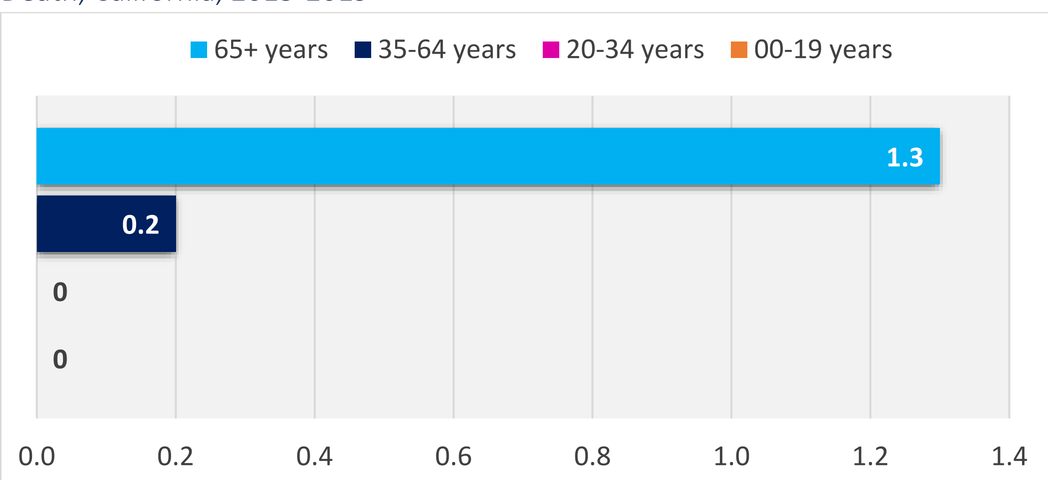
Incidence and mortality of oropharyngeal cancer were highest among individuals aged 65 years and older (AAIR=14.9 per 100,000; AAMR=1.3 per 100,000) compared to those aged 35 to 64 years (AAIR=5.5 per 100,000; AAMR=0.2 per 100,000) (Figures 30 and 31). Incidence and mortality of oropharyngeal cancer were very low among individuals less than 35 years of age. From 2015 to 2019, there were no cases of oropharyngeal cancer or deaths among individuals aged 19 years and younger.

Figure 30. Five-Year Age-Adjusted Incidence Rate (AAIR) of Oropharyngeal Cancer by Age at Diagnosis, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

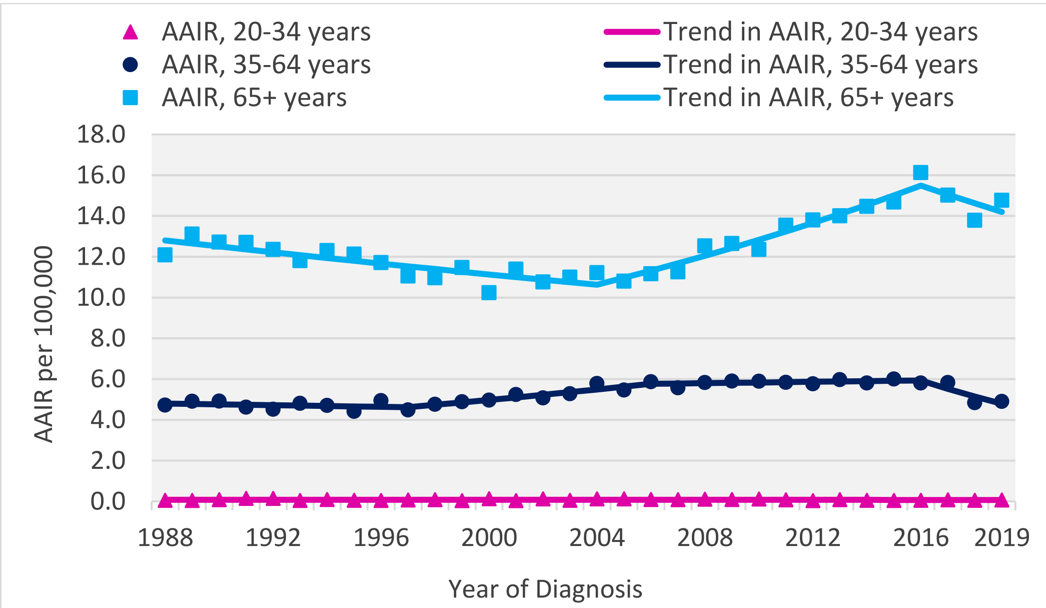
Figure 31. Five-Year Age-Adjusted Mortality Rate (AAMR) of Oropharyngeal Cancer by Age at Death, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

During the study period, incidence of oropharyngeal cancer was stable among persons aged 20 to 34 years and 65 years and older (Figure 32 and Table 23). Among persons aged 35 to 64 years, incidence significantly decreased by 1.9 percent per year during the post-vaccine period. The trend in oropharyngeal cancer incidence could not be calculated for those aged 19 years and younger because no cases of oropharyngeal cancer were reported in this population in one or more years.

Figure 32. Trend in the Age-Adjusted Incidence Rate (AAIR) of Oropharyngeal Cancer by Age at Diagnosis, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

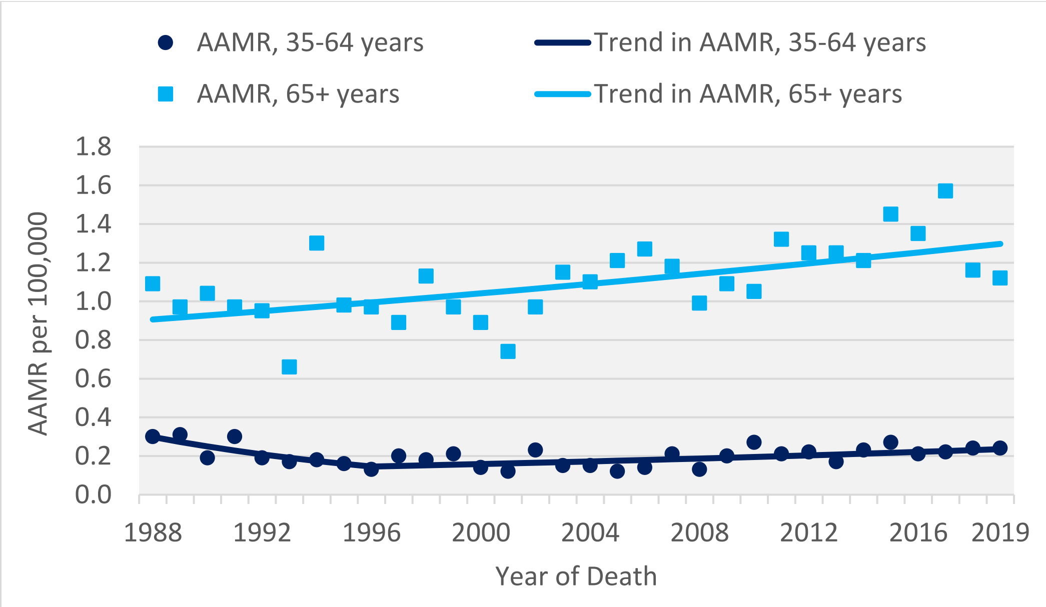
Table 23. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence Trend of Oropharyngeal Cancer by Age at Diagnosis, California, 1988-2019

Age Group (years)	Joinpoint Analyses (1988-2019)											
	Trend 1		Trend 2		Trend 3		Trend 4		Overall Trend		Post-Vaccine Trend†	
	Time Period	APC	Time Period	APC	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
0-19	^	^	^	^	^	^	^	^	^	^	^	^
20-34	1988-2019	-0.4							1988-2019	-0.4	2009-2019	-0.4
35-64	1988-1997	-0.4	1997-2006	2.5*	2006-2016	0.3	2016-2019	-6.9*	1988-2019	-0.01	2009-2019	-1.9*
65+	1988-2004	-1.2*	2004-2016	3.2*	2016-2019	-2.9			1988-2019	0.3	2009-2019	1.3

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†Since the HPV-vaccine was available for both females and males in 2009, the post-vaccine trend for females and males combined was calculated from 2009-2019.
^Trend could not be calculated because at least one year had zero cases reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

Among persons aged 35 to 64 years, oropharyngeal cancer mortality increased significantly by an average of 2.1 percent per year from 1996 to 2019 (Figure 33 and Table 24). Among persons aged 65 years and older, mortality increased significantly by 1.2 percent per year during the study period. The trend in oropharyngeal cancer mortality could not be calculated for those aged 19 years and younger and those aged 20 to 34 years because no deaths from oropharyngeal cancer were reported in this population in one or more years.

Figure 33. Trend in the Age-Adjusted Mortality Rate (AAMR) of Oropharyngeal Cancer by Age at Death, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

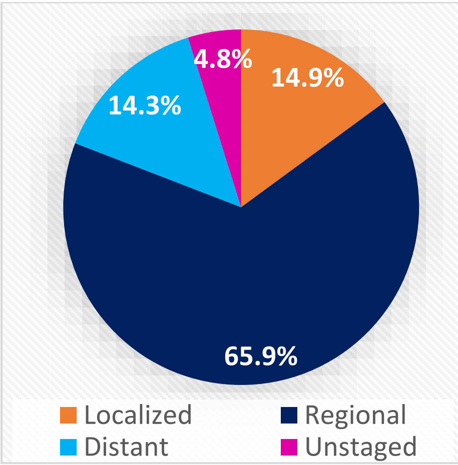
Table 24. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Mortality Trend of Oropharyngeal Cancer by Age at Death, California, 1988-2019

Age Group (years)	Joinpoint Analyses (1988-2019)							
	Trend 1		Trend 2		Overall Trend		Post-Vaccine Trend†	
	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
0-19	^	^	^	^	^	^	^	^
20-34	^	^	^	^	^	^	^	^
35-64	1988-1996	-8.6*	1996-2019	2.1*	1988-2019	-0.8	2009-2019	2.1*
65+	1988-2019	1.2*			1988-2019	1.2*	2009-2019	1.2*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†Since the HPV-vaccine was available for both females and males in 2009, the post-vaccine trend for females and males combined was calculated from 2009-2019.
^Trend could not be calculated because at least one year had zero deaths from the disease reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

Eighty percent of oropharyngeal cancers were diagnosed late stage (65.9 regional stage and 14.3 distant stage) (Figure 34).

Figure 34. Distribution of Oropharyngeal Cancer by Stage at Diagnosis, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

A higher percent of late-stage oropharyngeal cancers was diagnosed among Native Americans (86.4 percent), Hispanic/Latinos (83.0 percent), persons with Medicaid/public health insurance (85.1 percent), and individuals with no health insurance (84.4 percent) (Table 25).

Table 25. Associations of Late-Stage Diagnosis with Race/Ethnicity, Health Insurance Type, and Neighborhood Socioeconomic Status among Oropharyngeal Cancer Patients, California, 1988-2019 (N=40,091)

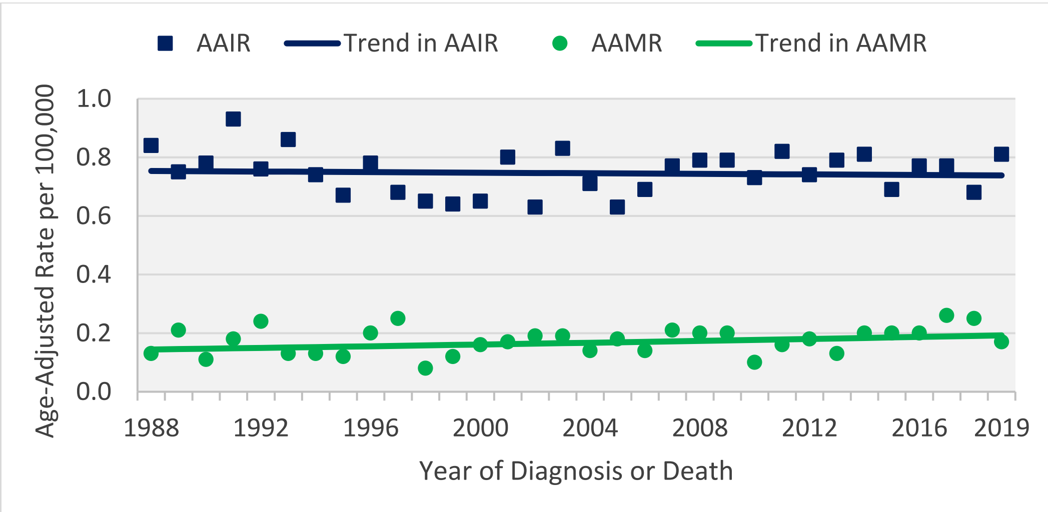
	Late-Stage Diagnoses		
Characteristic	**N**	**Percent (%)**	**P Value**
Race/Ethnicity			
Asian/Pacific Islander	1,270	76.6%	<0.001
Black/African American	2,246	81.9%	
Hispanic/Latino	3,488	83.0%	
Native American	204	86.4%	
Non-Hispanic/Latino White	24,837	80.1%	
Other/Unknown	130	49.2%	
Health Insurance			
Private/ Government	18,701	82.9%	<0.001
Medicare/ No Supplement	2,652	77.3%	
Medicaid/ Public	5,193	85.1%	
Uninsured	619	84.4%	
Unknown	5,010	68.9%	
Neighborhood Socioeconomic Status			
Low	8,534	80.2%	0.017
Medium	11,636	79.6%	
High	12,005	80.9%	

Source of data: California Cancer Registry, California Department of Public Health.

Penile Cancer

HPV is the probable cause of 63 percent of penile cancers.[18] Each year, approximately 145 males in California are diagnosed with penile cancer and 40 die of the disease. Penile cancer is the fifth most common HPV-associated cancer with a five-year age-adjusted incidence rate of 0.7 per 100,000 and a five-year age-adjusted mortality rate of 0.3 per 100,000. During the study period, penile cancer incidence and mortality were stable (Figure 35 and Table 26).

Figure 35. Trend in the Age-Adjusted Incidence (AAIR) and Mortality (AAMR) Rate of Penile Cancer, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

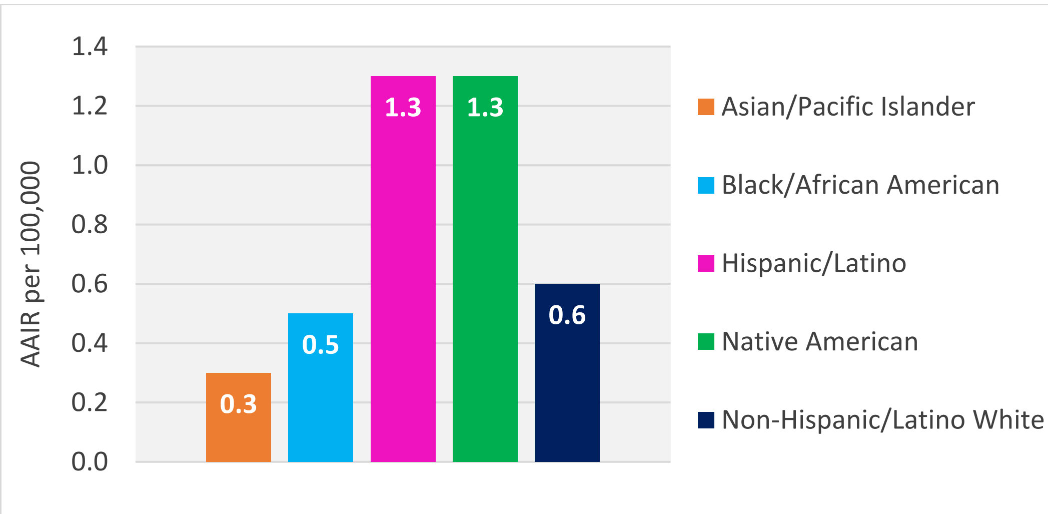
Table 26. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence and Mortality Trend of Penile Cancer, California, 1988-2019

	Joinpoint Analyses (1988-2019)			
	Trend 1/Overall Trend		Post-Vaccine Trend†	
Trend	Time Period	APC/AAPC	Time Period	AAPC
Incidence	1988-2019	-0.1	2009-2019	-0.1
Mortality	1988-2019	0.9	2009-2019	0.9

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for males was calculated from 2009-2019.
Source of data: California Cancer Registry, California Department of Public Health.

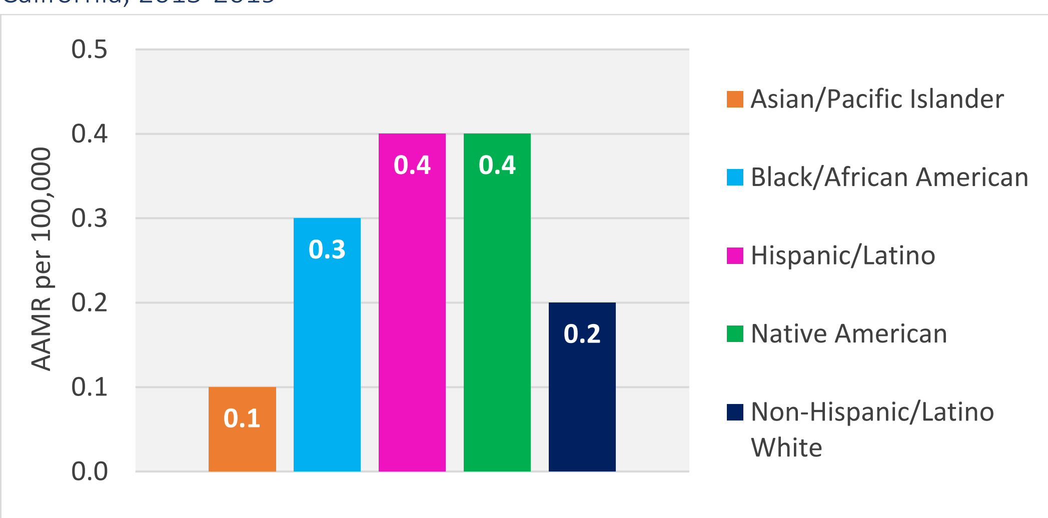
From 2015 to 2019, the five-year age-adjusted incidence rate of penile cancer was highest among Hispanic/Latinos and Native Americans (AAIR=1.3 per 100,000, respectively), followed by Whites (AAIR=0.6 per 100,000), Black/African Americans (AAIR=0.5 per 100,000), and Asian/Pacific Islanders (AAIR=0.3 per 100,000) (Figure 36). The five-year age-adjusted mortality rate of penile cancer was highest among Hispanic/Latinos and Native Americans (AAMR=0.4 per 100,000, respectively), followed by Black/African Americans (AAMR=0.3 per 100,000), Whites (AAMR=0.2 per 100,000), and Asian/Pacific Islanders (AAMR=0.1 per 100,000) (Figure 37).

Figure 36. Five-Year, Age-Adjusted Incidence Rate (AAIR) of Penile Cancer by Race/Ethnicity, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

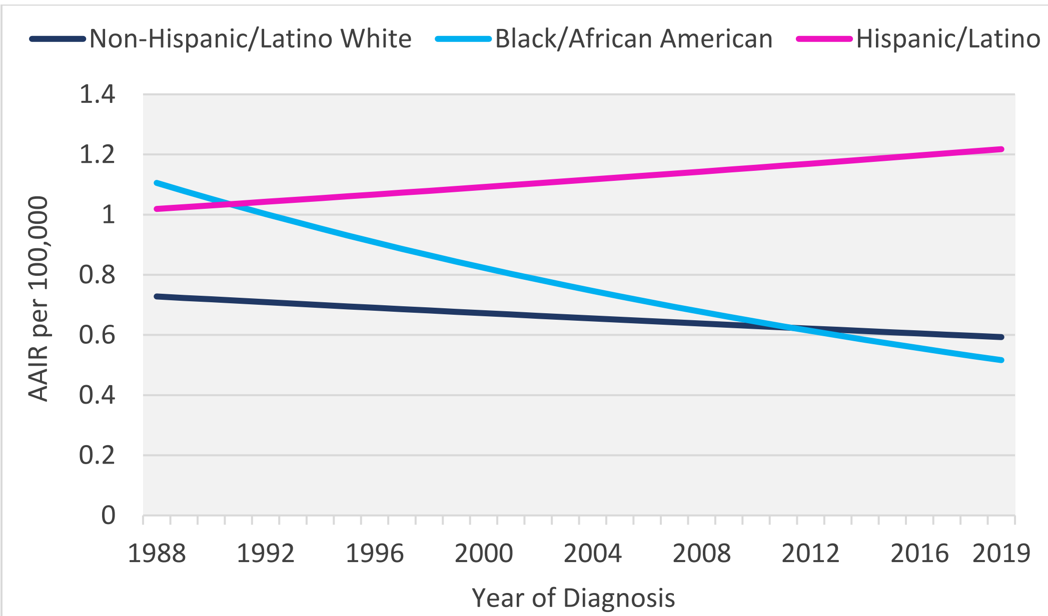
Figure 37. Five-Year, Age-Adjusted Mortality Rate (AAMR) of Penile Cancer by Race/Ethnicity, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

During the study period, penile cancer incidence decreased significantly among Black/African Americans and Whites by an average of 2.4 percent per year and 0.7 percent per year, respectively (Figure 38 and Table 27). Penile cancer incidence was stable among Hispanic/Latinos. The trend in penile cancer incidence could not be calculated for Asian/Pacific Islanders or Native Americans because no cases of penile cancer were reported in these populations in one or more years.

Figure 38. Trend in the Age-Adjusted Incidence Rate (AAIR) of Penile Cancer by Race/Ethnicity, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

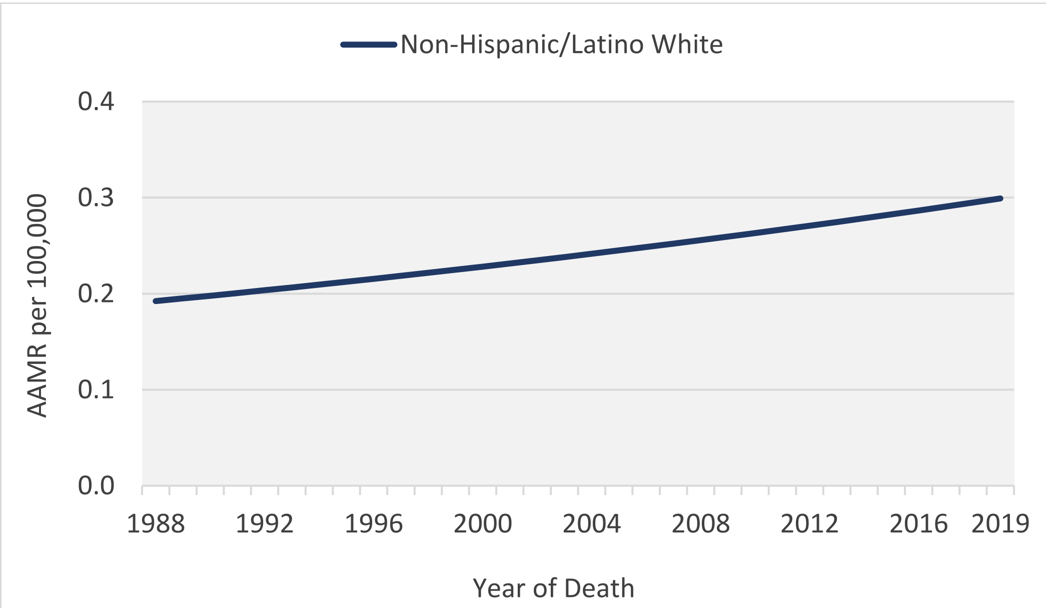
Table 27. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence Trend of Penile Cancer by Race/Ethnicity, California, 1988-2019

Race/Ethnicity	Joinpoint Analyses (1988-2019)			
	Trend 1/Overall Trend		Post-Vaccine Trend†	
	Time Period	APC/AAPC	Time Period	AAPC
Asian/Pacific Islander	^	^	^	^
Black/African American	1988-2019	-2.4*	2009-2019	-2.4*
Hispanic/Latino	1988-2019	0.6	2009-2019	0.6
Native American	^	^	^	^
Non-Hispanic/Latino White	1988-2019	-0.7*	2009-2019	-0.7*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for males was calculated from 2009-2019.
^Trend could not be calculated because at least one year had zero cases reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

Among Whites, penile cancer mortality was stable (Figure 39 and Table 28). The trend in penile cancer mortality could not be calculated for Asian/Pacific Islanders, Black/African Americans, Hispanic/Latinos, or Native Americans because no deaths from penile cancer were reported in these populations in one or more years.

Figure 39. Trend in the Age-Adjusted Mortality Rate (AAMR) of Penile Cancer by Race/Ethnicity, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

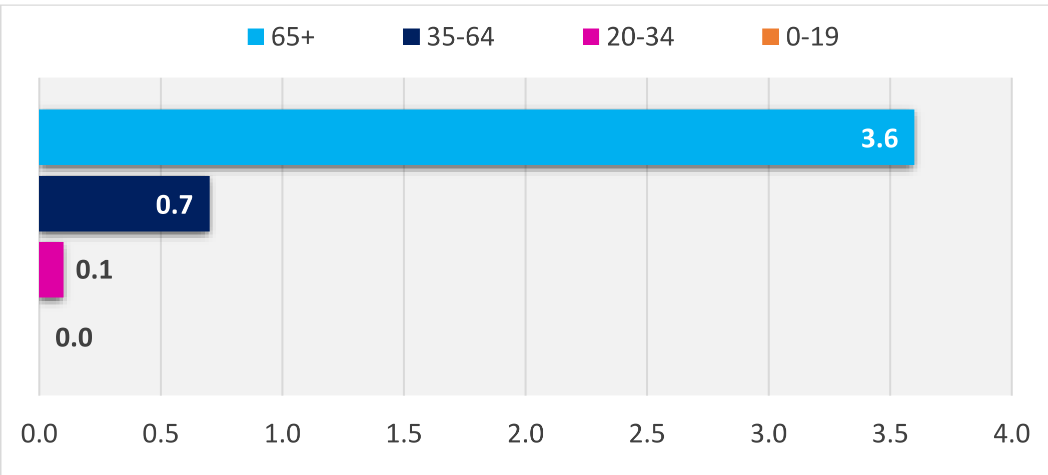
Table 28. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Mortality Trend of Penile Cancer by Race/Ethnicity, California, 1988-2019

Race/Ethnicity	Joinpoint Analyses (1988-2019)			
	Trend 1/ Overall Trend		Post-Vaccine Trend†	
	Time Period	APC/AAPC	Time Period	AAPC
Asian/Pacific Islander	^	^	^	^
Black/African American	^	^	^	^
Hispanic/Latino	^	^	^	^
Native American	^	^	^	^
Non-Hispanic/Latino White	1988-2019	0.2	2009-2019	0.2

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for males was calculated from 2009-2019.
^Trend could not be calculated because at least one year had zero deaths from the disease reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

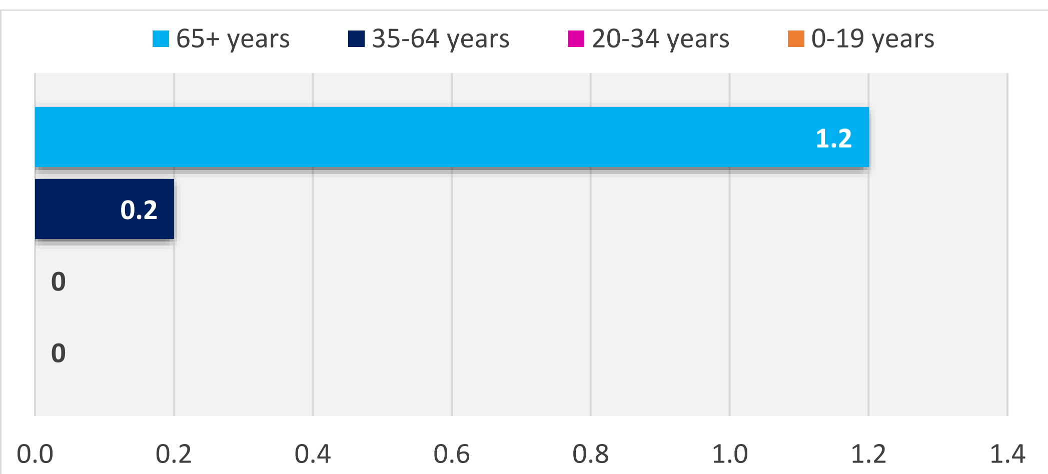
Incidence of penile cancer was highest among males aged 65 years and older (AAIR=3.6 per 100,000), followed by males aged 35-64 years (AAIR=0.7 per 100,000), and males aged 20-34 years (AAIR=0.1 per 100,000). There were no penile cancer cases reported in males aged 19 years or younger from 2015 to 2019 (Figure 40). Males aged 65 years and older had the highest mortality rate of penile cancer (AAMR=1.2 per 100,00), followed by males aged 35-64 years (AAMR=0.2 per 100,000). There were less than five deaths due to penile cancer reported among males aged 20 to 34 years and no deaths due to penile cancer reported among males aged 19 years and younger from 2015 to 2019 (Figure 41).

Figure 40. Age-Adjusted Incidence Rate (AAIR) of Penile Cancer by Age at Diagnosis, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

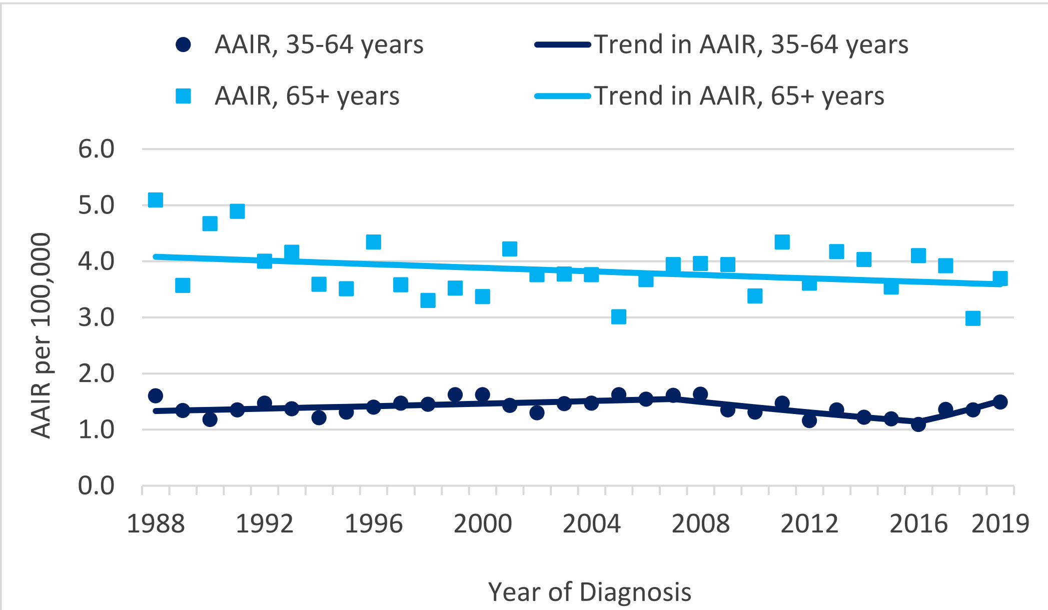
Figure 41. Age-Adjusted Mortality Rate (AAMR) of Penile Cancer by Age at Death, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

Among males aged 35 to 64 years and those aged 65 years and older, incidence of penile cancer was stable (Figure 42 and Table 29). The trend could not be calculated for males aged 19 years and younger or those aged 20 to 34 years because no cases of penile cancer were reported in these populations in one or more years.

Figure 42. Trend in the Age-Adjusted Incidence Rate (AAIR) of Penile Cancer by Age at Diagnosis, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

Table 29. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence Trend of Penile Cancer by Age at Diagnosis, California, 1988-2019

Age Group (years)	Joinpoint Analyses (1988-2019)			
	Trend 1/Overall Trend		Post-Vaccine Trend†	
	Time Period	APC/AAPC	Time Period	AAPC
0-19	^	^	^	^
20-34	^	^	^	^
35-64	1988-2019	0.7	2009-2019	0.7
65+	1988-2000	-0.4	2009-2019	-0.4

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for males was calculated from 2009-2019.
^Trend could not be calculated because at least one year had zero cases reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

Penile cancer mortality was stable among males aged 35 to 64 years and those aged 65 years and older. The trend in penile cancer mortality could not be calculated for those aged 19 years and younger and those aged 20 to 34 years because no deaths from penile cancer were reported in these populations in one or more years (Figure 43 and Table 30).

Figure 43. Trend in the Age-Adjusted Mortality Rate (AAMR) of Penile Cancer by Age at Death, California, 1988-2019

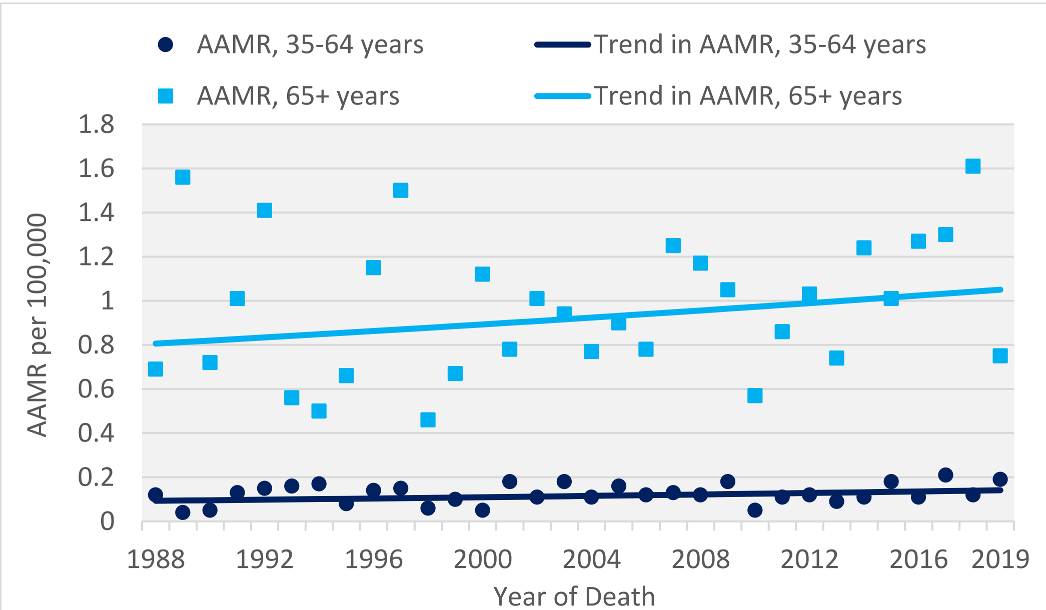


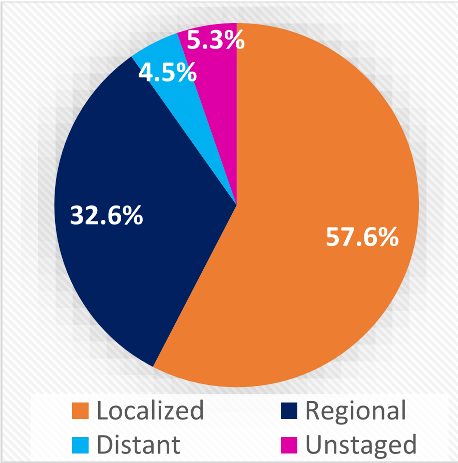
Table 30. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Mortality Trend of Penile Cancer by Age at Death, California, 1988-2019

Age Group (years)	Joinpoint Analyses (1988-2019)			
	Trend 1/Overall Trend		Post-Vaccine Trend†	
	Time Period	APC/AAPC	Time Period	AAPC
0-19	^	^	^	^
20-34	^	^	^	^
35-64	1988-2019	1.4	2009-2019	1.4
65+	1988-2000	0.9	2009-2019	0.9

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for males was calculated from 2009-2019.
^Trend could not be calculated because at least one year had zero deaths from the disease reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

From 2015 to 2019, 37 percent of penile cancers were diagnosed late-stage (32.6 percent regional stage and 4.5 percent distant stage) (Figure 44).

Figure 44. Distribution of Penile Cancer by Stage at Diagnosis, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

A higher percent of late-stage penile cancers was diagnosed among Black/African Americans (43.8 percent), Hispanic/Latinos (42.8 percent), persons with Medicaid/public health insurance (46.0 percent), and among individuals residing in low SES neighborhoods (39.2 percent) (Table 31).

Table 31. Associations of Late-Stage Diagnosis with Race/Ethnicity, Health Insurance Type, and Neighborhood Socioeconomic Status among Penile Cancer Patients, California, 1988-2019 (N=3,447)

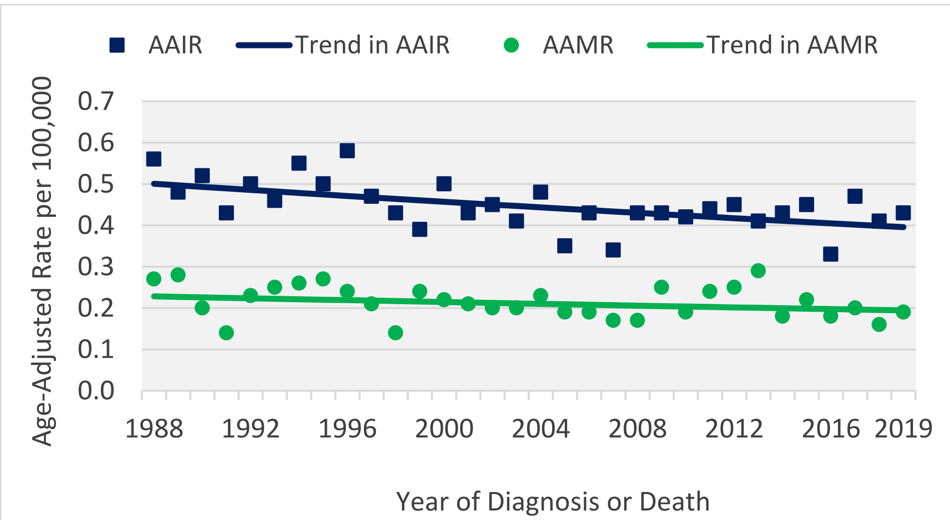
Characteristic	Late-Stage Diagnoses		P Value
	N	Percent (%)	
Race/Ethnicity			
Asian/Pacific Islander	78	38.0%	<0.001
Black/African American	81	43.8%	
Hispanic/Latino	473	42.8%	
Native American	8	40.0%	
Non-Hispanic/Latino White	640	33.7%	
Other/Unknown	1	3.0%	
Health Insurance			
Private/ Government	581	37.6%	<0.001
Medicare/ No Supplement	150	37.0%	
Medicaid/ Public	324	46.0%	
Uninsured	37	35.9%	
Unknown	189	27.4%	
Neighborhood Socioeconomic Status			
Low	540	39.2%	0.07
Medium	433	36.9%	
High	308	34.4%	

Source of data: California Cancer Registry, California Department of Public Health.

Vaginal Cancer

HPV is the probable cause of 75 percent of vaginal cancers.[18] Vaginal cancer is an uncommon disease, with 96 new diagnoses and 45 deaths in California per year. The five-year (2015-2019) age-adjusted incidence rate of vaginal cancer was 0.4 per 100,000 and the age-adjusted mortality rate was 0.2 per 100,000. During the study period, vaginal cancer incidence significantly decreased on average by 0.8 percent per year, but mortality was stable (Figure 45 and Table 32).

Figure 45. Trend in the Age-Adjusted Incidence (AAIR) and Mortality (AAMR) Rate of Vaginal Cancer, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

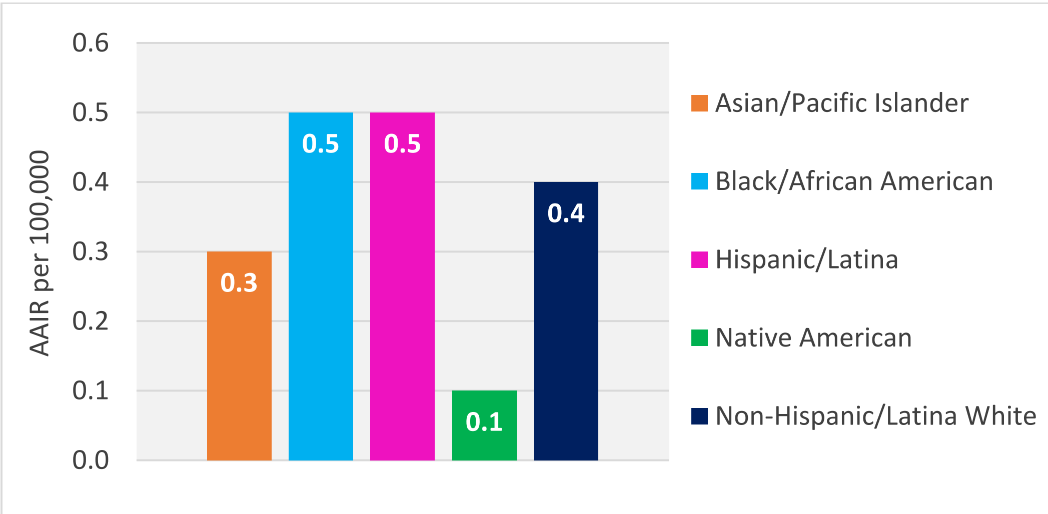
Table 32. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence and Mortality Trend of Vaginal Cancer, California, 1988-2019

Trend	Joinpoint Analyses (1988-2019)			
	Trend 1/ Overall Trend		Post-Vaccine Period†	
	Time Period	APC/AAPC	Time Period	AAPC
Incidence	1988-2019	-0.8*	2006-2019	-0.8*
Mortality	1988-2019	-0.5	2006-2019	-0.5

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019.
Source of data: California Cancer Registry, California Department of Public Health.

From 2015 to 2019, the five-year age-adjusted incidence rate of vaginal cancer was highest among Hispanic/Latinas and Black/African Americans (AAIR=0.5 per 100,000, respectively), followed by Whites (AAIR=0.4 per 100,000), Asian/Pacific Islanders (AAIR=0.3 per 100,00), and Native Americans (AAIR=0.1 per 100,000) (Figure 46).

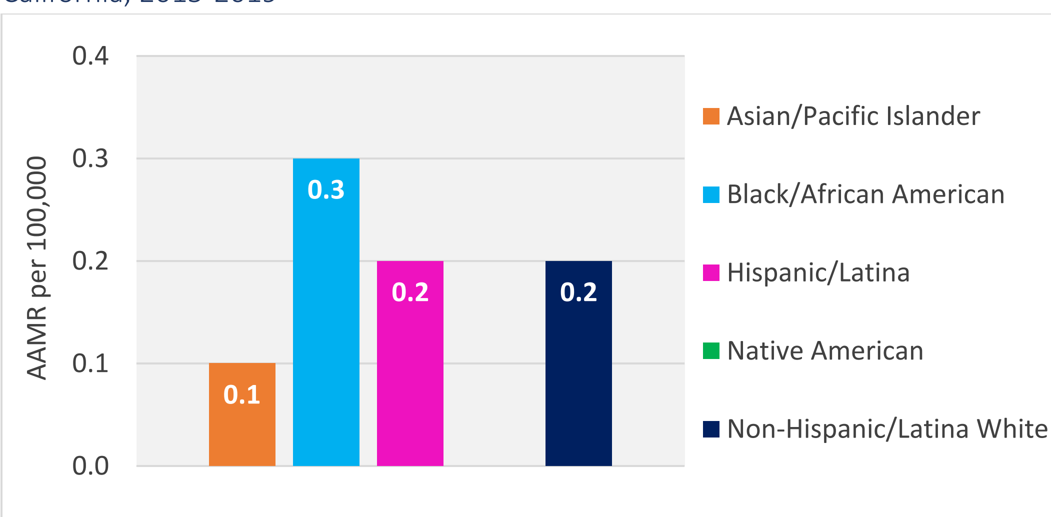
Figure 46. Five-Year, Age-Adjusted Incidence Rate (AAIR) of Vaginal Cancer by Race/Ethnicity, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

The five-year age-adjusted mortality rate of vaginal cancer was highest among Black/African Americans (AAMR= 0.3 per 100,000), followed by Hispanic/Latinas and Whites who had the same rate (AAMR=0.2 per 100,0000), and Asian/Pacific Islanders (AAMR=0.1 per 100,0000) (Figure 47).

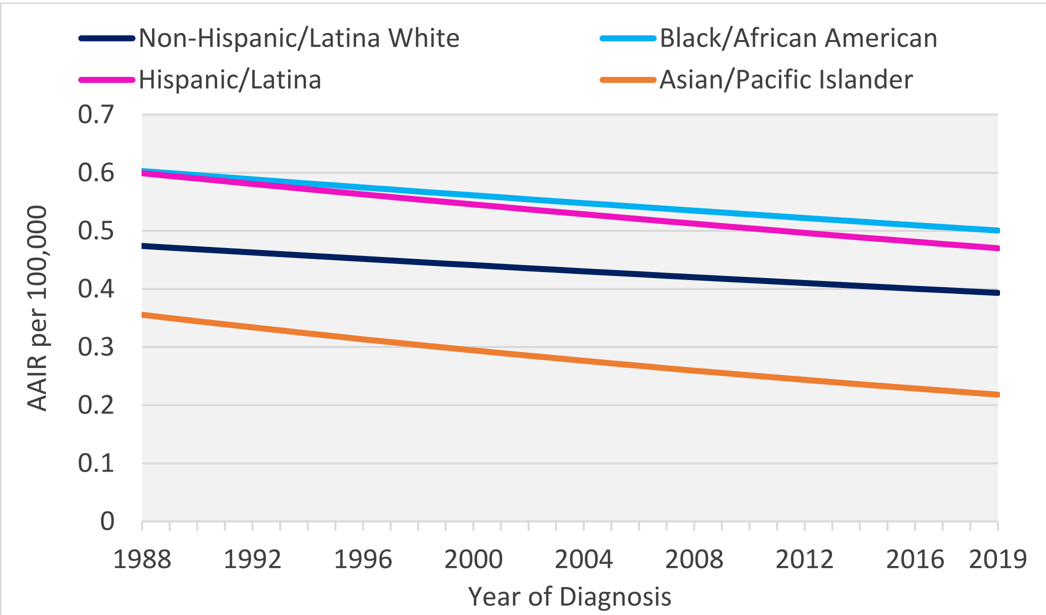
Figure 47. Five-Year, Age-Adjusted Mortality Rate (AAMR) of Vaginal Cancer by Race/Ethnicity, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.
Note: There were no deaths from vaginal cancer among Native Americans during the time period.

The incidence of vaginal cancer was stable for all race/ethnicities for which the trend could be calculated (Figure 48 and Table 33). The trend in vaginal cancer incidence could not be calculated for Native Americans because no cases of vaginal cancer were reported in this population in one or more years.

Figure 48. Trend in the Age-Adjusted Incidence Rate (AAIR) of Vaginal Cancer by Race/Ethnicity, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health

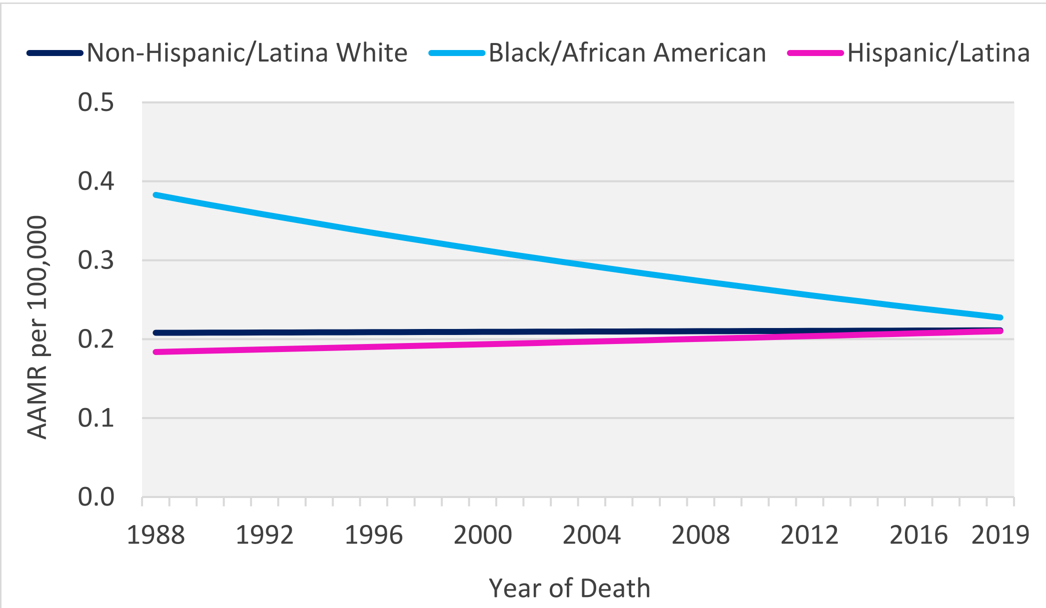
Table 33. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence Trend of Vaginal Cancer by Race/Ethnicity, California, 1988-2019

	Joinpoint Analyses (1988-2019)			
	Trend 1/ Overall Trend		Post-Vaccine Trend†	
Race/Ethnicity	Time Period	APC/AAPC	Time Period	AAPC
Asian/Pacific Islander	1988-2019	-1.6	2006-2019	-1.6
Black/African American	1988-2019	-0.6	2006-2019	-0.6
Hispanic/Latina	1988-2019	-0.8	2006-2019	-0.8
Native American	^	^	^	^
Non-Hispanic/Latina White	1988-2019	-0.6	2006-2019	-0.6

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019.
^Trend could not be calculated because at least one year had zero cases reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

Vaginal cancer mortality was stable for all race/ethnicities for which the trend could be calculated (Figure 49 and Table 34). The trend could not be calculated for Asian/Pacific Islanders or Native Americans because no deaths from vaginal cancer were reported in these populations in one or more years.

Figure 49. Trend in the Age-Adjusted Mortality Rate (AAMR) of Vaginal Cancer by Race/Ethnicity, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health

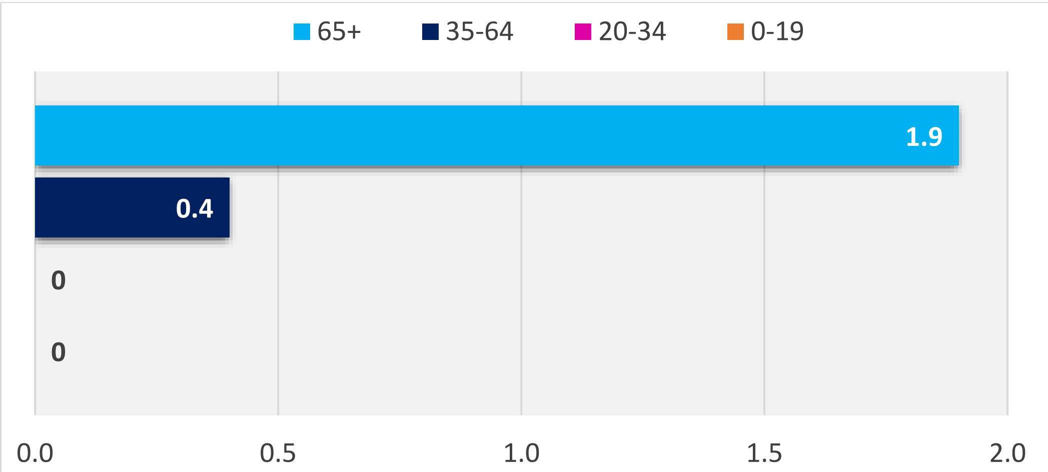
Table 34. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Mortality Trend of Vaginal Cancer by Race/Ethnicity, California, 1988-2019

	Joinpoint Analyses (1988-2019)			
	Trend 1/ Overall Trend		**Post-Vaccine Period†**	
Race/Ethnicity	**Time Period**	**APC/AAPC**	**Time Period**	**AAPC**
Asian/Pacific Islander	^	^	^	^
Black/African American	1988-2019	-1.7	2006-2019	-1.7
Hispanic/Latina	1988-2019	0.4	2006-2019	0.4
Native American	^	^	^	^
Non-Hispanic/Latina White	1988-2019	0.1	2006-2019	0.1

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019.
^Trend could not be calculated because at least one year had zero deaths from the disease reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

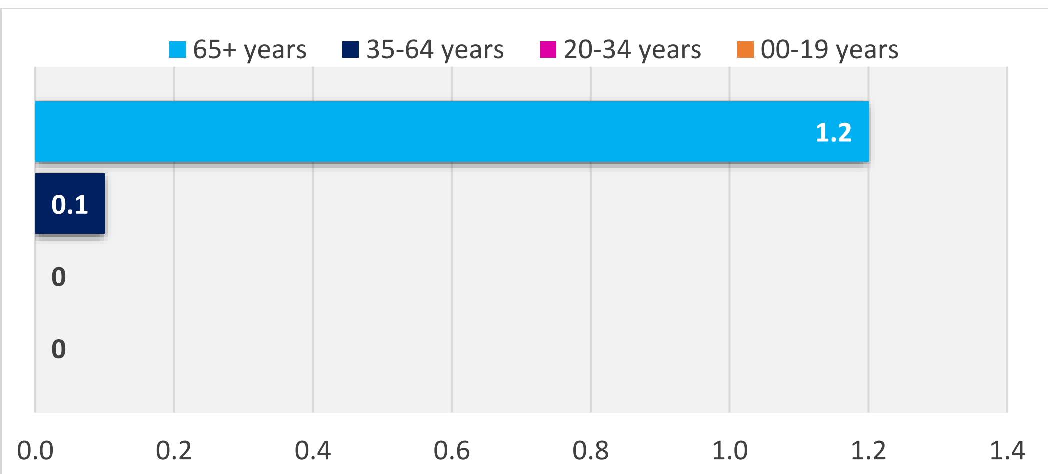
From 2015 to 2019, the age-adjusted incidence rate and age-adjusted mortality rate of vaginal cancer was highest among those aged 65 years and older (AAIR=1.9 per 10,000; AAMR=1.2 per 100,000) followed by those aged 35 to 64 years (AAIR=0.4 per 100,000; AAMR=0.1 per 100,000) (Figures 50 and 51). Less than 10 cases of vaginal cancer and deaths due to vaginal cancer were reported among females aged 20 to 34 years from 2015 to 2019. No cases of vaginal cancer or deaths due to vaginal cancer were reported among those aged 19 years or younger from 2015 to 2019.

Figure 50. Age-Adjusted Incidence Rate (AAIR) of Vaginal Cancer by Age at Diagnosis, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

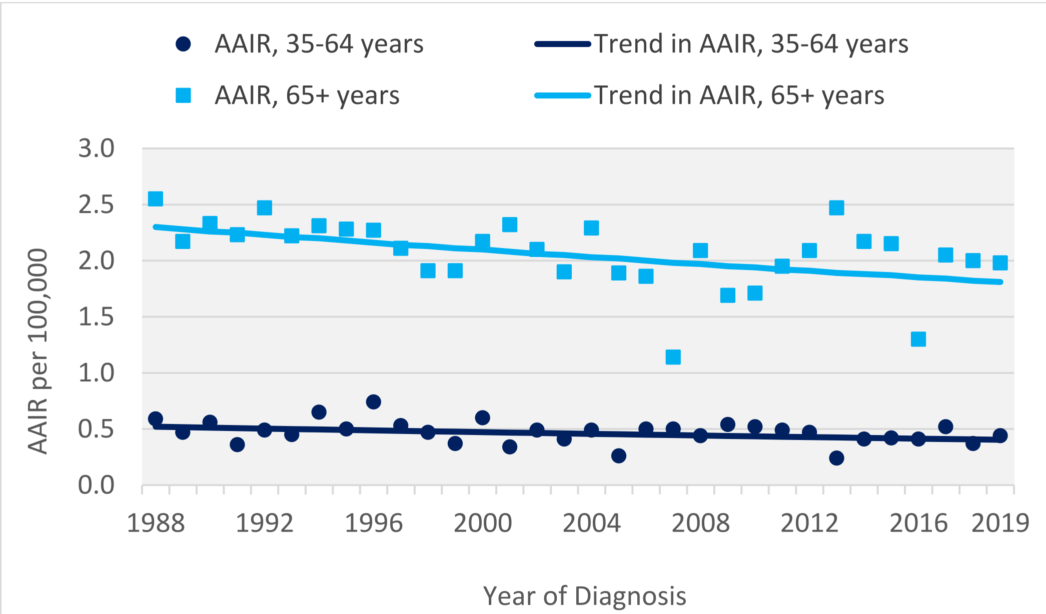
Figure 51. Age-Adjusted Mortality Rate (AAMR) of Vaginal Cancer by Age at Death, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

Among those aged 65 years and older, vaginal cancer incidence decreased significantly by an average of 0.8 percent per year (Figure 52 and Table 35). Incidence among those aged 35 to 64 years was stable. Trends in vaginal cancer incidence could not be calculated for those aged 19 years and younger or those aged 20 to 34 because no cases of vaginal cancer were reported in these populations in one or more years.

Figure 52. Trend in the Age-Adjusted Incidence Rate (AAIR) of Vaginal Cancer by Age at Diagnosis, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

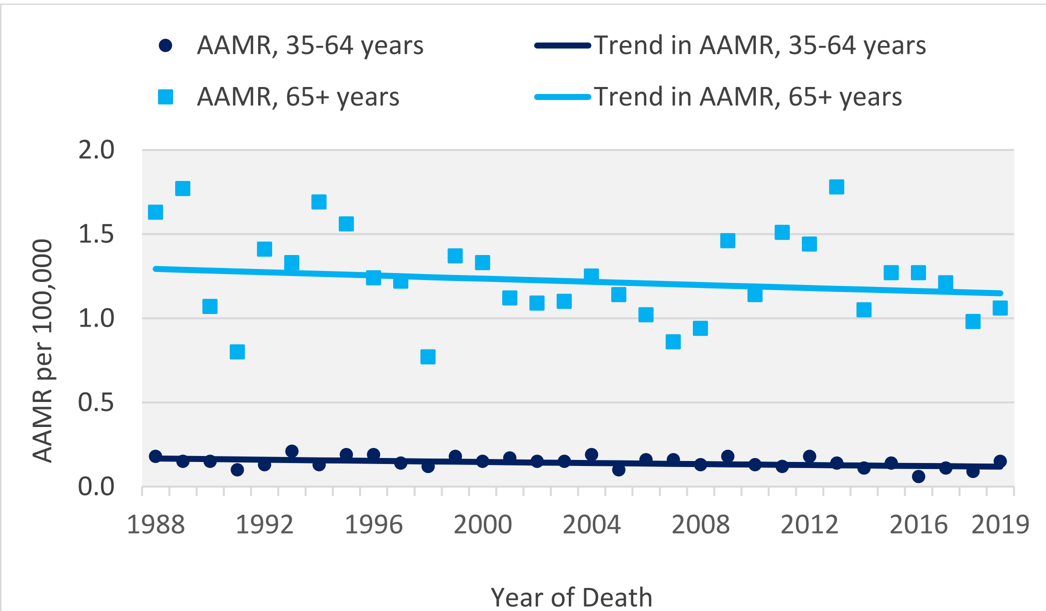
Table 35. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence Trend of Vaginal Cancer by Age at Diagnosis, California, 1988-2019

Age Group (years)	Joinpoint Analyses (1988-2019)			
	Trend 1/ Overall Trend		Post-Vaccine Trend†	
	Time Period	APC/AAPC	Time Period	AAPC
0-19	^	^	^	^
20-34	^	^	^	^
35-64	1988-2019	-0.8	2006-2019	-0.8
65+	1988-2000	-0.8*	2006-2019	-0.8*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019.
^Trend could not be calculated because at least one year had zero cases reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

A significant decrease in vaginal cancer mortality of 1.1 percent per year on average was observed among those aged 35 to 64 years, but mortality was stable among those aged 65 years and older (Figure 53 and Table 36). Trends in vaginal cancer mortality could not be calculated for those aged 19 years and younger or those aged 20 to 34 years because no deaths from vaginal cancer were reported in these populations in one or more years.

Figure 53. Trend in the Age-Adjusted Mortality Rate (AAMR) of Vaginal Cancer by Age at Diagnosis, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

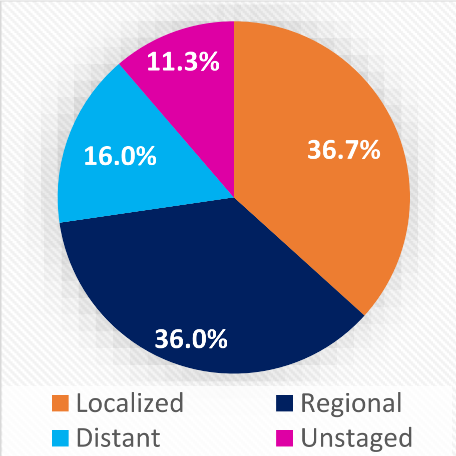
Table 36. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Mortality Trend of Vaginal Cancer by Age at Death, California, 1988-2019

Age Group (years)	Joinpoint Analyses (1988-2019)			
	Trend 1/Overall Trend		Post-Vaccine Trend†	
	Time Period	APC/AAPC	Time Period	AAPC
0-19	^	^	^	^
20-34	^	^	^	^
35-64	1988-2019	-1.1*	2006-2019	-1.1*
65+	1988-2019	-0.4	2006-2019	-0.4

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019.
^Trend could not be calculated because at least one year had zero deaths from the disease reported in the population
Source of data: California Cancer Registry, California Department of Public Health.

From 2015 to 2019, 52 percent of vaginal cancers were diagnosed late stage (36 percent regional stage and 16 percent distant stage) (Figure 54).

Figure 54. Distribution of Vaginal Cancer by Stage at Diagnosis, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

A higher percent of late-stage vaginal cancers was diagnosed among Black/African Americans (57.4 percent) and persons with Medicaid/public health insurance (59.5 percent) (Table 37).

Table 37. Associations of Late-Stage Diagnosis with Race/Ethnicity, Health Insurance Type, and Neighborhood Socioeconomic Status among Vaginal Cancer Patients, California, 1988-2019 (N=2,550)

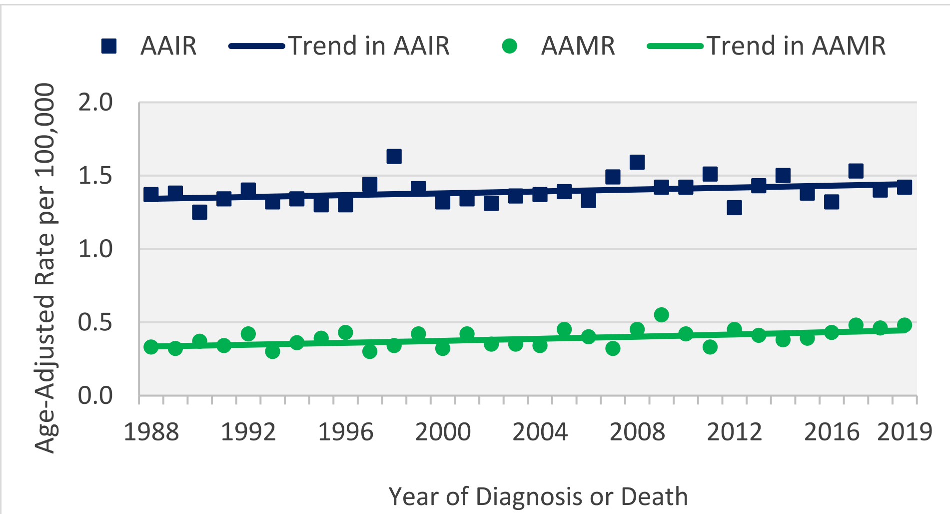
	Late-Stage Diagnoses		
Characteristic	**N**	**Percent (%)**	**P Value**
Race/Ethnicity			
Asian/Pacific Islander	111	53.4%	<0.001
Black/African American	113	57.4%	
Hispanic/Latina	282	49.6%	
Non-Hispanic/Latina White	815	52.6%	
Native American/Other/Unknown	4	14.8%	
Health Insurance			
Private/ Government	639	56.8%	<0.001
Medicare/ No Supplement	158	53.7%	
Medicaid/ Public	279	59.5%	
Uninsured	16	43.2%	
Unknown	233	37.3%	
Neighborhood Socioeconomic Status			
Low	438	52.6%	0.749
Medium	512	52.2%	
High	375	50.8%	

Source of data: California Cancer Registry, California Department of Public Health.

Vulvar Cancer

HPV is the probable cause of 69 percent of vulvar cancers.[18] Vulvar cancer is an uncommon disease, with 330 new diagnoses and 109 deaths in California per year. Vulvar cancer is the fourth most common HPV-associated cancer with a five-year age-adjusted incidence rate of 1.4 per 100,000 and a five-year age-adjusted mortality rate of 0.4 per 100,000. During the study period, incidence of vulvar cancer was stable but mortality from vulvar cancer significantly increased by an average of 0.9 percent per year (Figure 55 and Table 38).

Figure 55. Trend in the Age-Adjusted Incidence (AAIR) and Mortality (AAMR) Rate of Vulvar Cancer, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health

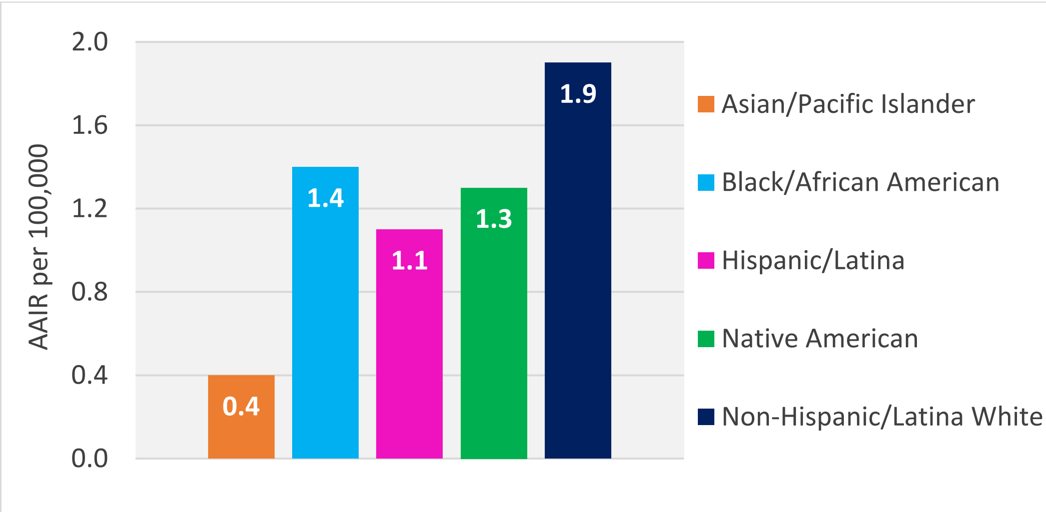
Table 38. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence and Mortality Trend of Vulvar Cancer, California, 1988-2019

	Joinpoint Analyses (1988-2019)			
	Trend 1/ Overall Trend		Post-Vaccine Period†	
Trend	Time Period	APC/AAPC	Time Period	AAPC
Incidence	1988-2019	0.2	2006-2019	0.2
Mortality	1988-2019	0.9*	2006-2019	0.9*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019.
Source of data: California Cancer Registry, California Department of Public Health

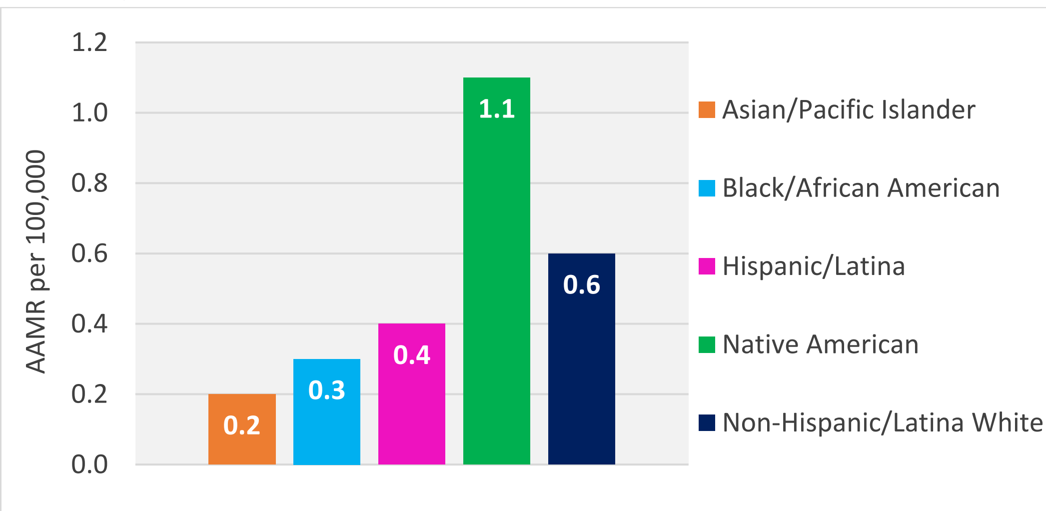
From 2015 to 2019, Whites had the highest age-adjusted incidence rate of vulvar cancer (AAIR= 1.9 per 100,000), followed by Black/African Americans (AAIR=1.4 per 100,000), Native Americans (AAIR=1.3 per 100,000), Hispanic/Latinas (AAIR=1.1 per 100,000), and Asian/Pacific Islanders (AAIR=0.4 per 100,000) (Figure 56). Native Americans had the highest age-adjusted mortality rate (AAMR=1.1 per 100,000), followed by Whites (AAMR=0.6 per 100,000), Hispanic/Latinas (AAMR=0.4 per 100,000), Black/African Americans (AAMR=0.3 per 100,000), and Asian/Pacific Islanders (AAMR=0.2 per 100,000) (Figure 57).

Figure 56. Five-Year, Age-Adjusted Incidence Rate (AAIR) of Vulvar Cancer by Race/Ethnicity, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

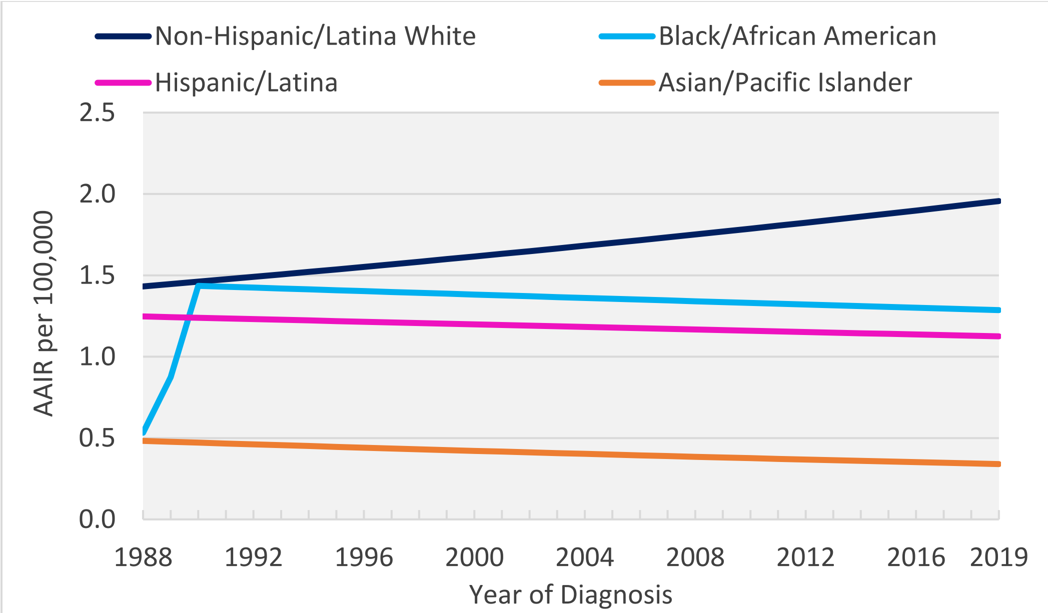
Figure 57. Five-Year, Age-Adjusted Mortality Rate (AAMR) of Vulvar Cancer by Race/Ethnicity, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

Vulvar cancer incidence increased significantly among Whites during the study period by an average of 1.0 percent per year (Figure 58 and Table 39). Incidence trends were stable for Asian/Pacific Islanders, Hispanic/Latinas, and Black/African Americans. The trend in vulvar cancer incidence could not be calculated for Native Americans because no cases of vulvar cancer were reported in this population in one or more years.

Figure 58. Trend in the Age-Adjusted Incidence Rate (AAIR) of Vulvar Cancer by Race/Ethnicity, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

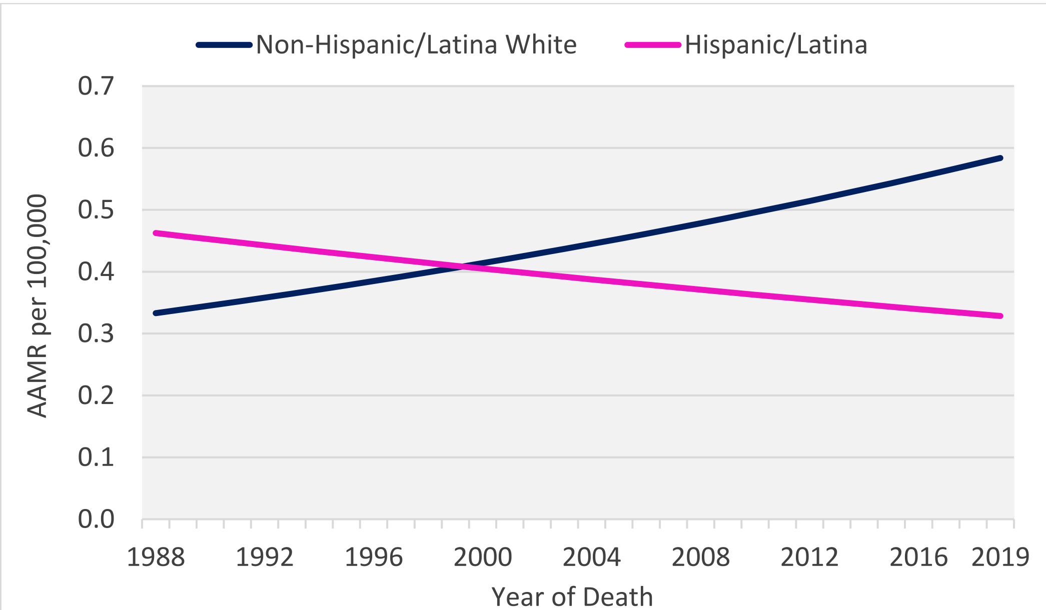
Table 39. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence Trend of Vulvar Cancer by Race/Ethnicity, California, 1988-2019

	Joinpoint Analyses (1988-2019)							
	Trend 1		Trend 2		Overall Trend		Post-Vaccine Trend†	
Race/Ethnicity	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
Asian/Pacific Islander	1988-2019	-1.1			1988-2019	-1.1	2006-2019	-1.1
Black/African American	1988-1990	64.2	1990-2019	-0.4	1988-2019	2.9	2006-2019	-0.4
Hispanic/Latina	1988-2019	-0.3			1988-2019	-0.3	2006-2019	-0.3
Native American	^	^	^	^	^	^	^	^
Non-Hispanic/Latina White	1988-2019	1.0*			1988-2019	1.0*	2006-2019	1.0*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019.
^Trend could not be calculated because at least one year had zero cases reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

Among Hispanic/Latinas, vulvar cancer mortality decreased significantly by an average of 1.1 percent per year during the study period (Figure 59 and Table 40). In contrast, vulvar cancer mortality among Whites significantly increased by an average of 1.8 percent per year. The trend in vulvar cancer mortality could not be calculated for Asian/Pacific Islanders, Black/African Americans, or Native Americans because no deaths from vulvar cancer were reported in these populations in one or more year.

Figure 59. Trend in the Age-Adjusted Mortality Rate (AAMR) of Vulvar Cancer by Race/Ethnicity, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health

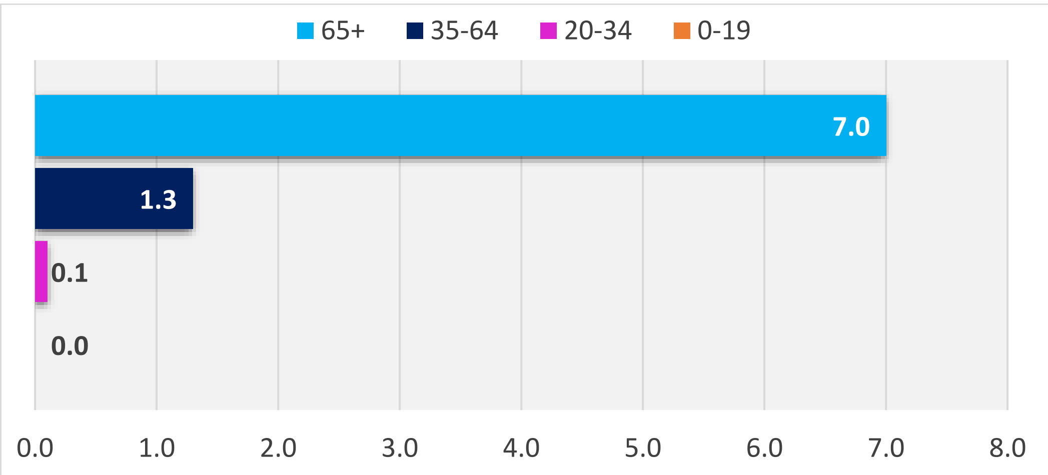
Table 40. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Mortality Trend of Vulvar Cancer by Race/Ethnicity, California, 1988-2019

	Joinpoint Analyses (1988-2019)			
	Trend 1/ Overall Trend		Post-Vaccine Trend†	
Race/Ethnicity	Time Period	APC/AAPC	Time Period	AAPC
Asian/Pacific Islander	^	^	^	^
Black/African American	^	^	^	^
Hispanic/Latina	1988-2019	-1.1*	2006-2019	-1.1*
Native American	^	^	^	^
Non-Hispanic/Latina White	1988-2019	1.8*	2006-2019	1.8*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019.
^Trend could not be calculated because at least one year had zero deaths from the disease reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

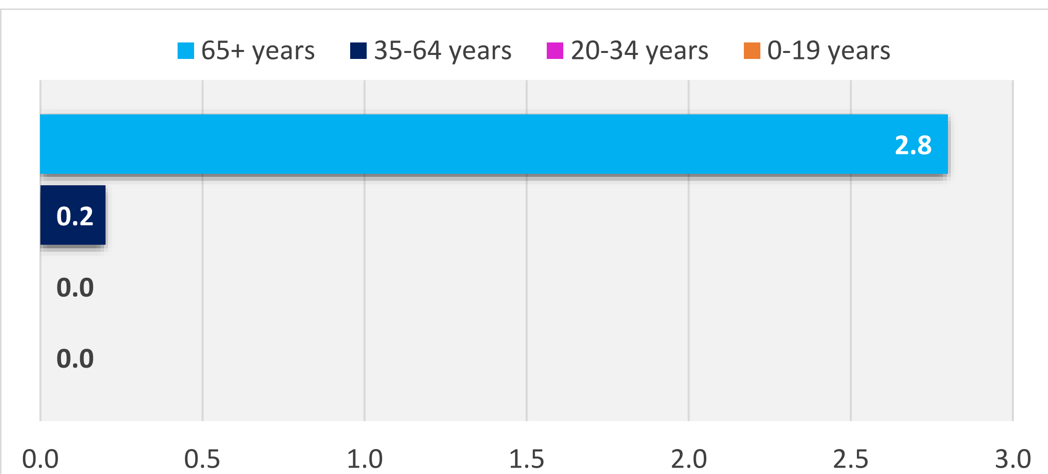
Incidence of vulvar cancer was highest among females aged 65 years and older (AAIR=7.0 per 100,000), followed by those aged 35 to 64 years (AAIR= 1.3 per 100,000), and those aged 20 to 34 years (AAIR=0.1 per 100,000) (Figure 60). There were no vulvar cancer cases reported among females aged 19 years or younger from 2015 to 2019. Females aged 65 years and older also had the highest age-adjusted mortality rate of vulvar cancer (AAMR= 2.8 per 100,00), followed by females aged 35 to 64 years (AAMR=0.2 per 100,000). There were less than 10 vulvar cancer deaths reported among females aged 20 to 34 years and no vulvar cancer deaths reported among those aged 19 years and younger from 2015 to 2019 (Figure 61).

Figure 60. Age-Adjusted Incidence Rate (AAIR) of Vulvar Cancer by Age at Diagnosis, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

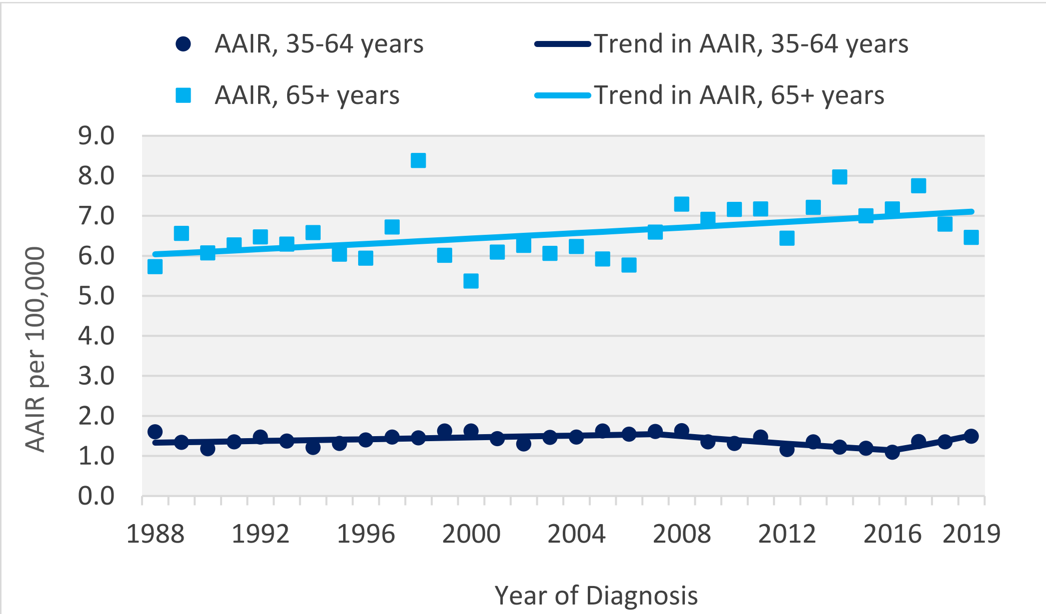
Figure 61. Age-Adjusted Mortality Rate (AAMR) of Vulvar Cancer by Age at Death, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

Vulvar cancer incidence among those aged 65 years and older significantly increased by an average of 0.5 percent per year during the study period (Figure 62 and Table 41). Among those aged 35 to 64 years, incidence of vulvar cancer was stable. Trends in vulvar cancer incidence could not be calculated for females aged 19 years or younger or those aged 20 to 34 years because no cases of vulvar cancer were reported in these populations in one or more years.

Figure 62. Trend in the Age-Adjusted Incidence Rate (AAIR) of Vulvar Cancer by Age at Diagnosis, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

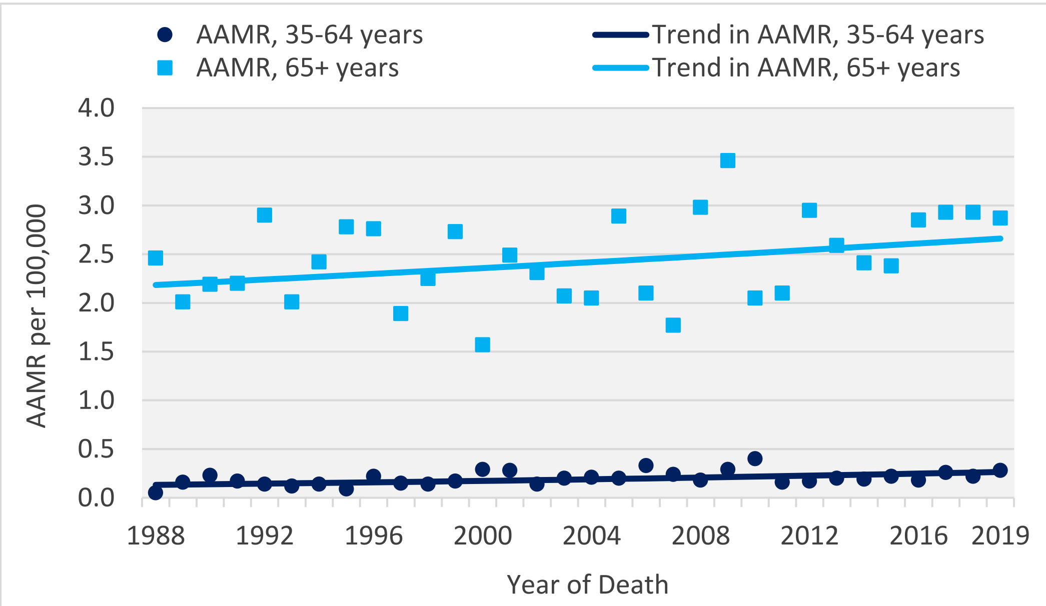
Table 41. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Incidence Trend of Vulvar Cancer by Age at Diagnosis, California, 1988-2019

Age Group (years)	Joinpoint Analyses (1988-2019)									
	Trend 1		Trend 2		Trend 3		Overall Trend		Post-Vaccine Trend†	
	Time Period	APC	Time Period	APC	Time Period	APC	Time Period	AAPC	Time Period	AAPC
0-19	^	^	^	^	^	^	^	^	^	^
20-34	^	^	^	^	^	^	^	^	^	^
35-64	1988-2007	0.8*	2007-2016	-3.3*	2016-2019	9.8	1988-2019	0.4	2006-2019	-0.1
65+	1988-2019	0.5*					1988-2019	0.5*	2006-2019	0.5*

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019.
^Trend could not be calculated because at least one year had zero cases reported in the population.
Source of data: California Cancer Registry, California Department of Public Health.

Although mortality from vulvar cancer is very low among those aged 35 to 64 years, a significant increase of 2.3 percent per year on average was observed in this population during the study period (Figure 63 and Table 42). However, vulvar cancer mortality was stable among those aged 65 years and older. Trends in vulvar cancer mortality could not be calculated for females aged 19 years or younger or those aged 20 to 34 years because no deaths from vulvar cancer were reported in these populations in one or more years.

Figure 63. Trend in the Age-Adjusted Mortality Rate (AAMR) of Vulvar Cancer by Age at Death, California, 1988-2019



Source of data: California Cancer Registry, California Department of Public Health.

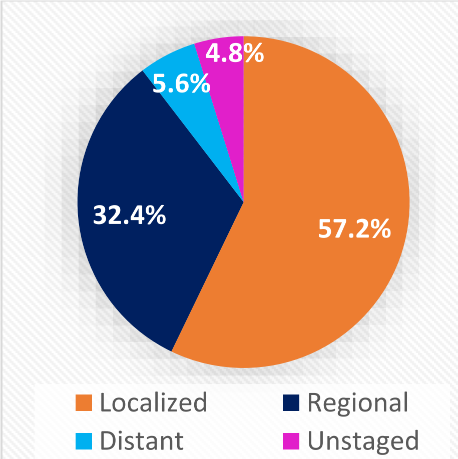
Table 42. Time Period and Corresponding Annual Percent Change (APC) and Average Annual Percent Change (AAPC) in the Mortality Trend of Vulvar Cancer by Age at Death, California, 1988-2019

Age Group (years)	Joinpoint Analyses (1988-2019)			
	Trend 1/Overall Trend		Post-Vaccine Trend†	
	Time Period	APC/AAPC	Time Period	AAPC
0-19	^	^	^	^
20-34	^	^	^	^
35-64	1988-2019	2.3*	2006-2019	2.3*
65+	1988-2019	0.6	2006-2019	0.6

*The APC and/or AAPC is significantly different from zero at alpha=0.05.
†The post-vaccine trend for females was calculated from 2006-2019.
^Trend could not be calculated because at least one year had zero deaths from the disease reported in the population
Source of data: California Cancer Registry, California Department of Public Health.

From 2015 to 2019, 38 percent of vulvar cancers were diagnosed late stage (32.4 percent regional stage and 5.6 percent late stage) (Figure 64).

Figure 64. Distribution of Vulvar Cancer by Stage at Diagnosis, California, 2015-2019



Source of data: California Cancer Registry, California Department of Public Health.

A higher percent of late-stage vulvar cancers was diagnosed among Asian/Pacific Islanders (42.9 percent), Hispanic/Latinas (42.0 percent), those with Medicaid/public health insurance (44.7 percent) and Medicare without supplement (41.2 percent), as well as individuals residing in low SES neighborhoods (41.2 percent) (Table 43).

Table 43. Associations of Late-Stage Diagnosis with Race/Ethnicity, Health Insurance Type, and Neighborhood Socioeconomic Status among Vulvar Cancer Patients, California, 1988-2019 (N=8,120)

Characteristic	Late-Stage Diagnoses		P Value
	N	Percent (%)	
Race/Ethnicity			
Asian/Pacific Islander	126	42.9%	<0.001
Black/African American	171	36.3%	
Hispanic/Latina	504	42.0%	
Native American	14	35.0%	
Non-Hispanic/Latina White	2,267	37.6%	
Other/Unknown	9	10.1%	
Health Insurance			
Private/ Government	1,483	37.7%	<0.001
Medicare/ No Supplement	418	41.2%	
Medicaid/ Public	665	44.7%	
Uninsured	32	30.8%	
Unknown	493	31.3%	
Neighborhood Socioeconomic Status			
Low	1,049	41.2%	<0.001
Medium	1,149	37.4%	
High	893	35.6%	

Source of data: California Cancer Registry, California Department of Public Health.

CONCLUSION

This report evaluated the burden of HPV-associated cancers in California from 1988 to 2019 and during distinct post-vaccine periods for females (2006-2019) and males (2009-2019). Disparities in incidence and mortality were observed by race/ethnicity, sex, and age at diagnosis or death. Disparities in the proportion of late-stage diagnoses were also observed by race/ethnicity, type of health insurance, and neighborhood SES. Data on HPV vaccine prevalence in California provide a lens through which to interpret our findings.

Vaccines that protect against infection of high-risk HPV strains that cause cancer have been available for females since 2006 and for males since 2009. The HPV vaccine has the potential to prevent over 90 percent of cancers caused by HPV infection.[19] In 2019, the overall HPV vaccination rate among California adolescents aged 13 to 17 years (56.4 percent) was lower than the Healthy People 2020 target rate of 80 percent.[8,20] Differences in HPV vaccination rates by sex, race/ethnicity, and health insurance coverage were also observed.[8] Multiple factors may contribute to these differences and the below-target vaccination rate. Such factors include: initial recommendation of HPV vaccination was for females only, HPV vaccination is not mandated for school entry, parental beliefs regarding necessity of vaccine, parental beliefs regarding sexual behavior, disparities in access to healthcare, and differing practices by healthcare providers.[21,22] Current differences in vaccination rates among sociodemographic subgroups may contribute to continuing differences in the incidence and mortality of HPV-associated cancers observed in these analyses.

Eventually, if vaccine rates improve, we would expect to see a significant decrease in the incidence of HPV-associated cancers in the post-vaccine period. Although some statistically significant decreases in cervical, oropharyngeal, penile, and vaginal cancer incidence were observed, these decreases were also occurring at a faster or similar rate during the entire study period. This indicates these decreases were probably not due to HPV vaccine uptake, but instead due to screening for cervical cancer and a decline in tobacco use for oropharyngeal cancer.[23,24]

It may be too early to detect changes in the incidence and mortality of HPV-associated cancers resulting from the HPV vaccine. Cancer has a long latency period of several decades. Females who were 11 years of age in 2006 when the HPV vaccine became available are now 27 years old. Males who were 11 years of age in 2009 when the HPV vaccine became available are now 24 years old. It may take several decades before we see a significant decline in the burden of HPV-associated cancers resulting from the HPV vaccine. Nonetheless, this report serves as a foundation on which to base future progress.

The observed disparities in the proportion of late-stage diagnoses of HPV-associated cancers by race/ethnicity, health insurance type, and neighborhood SES are concerning. Cervical cancer is the only HPV-associated cancer for which the U.S. Preventive Services Task Force recommends screening; yet 46 percent of cervical cancers in California were diagnosed late stage.[25] We found more late-stage diagnoses of cervical cancers among females with Medicaid/public health insurance or Medicare without supplement, among those residing in low SES neighborhoods, and among Asian/Pacific Islanders and Black/African Americans. These findings suggest a need for equitable access to cervical cancer screening and innovative public health programs focused on reducing social and structural barriers to care among these groups.

Other HPV-associated cancers have the potential to be detected early if patients have access to, and are seen regularly by, a healthcare provider. Vulvar and penile cancers exhibit symptoms that can be visualized including changes to the skin.[26,27] This could explain why these cancers had the lowest percentage of cases diagnosed late-stage (38 percent and 37 percent, respectively). Oropharyngeal cancer can also be detected early during routine oral exams by a dental hygienist, dentist, doctor, or self-exam, yet 80 percent of oropharyngeal cancers in California were diagnosed late-stage.[28]

Our findings highlight some potential directions for both future research and cancer control. Further research into the specific barriers to HPV vaccination and cancer screening in specific population subgroups would aid developing appropriate interventions to increase vaccination rates and reduce social and structural barriers to healthcare.

REFERENCES

1. Tommasino M. The human papillomavirus family and its role in carcinogenesis. *Semin Cancer Biol*. 2014;26:13-21. doi:10.1016/j.semcancer.2013.11.002

2. Araldi RP, Sant'Ana TA, Módolo DG, et al. The human papillomavirus (HPV)-related cancer biology: An overview. *Biomed Pharmacother*. 2018;106:1537-1556. doi:10.1016/j.biopha.2018.06.149

3. HPV and Cancer. National Cancer Institute. Updated October 2021. Accessed May 16, 2022. https://www.cancer.gov/about-cancer/causes-prevention/risk/infectious-agents/hpv-and-cancer

4. Human Papillomavirus (HPV) Vaccination & Cancer Prevention. Centers for Disease Control and Prevention. Updated November 2021. Accessed March 23, 2022. https://www.cdc.gov/vaccines/vpd/hpv/index.html

5. 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. doi:10.15585/mmwr.mm6833a3

6. Human Papillomavirus (HPV) Vaccines. National Cancer Institute. Updated May 2021. Accessed May 16, 2022. https://www.cancer.gov/about-cancer/causes-prevention/risk/infectious-agents/hpv-vaccine-fact-sheet

7. HPV Vaccination Recommendations. Centers for Disease Control and Prevention. Updated November 2021. Accessed May 19, 2022. https://www.cdc.gov/vaccines/vpd/hpv/hcp/recommendations.html.

8. Vaccination Coverage among Adolescents (13-17 Years). Centers for Disease Control and Prevention. Updated May 2021. Accessed May 5, 2022. https://www.cdc.gov/vaccines/imz-managers/coverage/teenvaxview/data-reports/index.html

9. International classification of diseases for oncology (ICD-O), 3rd ed., 1st revision. World Health Organization.

10. International Classification of Diseases, Ninth Revision (ICD-9). World Health Organization.

11. International Classification of Diseases, Tenth Revision (ICD-10). World Health Organization.

12. *SEER*Stat Software*. Version 8.4.0.0 National Cancer Institute; 2022. https://seer.cancer.gov/seerstat/

13. *Joinpoint Regression Program*. Version 4.7.0.0. National Cancer Institute; February 2019; https://surveillance.cancer.gov/joinpoint/

14. Young JL Jr, Roffers SD, Ries LAG, Fritz AG, Hurlbut AA (eds). SEER Summary Staging Manual - 2000: Codes and Coding Instructions, National Cancer Institute, NIH Pub. No. 01-4969, Bethesda, MD, 2001.

15. California Department of Public Health, Chronic Disease and Surveillance and Research Branch. California Cancer Reporting System Reporting Standards. Volume III: Data Standards for Regional Registries and California Cancer Registry. Sacramento, CA: California Department of Public Health, Chronic Disease and Surveillance and Research Branch; 2021.

16. Yost K, Perkins C, Cohen R, Morris C, Wright W. Socioeconomic status and breast cancer incidence in California for different race/ethnic groups. *Cancer Causes Control*. 2001;12(8):703-711. doi:10.1023/a:1011240019516

17. Yang J, Schupp CW, Harrati A, Clarke C, Keegan THM, Gomez SL. Developing an area-based socioeconomic measure from American Community Survey data. Cancer Prevention Institute of California, Fremont, California. 2014.

18. Center for Disease Control and Prevention. How Many Cancers Are Linked with HPV Each Year? Centers for Disease Control and Prevention. Updated 2021. Accessed June 8, 2022. https://www.cdc.gov/cancer/hpv/statistics/cases.htm.

19. HPV Cancers are Preventable. Centers for Disease Control and Prevention. Updated November 2021. Accessed June 15, 2022. https://www.cdc.gov/cancer/hpv/statistics/cases.htm.

20. 2020 Topics and Objectives: Immunization and Infectious Diseases. Office of Disease Prevention and Health Promotion. Updated February 2020. Accessed June 15, 2022. https://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases/objectives

21. Hirth J. Disparities in HPV vaccination rates and HPV prevalence in the United States: a review of the literature. *Hum Vaccin Immunother*. 2019;15(1):146-155. doi:10.1080/21645515.2018.1512453

22. Choi Y, Eworuke E, Segal R. What explains the different rates of human papillomavirus vaccination among adolescent males and females in the United States?. *Papillomavirus Res*. 2016;2:46-51. doi:10.1016/j.pvr.2016.02.001

23. Ma Z, Richardson LC. Cancer Screening Prevalence and Associated Factors Among US Adults. Prev Chronic Dis 2022;19:220063. DOI: http://dx.doi.org/10.5888/pcd19.2

24. Ellington TD, Henley SJ, Senkomago V, et al. Trends in Incidence of Cancers of the Oral Cavity and Pharynx — United States 2007–2016. MMWR Morb Mortal Wkly Rep 2020;69:433–438. DOI: http://dx.doi.org/10.15585/mmwr.mm6915a1

25. Recommendation: Cervical Cancer: Screening. U.S. Preventative Services Task Force website. Accessed June 15, 2022. https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/cervical-cancer-screening

26. Penile Cancer: Early Detection, Diagnosis and Staging. American Cancer Society. Updated January 2018. Accessed May 4, 2022. https://www.cancer.org/cancer/penile-cancer/detection-diagnosis-staging/signs-symptoms.html

27. Vulvar Cancer: Early Detection, Diagnosis, and Staging. American Cancer Society. Updated January 2018. Accessed May 4, 2022.https://www.cancer.org/cancer/vulvar-cancer/detection-diagnosis-staging/signs-symptoms.html.

28. Geographic Variations in Advanced Stage Oral and Oropharyngeal Cancers in California, 2008-2012. California Cancer Registry. Accessed June 15, 2022. https://www.ccrcal.org/retrieve-data/data-for-the-public/data-on-geographic-variations/geographic-variations-in-advanced-stage-oral-and-oropharyngeal-cancers/.

29. U.S. Cancer Statistics American Indian and Alaska Native Incidence Data. Centers for Disease Control and Prevention. Updated June 2022. Accessed June 15, 2022. https://www.cdc.gov/cancer/uscs/about/tools/AIAN-incidence-analytic-db.htm

APPENDIX A

Primary Site and Histology Classification of HPV-Associated Cancers[5]

Cancer Type	ICD-O-3* Histology Codes	ICD-O-3* Primary Site Code	Primary Site
Squamous Cell Carcinoma of the Oropharynx	8050-8084, 8120-8131	C01.9	Base of tongue, NOS^
		C02.4	Lingual tonsil
		C02.8	Overlapping lesion of tongue
		C05.1	Soft palate, NOS^
		C05.2	Uvula
		C09.0	Tonsillar fossa
		C09.1	Tonsillar pillar
		C09.8	Overlapping lesion of tonsil
		C09.9	Tonsil, NOS^
		C10.0	Vallecula
		C10.1	Anterior surface of epiglottis
		C10.2	Lateral wall of oropharynx
		C10.3	Posterior wall of oropharynx
		C10.4	Branchial cleft
		C10.8	Overlapping lesion of oropharynx
		C10.9	Oropharynx, NOS^
		C14.0	Pharynx, NOS^
		C14.2	Waldeyer ring
		C14.8	Overlapping lesion of lip, oral cavity, and pharynx
Squamous Cell Carcinoma of the Anus and Rectum	8050-8084, 8120-8131	C20.9	Rectum, NOS^
		C21.0	Anus, NOS^
		C21.1	Anal canal
		C21.2	Cloacogenic zone
		C21.8	Overlapping lesion of rectum, anus, and anal canal
Squamous Cell Carcinoma of the Vulva	8050-8084, 8120-8131	C51.0	Labium majus
		C51.1	Labium minus
		C51.2	Clitorus
		C51.8	Overlapping lesion of vulva
		C51.9	Vulva, NOS^
Squamous Cell Carcinoma of the Vagina	8050-8084, 8120-8131	C52.9	Vagina, NOS^

Primary Site and Histology Classification of HPV-Associated Cancers, Continued

Squamous Cell Carcinoma of the Penis	8050-8084, 8120-8131	C60.0	Prepuce
		C60.1	Glans penis
		C60.2	Body of penis
		C60.8	Overlapping lesion of penis
		C60.9	Penis, NOS^
Carcinoma of the Cervix	8010-8671, 8940-8941	C53.0	Endocervix
		C53.1	Exocervix
		C53.8	Overlapping lesion of cervix uteri
		C53.9	Cervix uteri

*ICD-O-3: International Classification of Diseases for Oncology, Third Edition.

^NOS: Not otherwise specified