



Trends in Human Papillomavirus (HPV)-Associated Cancers, Arkansas, 2001-2015

Kristyn Vang, MPH

Outline

- Purpose
- Background
 - Defining HPV-associated cancers
- U.S. Trends
- AR Trends
 - Incidence
 - Cancer by site
 - Demographics
 - Age, Sex, Race
- Associated vs. Attributable Risk
- Immunization Rates in AR

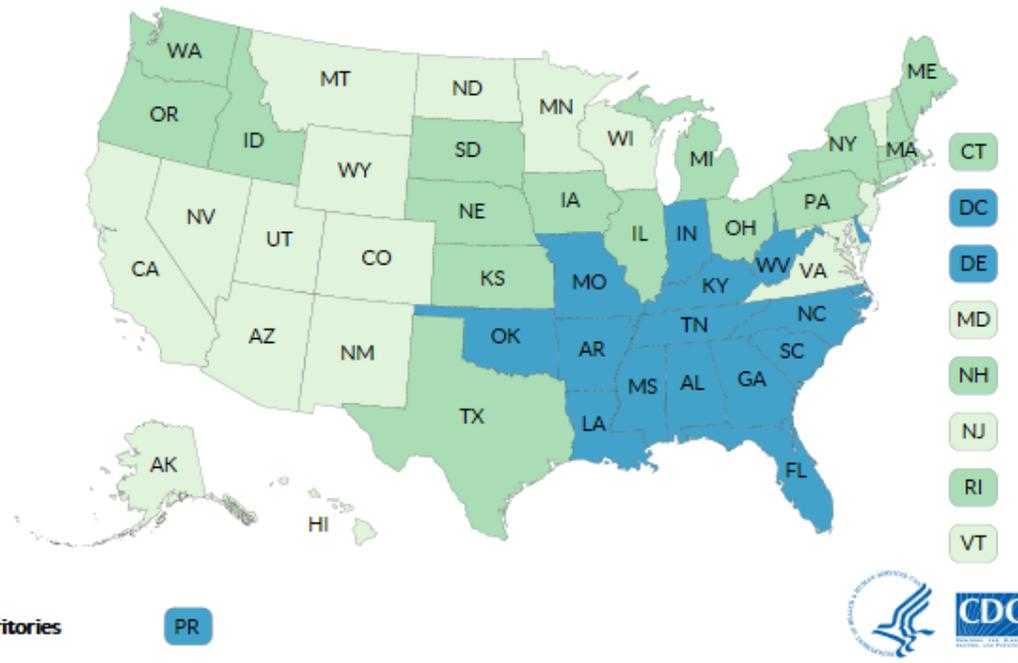
Purpose

- Analyze state-specific trends in HPV-associated cancers
- Describe current HPV vaccination rates in Arkansas
- Specify target populations
 - Cancer risk
 - Vaccination

Background

- Estimated 79 million HPV infections in U.S., 2008
- Most infections are transient, clear spontaneously
- Persistent infection can lead to cancer
 - Progression from infection to invasive cervical cancer: 10-15 years
- HPV causes cancer of the following sites:
 - Cervix
 - Vagina
 - Vulva
 - Anus/Rectum
 - Penis
 - Oropharynx (*including base of tongue, tonsils, and back of throat*)
- HPV vaccine publicly available in U.S. starting June 2006

HPV-Associated Cancer Rates by State, 2011-2015 Combined



Interval

- 8.05 to 11.33
- 11.34 to 13.08
- 13.09 to 15.67

State	Rate
1. KY	15.67
2. WV	14.94
3. MS	14.39
4. FL	14.27
5. AR	14.18
6. LA	13.91
7. DC	13.89
8. TN	13.79
9. PR	13.61
10. MO	13.57

Notes: Rates per 100,000, age –adjusted to the 2000 U.S. Standard Population.

Data source: National Program of Cancer Registries SEER*Stat Database: U.S. Cancer Statistics Incidence Analytic file 1998–2015. United States Department of Health and Human Services, Centers for Disease Control and Prevention. Released June 2018, based on the November 2017 submission.

Adapted from *HPV-Associated Cancer Rates by State*, by Division of Cancer Prevention and Control, Centers for Disease Control and Prevention, 2018, retrieved from <https://www.cdc.gov/cancer/hpv/statistics/state/index.htm> on 10/31/2018.

Technical Notes

Reporting Cancer Cases

The majority of cancer registries across the United States report to one of the following:

- CDC National Program of Cancer Registries (NPCR)
 - Arkansas Central Cancer Registry
- National Cancer Institute's (NCI) Surveillance, Epidemiology, and End Results (SEER) Program

NPCR recently collaborated with the Surveillance, Epidemiology, and End Results (SEER) Program to generate a high-quality population-based cancer incidence database for the entire United States.

Technical Notes (cont.)

Data Analysis for this Report

Data: National Program of Cancer Registries and Surveillance, Epidemiology, and End Results SEER*Stat Database: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Research Database, Nov 2017 submission (2001-2015), United States Department of Health and Human Services, Centers for Disease Control and Prevention and National Cancer Institute. Released June 2018, based on November 2017 submissions. Available at www.cdc.gov/cancer/public-use.

Software: Surveillance Research Program, National Cancer Institute SEER*Stat software (www.seer.cancer.gov/seerstat) version 8.3.5

- Incident cases only
 - Year listed = year of diagnosis
- Software automatically suppresses data and analysis if <16 cases in a group

Note: Some data, including county-level and survival information, sourced directly from Arkansas Central Cancer Registry and analyzed in the Central Cancer Registry Database Management System, CancerCORE v2.

Predefined Variables

Human Papillomavirus-Associated Cancers³⁻⁷

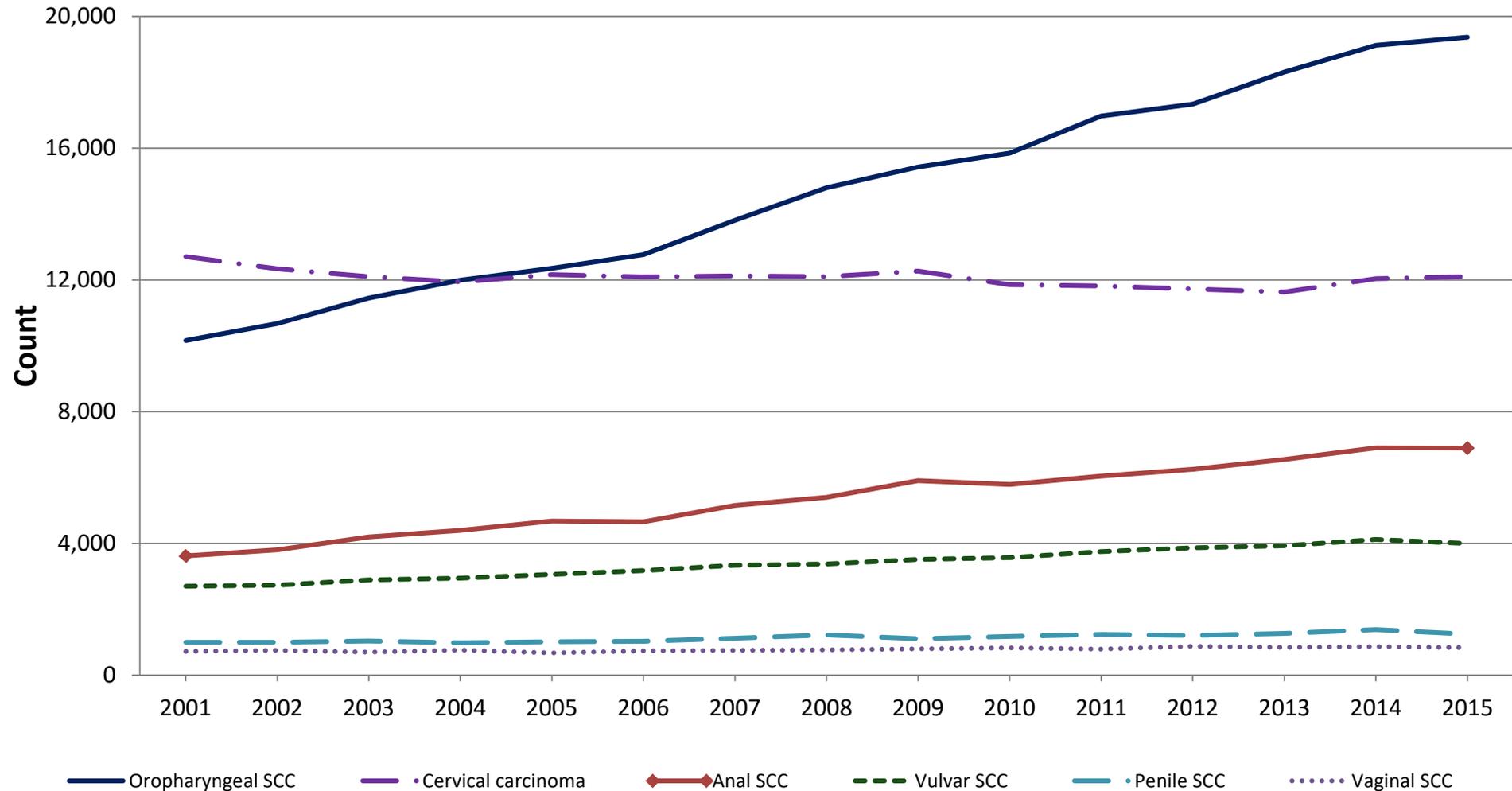
Cancer	ICD-O-3 site codes	ICD-O-3 histology codes	Additional restrictions
Squamous cell carcinoma of the oropharynx	C01.9, 02.4, 02.8, 05.1–05.2, 09.0–09.1, 09.8–09.9, 10.0–10.9, 10.8–10.9, 14.0, 14.2, 14.8	8050–8084, 8120–8131	Restrict to microscopically confirmed
Squamous cell carcinoma of the anus	C21.0–21.8, 20.9	8050–8084, 8120–8131	Restrict to microscopically confirmed
Squamous cell carcinoma of the vulva	C51.0–51.9	8050–8084, 8120–8131	Restrict to females and restrict to microscopically confirmed
Squamous cell carcinoma of the vagina	C52.9	8050–8084, 8120–8131	Restrict to females and restrict to microscopically confirmed
Carcinoma of the cervix	C53.0–53.9	8010–8671, 8940–8941	Restrict to females and restrict to microscopically confirmed
Squamous cell carcinoma of the penis	C60.0–60.9	8050–8084, 8120–8131	Restrict to males and restrict to microscopically confirmed

Notes: Table showing which International Classification of Disease for Oncology (ICD-O)-3 site codes, histology codes, and other restrictions used for the predefined SEER*Stat variables. Adapted from *Predefined SEER*Stat Variables for Calculating the Number of Associated Cancers for Selected Risk Factors*, by Centers for Disease Control and Prevention, 2017, retrieved from <https://www.cdc.gov/cancer/npcr/pdf/public-use/predefined-seer-stat-variables.pdf>

National Trends

2001-2015

Number of Incident HPV-Associated Cancers by Site, United States, 2001-2015

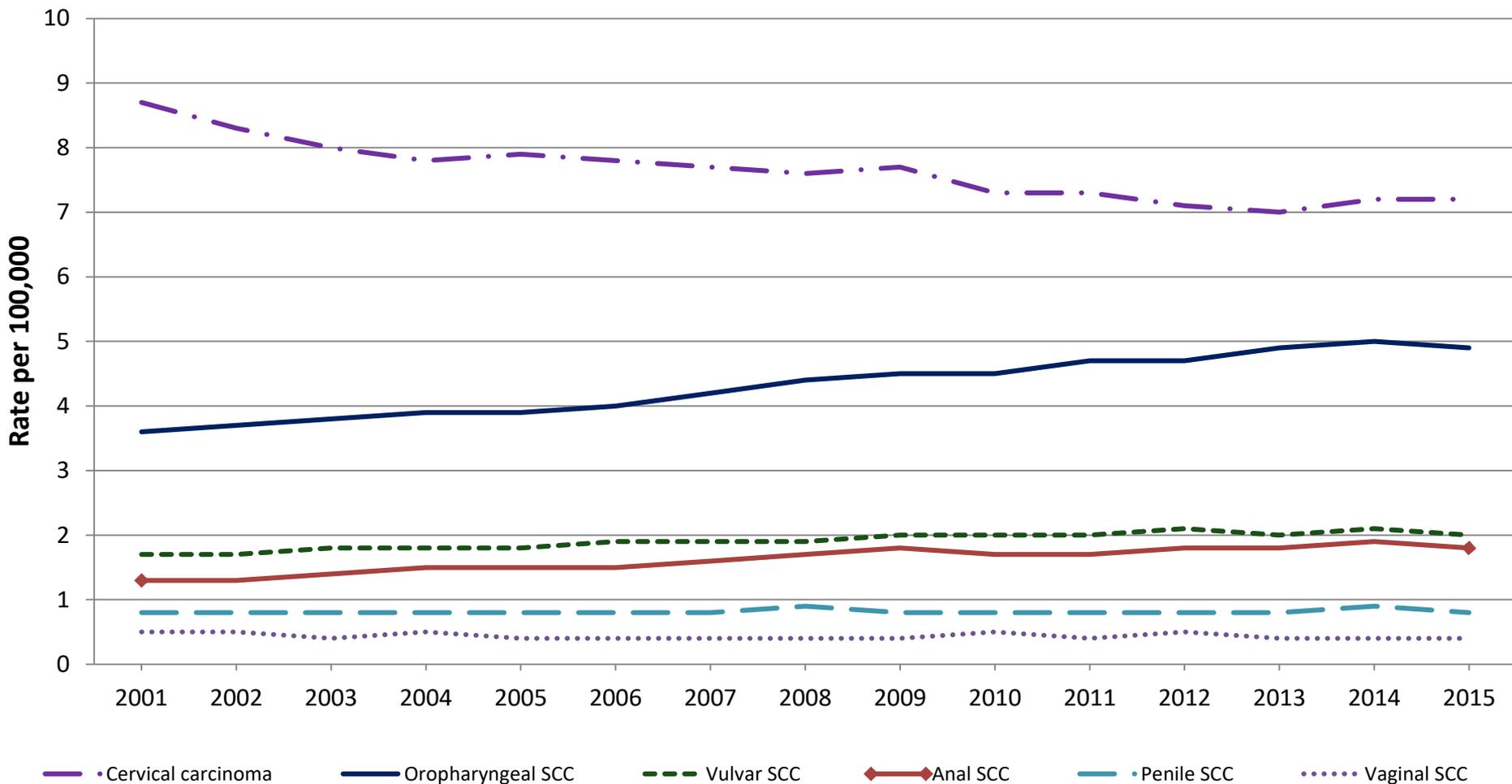


Abbreviations: SCC = squamous cell carcinoma

Software: Surveillance Research Program, National Cancer Institute SEER*Stat software (www.seer.cancer.gov/seerstat) version 8.3.5.

Data: SEER*Stat Database: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015). Created on 12/04/2018.

Trends in Age-Adjusted HPV-Associated Cancer Incidence by Site, United States, 2001-2015



Abbreviations: SCC = squamous cell carcinoma

Notes: Trend rates per 100,000 population age-adjusted to the 2000 U.S. Standard Population.

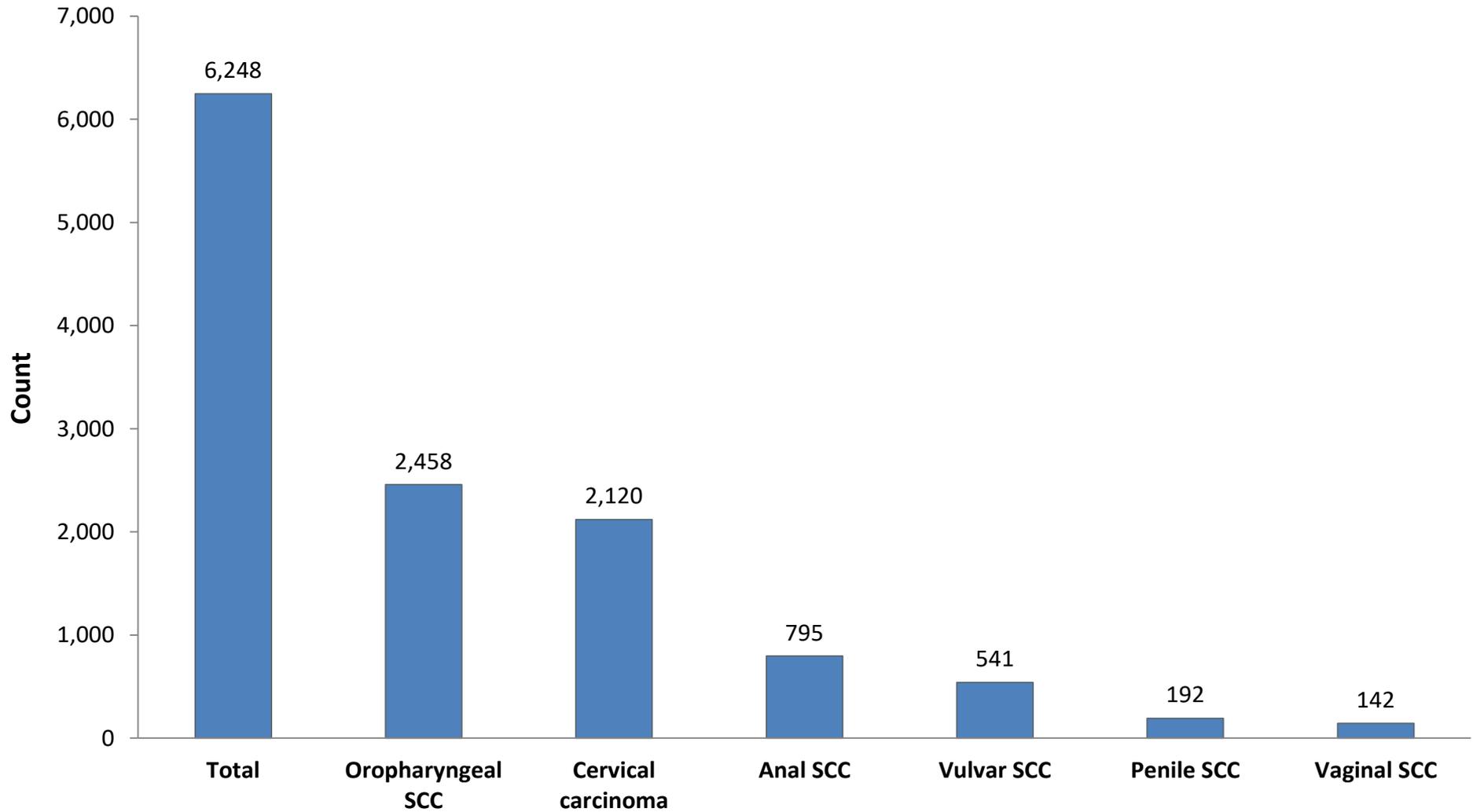
Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Created on 12/04/2018.

Arkansas Trends

2001-2015

Number of HPV-Associated Cancers Diagnosed in Arkansas by Cancer Type, 2001-2015 Combined

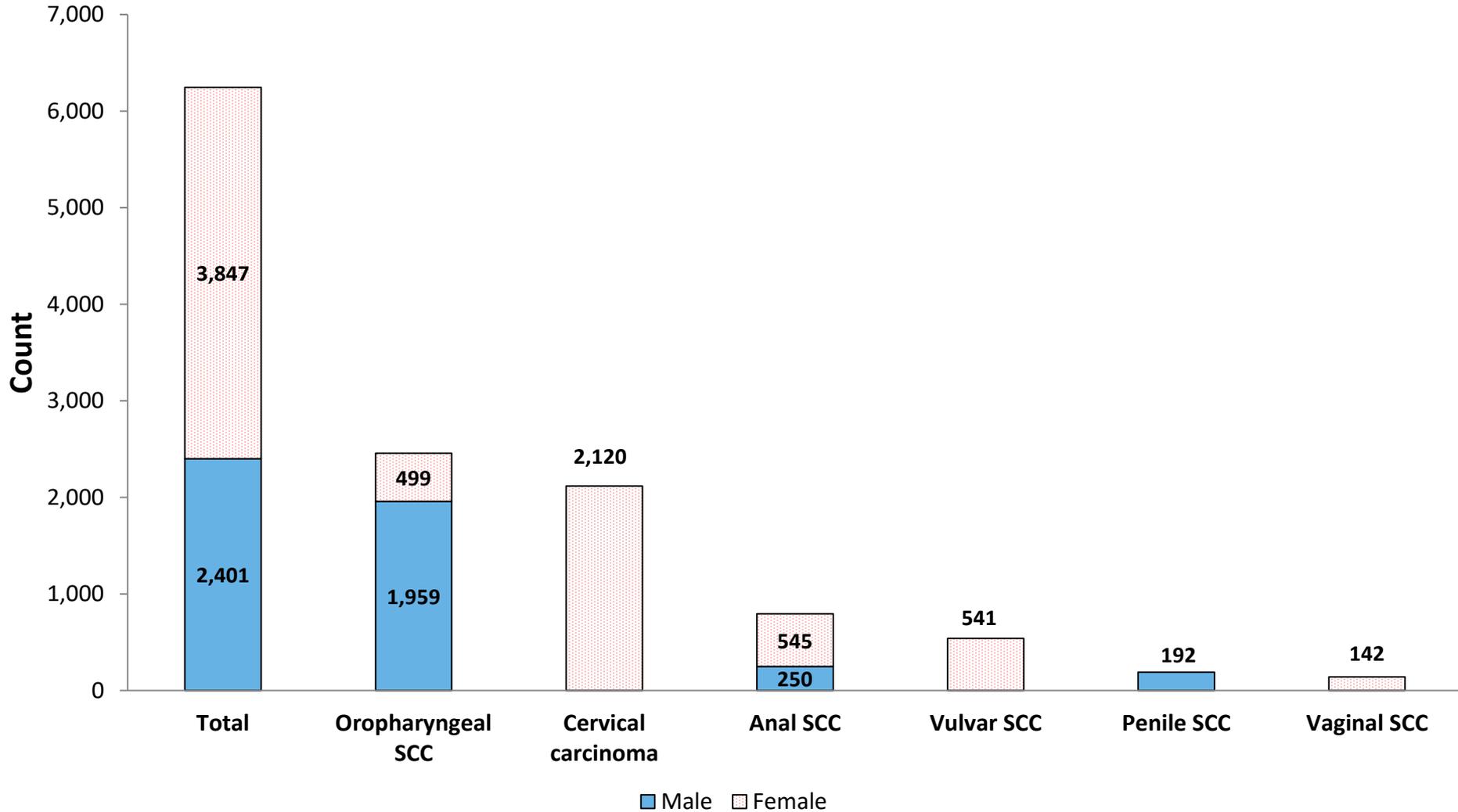


Abbreviations: SCC = squamous cell carcinoma

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Created on 11/6/2018.

Number of HPV-Associated Cancers Diagnosed in Arkansas by Cancer Type, 2001-2015 Combined

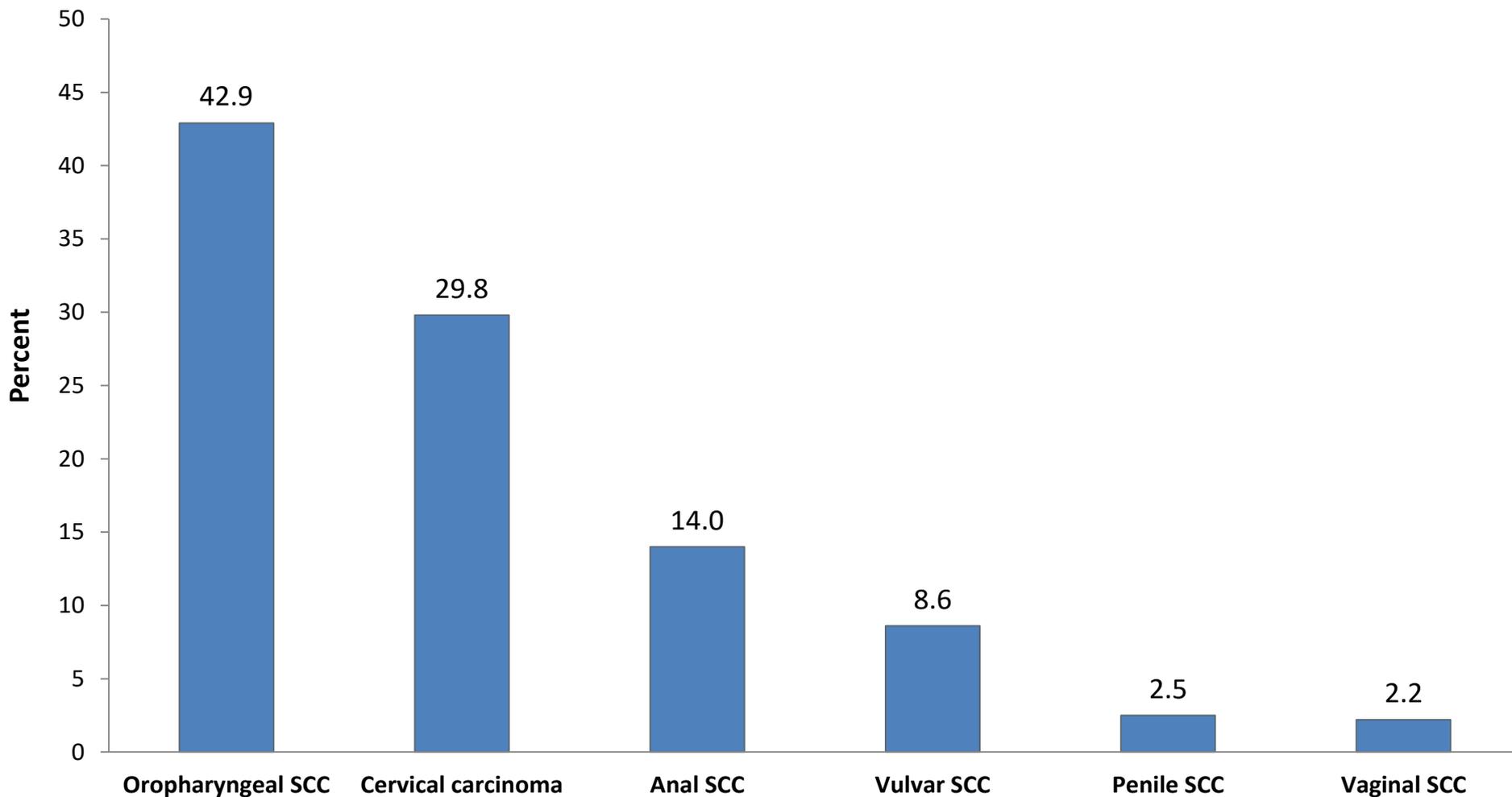


Abbreviations: SCC = squamous cell carcinoma

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Created on 12/04/2018.

Percentage of HPV-Associated Cancer by Type, Arkansas, 2013-2015 Combined

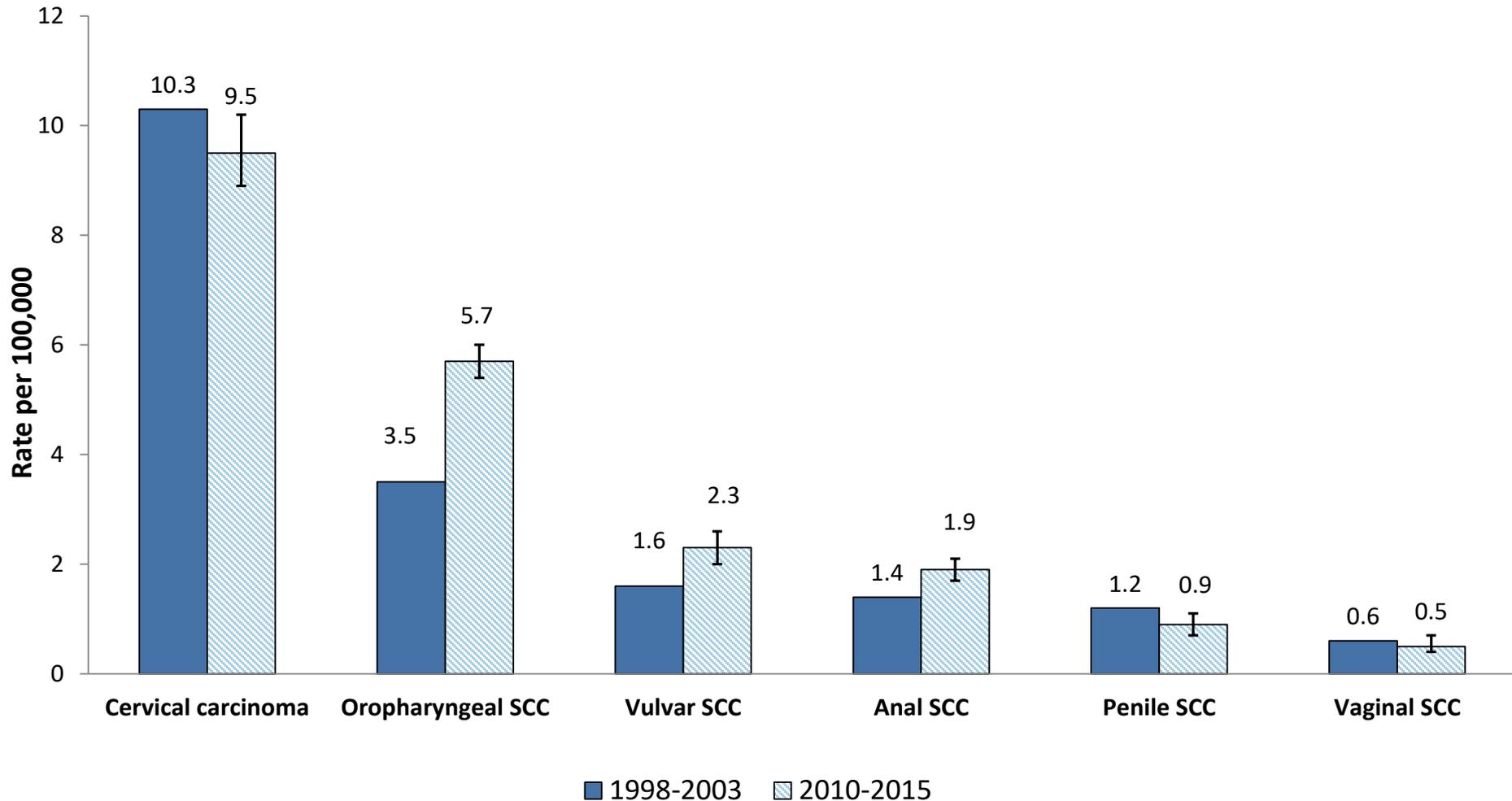


Abbreviations: SCC = squamous cell carcinoma

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Created on 10/19/2018.

Age-Adjusted Incidence of HPV-Associated Cancer by Site, Arkansas

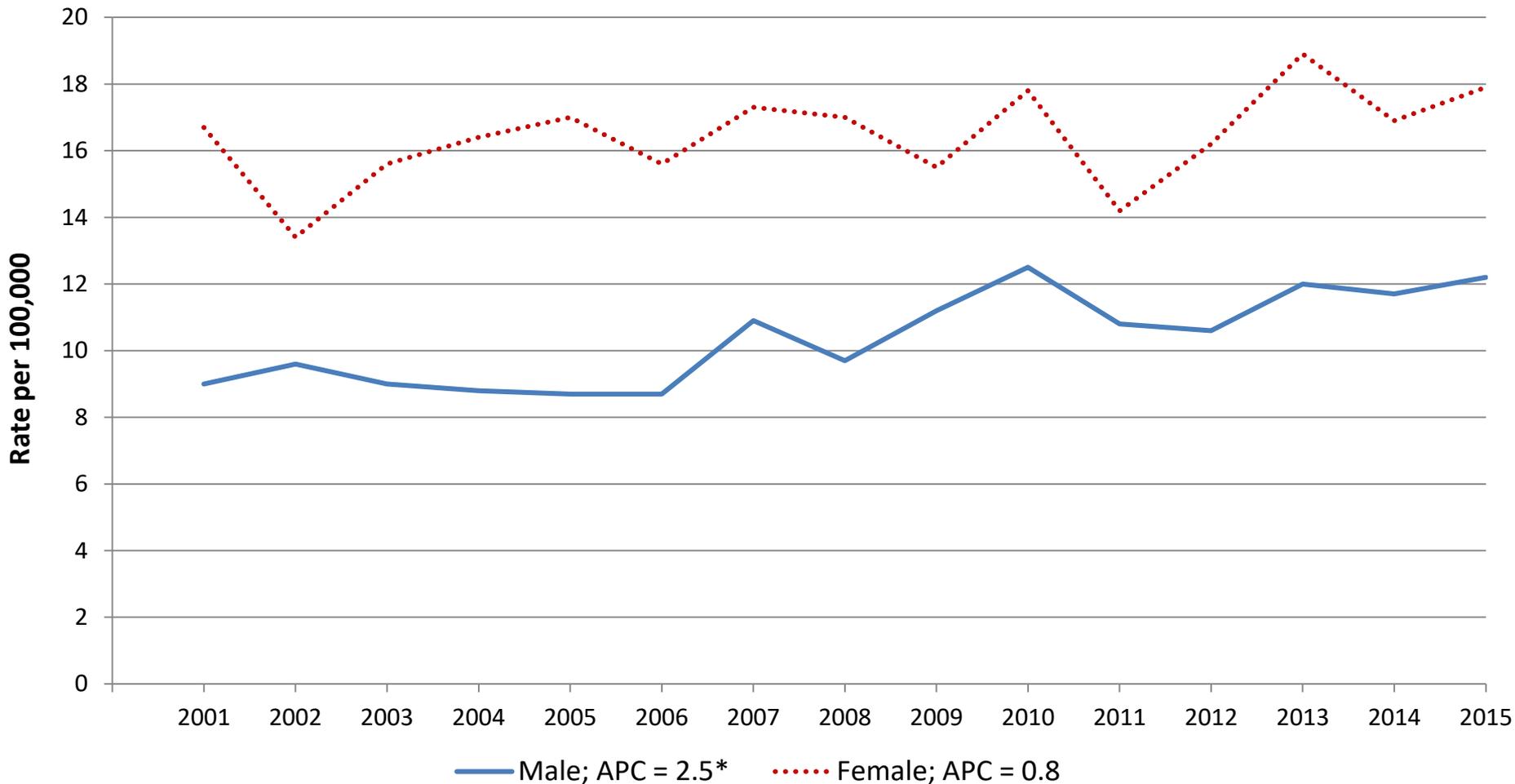


Abbreviations: SCC = squamous cell carcinoma

Notes: Trend rates per 100,000 population age-adjusted to the 2000 U.S. Standard Population. Rates are average annual estimates for years listed. 1998-2003 data adapted from Watson M et al. Using population-based cancer registry data to assess the burden of human papillomavirus-associated cancers in the United States: Overview of methods. *Cancer*. 2008 Nov 15;113(S10):2841-54.

Dataset, 2010-2015: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015). Created on 11/29/2018.

Trends in HPV-Associated Cancer[◇] by Sex, Arkansas, 2001-2015



[◇] HPV-associated cancers in males include oropharyngeal SCC, anal SCC, and penile SCC. HPV-associated cancers in females include oropharyngeal SCC, anal SCC, vaginal SCC, vulvar SCC, and cervical carcinoma.

* Significant at $p < 0.05$. Trends were measured with APC in rates and were considered to increase or decrease if $p < 0.05$.

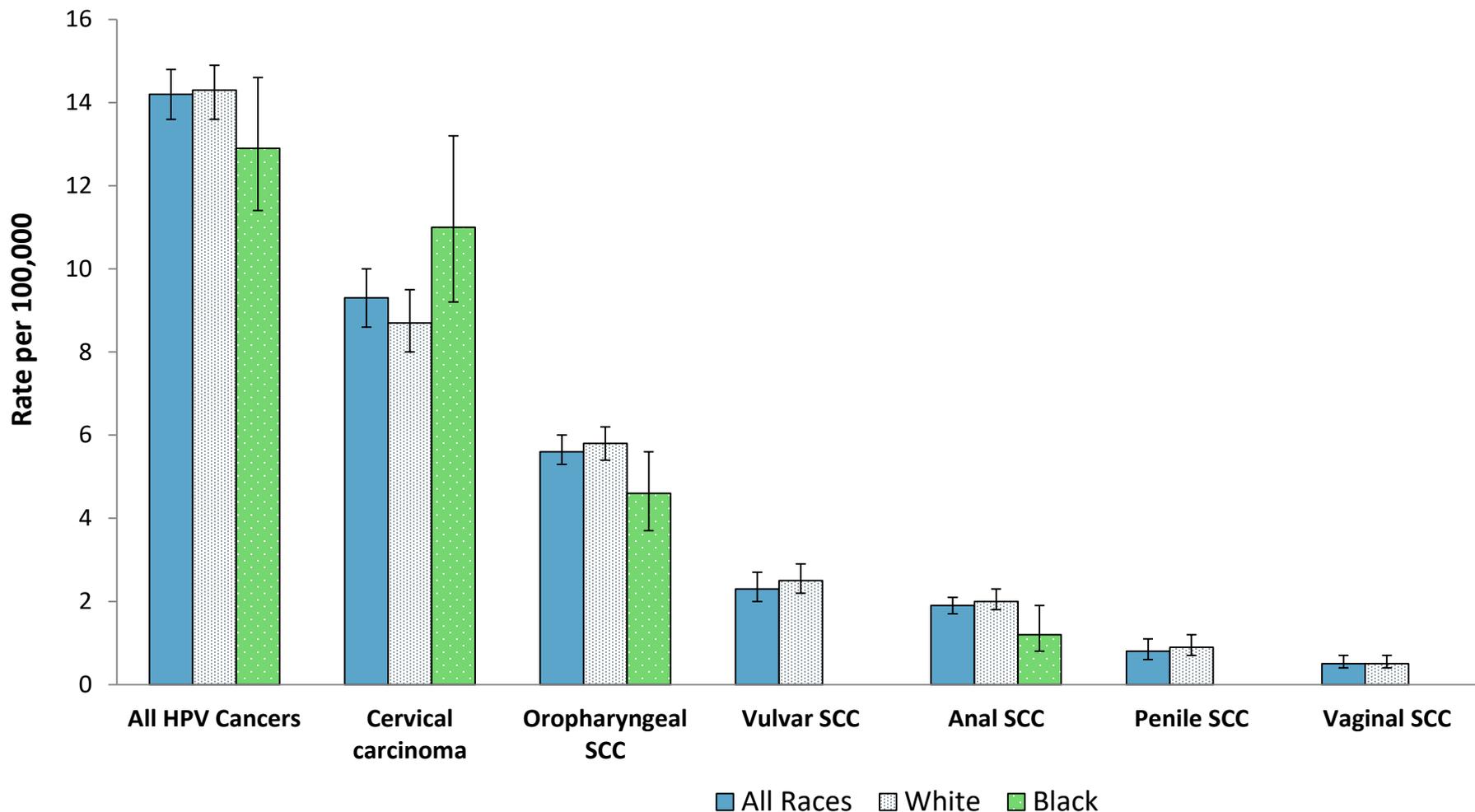
Note: Trend rates per 100,000 population age-adjusted to the 2000 U.S. Standard Population.

Abbreviations: APC = annual percentage change; SCC = squamous cell carcinoma.

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Created 11/14/18.

Age-Adjusted Incidence* of HPV-Associated Cancer by Site and Race, Arkansas, 2011-2015 Combined



*Rates suppressed if <16 cases per category.

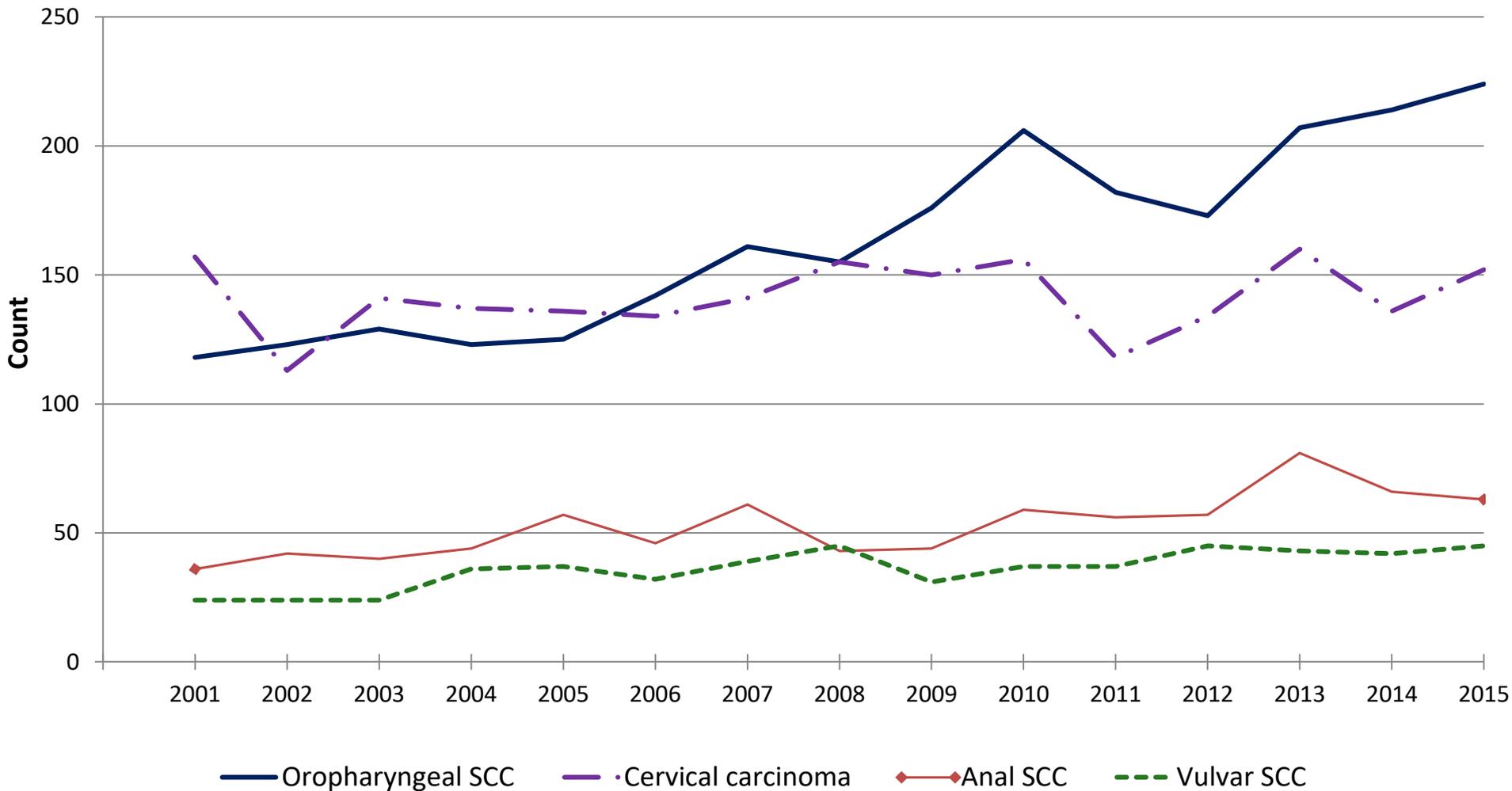
Abbreviations: SCC = squamous cell carcinoma

Notes: Trend rates per 100,000 population age-adjusted to the 2000 U.S. Standard Population.

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Created on 10/19/2018.

Number of Incident HPV-Associated Cancers by Site*, Arkansas, 2001-2015



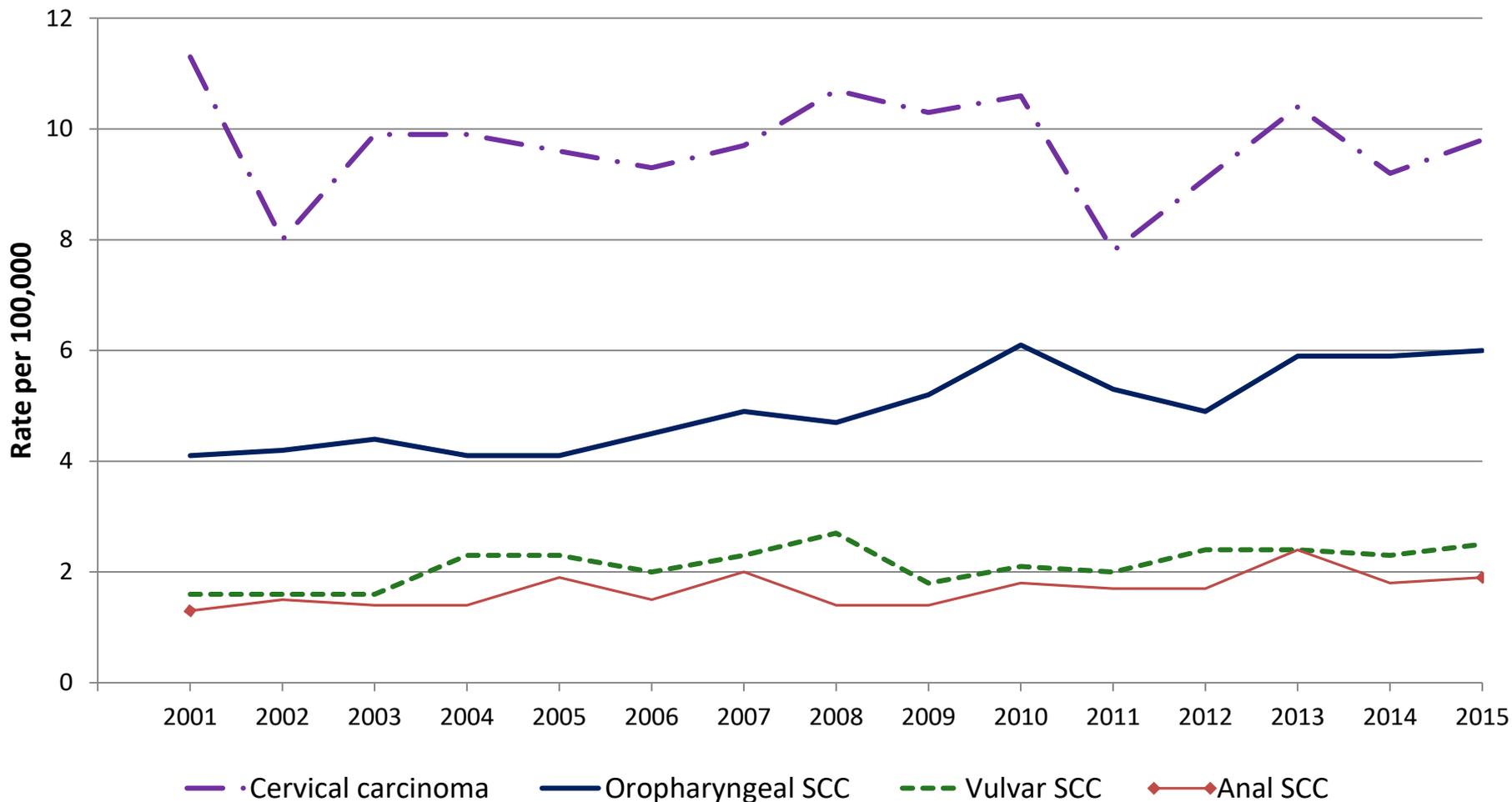
*Vaginal SCC and penile SCC statistics not displayed due to fewer than 16 cases per year.

Abbreviations: SCC = squamous cell carcinoma

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Created on 09/21/2018.

Trends in Age-Adjusted HPV-Associated Cancer Incidence by Site*, Arkansas, 2001-2015



* Vaginal SCC and penile SCC not displayed due to fewer than 16 cases per year in multiple years.

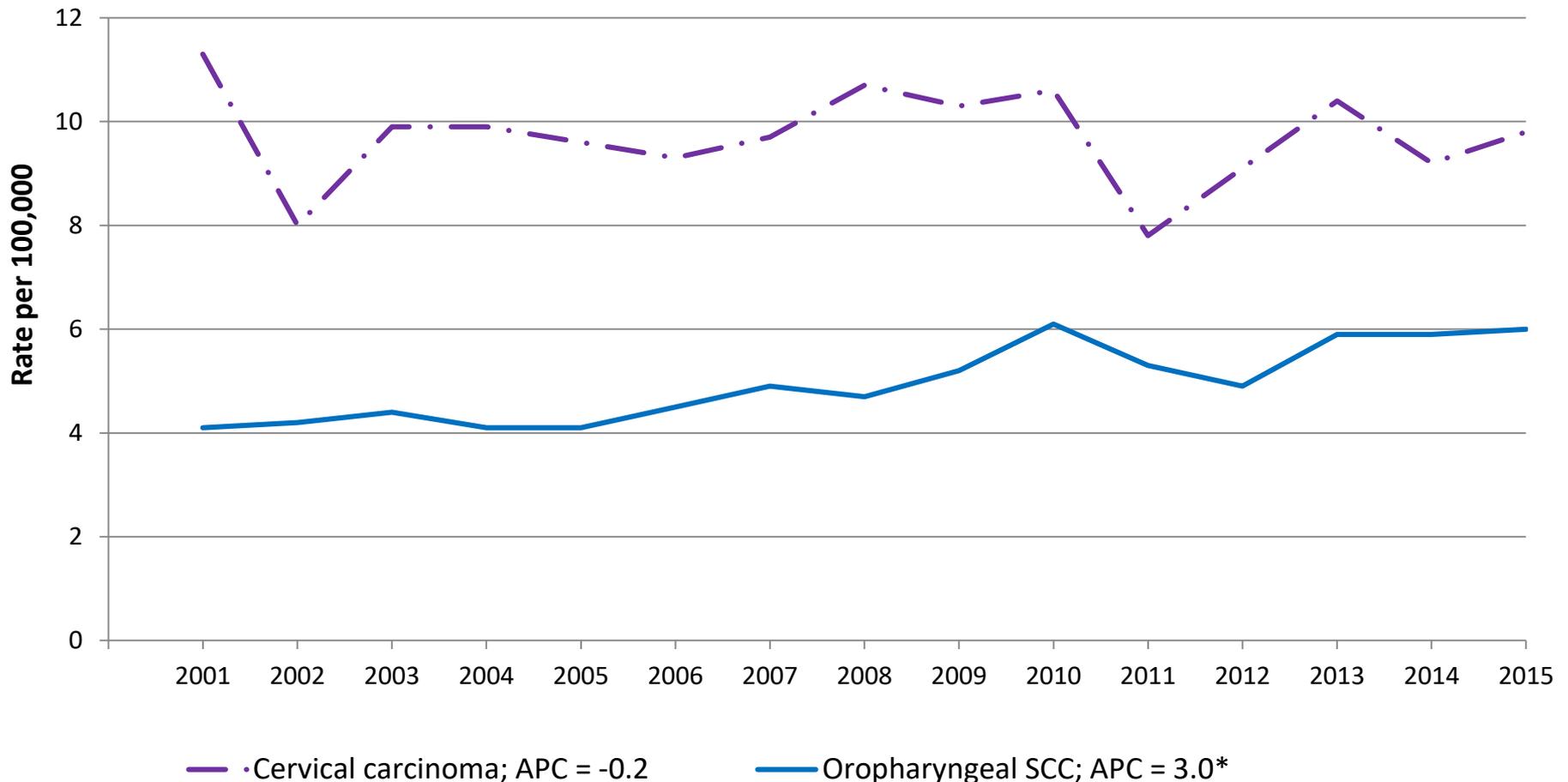
Abbreviations: SCC = squamous cell carcinoma

Notes: Trend rates per 100,000 population age-adjusted to the 2000 U.S. Standard Population.

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Created on 09/21/2018.

Trends in Age-Adjusted Incidence of Cervical Carcinoma Among Females and Oropharyngeal SCC Among Males and Females, Arkansas, 2001-2015



* Significant at $p < 0.05$. Trends were measured with APC in rates and were considered to increase or decrease if $p < 0.05$.

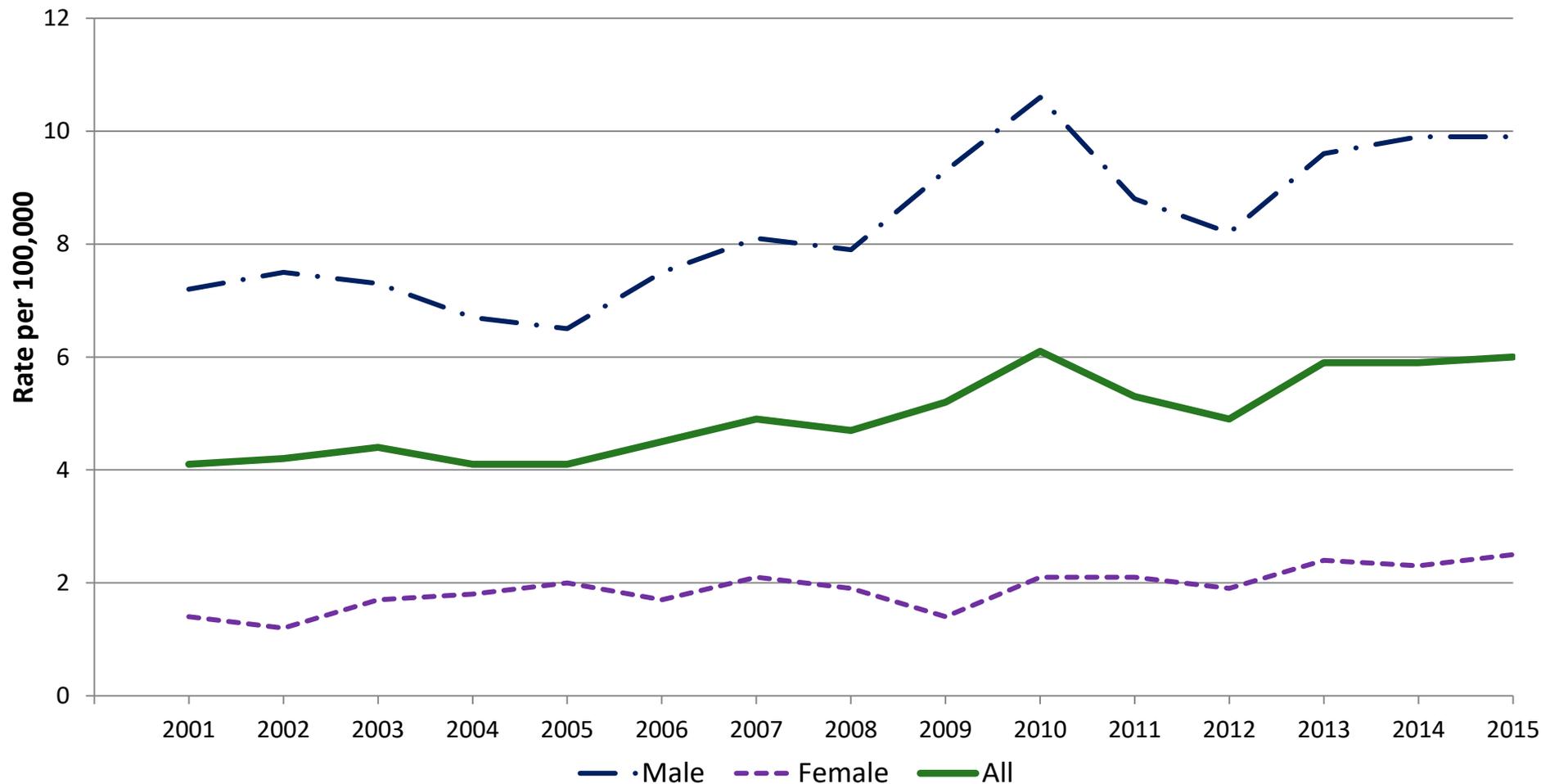
Abbreviations: APC = annual percentage change; SCC = squamous cell carcinoma.

Notes: Trend rates per 100,000 population age-adjusted to the 2000 U.S. Standard Population.

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Created on 09/21/2018.

Trends in Age-Adjusted Oropharyngeal SCC Rates by Sex, Arkansas, 2001-2015



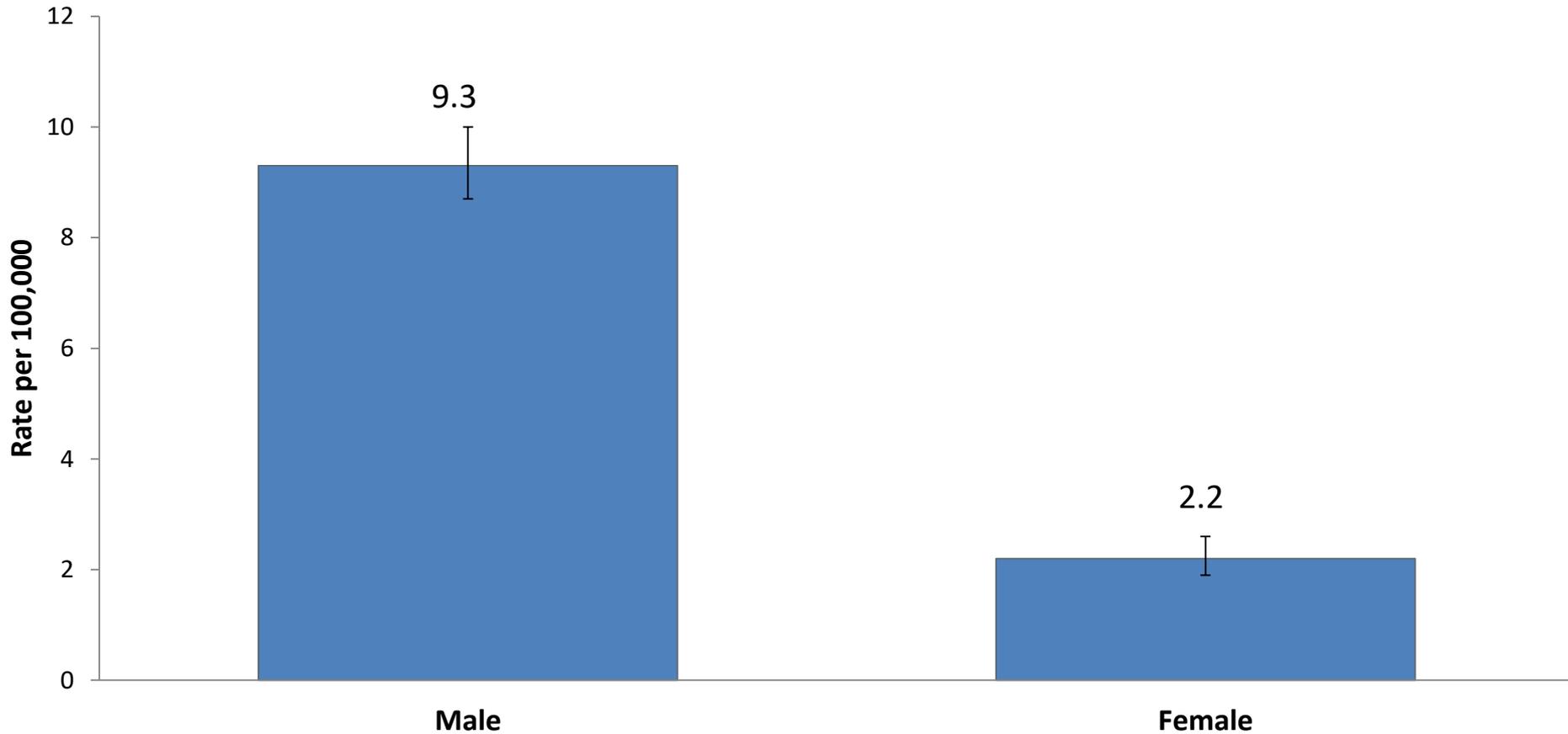
Abbreviations: SCC = squamous cell carcinoma

Notes: Trend rates per 100,000 population age-adjusted to the 2000 U.S. Standard Population.

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Created on 09/21/2018.

Age-Adjusted Oropharyngeal SCC Rates Among Males and Females, Arkansas, 2011-2015 Combined



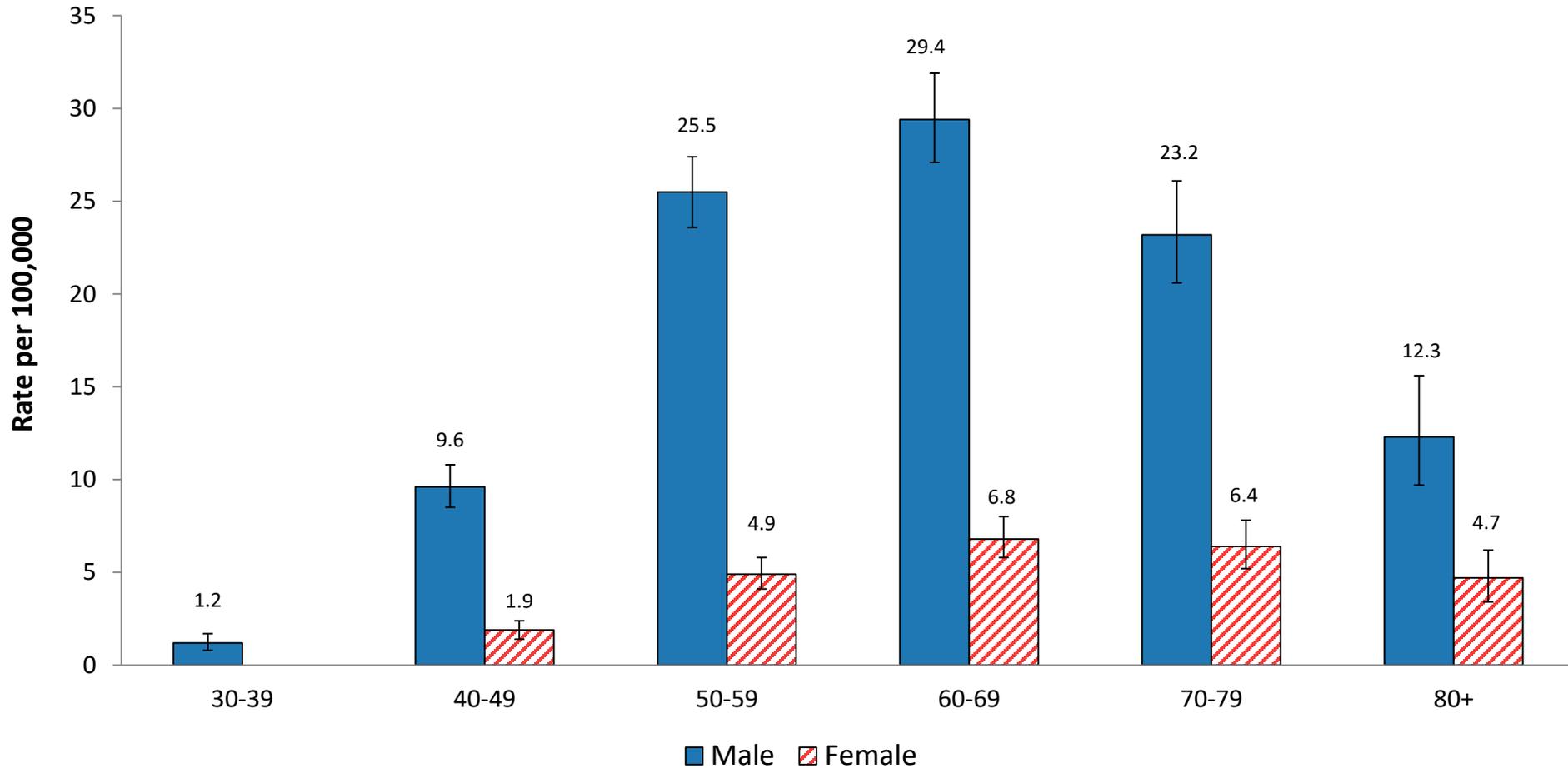
Abbreviations: SCC = squamous cell carcinoma

Notes: Trend rates per 100,000 population age-adjusted to the 2000 U.S. Standard Population.

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Created 10/29/2018.

Age-Adjusted Oropharyngeal SCC Rates* Among Males and Females by Age, Arkansas, 2001-2015 Combined



*Data suppressed for rates when the number of cases was <16 for a given category.

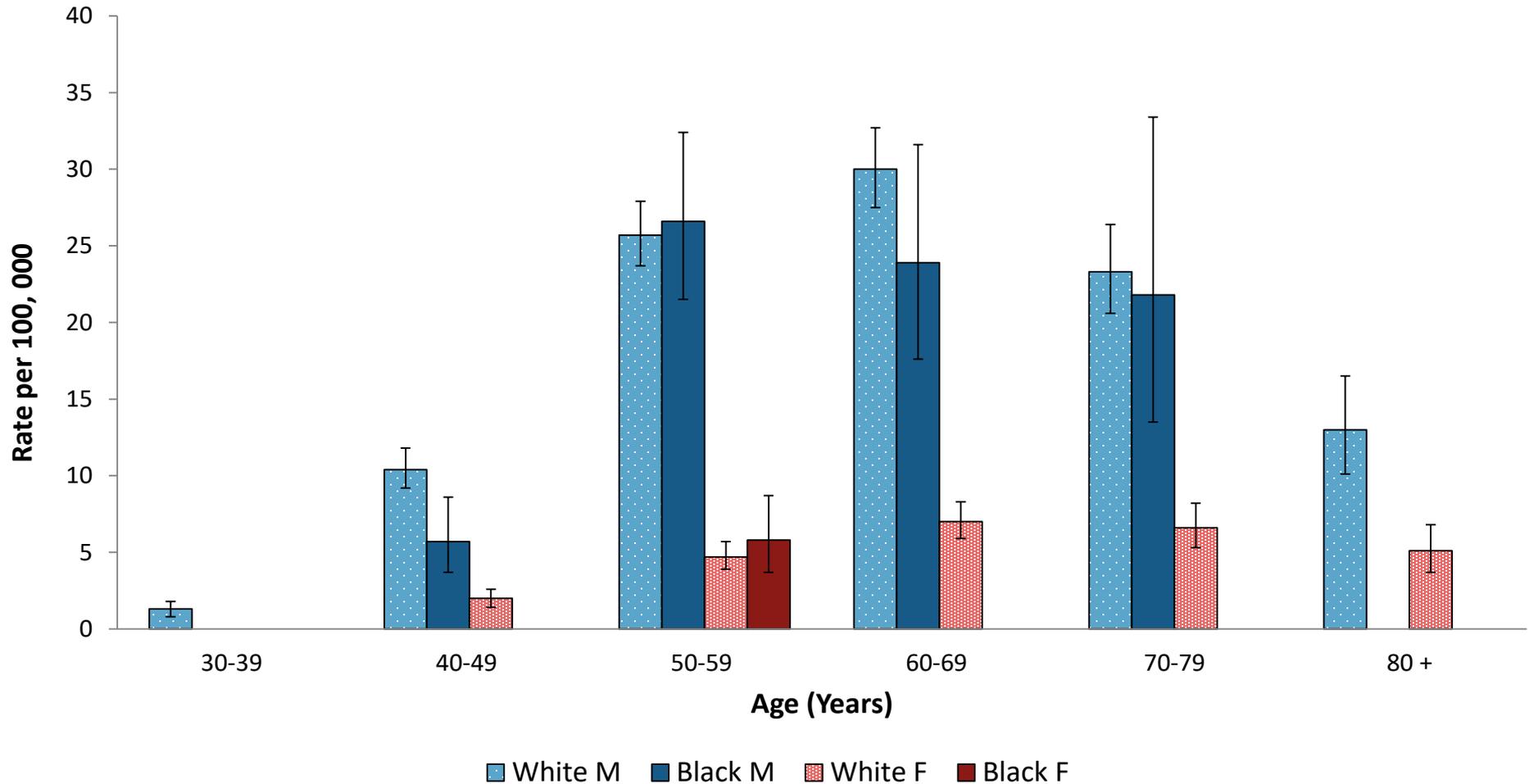
Abbreviations: SCC = squamous cell carcinoma

Notes: Trend rates per 100,000 population age-adjusted to the 2000 U.S. Standard Population.

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Created 11/13/2018.

Age-Adjusted Oropharyngeal SCC Rates* Among Males and Females by Race and Age, Arkansas, 2001-2015 Combined



*Data suppressed for rates when the number of cases was <16 for a given category.

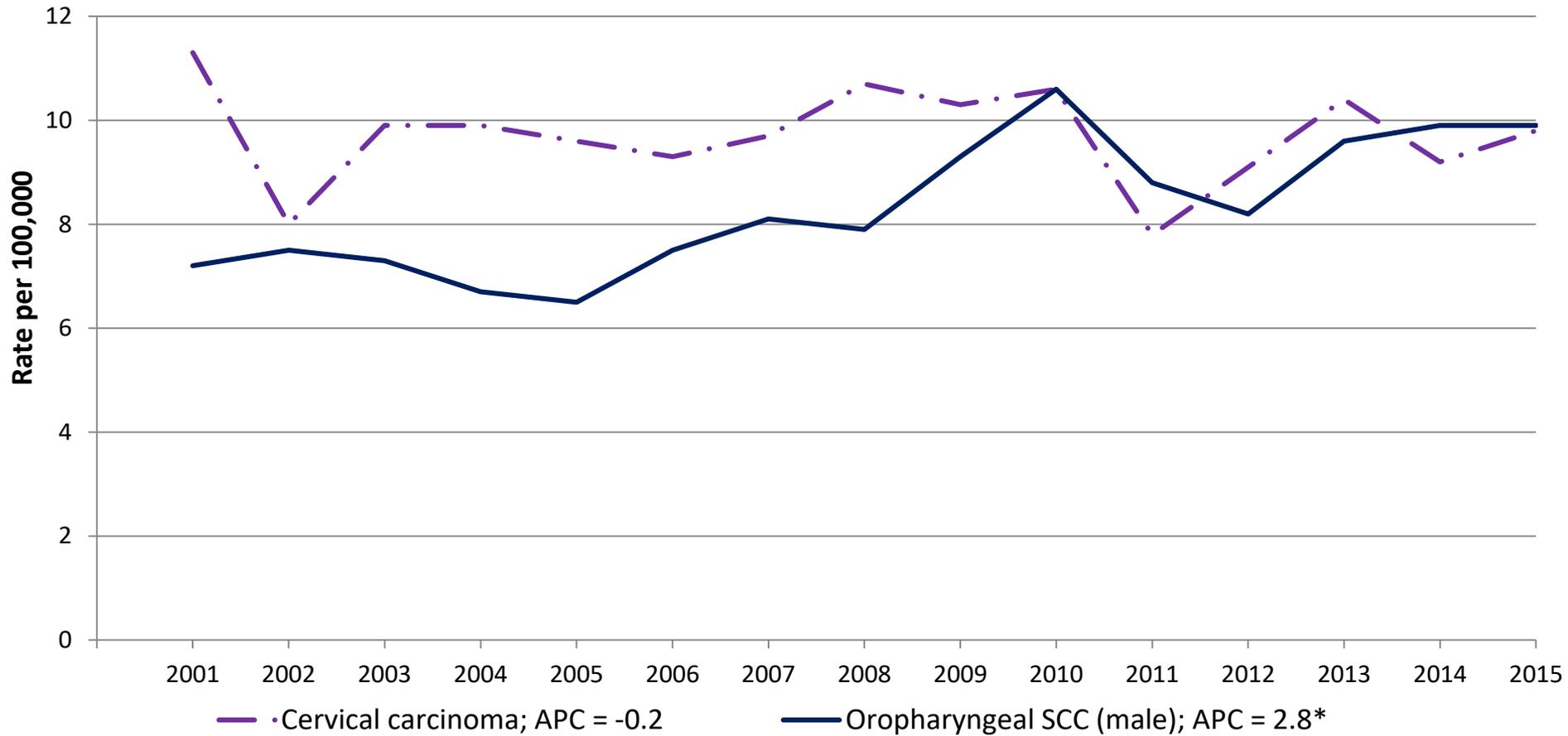
Abbreviations: SCC = squamous cell carcinoma

Notes: Trend rates per 100,000 population age-adjusted to the 2000 U.S. Standard Population.

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Created 10/29/2018.

Trends in Age-Adjusted Incidence of Cervical Carcinoma Among Females and Oropharyngeal SCC Among Men, Arkansas, 2001-2015



* Significant at $p < 0.05$. Trends were measured with APC in rates and were considered to increase or decrease if $p < 0.05$.

Abbreviations: APC = annual percentage change; SCC = squamous cell carcinoma.

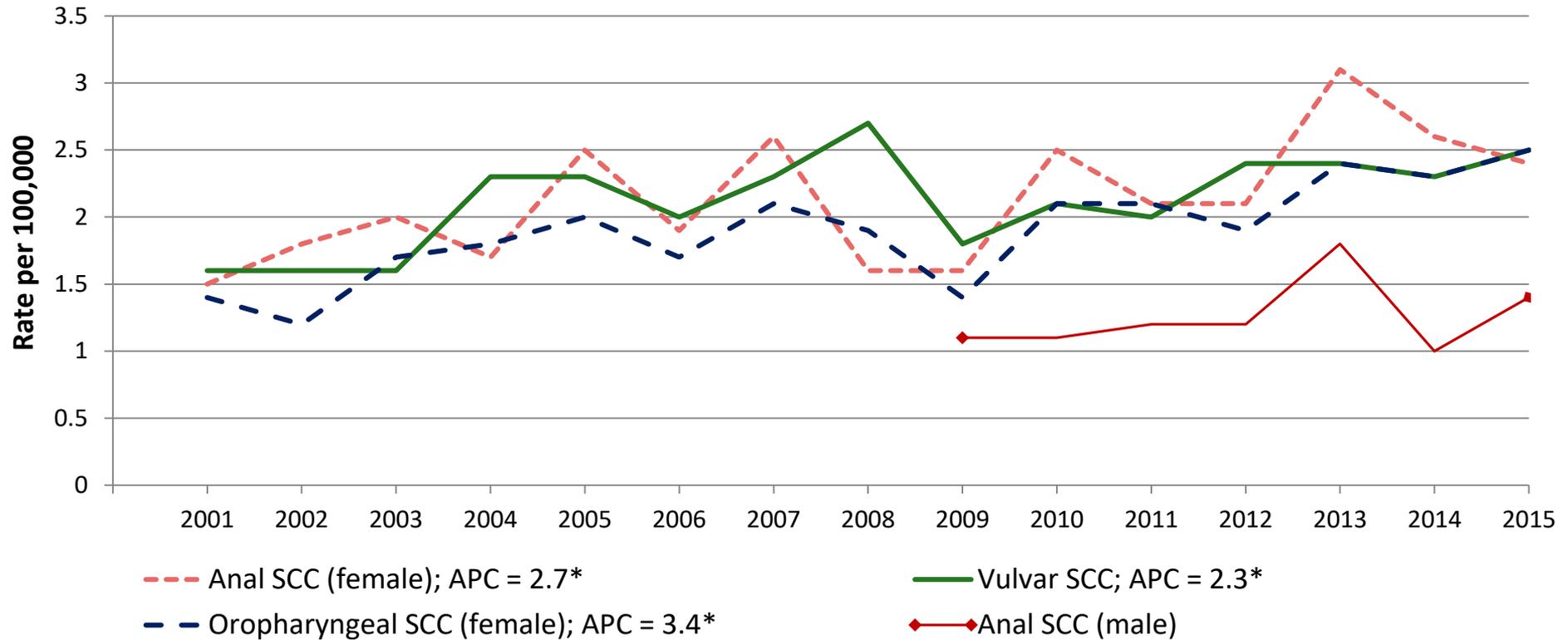
Notes: Trend rates per 100,000 population age-adjusted to the 2000 U.S. Standard Population.

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Analysis and methods based on: Van Dyne et al. Trends in Human Papillomavirus–Associated Cancers — United States, 1999–2015. *MMWR* 2018;67(33):918–924

Created on 09/21/2018.

Trends in Age-Adjusted HPV-Associated Cancer Incidence by Cancer Type and Sex, Arkansas, 2001-2015



* Significant at $p < 0.05$. Trends were measured with APC in rates and were considered to increase or decrease if $p < 0.05$.

Abbreviations: APC = annual percentage change; SCC = squamous cell carcinoma.

Notes: Anal SCC rates in males suppressed before 2010 when the number of cases was < 16 per year. Vaginal SCC and penile SCC not displayed due to < 16 cases per year in multiple years.

Trend rates per 100,000 population age-adjusted to the 2000 U.S. Standard Population.

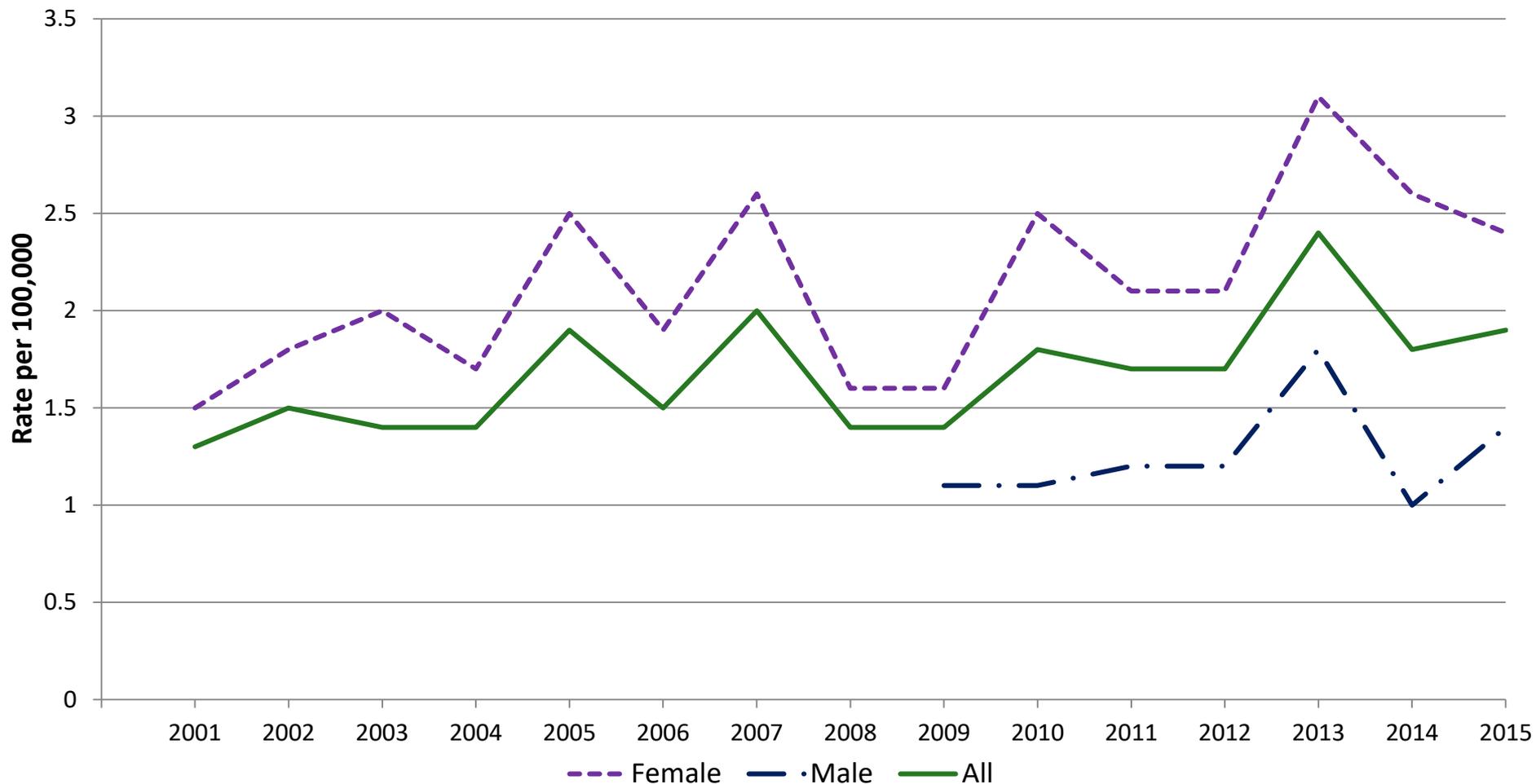
Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Analysis and methods based on: Van Dyne et al. Trends in Human Papillomavirus–Associated Cancers — United States, 1999–2015.

MMWR 2018;67(33):918–924

Created on 09/21/2018.

Trends in Age-Adjusted Anal SCC Incidence by Sex, Arkansas, 2001-2015



Notes: Counts for males 2001-2008 suppressed due to <16 cases per year for multiple years.

Abbreviations: SCC = squamous cell carcinoma

Trend rates per 100,000 population age-adjusted to the 2000 U.S. Standard Population.

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Created on 09/21/2018.

Annual Age-Adjusted Rates and Trends in HPV-Associated Cancer, Arkansas and United States, 2001-2015

Arkansas				United States			
Cancer Type	Period of Diagnosis			Cancer Type	Period of Diagnosis		
	2001	2015	2001-2015		2001	2015	2001-2015
	Rate (No.)	Rate (No.)	APC		Rate (No.)	Rate (No.)	AAPC
All HPV-associated cancers	13.0 (362)	15.0 (510)	1.4*	All HPV-associated cancers	11.0 (30,907)	12.1 (44,450)	0.9*
<i>Male</i>	9.0 (120)	12.2 (211)	2.5*	<i>Male</i>	7.7 (10,034)	10.6 (19,373)	2.4*
<i>Female</i>	16.7 (242)	17.9 (299)	0.8	<i>Female</i>	14.0 (20,873)	13.6 (25,077)	0
Oropharyngeal SCC	4.1 (118)	6.0 (224)	3.0*	Oropharyngeal SCC	3.6 (10,163)	4.9 (19,370)	2.4*
<i>Male</i>	7.2 (96)	9.9 (177)	2.8*	<i>Male</i>	5.9 (7,755)	8.5 (15,838)	2.7*
<i>Female</i>	1.4 (22)	2.5 (47)	3.4*	<i>Female</i>	1.6 (2,408)	1.7 (3,532)	1.0*
Anal SCC	1.3 (36)	1.9 (63)	2.7*	Anal SCC	1.3 (3,618)	1.8 (6,893)	2.4*
<i>Male</i>	~	1.4 (21)	~	<i>Male</i>	1.0 (1,282)	1.3 (2,288)	2.0*
<i>Female</i>	1.5 (25)	2.4 (42)	2.7*	<i>Female</i>	1.5 (2,336)	2.3 (4,605)	2.8*
Vulvar SCC	1.6 (24)	2.5 (45)	2.3*	Vulvar SCC	1.7 (2,701)	2.0 (4,001)	1.4*
Vaginal SCC	~	~	~	Vaginal SCC	0.5 (721)	0.4 (837)	-0.3
Penile SCC	~	~	~	Penile SCC	0.8 (997)	0.8 (1,247)	0
Cervical carcinoma	11.3 (157)	9.8 (152)	-0.2	Cervical carcinoma	8.7 (12,707)	7.2 (12,102)	-1.3*

* Significant at p<0.05. Trends were measured with AAPC in rates and were considered to increase or decrease if p<0.05.

~ Data suppressed for rates when the number of cases was <16 per year.

Abbreviations: AAPC = average annual percentage change; SCC = squamous cell carcinoma.

Notes: Rates per 100,000 population age-adjusted to the 2000 U.S. Standard Population.

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

Analysis and methods based on: Van Dyne et al. Trends in Human Papillomavirus–Associated Cancers — United States, 1999–2015. MMWR 2018;67(33):918–924. Created on 12/04/2018.

Associated vs. Attributable HPV Cancers

Definition

HPV-Associated Cancer

- Specific cellular type of cancer that can be caused by HPV
- Diagnosed in a body site where HPV is commonly found

HPV-Attributable Cancer

- Proportion of HPV-associated cancers determined to be caused by HPV
- Based on CDC study that looked for HPV DNA in cancer tissue

HPV-Attributable Fraction

HPV is the attributable cause of the following proportion of cancers:

- Cervical - 91%
- Oropharyngeal - 71%
- Anal/Rectal - 92%
- Vulvar - 69%
- Penile - 63%
- Vaginal - 75%
- *Any HPV-Associated Cancer -79%*

Source: Centers for Disease Control and Prevention, 2016 <https://www.cdc.gov/mmwr/volumes/65/wr/mm6526a1.htm>

Incidence of HPV-Associated Cancer and Estimated Number of Cancers Attributable to HPV by Site -- Arkansas, 2001-2015

Cancer	No.	Attributable to Any HPV Type	Attributable to HPV 16/18	Attributable to HPV 31/33/45/52/58	Attributable to HPV 16/18/31/33/45/52/58
		No. (%)	No. (%)	No. (%)	No. (%)
Cervical carcinoma	2,120	1,900 (90.6)	1,400 (66.2)	300 (14.7)	1,700 (80.9)
Oropharyngeal SCC	2,458	1,700 (70.1)	1,500 (60.2)	100 (5.7)	1,600 (65.9)
Anal SCC	795	700 (91.1)	600 (79.4)	100 (8.2)	700 (87.6)
Vulvar SCC	541	400 (68.8)	300 (48.6)	100 (14.2)	300 (62.8)
Penile SCC	192	100 (63.3)	100 (47.9)	- (9.0)	100 (56.9)
Vaginal SCC	142	100 (75.0)	100 (55.1)	- (18.3)	100 (73.4)
Total	6,248	5,000	3,900	600	4,600

4,600



Preventable cancer cases with 9-valent HPV vaccine

Notes: Estimates for attributable fraction were based on studies that used population-based data from cancer tissue to estimate the percentage of those cancers probably caused by HPV. The estimated number of HPV-attributable cancers was calculated by multiplying the HPV-associated cancer counts by the percentage of each cancer attributable to HPV. Estimates were rounded to the nearest 100. Estimates less than 100 are not presented. Individual counts may not sum to the total count because of rounding.

Dataset: NPCR and SEER Incidence – U.S. Cancer Statistics Public Use Database, Nov 2017 submission (2001-2015).

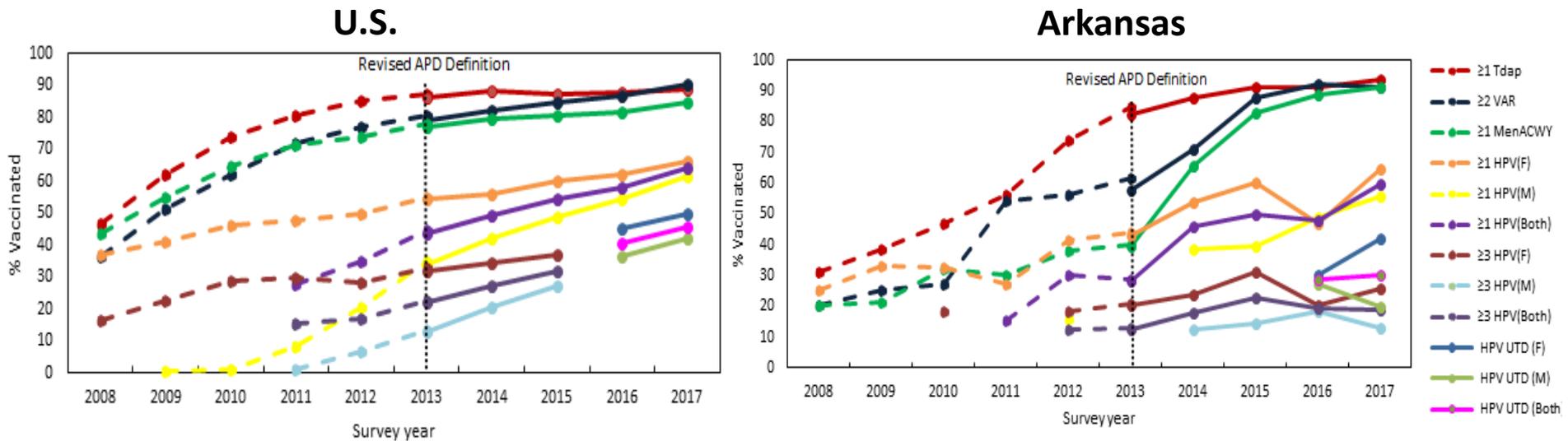
Analysis and methods based on: Viens et al. Human Papillomavirus-Associated Cancers— United States, 2008-2012. MMWR 2016;65(26):661-666 <https://www.cdc.gov/mmwr/volumes/65/wr/mm6526a1.htm>

Created on 10/19/2018.

HPV Vaccination Rates

Jennifer Dillaha, MD

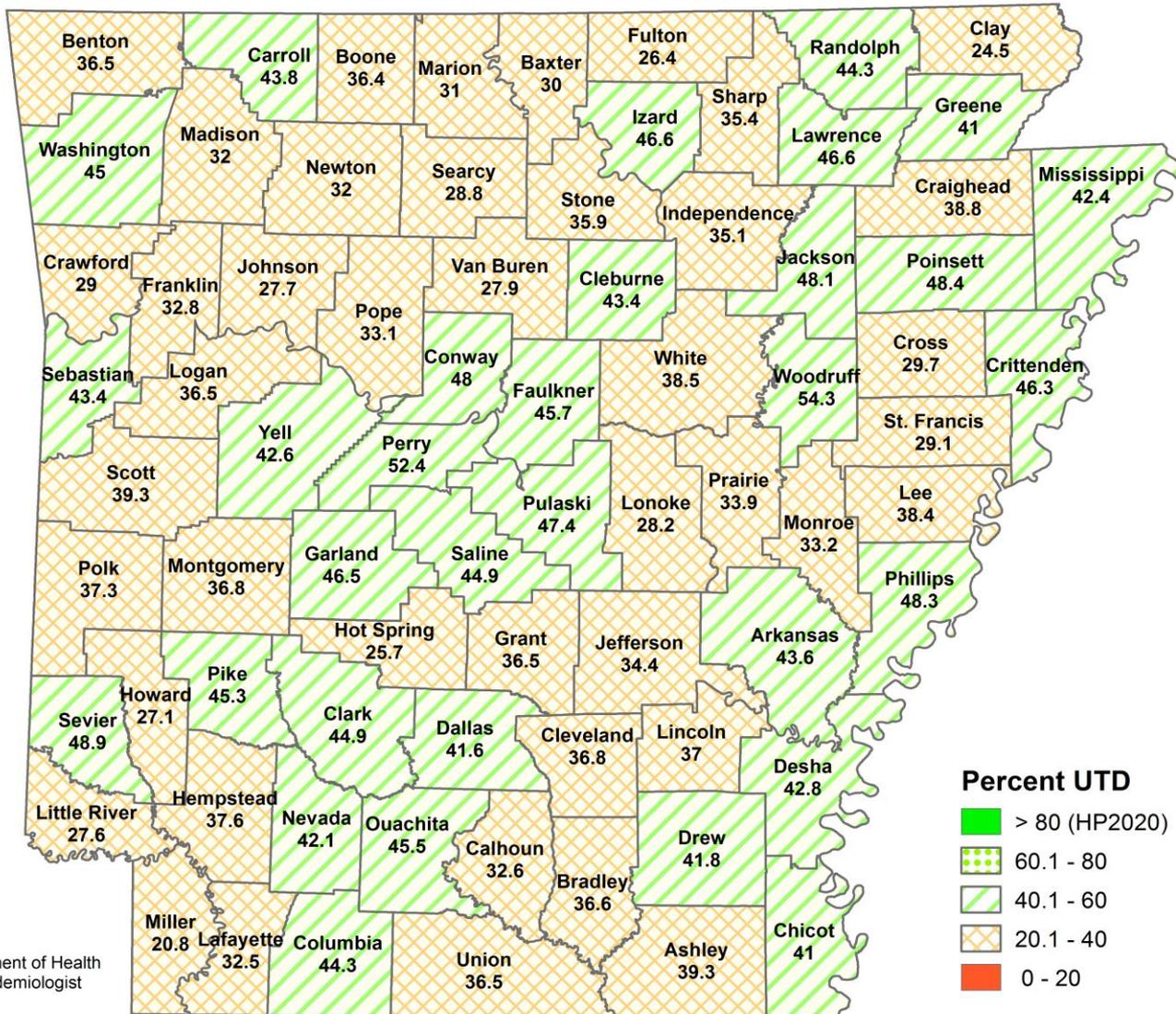
Estimated vaccination coverage with selected vaccines among adolescents aged 13-15 years, by survey year, NIS-Teen, United States and Arkansas, 2008-2017



Estimated vaccination coverage with selected vaccines and doses among adolescents aged 13-15 years, by survey year, NIS-Teen, Arkansas, 2008-2017

Survey Year	≥1 Tdap*	≥2 VAR*	≥1 MenACWY [§]	≥1 HPV [†] (F)	≥1 HPV [†] (M)	≥1 HPV [†] (Both)	≥3 HPV ^{**} (F)	≥3 HPV ^{**} (M)	≥3 HPV ^{**} (Both)	HPV UTD ^{**} (F)	HPV UTD ^{**} (M)	HPV UTD ^{**} (Both)
	% (95%CI) ^{##}	% (95%CI)	% (95%CI)	% (95%CI)	% (95%CI)	% (95%CI)	% (95%CI)	% (95%CI)	% (95%CI)	% (95%CI)	% (95%CI)	% (95%CI)
Healthy People 2020 Target	80.0%	90.0%	80.0%							80.0%	80.0%	
2008	31.3(±7.1)	20.2(±8.8)	20.3(±6.1)	25.2(±9.5)	NA		NA					
2009	38.4(±7.7)	25.3(±10.6)	21.2(±6.3)	33.1(±11.0)	NA		NA					
2010	47.0(±8.4)	27.1(±8.5)	32.0(±7.9)	32.6(±11.9)	NA		18.6(±9.2)					
2011	56.4(±10.1)	54.1(±12.4)	30.0(±9.0)	27.5(±14.5)	NA	15.7(±8.1)	NA	NA	NA			
2012	73.9(±7.8)	56.1(±9.9)	37.9(±8.4)	41.6(±12.6)	16.1(±9.1)	30.0(±8.3)	18.4(±8.7)	NA	12.4(±5.4)			
2013	84.7(±5.8)	61.6(±9.4)	40.2(±8.6)	44.2(±12.2)	NA	28.7(±8.1)	21.1(±10.3)	NA	12.9(±5.9)			
2013 – Revised ^{¶¶}	82.4(±6.3)	57.9(±9.4)	39.6(±8.3)	43.0(±12.1)	NA	28.2(±7.8)	20.2(±9.8)	NA	12.3(±5.5)			
2014 ^{¶¶}	87.9(±5.8)	71.2(±8.7)	65.4(±7.9)	54.0(±12.1)	38.7(±11.6)	45.9(±8.5)	23.7(±10.6)	12.4(±7.1)	17.7(±6.4)			
2015	91.0(±4.6)	88.0(±5.5)	83.0(±5.7)	60.2(±11.2)	39.7(±10.3)	50.0(±7.8)	31.3(±10.5)	14.6(±6.8)	23.0(±6.4)			
2016	91.1(±3.9)	92.2(±4.1)	89.0(±4.6)	47.1(±12.1)	48.8(±10.5)	48.0(±8.0)				30.0(±11.2)	27.5(±9.8)	28.8(±7.5)
2017	93.5(±3.6)	91.0(±4.5)	91.0(±4.9)	64.5(±12.1)	55.6(±11.2)	59.7(±8.3)				41.9(±13.2)	20.0(±8.2)	30.0(±8.0)

Vaccination Rate per County for 11-14 Years-old with 2 or More HPV Vaccine, Arkansas 2018



Date: October 11, 2018
 Source: Arkansas Department of Health
 Author: Haytham Safi, Epidemiologist

Conclusion

- While cervical carcinoma rates have remained stable over time, other HPV-associated cancers are being diagnosed more frequently.
- Both males and females need to be vaccinated for HPV.
- Improved vaccination rates could reduce the burden of disease in Arkansas.

Contact Information

Kristyn Vang, MPH
Cancer Epidemiologist
Arkansas Central Cancer Registry
Arkansas Department of Health

(501) 280-4830
Kristyn.Vang@Arkansas.gov