



Cancers Associated with Human Papillomavirus in Ohio

Human papillomavirus (HPV), a group of more than 200 related viruses, is the most common sexually transmitted disease. As of 2015, approximately 79 million Americans are currently infected with HPV and 14 million people become newly infected each year. HPV can be easily spread through direct sexual (vaginal, anal and oral) contact, from the skin and mucous membranes of infected people to the skin and mucous membranes of their partners. Some types of HPV, including high-risk HPV types 16 and 18, have been linked to cancer in both men and women. In most people, HPV infections are asymptomatic and cleared from the body within one to two years. In some cases, however, the infection persists or returns. Persistent infections with high-risk HPV types can lead to cell changes that, if untreated, may progress to cancer. Each year in the United States, an estimated 26,000 new cancers are attributed to HPV, about 17,000 in women and 9,000 in men.

HPV is associated with cancer at the following sites:

- Cervix
- Vagina
- Vulva
- Anus
- Penis
- Oropharynx

The HPV-associated cancers described in this report are all carcinomas of the cervix and squamous cell carcinomas of the vagina, vulva, anus, penis and oropharynx. HPV-associated oropharyngeal cancer includes squamous cell carcinomas of the base of tongue and lingual tonsil, tonsil and other oropharynx.

Key Findings

- In Ohio, in 2008-2012, approximately 1,157 cases of cancer were attributed to HPV each year.
- For all HPV-associated cancers combined, incidence rates were 48 percent higher among females compared to males and 6 percent higher among whites compared to blacks.
- Mortality rates for all HPV-associated cancers combined were two times higher among females compared to males and 32 percent higher among blacks compared to whites.
- HPV-associated cancer incidence rates increased from 1996 to 2012 for cancers of the vulva, anus and oropharynx; oropharyngeal cancer incidence rates approximately doubled in Ohio during this time period.
- The majority of counties with the highest HPV-associated cancer incidence rates were located in the Appalachian region of Ohio.
- For all HPV-associated cancers combined, females were more likely to be diagnosed early stage (*in situ* and local), whereas males were more likely to be diagnosed late stage (regional and distant).
- The 2005-2011 U.S. five-year survival probability for each HPV-associated cancer site/type was lower among blacks compared to whites, with the exception of vulvar cancer.
- In 2014, 35.2 percent of Ohio females and 23.3 percent of Ohio males 13-17 years old had completed the recommended three or more doses of HPV vaccine; the Healthy People 2020 target is 80.0 percent for both females and males.

HPV-associated Cancers and Cancers Attributed to HPV

For each of the cancer sites/types **associated** with HPV, only a certain percentage are actually **attributed** to HPV. HPV-associated cancers are the six cancer sites shown in Table 1. Cancers attributed to HPV are those specific cancer cases which occurred, at least in part, as a result of HPV. Thus, cancers attributed to HPV are a subset of HPV-associated cancers. For example, there was an annual average of 164 Ohio women diagnosed with HPV-associated vulvar cancer, of which 51 percent (84 cancer cases) were attributed to HPV.

Table 1. Estimated Average Annual Number and Percentage of HPV-associated Cancers Attributed to HPV, by Anatomic Site in Ohio, 2008–2012

	% Attributed to HPV*	Ohio Cases	Ohio Cases Attributed to HPV
Cervix	96%	460	442
Vagina	64%	30	19
Vulva	51%	164	84
Anus	93%	228	212
Penis	36%	49	18
Oropharynx	63%	606	382
Total Attributed to HPV		1,537	1,157

Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2015.

* Gillison ML, Chaturvedi AK, Lowy DR. HPV prophylactic vaccines and the potential prevention of noncervical cancers in both men and women. *Cancer*. 2008;113:3036-3046.

Table 1 shows the estimated average annual number and percentage of those cancers associated with HPV that are attributed to HPV in Ohio.

- In 2008-2012 there were 1,537 cancers annually in Ohio for cancer sites/types associated with HPV; of these, it is estimated that 1,157 were attributed to HPV.
- Nearly all HPV-associated cervical and anal cancers were attributed to HPV.
- HPV-associated cervical, anal and oropharyngeal cancers made up approximately 90 percent of Ohio cancer cases attributed to HPV.

Did You Know?

Vaccines are the best way to protect men and women against some of the most common types of HPV. HPV vaccines are safe and effective. The vaccine is administered in three doses over six months. HPV vaccines are most effective when given at 11 or 12 years old but can be given as early as 9 years old or as late as 26 years old.

HPV-associated Cancer Incidence by Sex, Race and Age

Table 2. HPV-associated Cancers: Average Annual Number of Cancer Cases and Age-adjusted Incidence Rates per 100,000 by Sex, Race and Age Group in Ohio, 2008-2012

	All HPV-associated Sites/Types		Cervix		Vagina		Vulva		Anus		Penis		Oropharynx	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Total	1,537	11.8	460	7.5	30	0.4	164	2.2	228	1.7	49	0.8	606	4.4
Sex														
Male	610	9.4	*	*	*	*	*	*	71	1.1	49	0.8	489	7.4
Female	928	13.9	460	7.5	30	0.4	164	2.2	157	2.2	*	*	117	1.6
Race														
White	1,355	11.8	385	7.4	24	0.4	150	2.3	203	1.7	46	0.9	548	4.5
Black	152	11.1	57	7.7	5	0.7	13	1.6	22	1.6	3	0.6	52	3.7
Age														
0-49	394	5.3	227	6.2	4	0.1	24	0.6	44	0.6	4	0.1	91	1.2
50-69	817	28.9	175	12.0	10	0.7	73	5.0	124	4.4	20	1.5	415	14.6
70+	326	28.4	57	8.6	16	2.3	67	9.4	61	5.2	25	5.4	100	9.0

Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2015.

Table 2 shows the average annual number of cancer cases and age-adjusted incidence rates of HPV-associated cancers by sex, race and age group in Ohio.

- Oropharyngeal cancer has the highest number of cases of the HPV-associated cancers, with an annual average of 606 cases in Ohio from 2008 to 2012. HPV-associated cervical cancer was the second most common (460 cases).
- For all HPV-associated cancers combined, the incidence rate among females was 48 percent greater than that for males; however, the incidence rate of oropharyngeal cancer among males was more than four times that for females.
- The incidence rate of all HPV-associated cancers combined was slightly greater among whites compared to blacks. Incidence rates of HPV-associated vulvar, anal, penile and oropharyngeal cancers were greater among whites.
- For HPV-associated vaginal, vulvar, anal and penile cancers, incidence rates increased with advancing age group, while incidence rates for HPV-associated cervical and oropharyngeal cancers were highest in the 50 to 69 years age group.

The following points pertain to comparisons between Ohio and the United States, which are not shown in Table 2.

- Incidence rates for HPV-associated cancers among males in Ohio were similar to those for the United States, with the exception that the incidence rate for HPV-associated oropharyngeal cancer was greater in Ohio (7.4), compared to the United States (6.8). Among females, incidence rates in Ohio were similar to those for the United States, with the exceptions that incidence rates of HPV-associated vulvar and anal cancers were slightly higher in Ohio (both were 2.2), compared to those for the United States (both were 1.8).
- Race-specific incidence rates of HPV-associated cancers were similar in Ohio and the United States, with the exception of HPV-associated cervical cancer among blacks, which was lower in Ohio (7.7 versus 8.8).
- Incidence rates of HPV-associated cancers were similar in Ohio and the United States for those 0 to 49 years old. Among those 50 to 69 years old, Ohio incidence rates of vulvar cancer (5.0) and oropharyngeal cancer (14.6) were greater than those in the United States (3.4 and 12.7, respectively). Among those 70 years and older, Ohio incidence rates of cervical cancer (8.6) and oropharyngeal cancer (9.0) were lower than those in the United States (10.1 and 10.6, respectively).

HPV-associated Cancer Mortality by Sex, Race and Age

Table 3. HPV-associated Cancers: Average Annual Number of Cancer Deaths and Age-adjusted Mortality Rates per 100,000 by Sex, Race and Age Group in Ohio, 2008-2012

	All HPV-associated Sites/Types		Cervix		Vagina		Vulva		Anus		Penis		Oropharynx	
	Deaths	Rate	Deaths	Rate	Deaths	Rate	Deaths	Rate	Deaths	Rate	Deaths	Rate	Deaths	Rate
Total	416	3.1	170	2.6	17	0.2	52	0.7	36	0.3	11	0.2	131	0.9
Sex														
Male	125	2.0	*	*	*	*	*	*	14	0.2	11	0.2	100	1.6
Female	291	4.1	170	2.6	17	0.2	52	0.7	22	0.3	*	*	31	0.4
Race														
White	359	3.1	141	2.4	14	0.2	50	0.7	30	0.3	10	0.2	113	0.9
Black	53	4.1	26	3.6	3	0.4	2	0.3	5	0.4	<1	**	17	1.3
Age														
0-49	74	1.0	55	1.5	1	<0.1	2	0.1	5	0.1	<1	**	9	0.1
50-69	190	6.7	74	5.1	5	0.3	14	0.9	17	0.6	3	0.2	77	2.7
70+	153	13.0	40	5.9	11	1.4	36	4.8	14	1.2	6	1.4	45	3.9

Source: Bureau of Vital Statistics, Ohio Department of Health, 2015.

* Not Applicable

** Rates may be unstable and are not presented when the case count for 2008-2012 is less than five (i.e., the average annual count is less than one).

Table 3 shows the average annual number of deaths and age-adjusted mortality rates of HPV-associated cancers by sex, race and age group in Ohio.

- Cervical cancer has the highest number of deaths of the HPV-associated cancers, with an annual average of 170 deaths in Ohio from 2008 to 2012, followed by HPV-associated oropharyngeal cancer (131 deaths).
- The mortality rate for all HPV-associated cancers combined among females was more than double that of males; however, the HPV-associated oropharyngeal cancer mortality rate among males was four times that of females.
- Mortality rates among blacks were greater than those for whites for all HPV-associated cancers combined and for each of the HPV-associated cancers, with the exception of vulvar cancer.
- Of the three age groups, the highest mortality rates from HPV-associated cancers occurred in the older age groups, with those 70 years and older having the highest age-adjusted mortality rates.

Figure 1. Map of Ohio and the 32-County Appalachian Region



The Appalachian region of the United States is a federally designated 205,000 square mile region that contains 420 counties in 13 states along the Appalachia Mountains from New York to Mississippi.

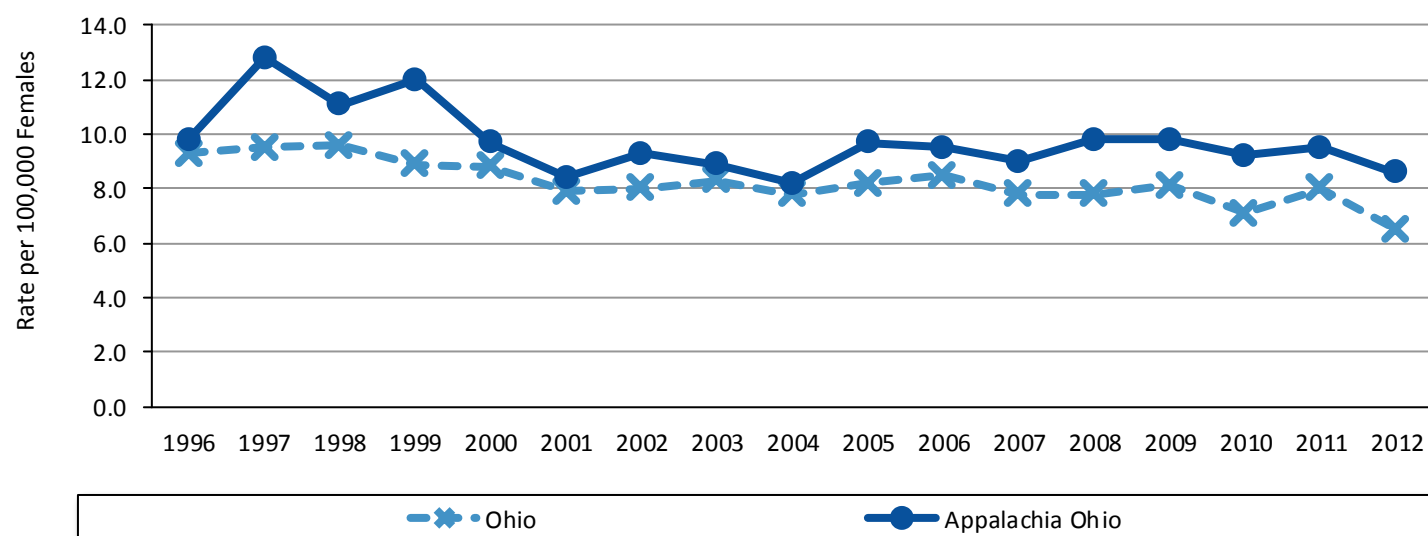
Public health reports and results from research articles have revealed that cervical cancer incidence and mortality rates are, in general, higher in Appalachia Ohio, a 32-county region. These disparities have largely been attributed to differences in factors related to HPV. As a result, trends in HPV-associated cancer incidence rates were examined for Appalachia Ohio, as well as Ohio (Figures 2-7). The Appalachian region of Ohio is highlighted in Figure 1.

HPV-associated Cancer Incidence by Region and Year

Trends in incidence rates of HPV-associated cancers are shown in Figures 2-7. Note that trends are shown for overlapping geographic regions: Ohio and Appalachia Ohio. Please use caution when interpreting Figures 2-7 due to variations in scales.

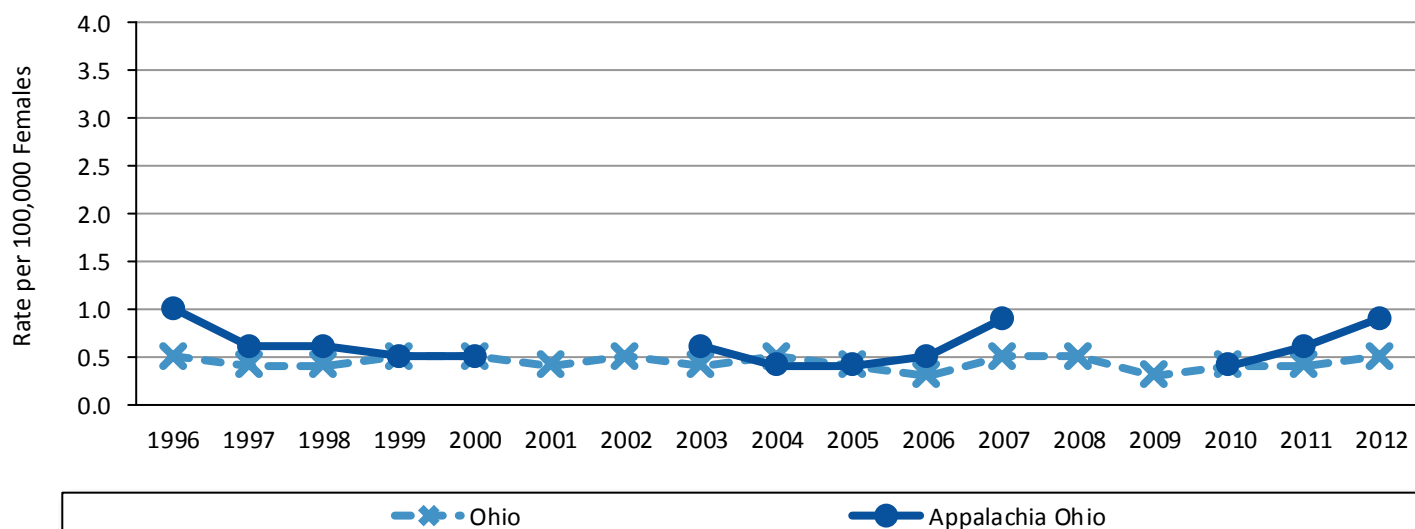
- HPV-associated cervical cancer incidence rates decreased slightly in Ohio from 1996 to 2012. For each year, HPV-associated cervical cancer incidence rates were at least slightly greater in Appalachia Ohio compared to Ohio.
- HPV-associated vaginal cancer incidence rates remained relatively stable from 1996 to 2012 in Ohio.

Figure 2. HPV-associated Cervical Cancer: Age-adjusted Incidence Rates per 100,000 Females by Year in Ohio and Appalachia Ohio, 1996-2012



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2015.

Figure 3. HPV-associated Vaginal Cancer: Age-adjusted Incidence Rates per 100,000 Females by Year in Ohio and Appalachia Ohio, 1996-2012



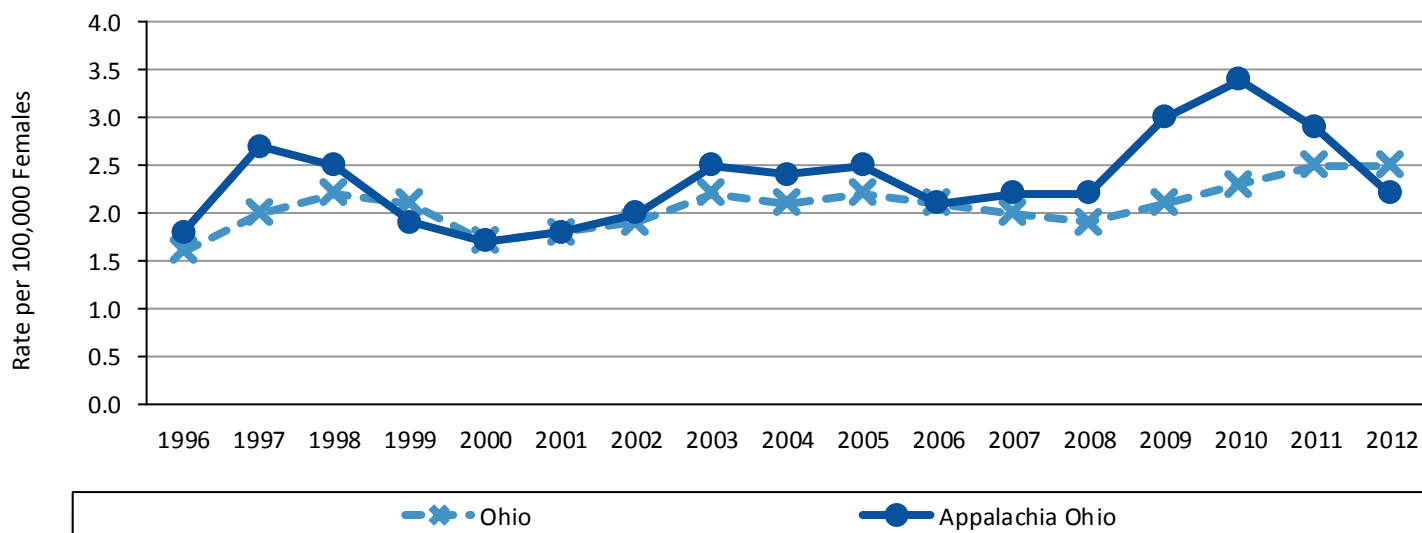
Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2015.

Rates may be unstable and are not presented when the case count is less than five (i.e., the average annual count is less than one).

HPV-associated Cancer Incidence by Region and Year

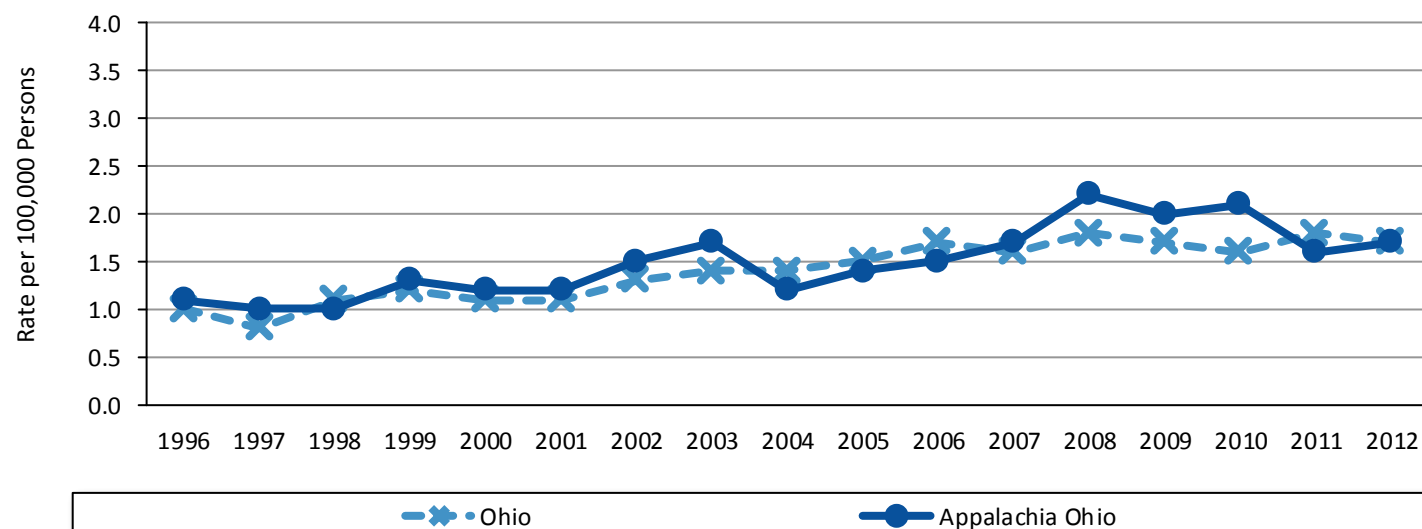
- HPV-associated vulvar cancer incidence rates increased in Ohio from 1996 to 2012. For most years, HPV-associated vulvar cancer incidence rates were at least slightly greater in Appalachia Ohio compared to Ohio.
- HPV-associated anal cancer incidence rates increased from 1996 to 2012 in Ohio.

Figure 4. HPV-associated Vulvar Cancer: Age-adjusted Incidence Rates per 100,000 Females by Year in Ohio and Appalachia Ohio, 1996-2012



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2015.

Figure 5. HPV-associated Anal Cancer: Age-adjusted Incidence Rates per 100,000 Persons by Year in Ohio and Appalachia Ohio, 1996-2012

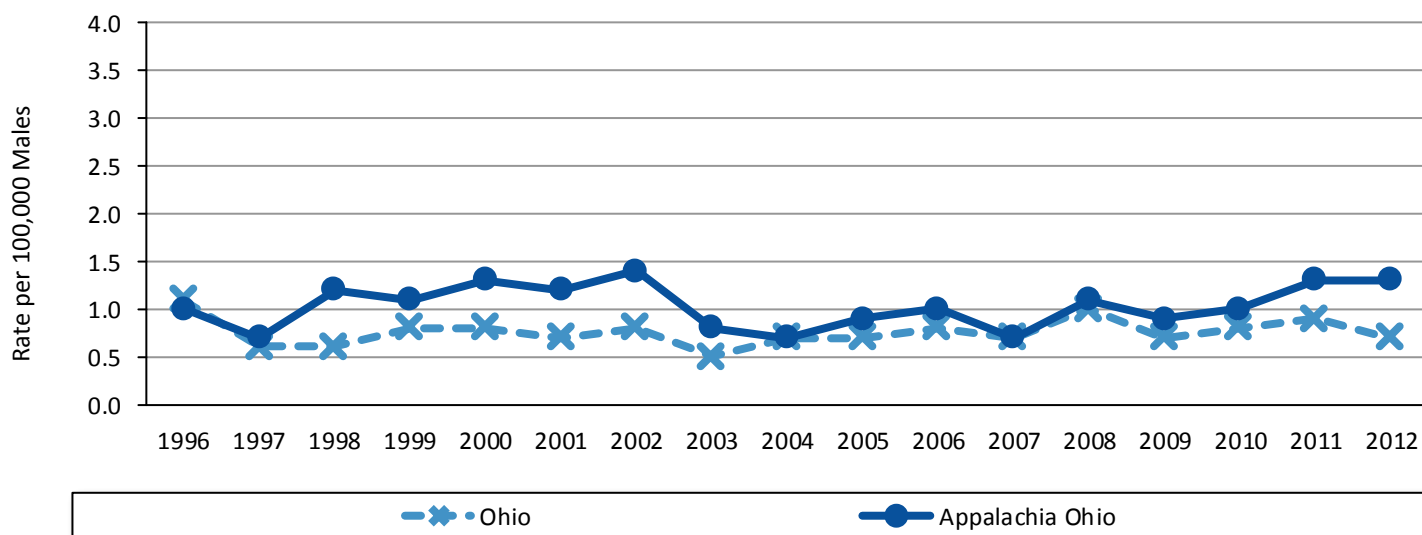


Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2015.

HPV-associated Cancer Incidence by Region and Year

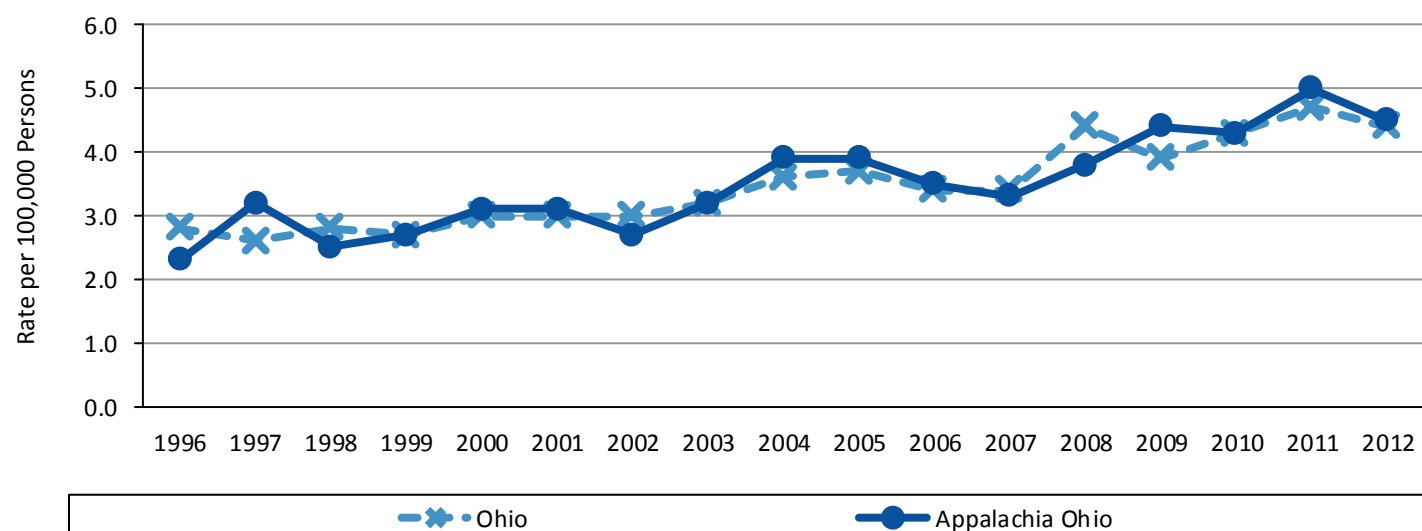
- HPV-associated penile cancer incidence rates were relatively stable from 1996 to 2012. For most years, HPV-associated penile cancer incidence rates were at least slightly greater in Appalachia Ohio compared to Ohio.
- HPV-associated oropharyngeal cancer incidence rates approximately doubled in Ohio from 1996 to 2012.

Figure 6. HPV-associated Penile Cancer: Age-adjusted Incidence Rates per 100,000 Males by Year in Ohio and Appalachia Ohio, 1996-2012



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2015.

Figure 7. HPV-associated Oropharyngeal Cancer: Age-adjusted Incidence Rates per 100,000 Persons by Year in Ohio and Appalachia Ohio, 1996-2012

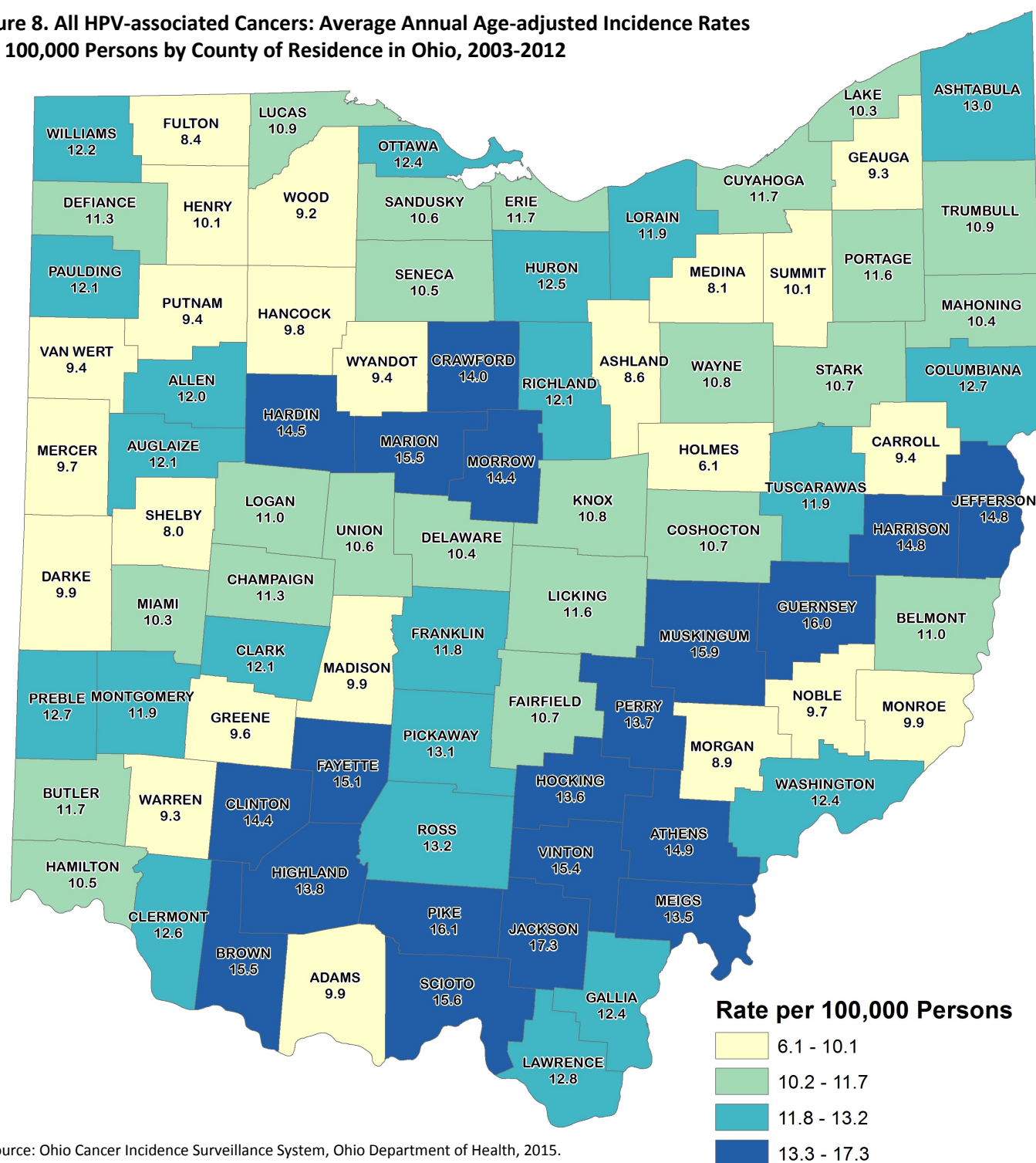


Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2015.

HPV-associated Cancer Incidence by County

Figure 8 shows 2003-2012 average annual age-adjusted incidence rates for all HPV-associated cancers combined by county of residence. County-specific incidence rates in Ohio ranged from 6.1 to 17.3. The majority of counties with the highest incidence rates were located in the Appalachian region of Ohio.

Figure 8. All HPV-associated Cancers: Average Annual Age-adjusted Incidence Rates per 100,000 Persons by County of Residence in Ohio, 2003-2012

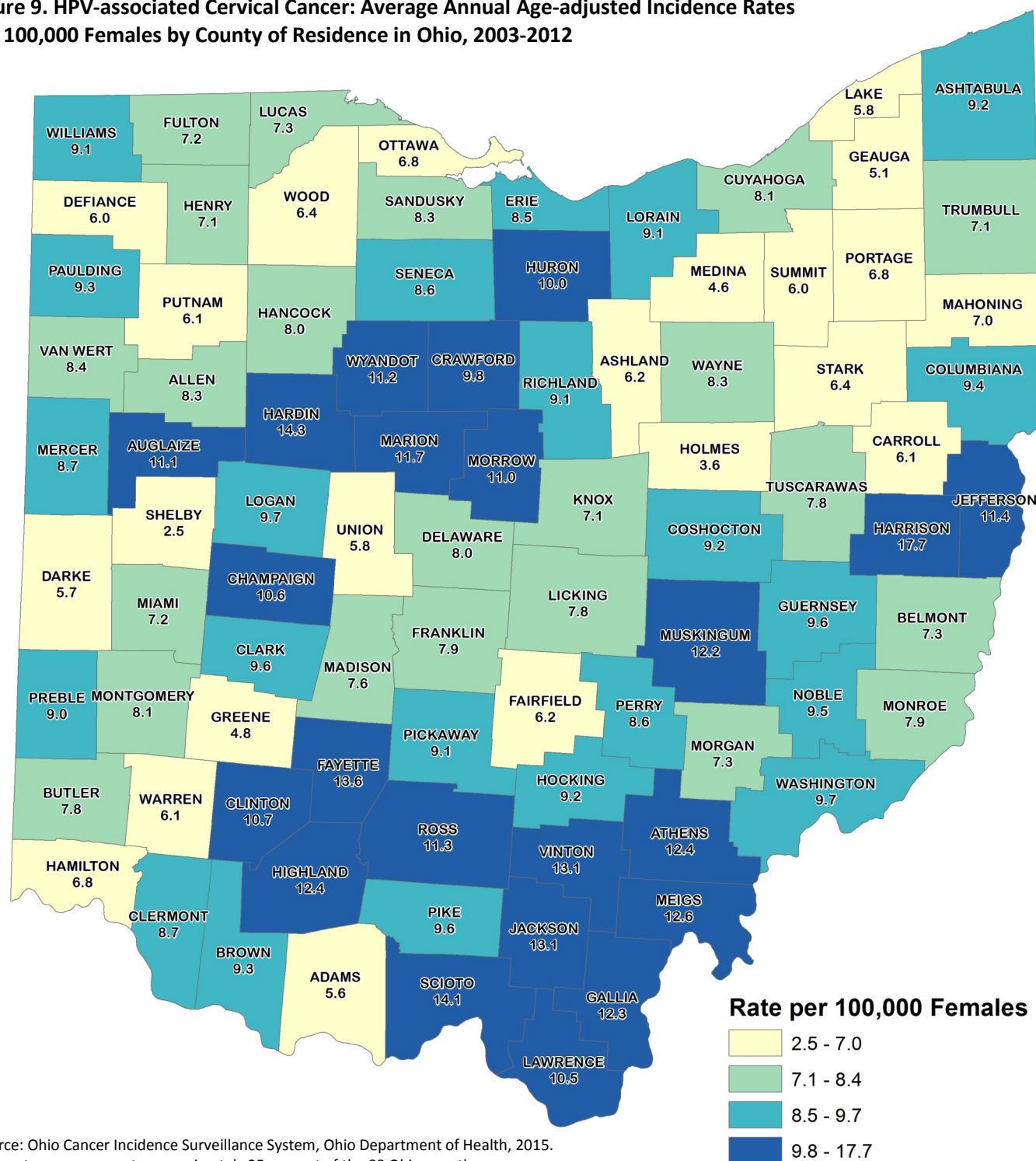


Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2015.
Each category represents approximately 25 percent of the 88 Ohio counties.

HPV-associated Cancer Incidence by County

Figure 9 shows 2003-2012 average annual age-adjusted cervical cancer incidence rates by county of residence. County-specific incidence rates in Ohio ranged from 2.5 to 17.7. The majority of counties with the highest incidence rates were located in two areas: southern Ohio and north-central Ohio.

Figure 9. HPV-associated Cervical Cancer: Average Annual Age-adjusted Incidence Rates per 100,000 Females by County of Residence in Ohio, 2003-2012



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2015.
Each category represents approximately 25 percent of the 88 Ohio counties.

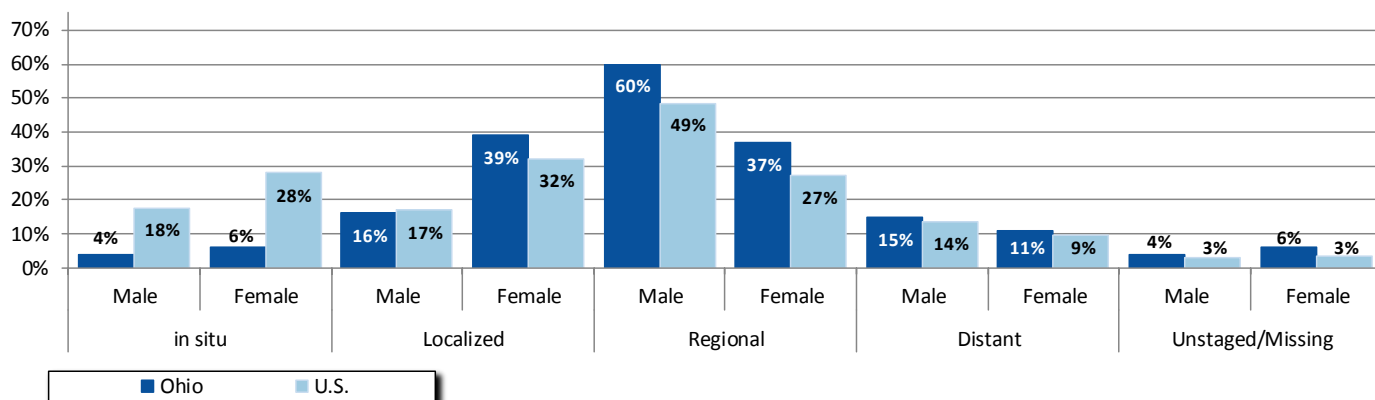
HPV-associated Cancer Stage at Diagnosis

Figure 10 shows the proportion of all HPV-associated cancers combined by stage at diagnosis and sex in Ohio and the United States in 2008-2012. (The definition of stage at diagnosis can be found in technical notes section of this report.)

- In Ohio and the United States, there were greater proportions diagnosed at the *in situ* and localized stages (early stages) among females, while there were greater proportions of males diagnosed at both regional and distant stages (late stages).
- The greatest difference between proportions in Ohio and the United States was observed for the proportion diagnosed *in situ*, which was more than four times greater in the United States for both males and females.

In addition to all HPV-associated cancers combined, stage at diagnosis is examined in Figures 11 and 12 for the specific HPV-associated cancers for which there is a routinely-used screening test (HPV-associated cervical and oropharyngeal cancers, respectively).

Figure 10. All HPV-associated Cancers: Proportion of Cases (%) by Stage at Diagnosis and Sex in Ohio and the United States, 2008-2012



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2015; Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence - SEER 18 registries released April 2015, based on the November 2014 submission.

Figure 11. HPV-associated Cervical Cancer: Proportion of Cases (%) by Stage at Diagnosis in Ohio and the United States, 2008-2012

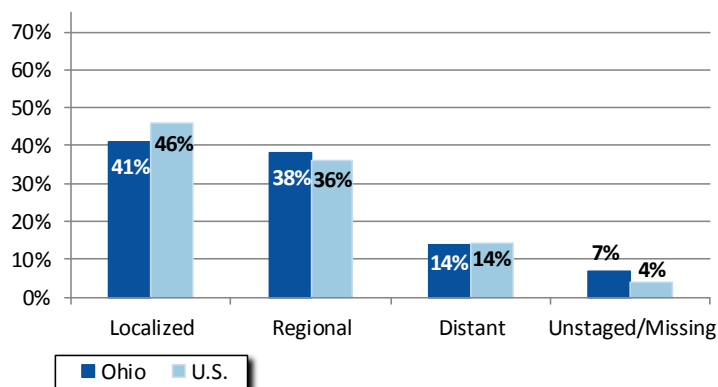


Figure 11 shows the proportion of HPV-associated cervical cancers by stage at diagnosis in Ohio and the United States in 2008-2012.

- In the United States, there was a greater proportion of HPV-associated cervical cancers diagnosed at the localized stage, while proportions diagnosed at the regional stage or with an 'unstaged/missing' stage at diagnosis were greater in Ohio. (Note that *in situ* cervical cancer is not required to be reported.)

Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2015; Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence - SEER 18 registries released April 2015, based on the November 2014 submission.

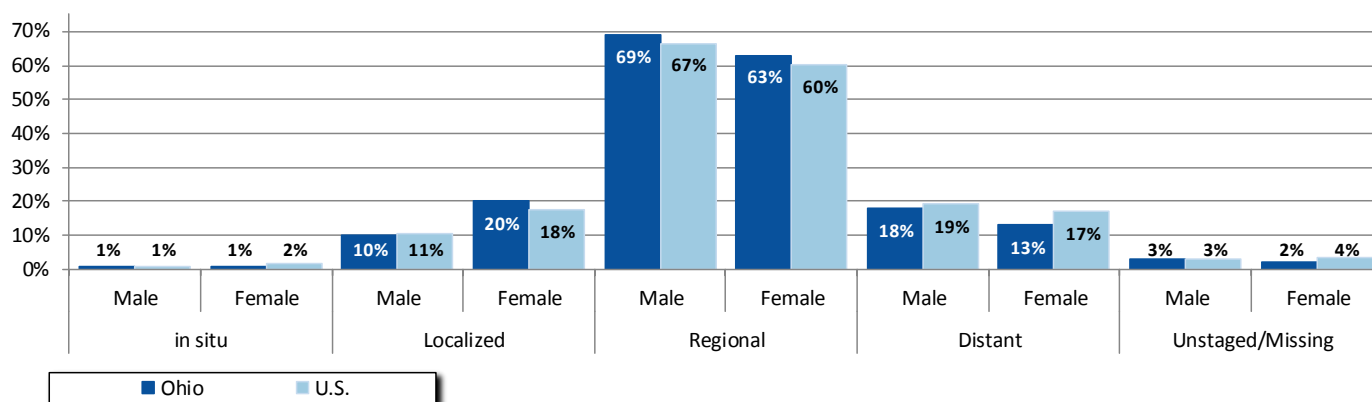
Note: *in situ* cervical cancer cases are not required to be reported.

HPV-associated Cancer Stage at Diagnosis

Figure 12 shows proportions of HPV-associated oropharyngeal cancers by stage at diagnosis and sex in Ohio and the United States in 2008-2012.

- There were greater proportions of HPV-associated oropharyngeal cancers diagnosed at the localized stage among females while there were slightly greater proportions of males diagnosed at the regional and distant stages.
- The proportion at each stage was similar between Ohio and the United States.

Figure 12. HPV-associated Oropharyngeal Cancer: Proportion of Cases (%) by Stage at Diagnosis and Sex in Ohio and the United States, 2008-2012



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2015; Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence - SEER 18 registries released April 2015, based on the November 2014 submission.

HPV-associated Cancer Survival Probability

Table 4 shows the U.S. (Surveillance, Epidemiology, and End Results (SEER) Program) five-year survival probability for HPV-associated cancers in 2005-2011 by race and stage at diagnosis.

- The five-year survival probability among blacks was lower than the probability among whites for each of the HPV-associated cancers, with the exception of HPV-associated vulvar cancer. The race difference for HPV-associated oropharyngeal cancer is marked (67.9 percent versus 41.3 percent for whites and blacks respectively).
- Survival probability decreased with advancing stage for each HPV-associated cancer.

Table 4. HPV-associated Cancers: Five-year Survival Probability (%) by Race and Stage at Diagnosis in the United States, 2005-2011

	Race		Stage		
	White	Black	Localized	Regional	Distant
All HPV-associated Sites/Types	69.7%	58.2%	86.6%	68.9%	30.2%
Cervix	69.7%	58.9%	91.7%	57.7%	16.7%
Vagina	53.7%	52.2%	75.9%	53.4%	15.3%
Vulva	67.3%	73.2%	55.6%	82.5%	17.2%
Anus	70.9%	60.2%	82.5%	62.0%	36.7%
Penis	67.4%	66.7%	79.3%	56.8%	8.3%
Oropharynx	67.9%	41.3%	76.0%	70.8%	42.9%

Source: Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence - SEER 18 registries released April 2015, based on the November 2014 submission.

HPV-associated Cancer Protective Factors

Vaccines are the best way to protect males and females against some of the most common types of HPV. HPV vaccines are safe and effective. The vaccine is administered in three doses over six months. HPV vaccines are most effective when given at 11 or 12 years old but can be given as early as 9 years old. Current vaccine recommendations include the following:

- **Girls and women:** Three vaccines (Cervarix, Gardasil and Gardasil 9) are available to protect females against the types of HPV that cause most cervical cancers. Gardasil and Gardasil 9 also protect against most genital warts and additional HPV-associated cancers. These vaccines are recommended for 11 or 12 year-old girls, and for females through 26 years of age, who did not get any or all of the doses when they were younger.
- **Boys and men:** Two vaccines (Gardasil and Gardasil 9) protect males against most genital warts and anal cancers. These vaccines are recommended for boys aged 11 or 12 years, and for males through 21 years of age, who did not get any or all doses when they were younger. These vaccines are also recommended for gay and bisexual young men (or any young man who has sex with men) and also for young men with compromised immune systems (including HIV) through age 26, if they did not get HPV vaccine when they were younger.

Condoms used consistently and correctly can lower the chances of acquiring and transmitting HPV and developing HPV-related diseases (e.g., genital warts and cervical cancer). However, because HPV can infect areas not covered by a condom, condoms might not fully protect against HPV.

Limiting the number of sex partners can reduce the risk for HPV. However, even persons with only one lifetime sex partner can get HPV.

HPV Immunization Rates

Table 5 shows the estimated vaccination rates among 13-17 year olds in Ohio and the United States. Despite the demonstrated effectiveness of the HPV vaccines, rates remain well below Healthy People 2020 goals (80 percent vaccination rate for both females and males).

- Nearly two thirds of Ohio females 13-17 years old had initiated the HPV vaccine and just over one-third of Ohio females had completed the recommended 3 dose vaccine series.
- Slightly more than one-third of Ohio males 13-17 years old had initiated the HPV vaccine and less than one-fourth of Ohio males had completed the recommended 3 dose vaccine series.

Table 5. Estimated Vaccination Coverage of HPV Vaccine Among Adolescents 13-17 Years Old in Ohio and the United States, 2014*

	≥ 1 dose of HPV vaccine		≥ 3 doses of HPV vaccine	
	Ohio	United States	Ohio	United States
Females	61.0%	60.0%	35.2%	39.7%
Males	36.8%	41.7%	23.3%	21.6%

Sources: Reagan-Steiner S, Yankey D, Jeyarajah J, et al. National, regional, state, and selected local area vaccination coverage among adolescents aged 13-17 years — United States, 2014. *MMWR Morb Mortal Wkly Rep.* 2015;64:784-792.

Petrosky E, Bocchini JA, Hariri S, et al. Use of the 9-valent human papillomavirus (HPV) vaccine: updated HPV vaccination recommendations of the Advisory Committee on Immunization Practices. *MMWR Morb Mortal Wkly Rep.* 2015;64:300-304.

*Adolescents in the 2014 National Immunization Survey-Teen were born January 1996 through February 2002. Vaccination coverage estimates include only adolescents who had adequate provider-reported immunization records.

Technical Notes

Age-Adjusted Rate: A summary rate that is a weighted average of age-specific rates, where the weights represent the age distribution of a standard population (direct adjustment). The incidence and mortality rates presented in this report were standardized to the age distribution of the 2000 U.S. Standard Population. Under the direct method, the population was first divided into 19 five-year age groups, i.e., <1, 1-4, 5-9, 10-14, 15-19...85+, and the age-specific rate was calculated for each age group. Each age-specific rate was then multiplied by the standard population proportion for the respective age group.

Average Annual Number: The number of cases or deaths diagnosed per year, on average, for the time period of interest (e.g., 2008-2012). Average annual numbers are calculated by summing the number of cases or deaths for a given time period, dividing by the number of years that comprise the time period and rounding to the nearest whole number.

Census Data: The 1996-2012 rates were calculated using bridged-race intercensal population estimates for July 1, 1996-July 1, 1999 (U.S. Census Bureau and National Center for Health Statistics, 2004); revised bridged-race intercensal population estimates for July 1, 2000-July 1, 2009 (U.S. Census Bureau and National Center for Health Statistics, 2012); and vintage 2013 bridged-race postcensal population estimates for July 1, 2010-July 1, 2012 (U.S. Census Bureau and National Center for Health Statistics, 2013).

Incidence: The number of cases diagnosed during a specified time period (e.g., 2008-2012).

Invasive Cancer: A malignant tumor that has infiltrated the organ in which the tumor originated. Invasive cancers consist of those diagnosed at the localized, regional, distant and unstaged/missing stages. Only invasive cancers were included in the calculation of incidence rates in this document.

Mortality: The number of deaths during a specified time period (e.g., 2008-2012).

Rate: The number of cases or deaths per unit of population (e.g., per 100,000 persons) during a specified time period (e.g., 2008-2012). Rates may be unstable and are not presented when the case count is less than five.

Stage at Diagnosis: The degree to which a tumor has spread from its site of origin at the time of diagnosis. Cancer stage is often related to survival and is used to select appropriate treatment. Patients with early stage disease often have better long-term survival, and detecting cancers at an early stage may lead to a reduction in mortality. The stages presented in this report, in the order of increasing spread, are *in situ*, localized, regional, and distant. *In situ* and localized tumors are referred to as early stage tumors, and regional and distant tumors are termed late stage. Cancers diagnosed at the localized, regional, distant and unstaged/missing stages are categorized as invasive.

in situ—Noninvasive cancer that has not penetrated surrounding tissue.

Localized—A malignant tumor confined entirely to the organ of origin.

Regional—A malignant tumor that has extended beyond the organ of origin directly into surrounding organs or tissues or into regional lymph nodes.

Distant—A malignant tumor that has spread to parts of the body (distant organs, tissues, and/or lymph nodes) remote from the primary tumor.

Unstaged/Missing—Insufficient information is available to determine the stage or extent of the disease at diagnosis.

Survival Probability: The probability that an individual will survive a given number of years after diagnosis. Five-year relative survival probabilities are from the SEER 18 areas for diagnosis years 2005-2011. Probabilities are based on follow-up of patients into 2012.

Technical Notes

Table 6: HPV-associated Cancer Site and Histology Codes
International Classification of Diseases for Oncology, Third Edition (ICD-O-3)

Cancer Site/Type	ICD-O-3 Site Codes WHO 2008 Definition	ICD-O-3 Histology Codes
Cervix (All carcinomas)	C530-C539	All codes except 9590-9989
Vagina (Squamous cell carcinomas)	C529	8050-8084
Vulva (Squamous cell carcinomas)	C510-C519	8050-8084
Anus (Squamous cell carcinomas)	C210-C212, C218	8050-8084
Penis (Squamous cell carcinomas)	C600-C609	8050-8084
Oropharynx (Squamous cell carcinomas)	C019-C029, C090-C099, C140, C142, C148	8050-8084

Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2015, adapted from the International Classification of Diseases for Oncology, Third Edition, World Health Organization, Geneva, 2000.

Table 7: HPV-associated Cancer Mortality Codes
International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10)

Cancer Site/Type	ICD-10
Cervix	C53
Vagina	C52
Vulva	C51
Anus	C21
Penis	C60
Oropharynx	C01, C02.4, C02.8, C09, C10.2, C10.8, C10.9, C14

Source: Chronic Disease Epidemiology and Evaluation Section, Ohio Department of Health, 2015, adapted from the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10), World Health Organization, 2015.

Sources of Data and Additional Information

- **Ohio Cancer Incidence Surveillance System:**
http://www.healthy.ohio.gov/cancer/ocisshs/ci_surv1.aspx
- **National Cancer Institute:** HPV and Cancer.
<http://www.cancer.gov/about-cancer/causes-prevention/risk/infectious-agents/hpv-fact-sheet/print>
- **American Cancer Society:** HPV and Cancer.
<http://www.cancer.org/cancer/cancercauses/othercarcinogens/infectiousagents/hpv/hpv-and-cancer-info>
- **Centers for Disease Control and Prevention:** Human Papillomavirus-Associated Cancers—United States, 2004-2008.
<http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6115a2.htm>

References

Appalachian Community Cancer Network. The cancer burden in Appalachia. Lexington, KY: Appalachian Community Cancer Network; 2009.

Centers for Disease Control and Prevention (CDC). HPV Fact Sheet. Atlanta, GA: U.S. Department of Health and Human Services, CDC; 2015.

Centers for Disease Control and Prevention (CDC). Human papillomavirus (HPV)-associated cancers. Atlanta, GA: U.S. Department of Health and Human Services, CDC; 2013. Available at <http://www.cdc.gov/cancer/hpv/statistics/cases.htm>.

Gillison ML, Chaturvedi AK, Lowy DR. HPV prophylactic vaccines and the potential prevention of noncervical cancers in both men and women. *Cancer*. 2008;113:3036-3046.

Petrosky E, Bocchini JA, Hariri S, et al. Use of the 9-valent human papillomavirus (HPV) vaccine: updated HPV vaccination recommendations of the advisory committee on immunization practices. *MMWR Morb Mortal Wkly Rep*. 2015;64:300-304.

Reiter PL, Fisher JL, Hudson AG, et al. Assessing the burden of HPV-related cancer in Appalachia. *Human Vaccin Immunother*. 2013;9:90-96.

Reagan-Steiner S, Yankey D, Jeyarajah J, et al. National, regional, state, and selected local area vaccination coverage among adolescents aged 13-17 years — United States, 2014. *MMWR Morb Mortal Wkly Rep*. 2015;64:784-792.

Watson M, Saraiya M, Ahmed F, 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;113:2841-2854.

To address comments and information requests:

Ohio Cancer Incidence Surveillance System (OCISS)
Ohio Department of Health
246 North High Street
Columbus, OH 43215
Phone: (614) 752-2689
Fax: (614) 644-8028
E-mail: ociss@odh.ohio.gov
OCISS website: http://www.odh.ohio.gov/healthstats/ociss/ci_surv1.aspx
Healthy Ohio website: <http://www.healthy.ohio.gov>

Acknowledgements

The following individuals contributed to this report:

Holly L. Sobotka, M.S.; John Kollman, M.S.; Mary B. Lynn, M.S.
Ohio Department of Health

James L. Fisher, Ph.D.; Julie A. Stephens, M.S.; Rory C. Weier, Ph.D.; Ryan D. Baltic, M.P.H.;
Jessica L. Krok-Schoen, Ph.D.; Electra D. Paskett, Ph.D.
The Ohio State University

Sincere appreciation to the OCISS, cancer registrars, medical records technicians and other health professionals who improve the collection and quality of cancer data in Ohio.

Suggested Citation

Cancers Associated with Human Papillomavirus in Ohio. Ohio Cancer Incidence Surveillance System, Ohio Department of Health and The Ohio State University, Columbus, Ohio, October 2015.

This report is public information. Reproduction and copying of this report for cancer prevention and control, education and program planning are greatly encouraged. Citation of source, however, is appreciated.

