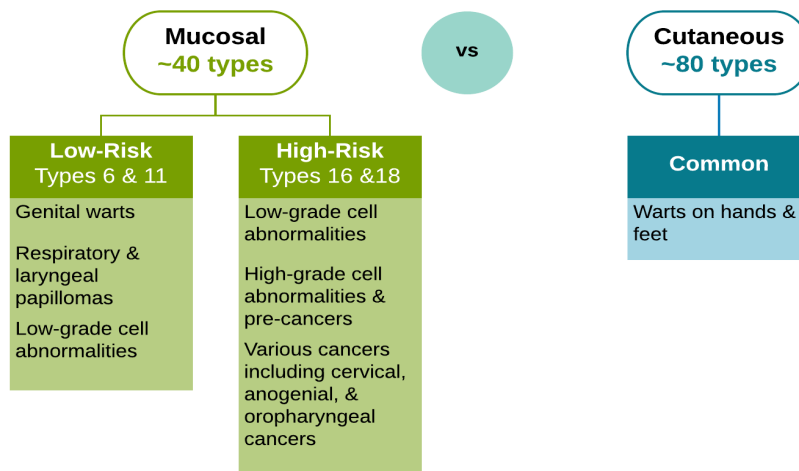


### What is Human Papillomavirus (HPV)?

Human papillomavirus (HPV) is a group of more than 200 related viruses that can enter the body through: the mucous membranes, such as the inner lining of the nose or mouth, the lining of the eyes, or the genitals; the digestive system, such as the lining of the stomach or intestines; and insect bites, needle sticks, other breaks in the skin, and unbroken skin. HPV infections are so common that nearly all men and women will get at least one type of HPV at some point in their lives.<sup>1</sup>

Mucosal types of HPV are commonly characterized by the type and location of infection and how likely it is for that infection to cause cancer or other cell abnormalities (Figure 1).<sup>2</sup> In most people, the body clears the infection on its own. But sometimes, the infection does not go away. Chronic or long-lasting HPV infections can cause pre-cancers and cancer.<sup>2</sup> HPV16 and HPV18 are the two subtypes that cause most HPV-associated (HPVa) cancers.<sup>3</sup>

**Figure 1: Low- and High-Risk Mucosal and Cutaneous Types of HPV<sup>3</sup>**



### Cancer Burden Associated with HPV Infections

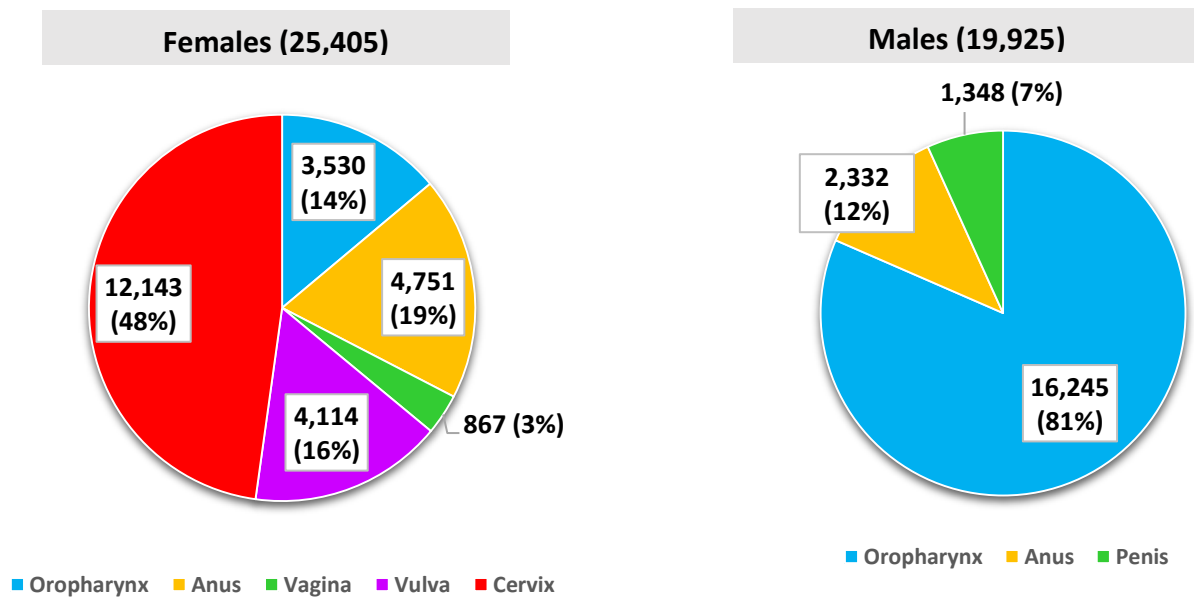
HPV has been determined to be a primary cause of six types of cancer: cervical, vulvar, and vaginal cancers in females; penile cancer in males; and oropharyngeal and anal cancers in both males and females. The term oropharyngeal cancer refers to cancers of the oropharynx (back of the throat, including the base of the tongue and tonsils)<sup>4</sup> and anal and rectal squamous cell carcinomas.

Evidence suggests that HPV is the cause of nearly all cervical and anal cancers, 75% of vaginal cancers, 72% of cancers of the mouth and throat (oropharyngeal), 70% of vulvar cancers, and 60% of penile cancers.<sup>5</sup>

Based on data from 2013 – 2017, about 43,300 new cases of HPV-associated cancers occurred in the United States each year, including 25,405 among females, and 19,925 among males.<sup>6</sup> In the U.S., almost half (48%) of HPV-associated cancers in women are cervical and in men more than 80% are from the oropharynx (mouth and throat) (Figure 2).

An **HPV-associated cancer** is a specific cellular type of cancer that is diagnosed in a part of the body where HPV is often found. These parts of the body include the cervix, vagina, vulva, penis, anus, rectum, and oropharynx (back of the throat, including the base of the tongue and tonsils).<sup>2</sup>

**Figure 2: Number of New HPV-Associated Cancer Cases in the U.S. Per Year (2013 – 2017)**



Nearly all cervical cancers (91%) are attributable to HPV16 and HPV18. Approximately 70% of oropharyngeal cancers are attributable to HPV and the other 30% are thought to be caused by behavioral risk factors like tobacco and alcohol.<sup>7,8,9</sup> Cancer registries do not routinely collect information about HPV status, so, in this report, HPV-associated cancers are defined as a specific cellular type of cancer that is diagnosed in a part of the body where HPV is often found. In Illinois, a total of 1,592 HPV-associated cancers, from sites where HPV is often found, were reported in 2017 (Table 1). Of these, around 80% (1,281) were attributable to (or probably caused by) HPV.

**Table 1: Number of HPV-Associated and Estimated Number of HPV-Attributable Cancer Cases per Year, U.S. and Illinois (2017)**

| Site              | Avg. # of cancers per year in sites where HPV is often found - U.S.* | % probably caused by any HPV type <sup>†</sup> | Observed Cases-Illinois <sup>‡</sup> | Estimated # probably caused by any HPV type – Illinois.& |
|-------------------|--|--|--------------------------------------|--|
|                   | <i>Number</i>  | <i>%</i>                                       | <i>#</i>                             | <i>#</i>   |
| <b>Cervix</b>     | 12,143   | 91%  | <b>497</b>                           | <b>452</b>   |
| <b>Vulva</b>      | 4,114  | 69%  | **                                   | **   |
| <b>Vagina</b>     | 867  | 75%  | **                                   | **   |
| <b>Penis</b>      | 1,348  | 63%  | <b>47</b>                            | <b>30</b>  |
| <b>Oropharynx</b> | 19,775   | 70%  | <b>770</b>                           | <b>539</b>   |
| <b>Male</b>       | 16,245   | 72%  | <b>653</b>                           | <b>470</b>   |
| <b>Female</b>     | 3,530  | 63%  | <b>117</b>                           | <b>74</b>  |
| <b>Anal</b>       | 7,083  | 91%  | <b>278</b>                           | <b>253</b>   |
| <b>Male</b>       | 2,332  | 89%  | <b>90</b>                            | <b>80</b>  |
| <b>Female</b>     | 4,751  | 93%  | <b>188</b>                           | <b>175</b>   |
| <b>Total</b>      | <b>43,330</b>  | <b>79%</b>                                     | <b>1,592</b>                         | <b>1,281</b>   |
| <b>Male</b>       | <b>19,925</b>  | <b>74%</b>                                     | <b>790</b>                           | <b>580</b>   |
| <b>Female</b>     | <b>25,405</b>  | <b>83%</b>                                     | <b>802</b>                           | <b>701</b>   |

\*Centers for Disease Control and Prevention. How Many Cancers and Linked with HPV Each Year?

<https://www.cdc.gov/cancer/hpv/statistics/cases.htm>. Accessed September 19, 2020

<sup>†</sup>HPV types detected in genotyping study; most were high-risk HPV types known to cause cancer (Saraiya M, et al. U.S. assessment of HPV types in cancers: implications for current and 9-valent HPV vaccines. *Journal of the National Cancer Institute* 2016;107:djv086.)

<sup>‡</sup> Illinois State Cancer Registry (2017). <http://www.idph.state.il.us/isrstats/>. Accessed November 2020.

& Estimated number of cancer cases in Illinois probably caused by HPV was calculated using the % of cases probably caused by HPV, multiplied by the observed number of cases reported. Estimates were rounded to the nearest 100 and might not sum to total because of rounding.

\*\*Data has been suppressed due to confidentiality.

In 2017, females experienced a higher percentage of new HPV-associated cancer cases compared to males; 55% vs. 45% (Table 1). In Illinois, approximately 42% (544/1,281) of all cancer cases probably caused by HPV are of the mouth and throat (oropharynx). Cervical cancer is the most common HPV-associated cancer among women; 64% of all new cases among Illinois women were most likely caused by HPV. Cancer of the oropharynx (back of the throat, including the base of the tongue and tonsils) accounts for 81% of cancers probably caused by HPV in men.

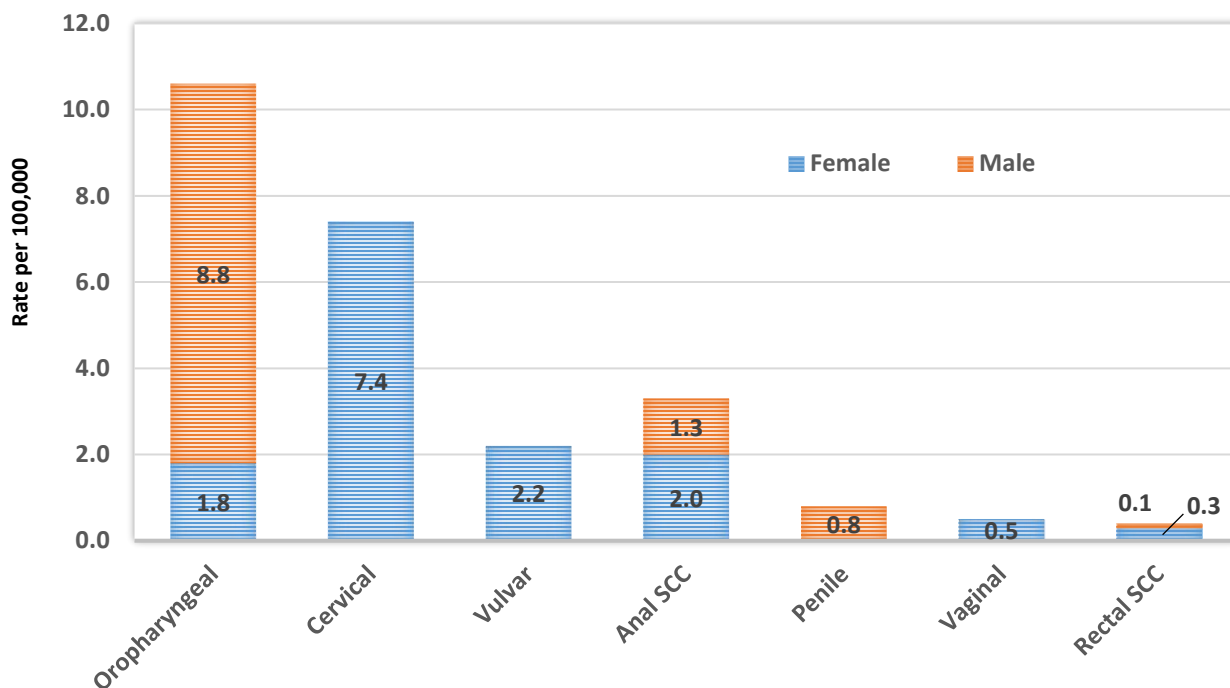
#### *HPV-Associated Cancers Trends, by Sex (2013-2017)*

Women are more likely than men to be diagnosed with HPV-associated cancers, as cervical cancer remains the most commonly diagnosed HPV-associated cancer. However, male HPV infection is also an important concern, both for the disease burden in men and for the risk of transmission to women. HPV is associated with a variety of cancers in men, including anal cancer and a subset of penile and oral

cancers. The incidence of anal and oral cancers related to HPV is increasing in the general population and is growing even faster among individuals who are immunocompromised due to HIV infection.<sup>10</sup> This trend is driven largely by increases in HPV-associated oropharyngeal cancer over the past three decades, particularly among men, even as incidence (new cancer) rates of other head and neck cancers and many other HPV-associated cancers are decreasing.<sup>7</sup>

For both males and females, incidence rates for HPV-associated cancers in Illinois reflect national trends. In Illinois, males are disproportionately impacted by cancers of the mouth and throat (oropharynx) as compared to females (Figure 3). Nationally, the incidence of oropharyngeal cancers among men (8.9 per 100,000) is greater than the incidence of cervical cancers among women (7.1 per 100,000).<sup>9</sup>

**Figure 3: Age-Adjusted Rate of New HPV-Associated Cancers by Cancer Type, Female vs. Male, Illinois (2013 – 2017)**



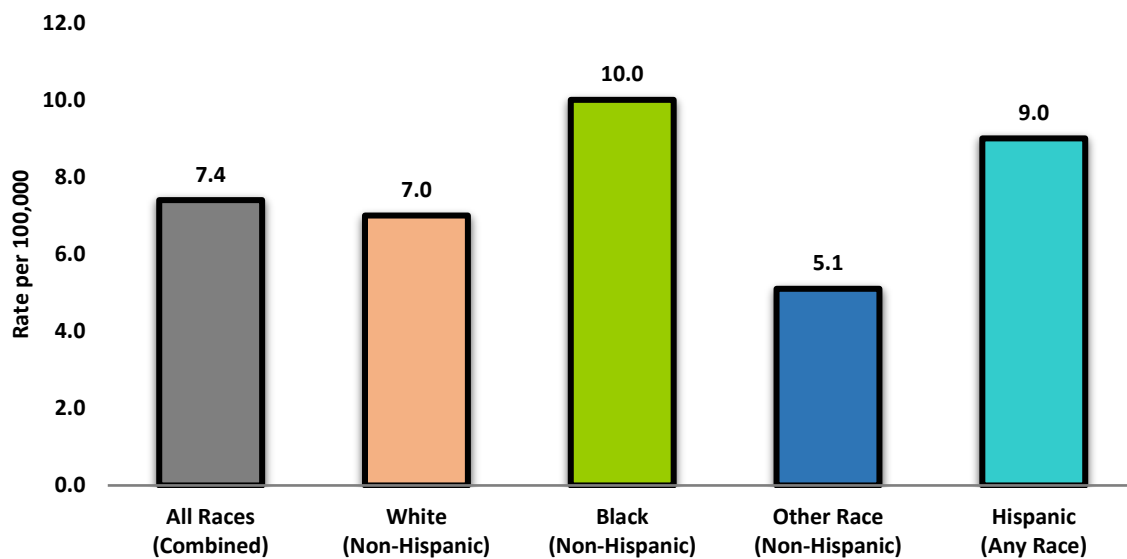
Data Source: Illinois State Cancer Registry (Accessed October 2020); rates are the number of cases per 100,000 people and are age-adjusted to the 2000 U.S. standard population.

Aside from cervical cancer screening, there are no recommended screening tests for the five other types of cancers linked to HPV, so these cancers may not be detected until they cause health problems.<sup>11</sup> Although the HPV vaccine was initially developed to prevent cervical cancers and other cancers of the reproductive system, the vaccine also protects against the HPV types that cause oropharyngeal cancers.<sup>12</sup> The rates of HPV-associated oropharyngeal cancers among men and cervical cancers among women, highlight the importance of vaccinating both boys and girls.

### HPV-Associated Cancers, by Race and Ethnicity

Incidence rates of HPV-associated cancers varies by race and ethnicity. In the U.S., Black and Hispanic women have significantly higher rates of HPV-associated cervical cancer when compared to non-Hispanic White women.<sup>5</sup> In Illinois, the highest cervical cancer incidence rates were among non-Hispanic Black women (10.0 per 100,000, [95% CI, 9.2-11.0]) and Hispanic women (9.0 per 100,000, [95% CI, 8.1-10.0]) and are significantly higher than all other race/ethnic groups (Figure 4).

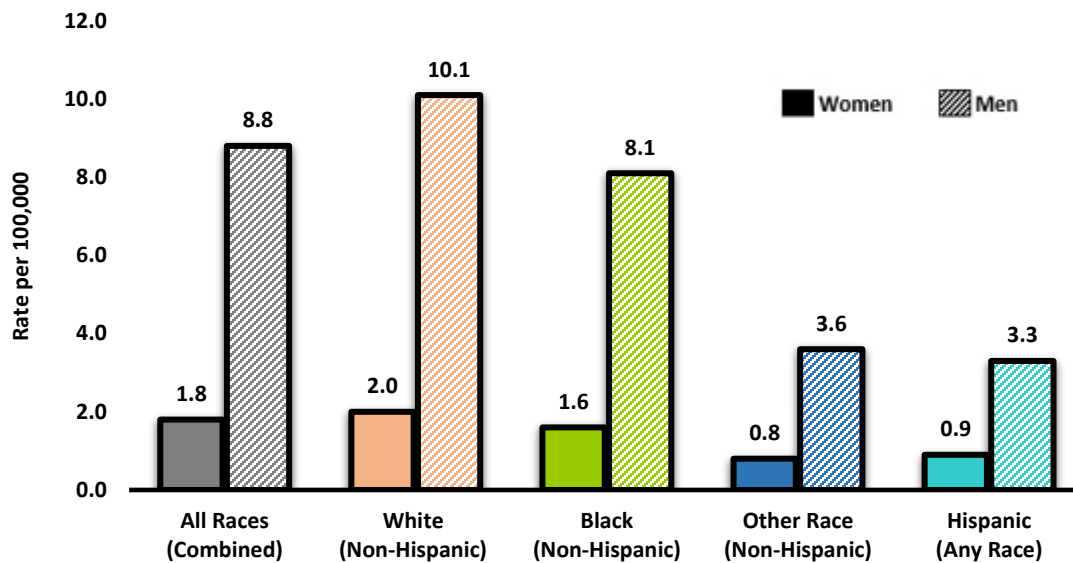
**Figure 4. Rate of New HPV-Associated Cervical Cancers, by Race/Ethnicity, Illinois (2013-2017)**



Data Source: Illinois State Cancer Registry (Accessed October 2020); rates are per 100,000 and age-adjusted to the 2000 US Std Population.  
Other Race includes the race designations Asian/Pacific Islander and American Indian/Alaska Native.

For oropharyngeal cancer, the incidence rates were significantly greater among non-Hispanic White men (10.1 per 100,000, [95% CI, 9.7-10.5]) when compared to all other race/ethnic groups; non-Hispanic Black (8.1 per 100,000, [95% CI, 7.2-9.0]), non-Hispanic Other (3.3 per 100,000, [95% CI, 2.7-4.6]) and Hispanic (3.3 per 100,000, [95% CI, 2.7-4.1]). Among non-Hispanic White women, oropharyngeal cancer was significantly higher (2.0 per 100,000, [95% CI, 1.8-2.1]) when compared to Hispanic women (0.9 per 100,000, [95% CI, 0.6-1.3]) (Figure 5). Incidence rates for HPV-associated cancers were lowest among non-Hispanic (other race) populations for cervical cancer (5.1 per 100,000, [95% CI, 4.2-6.3]). Rates of new HPV-associated oropharyngeal cancer were lowest among non-Hispanic (other race) populations for females (0.8 per 100,000, [95% CI, 0.4-1.2]).

**Figure 5. Rate of New HPV-Associated Oropharyngeal Cancers, by Sex, Race/Ethnicity, Illinois (2013-2017)**



Data Source: Illinois State Cancer Registry (Accessed October 2020); rates are per 100,000 and age-adjusted to the 2000 US Std Population. Other Race includes the race designations Asian/Pacific Islander and American Indian/Alaska Native.

### *HPV-Associated Cancers, Urban vs. Rural*

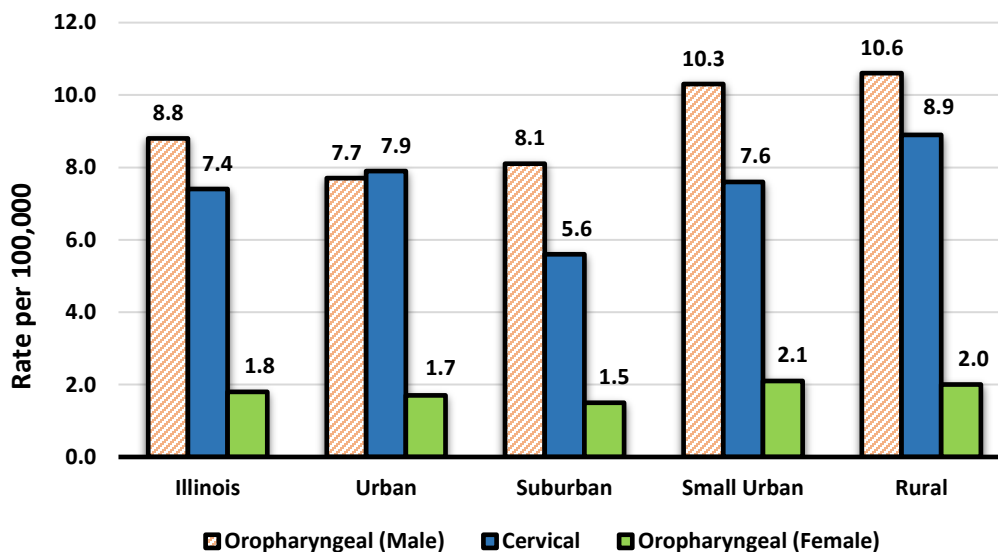
Rural populations in the U.S. and in Illinois experience consistent disparities around HPV-associated cancer-related disease prevention and management. Rural individuals are less likely to be aware of HPV. Among those who are aware of HPV, they are less likely to believe that HPV can cause cancer and that HPV can be transmitted through sexual contact.<sup>13</sup> Rural communities also experience limited access to health care and physician and mental health provider shortages that contribute to HPV health disparities. Other factors include aging populations; race/ethnicity distribution; higher rates of poor health risk behaviors, such as inadequate physical activity, unhealthy eating behaviors, smoking, and alcohol consumption, as well as lower education; and lack of safe and affordable housing.<sup>14</sup>

In Illinois, rural populations, when compared to populations in urban, suburban, and small urban areas\*, experience some of the highest rates of HPV-associated cancers. Specifically, oropharyngeal cancers among males in rural Illinois (10.6 per 100,000, [95% CI, 9.9-11.4]) were significantly higher than populations in urban (7.7 per 100,000, [95% CI, 7.2-8.2]) and suburban (8.1 per 100,000, [95% CI, 7.5-8.7]) Illinois. In addition, cervical cancers were significantly higher among rural populations

\*Illinois State Cancer Registry county reference groups were established in 1993 and used for reference groups in investigative cancer studies. The groups are based upon population density, rate of growth, and Rural-Urban Continuum codes (<https://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx>)

(8.9 per 100,000, [95% CI, 8.1-9.8]) than populations in suburban (5.6 per 100,000, [95% CI, 5.1-6.1]) Illinois (Figure 6). Populations living in small urban areas in Illinois experience the second highest rates of HPV-related cancers for oropharyngeal cancer among males (10.3 per 100,000, [95% CI, 9.6-11.2]) and the third highest rates for cervical cancer (7.6 per 100,000, [95% CI, 6.9-8.4]). This data is consistent with recent studies indicating significant disparities for all HPV-related cancers among rural U.S. populations compared to urban for both cancer incidence and mortality.<sup>15</sup>

**Figure 6. Rate of New HPV-related Oropharyngeal and Cervical Cancers, by Location, Illinois (2013-2017)**



Data Source: Illinois State Cancer Registry (Accessed October 2020); rates are per 100,000 and age-adjusted to the 2000 US Std Population.

### Conclusion

HPV is a common virus that can be spread from one person to another person through anal, vaginal, or oral sex, or through other close skin-to-skin touching during sexual activity. There is variation by cancer type, but the most common HPV-related cancer is cervical cancer among women and oropharyngeal cancer among men. Non-Hispanic Black women had the highest rate of new cervical cancer cases when compared to other race/ethnic groups, while non-Hispanic White men had the highest rate of new oropharyngeal cancer. In addition, significant differences in new cancer rates for oropharyngeal and cervical cancer were observed for populations who live in rural areas, when compared to Illinois suburban areas.

Many public health strategies can be implemented to address HPV-related cancers. One of the most effective evidence-based interventions is uptake of the HPV vaccine. Studies in the U.S. and other

countries have shown the HPV vaccination is preventing cancer-causing infections.<sup>16</sup> The highly effective 9-valent HPV vaccine, Gardasil 9, has been available for use in the United States since late 2016 and protects against nine types of HPV (types 6, 11, 16, 18, 31, 33, 45, 52 and 58).<sup>22</sup> The majority of HPVa cancers are caused by HPV 16 or 18. Today, Gardasil 9 is the only HPV vaccine available in the U.S. The HPV vaccine is an effective way to protect against HPV when administered at the recommended age of 11 or 12 years (or can start at age 9) for both girls and boys.

Although effective, use of the 9-valent HPV vaccine (Gardasil 9) will not eliminate the need for cancer screening in the U.S. or Illinois because not all HPV types that cause HPVa cancers are included in the vaccine. Another proven and long-standing public health measure is cervical cancer screening. Routine screening for women aged 21 to 65 years old is critical as early detection and treatment are key to positive health outcomes. Other evidence-based strategies include oral health cancer screenings as well as awareness and education strategies like those used for other sexually transmitted infections.

HPV infection remains the most common sexually transmitted infection in men and women in the United States and HPVa cancers remain a public health concern in the U.S. and Illinois. HPV infections can lead to poor health outcomes, especially for urban non-Hispanic Black women (cervical cancer) as well as rural non-Hispanic white men and women (oropharyngeal cancer). Illinois partners and stakeholder groups can work together to target disparate groups and reduce HPVa cancers.



## References

- <sup>1</sup>HPV Statistics. Centers for Disease Control and Prevention. <https://www.cdc.gov/std/hpv/stats.htm>. Published January 4, 2017. Accessed June 24, 2020.
- <sup>2</sup>Basic Information about HPV and Cancer. Centers for Disease Control and Prevention. [https://www.cdc.gov/cancer/hpv/basic\\_info/index.htm](https://www.cdc.gov/cancer/hpv/basic_info/index.htm). Published August 22, 2018. Accessed June 24, 2020.
- <sup>3</sup>Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases. Homborsky J, Kroger A, Wolfe S, Eds. 13<sup>th</sup> ed. Washington D.C. Public Health Foundation, 2015.
- <sup>4</sup>HPV-Associated Oropharyngeal Cancer Rates by Race and Ethnicity. Centers for Disease Control and Prevention. <https://www.cdc.gov/cancer/hpv/statistics/headneck.htm>. Published August 2, 2019. Accessed July 22, 2020.
- <sup>5</sup>National Cancer Institute. HPV and Cancer. Accessed September 27, 2020. <https://www.cancer.gov/about-cancer/causes-prevention/risk/infectious-agents/hpv-and-cancer>.
- <sup>6</sup>Centers for Disease Control and Prevention. Cancers Associated with Human Papillomavirus, United States—2013–2017. USCS Data Brief, no 18. Atlanta, GA: Centers for Disease Control and Prevention, US Department of Health and Human Services; 2020.
- <sup>7</sup>Saraiya M, Unger ER, Thompson TD, et al. US assessment of HPV types in cancers: implications for current and 9-valent HPV vaccines. *J Natl Cancer Inst*. 2015;107(6):djv086. Published 2015 Apr 29. doi:10.1093/jnci/djv086.
- <sup>8</sup>Chaturvedi AK, Engels EA, Pfeiffer RM, et al. Human papillomavirus and rising oropharyngeal cancer incidence in the United States. *J Clin Oncol*. 2011;29(32):4294-4301. doi:10.1200/JCO.2011.36.4596.
- <sup>9</sup>Gillison ML, Chaturvedi AK, Lowy DR. HPV prophylactic vaccines and the potential prevention of noncervical cancers in both men and women. *Cancer*. 2008;113(10 Suppl):3036-3046. doi:10.1002/cncr.23764.
- <sup>10</sup>Palefsky JM. Human papillomavirus-related disease in men: not just a women's issue [published correction appears in *J Adolesc Health*. 2010 Jun;46(6):614]. *J Adolesc Health*. 2010;46(4 Suppl):S12-S19. doi:10.1016/j.jadohealth.2010.01.010.
- <sup>11</sup>HPV. Centers for Disease Control and Prevention. <https://www.cdc.gov/hpv/hcp/protecting-patients.html>. Published November 13, 2019. Accessed July 22, 2020.
- <sup>12</sup>HPV and Oropharyngeal Cancer. Centers for Disease Control and Prevention. [https://www.cdc.gov/cancer/hpv/basic\\_info/hpv\\_oropharyngeal.htm](https://www.cdc.gov/cancer/hpv/basic_info/hpv_oropharyngeal.htm). Published March 14, 2018. Accessed July 22, 2020.
- <sup>13</sup>Mohammed KA, Subramaniam DS, Geneus CJ, Henderson ER, Dean CA, Subramaniam DP, Burroughs TE. Rural-urban differences in human papillomavirus knowledge and awareness among US adults. *Prev Med*. 2018 Apr;109:39-43. doi: 10.1016/j.ypmed.2018.01.016. Epub 2018 Jan 31. PMID: 29378268.
- <sup>14</sup>The State of Rural Health in Illinois: Great Challenges and a Path Forward. October 2018. [https://www.siumed.edu/sites/default/files/u9451/rhs\\_stateofillinois\\_final1115.pdf](https://www.siumed.edu/sites/default/files/u9451/rhs_stateofillinois_final1115.pdf). Accessed November 21, 2020.
- <sup>15</sup>Zahnd WE, Rodriguez C, Jenkins WD. Rural-urban differences in human papillomavirus-associated cancer trends and rates. *J Rural Health* 2019; 35:208–215.
- <sup>16</sup>Centers for Disease Control and Prevention. HPV Vaccine Safety and Effectiveness Data <https://www.cdc.gov/hpv/hcp/vaccine-safety-data.html>. Accessed September 27, 2020.