HPV and Cancer

What is HPV (human papillomavirus)?

HPV is a group of more than 200 related viruses, some of which are spread through vaginal, anal, or oral sex.

Sexually transmitted HPV types fall into two groups, low risk and high risk.

- Low-risk HPVs mostly cause no disease. However, a few low-risk HPV types can cause warts on or around the genitals, anus, mouth, or throat. In rare cases, they can cause recurrent respiratory papillomatosis, a condition in which benign tumors grow in the respiratory tract.
- High-risk HPVs can cause several types of cancer. There are about 14 high-risk HPV types. Two of these, HPV16 and HPV18, are responsible for most HPV-related cancers.

HPV infection is common: Nearly all sexually active people are infected with HPV almost immediately once they become sexually active. Around half of these infections are with a high-risk HPV type.

Most HPV infections don’t cause cancer: Your immune system usually controls HPV infections so they don’t cause cancer.

High-risk HPV infections that persist can cause cancer: Sometimes HPV infections are not successfully controlled by your immune system. When a high-risk HPV infection persists for many years, it can lead to cell changes that, if untreated, may get worse over time and become cancer.

HPV vaccination can prevent cancer: HPV vaccines can prevent infection with disease-causing HPV types, preventing many HPV-related cancers and cases of genital warts.

Cancers Caused by HPV Infection

Long-lasting infections with high-risk HPVs can cause cancer in parts of the body where HPV infects cells, such as in the cervix, oropharynx (the part of the throat at the back of the mouth, including the soft palate, the base of the tongue, and the tonsils), anus, rectum, penis, vagina, and vulva. HPV infects the squamous cells that line the inner surfaces of these organs. For this reason, most HPV-related cancers are a type of cancer called squamous cell carcinoma. Some cervical cancers come from HPV infection of gland cells in the cervix and are called adenocarcinomas.

Learn more about HPV-related cancers in the United States from the bulleted list below.

- **Cervical cancer:** Virtually all cervical cancers are caused by HPV. Routine screening can prevent most cervical cancers by allowing health care providers to find and remove precancerous cells before they develop into cancer. As a result, cervical cancer incidence rates in the United States are decreasing. Learn more about trends and statistics for cervical cancer.
- **Oropharyngeal cancers:** Most oropharyngeal cancers (70%) in the United States are caused by HPV. The number of new cases is increasing each year, and oropharyngeal cancers are now the most common HPV-related cancer in the United States. Learn more about trends in diagnosis and survival rates of oral cavity and pharynx cancer.
- **Anal cancer:** Over 90% of anal cancers are caused by HPV. The number of new cases and deaths from anal cancer are increasing each year. Learn more about anal cancer statistics.
• Penile cancer: Most penile cancers (over 60%) are caused by HPV. Learn about the importance of getting recommended treatments for penile cancer, a rare type of cancer.

• Vaginal cancer: Most vaginal cancers (75%) are caused by HPV. Learn about symptoms of, and treatment for, vaginal cancer, a rare type of cancer.

• Vulvar cancer: Most vulvar cancers (70%) are caused by HPV. Learn about new cases and death rates from vulvar cancer, a rare type of cancer.

In the United States, high-risk HPVs cause 3% of all cancers in women and 2% of all cancers in men, resulting in about 43,000 HPV-related cancers each year.

Worldwide, the burden of HPV-related cancers is much greater. High-risk HPVs cause about 5% of all cancers worldwide, with an estimated 570,000 women and an estimated 60,000 men getting an HPV-related cancer each year. Cervical cancer is among the most common cancers and a leading cause of cancer-related deaths in low- and middle-income countries, where screening tests and treatment of early cervical cell changes are not readily available.

How is HPV Transmitted?

HPV is transmitted through vaginal intercourse, anal and oral sex, and other intimate, skin-to-skin contact. The infection passes easily between sexual partners. Condoms and dental dams can reduce the likelihood of HPV transmission but do not completely prevent it.

Does HPV Infection Cause Symptoms?

No, infection with high-risk HPV does not cause symptoms. The precancerous cell changes caused by a persistent HPV infection at the cervix also do not cause symptoms. However, precancerous lesions at other sites in the body may cause symptoms. And if an HPV infection develops into cancer, the cancer may cause symptoms. Learn more about signs and symptoms for cervical, vaginal, vulvar, penile, anal, and oropharyngeal cancers.

Preventing HPV Infection with HPV Vaccination

The HPV vaccine Gardasil 9® protects against infection with nine HPV types: the two low-risk HPV types that cause most genital warts, plus the seven high-risk HPV types that cause most HPV-related cancers.

HPV vaccination is approved by the Food and Drug Administration (FDA) and recommended by the Centers for Disease Control and Prevention (CDC):

• For girls and young women, to prevent HPV-caused anal cancer, cervical cancer, vulvar cancer, and vaginal cancer; precancerous cell changes in the cervix, vulva, vagina, and anus; and genital warts.

• For boys and young men, to prevent anal cancer, precancerous anal lesions, and genital warts.

CDC recommends that the HPV vaccine be given to all children at age 11 or 12, although it is approved for use beginning at the age of 9. CDC also recommends that it be given through age 26 in women and age 21 in men (or 26 for certain groups of men, such as men with a compromised immune system) for those who did not complete vaccination earlier.

HPV vaccination provides strong protection against new HPV infections, but the vaccine does not treat HPV
infections or diseases caused by HPV. Learn more about the safety and effectiveness of the human papillomavirus (HPV) vaccine.

Screening for HPV and Cell Changes Caused by HPV

Screening tests are tests used to check for disease when there are no symptoms. The goal of screening for cervical cancer is to find precancerous cell changes at an early stage, even before they become cancer and when treatment can work to prevent cancer from ever happening. Currently, cervical cancer is the only HPV-caused cancer for which FDA-approved screening tests are available.

Screening for Cervical Cancer

Cervical cancer screening tests:

• the HPV test checks cervical cells for high-risk HPV
• the Pap test checks for cervical cell changes that can be caused by high-risk HPV
• the HPV/Pap cotest checks for both high-risk HPV and cervical cell changes

These screening ages and intervals apply to most women:

• Age 21-29 years: Pap testing every 3 years.
• Age 30-65 years: Screening using one of these tests:
  • HPV testing every 5 years
  • HPV/Pap cotesting every 5 years
  • Pap testing every 3 years
• Older than 65 years: If you have been screened regularly and your recent test results were normal, you may be advised that you no longer need to be screened for cervical cancer.

Learn more about HPV and Pap testing and find out about next steps after an abnormal Pap test or positive HPV test. Depending on the test results and her age, a woman may have another test after 12 months, or she may have an exam called a colposcopy to allow her provider to examine the cervix and, if needed, remove a sample of tissue for analysis (a procedure called a biopsy).

Screening for Other HPV-Related Cancers

There are no FDA-approved tests to detect HPV infections or HPV-caused cell changes in anal, rectal, vulvar, vaginal, penile, or oropharyngeal tissues. However, there is some evidence that, among populations that are at higher risk for HPV infection, such as men who have sex with men or men who are HIV-positive, anal Pap tests may help to detect early cell changes or precancerous cells. In anal Pap tests, a sample of anal cells is checked for abnormal cells.

Treatment for Cell Changes Caused by HPV Infection

Although HPV infection itself cannot be treated, there are treatments for the precancerous cell changes caused by infection with high-risk HPV.

• Precancerous cervical cell changes: Most women who have precancerous cervical cell changes are treated with the loop electrosurgical excision procedure (LEEP), which is a method to remove the abnormal tissue. Learn more about treatments for abnormal cervical cell changes.
• Precancerous vaginal, vulvar, penile, and anal lesions; genital warts; and benign respiratory tract tumors: Treatment methods include topical medicines, surgical excision, cryosurgery, and LEEP.
• HPV-related cancers: Individuals who develop an HPV-related cancer generally receive the same treatment as patients with tumors at the same site that are not related to HPV infection. However, patients with HPV-positive oropharyngeal cancer may receive different treatments than patients whose oropharyngeal cancers are not caused by HPV. Learn more about treatment options for oropharyngeal cancer.

How Does HPV Cause Cancer?

Once high-risk HPV infects cells, it interferes with the ways in which these cells communicate with one another, causing infected cells to multiply in an uncontrolled manner. These infected cells are usually recognized and
controlled by the immune system. However, sometimes the infected cells remain and continue to grow, eventually forming an area of precancerous cells that, if not treated, can become cancer. Research has found that it can take 10 to 20 years, or even longer, for HPV-infected cervical cells to develop into a cancerous tumor.

Among women whose cervical cells are infected with high-risk HPV, several factors increase the chance that the infection will be long lasting and lead to precancerous cervical cells:

- giving birth to many children
- using oral contraceptives for a long time
- smoking cigarettes

**NCI and HPV-Related Research**

Clinical trials are an important step in learning about better ways to prevent, diagnose, and treat diseases, such as cancers caused by HPV. **NCI’s Cancer Information Service** can help you learn about HPV trials.

The National Cancer Institute is conducting and funding research to learn more about HPV:

- The Division of Cancer Epidemiology and Genetics (DCEG) conducts research into cervical and other HPV-related cancers to advance our understanding of how HPV causes cancer; evaluates screening practices to determine the most effective methods to detect precancerous changes early; develops and test new approaches to screening that may be easier to use in low-resource settings; refines tools for risk assessment in the clinic to help health care providers follow up on abnormal screening test results. Investigators in DCEG conducted the first population-based clinical trial of the HPV vaccines. Currently, DCEG is conducting a clinical trial of one-dose of the HPV vaccines to determine if it is sufficient to protect against HPV-caused cervical cancer.

- The Division of Cancer Prevention (DCP) conducts and fosters the development of research on the prevention and early detection of human papillomavirus (HPV)-related cancers and related conditions.

- The Division of Cancer Control and Population Sciences (DCCPS) supports research-tested intervention programs related to HPV and the investigation of implementation strategies to promote the HPV vaccine in regions with low HPV vaccine rates.

- The Center for Cancer Research (CCR) is home to scientists and clinicians who are exploring the cutting-edge of cancer-related research. CCR scientists work on a wide spectrum of biological and biomedical problems, including HPV. Investigators in CCR conducted the research that led the initial development and characterization of the human papillomavirus (HPV) vaccines.

**Related Resources**

- Cancer Trends Progress Report: HPV
- HPV Vaccination Linked to Decreased Oral HPV Infections
- Human Papillomavirus (HPV) Vaccines
- HPV and Pap Testing
- Understanding Cervical Changes: A Health Guide for Women
- Cervical Cancer Screening May Be Less Effective in Obese Women
- For HPV-Positive Women, Test Can Guide Cervical Cancer Screening Follow-Up

AI approach outperformed human experts in identifying cervical precancer

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