Infections That Can Lead to Cancer

Can infections cause cancer?

Since the start of the 20th century, it's been known that certain infections play a role in cancer in animals. More recently, infections with certain viruses, bacteria, and parasites have been recognized as risk factors for several types of cancer in humans.

Worldwide, infections are linked to about 15% to 20% of cancers. This percentage is even higher in developing countries, but it is lower in the United States and other developed countries. This is partly because certain infections are more common in developing countries, and partly because some other risk factors for cancer, such as obesity, are more common in developed countries.

Infections can raise a person's risk of cancer in different ways. For example:

- Some viruses directly affect the genes inside cells that control their growth. These viruses can insert their own genes into the cell, causing the cell to grow out of control.
- Some infections can cause long-term inflammation in a part of the body. This can lead to changes in the affected cells and in nearby immune cells, which can eventually lead to cancer.
- Some types of infections can suppress a person's immune system, which normally helps protect the body from some cancers.

Any of these changes might lead to a higher risk of cancer.

Even though the infections described here can raise a person's risk of certain types of cancer, most people with these infections never develop cancer. The risk of developing cancer is also influenced by other factors. For example, infection with *Helicobacter pylori* (*H pylori*) bacteria might increase your risk of stomach cancer, but what you eat, whether or not you smoke, and other factors also affect your risk.

Many of the infections that influence cancer risk can be passed from person to person, but cancer itself cannot. A healthy person can't "catch" cancer from someone who has it.

Viruses that can lead to cancer

Viruses are very small organisms; most can't even be seen with an ordinary microscope. They are made up of a small number of genes in the form of DNA or RNA surrounded by a protein coating. A virus must enter a living cell and "hijack" the cell's machinery in order to reproduce and make more viruses. Some viruses do this by inserting their own DNA (or RNA) into that of the host cell. When the DNA or RNA affects the host cell's genes, it can push the cell toward becoming cancer.

In general, each type of virus tends to infect only a certain type of cell in the body. (For example, the viruses that cause the common cold only infect the cells lining the nose and throat.)

Several viruses are linked with cancer in humans. Our growing knowledge of the role of viruses as a cause of cancer has led to the development of vaccines to help prevent certain human cancers. But these vaccines can only protect against infections if they are given **before** the person is exposed to the cancer-promoting virus.

Human papilloma viruses (HPVs)

Human papilloma viruses (HPVs) are a group of more than 150 related viruses. They are called *papilloma viruses* because some of them cause papillomas, which are more commonly known as warts. Some types of HPV only grow in skin, while others grow in mucous membranes such as the mouth, throat, or vagina.

All types of HPV are spread by contact (touch). More than 40 types of HPV can be passed on through sexual contact. Most sexually active people are infected with one or more of these HPV types at some point in their lives. At least a dozen of these types are known to cause cancer.

While HPV infections are very common, cancer caused by HPV is not. Most people infected with HPV will not develop a cancer related to the infection.

HPV infections of the mucous membranes can cause genital warts, but they usually have no symptoms. There are no effective medicines or other treatments for HPV, other than removing or destroying cells that are known to be infected. But in most people, the body's immune system controls the HPV infection or gets rid of it over time. To learn more, see *HPV and HPV Testing*.

HPV and cervical cancer

A few types of HPV are the main causes of cervical cancer, which is the second most common cancer among women worldwide. Cervical cancer has become much less common in the United States because the Pap test has been widely available for many years. This test can show pre-cancerous changes in cells of the cervix that might be caused by HPV infection. These changed cells can then be destroyed or removed, if needed. This can keep cancer from developing. Doctors may now also test for HPV, which can tell them if a woman might be at higher risk for cervical cancer.

Nearly all women with cervical cancer show signs of HPV infection on lab tests, but most women infected with HPV will **not** develop cervical cancer. Even though doctors can test women for HPV, there is no treatment directed at HPV itself. If the HPV causes abnormal cells to start growing, these cells can be removed or destroyed.

Our document *HPV and HPV Testing* has more information on this topic.

HPV and other cancers

HPVs also have a role in causing some cancers of the penis, anus, vagina, and vulva. They are linked to some cancers of the mouth and throat, too. Again, although HPVs have been linked to these cancers, most people infected with HPV never develop these cancers.

Smoking, which is also linked with these cancers, may work with HPV to increase cancer risk. Other genital infections may also increase the risk that HPV will cause cancer.

You can get more details in *HPV and Cancer*.

Vaccines against HPV

Vaccines are now available to help protect against infection from the main cancer-causing HPV types. These vaccines are approved for use in females from age 9 up to their mid-20's. Some HPV vaccines have also been approved for use in boys and young men.

The vaccines can only be used to help prevent HPV infection – they do not stop or help treat an existing infection. To be most effective, the vaccines should be given before a person becomes sexually active (has sex with another person).

Because the vaccines are still fairly new (first approved in 2006), and it often takes decades for cancer to develop, it's not yet known how well they will protect against it, or exactly which types of cancers they might help prevent. These vaccines and others like them are being studied further.

See *HPV Vaccines* for more on this.

Epstein-Barr virus (EBV)

EBV is a type of herpes virus. It is probably best known for causing infectious mononucleosis, often called "mono" or the "kissing disease." In addition to kissing, EBV can be passed from person to person by coughing, sneezing, or by sharing drinking or eating utensils. Most people in the United States are infected with EBV by the end of their teen years, although not everyone develops the symptoms of mono.

As with other herpes virus infections, EBV infection is life-long, even though most people have no symptoms after the first few weeks. EBV infects and stays in certain white blood cells in the body called *B lymphocytes* (also called *B cells*). There are no

medicines or other treatments to get rid of EBV, nor are there vaccines to help prevent it, but EBV infection doesn't cause serious problems in most people.

EBV infection increases a person's risk of getting nasopharyngeal cancer (cancer of the area in the back of the nose) and certain types of fast-growing lymphomas such as Burkitt lymphoma. It may also be linked to Hodgkin lymphoma and some cases of stomach cancer. EBV-related cancers are more common in Africa and parts of Southeast Asia. Overall, very few people who have been infected with EBV will ever develop these cancers.

Hepatitis B virus (HBV) and hepatitis C virus (HCV)

Both HBV and HCV cause viral hepatitis, a type of liver infection. Other viruses can also cause hepatitis (hepatitis A virus, for example), but only HBV and HCV can cause the long-term (chronic) infections that increase a person's chance of liver cancer. In the United States, less than half of liver cancers are linked to HBV or HCV infection. But this number is much higher in some other countries, where both viral hepatitis and liver cancer are much more common. Some research also suggests that long-term HCV infection might be linked with some other cancers, such as non-Hodgkin lymphoma.

HBV and HCV are spread from person to person in much the same way as HIV (see the section on HIV below) — through sharing needles (such as during injection drug use), unprotected sex, or childbirth. They can also be passed on through blood transfusions, but this is rare in the United States because donated blood is tested for these viruses.

Of the 2 viruses, infection with HBV is more likely to cause symptoms, such as a flu-like illness and jaundice (yellowing of the eyes and skin). Most adults recover completely from HBV infection within a few months. Only a very small portion of adults go on to have chronic HBV infections, but this risk is higher in young children. People with chronic HBV infections have a higher risk for liver cancer.

HCV is less likely to cause symptoms than HBV, but it is more likely to cause chronic infection, which can to lead to liver damage or even cancer. An estimated 3.2 million people in the United States have chronic HCV infection, and most of these people don't even know they have it. To help find some of these unknown infections, the US Centers for Disease Control and Prevention (CDC) recommends that all people born between 1945 and 1965 (as well as some other people at high risk) get blood tests to check for HCV. (For a more complete list of who should get tested for HCV, visit the CDC website at: www.cdc.gov/hepatitis/C/cFAQ.htm.)

Once an infection is found, treatment and preventive measures can be used to slow liver damage and reduce cancer risk. Both hepatitis B and C infections can be treated with drugs. Treating chronic hepatitis C infection with a combination of drugs for at least a few months can get rid of HCV in many people. A number of drugs can also be used to help treat chronic hepatitis B. Although they don't cure the disease, they can lower the risk of liver damage and might lower the risk of liver cancer as well.

There is a vaccine to prevent HBV infection, but none for HCV. In the United States, the HBV vaccine is recommended for all children. It's also recommended for adults who are at risk of exposure. This includes people infected with HIV, men who have sex with men, injection drug users, people in certain group homes, people with certain medical conditions and occupations (such as health care workers), and others. (For a more complete list of who should get the HBV vaccine, visit the CDC website at: www.cdc.gov/hepatitis/B/bFAQ.htm.)

For more information, see our document *Liver Cancer*.

Human immunodeficiency virus (HIV)

HIV, the virus that causes acquired immune deficiency syndrome (AIDS), doesn't appear to cause cancers directly. But HIV infection increases a person's risk of getting several types of cancer, especially some linked to other viruses.

HIV can be spread through semen, vaginal fluids, blood, and breast milk from an HIV-infected person. Known routes of spread include:

- Unprotected sex (oral, vaginal, or anal) with an HIV-infected person
- Injections with needles or injection equipment previously used by an HIV-infected person
- Prenatal (before birth) and perinatal (during birth) exposure of infants from mothers with HIV
- Breastfeeding by mothers with HIV
- Transfusion of blood products containing HIV (the risk of HIV from a transfusion is less than 1 in a million in the United States due to blood testing and donor screening)
- Organ transplants from an HIV-infected person (donors are now tested for HIV)
- Penetrating injuries or accidents (usually needle sticks) in health care workers while caring for HIV-infected patients or handling their blood

HIV is **not** spread by insects, through water, or by casual contact such as talking, shaking hands, hugging, coughing, sneezing, or from sharing dishes, bathrooms, kitchens, phones, or computers. It is not spread through saliva, tears, or sweat.

HIV infects and destroys white blood cells known as helper T-cells, which weakens the body's immune system. This might let some other viruses, such as HPV, thrive, which might lead to cancer.

Many scientists believe that the immune system is also important in attacking and destroying newly formed cancer cells. A weak immune system might let new cancer cells survive long enough to grow into a serious, life-threatening tumor.

HIV infection has been linked to a higher risk of developing Kaposi sarcoma and cervical cancer. It's also linked to certain kinds of non-Hodgkin lymphoma, especially central nervous system lymphoma.

Other types of cancer that may be more likely to develop in people with HIV infection include:

- Anal cancer
- Hodgkin disease
- Lung cancer
- Cancers of the mouth and throat
- Some types of skin cancer
- Liver cancer

Some other, less common types of cancer may also be more likely to develop in people with HIV.

Because HIV infection often has no symptoms for years, a person can have HIV for a long time and not know it. The CDC recommends that everyone between the ages of 13 and 64 be tested for HIV at least once as part of their routine health care.

There is no vaccine to prevent HIV. But there are ways to lower your risk of getting it, such as not having unprotected sex or sharing needles with someone who has HIV. For people who are at high risk of HIV infection, such as injection drug users and people whose partners have HIV, taking medicine (as a pill every day) is another way to help lower your risk of infection.

For people already infected with HIV, taking anti-HIV drugs can help slow the damage to the immune system, which may help reduce the risk of getting some of the cancers above.

For more information, see our document *HIV Infection, AIDS, and Cancer.*

Human herpes virus 8 (HHV-8)

HHV-8, also known as *Kaposi sarcoma–associated herpes virus* (KSHV), has been found in nearly all tumors in patients with Kaposi sarcoma (KS). KS is a rare, slow-growing cancer that often appears as reddish-purple or blue-brown tumors just underneath the skin. In KS, the cells that line blood and lymph vessels are infected with HHV-8. The infection makes them divide too much and live longer than they should. These types of changes may eventually turn them into cancer cells.

HHV-8 is transmitted through sex and appears to be spread other ways, such as through blood and saliva, as well. Studies have shown that fewer than 10% of people in the US are infected with this virus.

HHV-8 infection is life-long (as with other herpes viruses), but it does not appear to cause disease in most healthy people. Many more people are infected with HHV-8 than ever develop KS, so it's likely that other factors are also needed for it to develop. Having a weakened immune system appears to be one such factor. In the US, almost all people who develop KS have other conditions that have weakened their immune system, such as HIV infection or immune suppression after an organ transplant.

KS was rare in the United States until it started appearing in people with AIDS in the early 1980s. The number of people with KS has dropped in the US since peaking in the early 1990s, most likely because of better treatment of HIV infection.

For more information on KS, see our document *Kaposi Sarcoma*.

HHV-8 infection has also been linked to some rare blood cancers, such as primary effusion lymphoma. The virus has also been found in many people with multicentric Castleman disease, an overgrowth of lymph nodes that acts very much like and often develops into cancer of the lymph nodes (lymphoma). (For more information, see our document *Castleman Disease*.) Further study is needed to better understand the role of HHV-8 in these diseases.

Human T-lymphotrophic virus-1 (HTLV-1)

HTLV-1 has been linked with a type of lymphocytic leukemia and non-Hodgkin lymphoma called *adult T-cell leukemia/lymphoma* (ATL). This cancer is found mostly in southern Japan, the Caribbean, central Africa, parts of South America, and in some immigrant groups in the southeastern United States.

In addition to ATL, this virus can cause other health problems, although many people with HTLV-1 don't have any of them.

HTLV-1 belongs to a class of viruses called *retroviruses*. These viruses use RNA (instead of DNA) for their genetic code. To reproduce, they must go through an extra step to change their RNA genes into DNA. Some of the new DNA genes can then become part of the chromosomes of the human cell infected by the virus. This can change how the cell grows and divides, which can sometimes lead to cancer.

HTLV-1 is something like HIV, which is another human retrovirus. But HTLV-1 cannot cause AIDS. In humans, HTLV-1 is spread in the same ways as HIV, such as unprotected sex with an HTLV-1-infected partner or injection with a needle after an infected person has used it. Mothers infected with HTLV-1 can also pass on the virus to their children, although this risk can be reduced if the mother doesn't breastfeed.

Infection with HTLV-1 is rare in the United States. Fewer than 1% of people in the US are infected with HTLV-1, but this rate is much higher in groups of people at high risk (such as injection drug users). Since 1988, all blood donated in the United States has been screened for HTLV-1. This has greatly reduced the chance of infection through transfusion, and has also helped control the potential spread of HTLV-1 infection.

Once infected with HTLV-1, a person's chance of developing ATL can be up to about 5%, usually after a long time with no symptoms (20 or more years).

Merkel cell polyomavirus (MCV)

MCV was discovered in 2008 in samples from a rare and aggressive type of skin cancer called *Merkel cell carcinoma*. Most people are infected with MCV at some point (often in childhood), and it usually causes no symptoms. But in a few people with this infection, the virus can affect the DNA inside cells, which can lead to Merkel cell cancer. Nearly all Merkel cell cancers are now thought to be linked to this infection.

It is not yet clear how people become infected with this virus, but it has been found in a number of places in the body, including normal skin and saliva.

For more information, see our document *Skin Cancer: Merkel Cell Carcinoma*.

Viruses with uncertain or unproven links to cancer in humans

Simian virus 40 (SV40)

SV40 is a virus that usually infects monkeys. Some polio vaccines prepared between 1955 and 1963 were made from monkey cells and were later found to be contaminated with SV40.

Some older studies suggested that infection with SV40 might increase a person's risk of developing mesothelioma (a rare cancer of the lining of the lungs or abdomen), as well as some brain tumors, bone cancers, and lymphomas. But the accuracy of these older studies has been questioned.

Scientists have found that some lab animals, such as hamsters, developed mesotheliomas when they were intentionally infected with SV40. Researchers have also noticed that SV40 can make mouse cells grown in the lab become cancerous.

Other researchers have studied biopsy specimens of certain human cancers and found fragments of DNA that look like they might be from SV40. But not all researchers have found this, and fragments much like these can also be found in human tissues that show no signs of cancer.

So far, the largest studies looking at this issue have not found any increased risk for mesothelioma or other cancers among people who got the contaminated polio vaccines as children. For example, the recent increase in lung mesothelioma cases has been seen mainly in men aged 75 and older, most of whom would not have received the vaccine. Among the age groups who were known to have gotten the vaccine, mesothelioma rates have actually gone down. And even though women were just as likely to have had the vaccine, many more men continue to be diagnosed with mesothelioma.

The bottom line: even though SV40 causes cancer in some lab animals, the evidence so far suggests that it does not cause cancer in humans.

Bacteria that can lead to cancer

Bacteria are very small living things that are made up of only one cell. Most types of bacteria aren't harmful, but some can infect people and cause diseases. A few have even been linked with cancer.

Helicobacter pylori

Stomach cancer is not common in the United States, but it's one of the more common types of cancer worldwide. Long-term infection of the stomach with *Helicobacter pylori (H pylori)* can cause ulcers. It can also inflame and damage the inner layer of the stomach. Some of these changes could lead to cancer over time, especially cancer in the lower part of the stomach. *H pylori* infection is also linked with some types of lymphoma of the stomach.

While *H pylori* infection is a major cause of stomach cancer, most people who have these bacteria in their stomachs never develop stomach cancer. There is also some evidence that people with *H pylori* might have a lower risk of some other types of cancer, although it is unclear exactly what role the bacteria plays in this.

About 2 in 3 adults worldwide are infected with *H pylori*. The rate of infection is higher developing countries and in older age groups. It's likely spread in a couple of ways. One is the fecal-oral route, such as through contaminated food or water sources. It can also be transmitted from one person to another, mouth to mouth.

Other factors also play a role in whether or not someone develops stomach cancer. For example, nitrites are substances commonly found in cured meats, some drinking water, and certain vegetables. They can be converted by certain bacteria, such as *H pylori*, into compounds that have been found to cause stomach cancer in lab animals.

Antibiotics and other medicines can be used to treat *H pylori* infections. According to the CDC, people who have active ulcers or a history of ulcers should be tested for *H pylori*, and, if they are infected, should be treated. Testing for and treating *H pylori* infection is also recommended after removal of an early stomach cancer.

Chlamydia trachomatis

Chlamydia trachomatis is a very common kind of bacteria that can infect the female reproductive system as well as other parts of the body in both men and women. It is spread through sex.

Although infection of the reproductive organs may cause symptoms in some people, most women have no symptoms. This means that women with chlamydia usually don't know they're infected unless samples are taken during a pelvic exam and tested for chlamydia. It's a common infection in younger women who are sexually active, and can remain for years unless it's detected and treated.

Some studies have found that women whose blood tests showed past or current chlamydia infection may be at greater risk for cervical cancer than women with negative blood test results.

Studies have not shown that chlamydia itself causes cancer, but it might work with HPV in a way that promotes cancer growth. For example, researchers have found that women who had chlamydia along with HPV are more likely to still have HPV when they are re-tested later than women who have not had chlamydia. Although more studies are needed to confirm these findings, there are already good reasons to be checked for chlamydia infection and have it treated with antibiotics if it is found.

In women, long-term chlamydia infection is known to cause pelvic inflammation that can lead to infertility, mainly by building up scar tissue in the Fallopian tubes. Like other infections that inflame or cause ulcers in the genital area, chlamydia can also increase the risk of becoming infected with HIV during exposure to an HIV-infected sexual partner.

Parasites that can lead to cancer

Certain parasitic worms that can live inside the human body can also raise the risk of developing some kinds of cancer. These organisms are not found in the United States, but they can be a concern for people who live in or travel to other parts of the world.

Opisthorchis viverrini and *Clonorchis sinensis* are liver flukes (a type of flatworm) that have been linked to increased risk of developing cancer of the bile ducts. The bile ducts are tubes that connect the liver to the intestines. These infections come from eating raw or undercooked freshwater fish. They occur mostly in East Asia and are rare in other parts of the world.

Schistosoma haematobium is a parasite found in the water of some countries in the Middle East, Africa, and Asia. Infection with this parasite (an illness called *schistosomiasis*) has been linked to bladder cancer. Possible links to other types of cancer are now being studied as well.

To learn more

More information from your American Cancer Society

Here is more information you might find helpful. You also can order free copies of our documents from our toll-free number, 1-800-227-2345, or read them on our website, www.cancer.org.

HIV Infection, AIDS, and Cancer (also in Spanish)

HPV and Cancer

HPV and HPV Testing

HPV Vaccines

Cancers and related diseases

Anal Cancer (also in Spanish)

Bladder Cancer (also in Spanish)

Castleman Disease

Cervical Cancer (also in Spanish)

Kaposi Sarcoma

Liver Cancer (also in Spanish)

Non-Hodgkin Lymphoma (also in Spanish)

Skin Cancer: Merkel Cell Carcinoma

Stomach Cancer (also in Spanish)

National organizations and websites*

Along with the American Cancer Society, other sources of information include:

American Sexual Health Association (ASHA)
Toll free number: 1-800-227-8922
Website: www.ashastd.org

> Offers facts and answers about sexually transmitted infections (STIs). Includes information on preventing the spread of HIV and other STIs.

Centers for Disease Control and Prevention (CDC)
Toll-free number: 1-800-232-4636 (1-800-CDC-INFO)
Website: www.cdc.gov

> Offers information about infectious disease prevention and transmission, in English or Spanish.

National Cancer Institute
Toll-free number: 1-800-4-CANCER (1-800-422-6237)
Website: www.cancer.gov

> Has information on cancer and viruses as well as vaccines and research.

**Inclusion on this list does not imply endorsement by the American Cancer Society.*

No matter who you are, we can help. Contact us anytime, day or night, for information and support. Call us at **1-800-227-2345** or visit www.cancer.org.

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