Infections in People With Cancer

What are infections and who is at risk?

Infections are caused by germs (also called *microbes* or *microorganisms*) that enter the body, multiply, and cause harm, illness, or even death. The main types of germs are bacteria, viruses, protozoa (some of which act as parasites), and fungal organisms (also called *fungi*).

Cancer itself can increase your risk of getting a life-threatening infection. So can certain types of cancer treatment. Once the cancer is gone and treatment is over, the risk of infection usually goes back down. For most people with cancer, the greatest risk of getting a serious infection only lasts for a limited time. And most people with cancer are not at a high risk of getting the kinds of serious infections described here. Your risk of infection also depends on the type of cancer you have and the treatment you get. For example, surgery does not weaken a person's resistance to infection nearly as much as a bone marrow transplant. And some chemotherapy drugs are less likely than others to affect a person's ability to resist infection. (The section called "What makes people with cancer more likely to get infections?" has more on this.)

Infections that develop in people who have cancer or who are getting cancer treatment can be more serious than those in people who are otherwise healthy. They can also be harder to treat. If you have cancer, it's important to find and treat infections early, before they get worse and spread. This information can help you learn what to look for and what to do if you do get an infection. This is one part of a series on information about cancer patients and their risk of infection.

- To learn more about different types of infections and how they're commonly treated, see *Causes (Germs) and Treatment of Infections in People With Cancer.*
- See *Vaccination* During Cancer Treatment to learn what vaccines can be given to people with cancer.
- For more on what you can do to try to prevent infections, see *Preventing Infections in People With Cancer.*

This information is about people with cancer and their risk of infection. If you are looking for information on infections that can cause cancer, see *Infections That Can Lead to Cancer*.

Know your risk of infection

It's important to weigh the risk of infection and other side effects against the benefits of cancer treatment. Talk with your doctors before or during chemotherapy or radiation therapy to see how this information applies to you. Here are some questions you can ask your doctor or cancer care team before and during cancer treatment:

- Will this cancer treatment make me more likely to get infections?
- Will you do anything special to help keep me from getting infections during treatment?
- What can I do to lower my risk of infection?
- How will I know if I have an infection?
- What kinds of infections are most common for someone in my situation?
- What should I do if I think I have an infection?
- If I get a fever, does that mean I have an infection?
- How will you decide how to treat my infection?
- What will you do if the treatment doesn't get rid of my infection?
- What are the likely side effects of the treatments for infection?

What are signs of infection in people with cancer?

It's important to watch for early signs of infection and tell your health care team about them right away. This way treatment can be started as early as possible. This is most important for people who have a low white blood cell count. This is discussed in the "How does the body normally resist infections?" section.

Signs and symptoms of an infection might include:

- Body temperature of 100.5º F or higher (a fever) taken by mouth
- Shaking chills or sweats (often goes along with fever)
- Sore throat
- Sores or white coating on your tongue or in your mouth
- Cough or shortness of breath
- Nasal congestion
- Burning or pain when urinating; bloody or cloudy urine
- Redness, swelling, drainage, or warmth at the site of an injury, surgical wound, or vascular access device (VAD), or anywhere on the skin including the genital and rectal areas
- Pain or tenderness in the stomach or abdomen (the belly)

- Stiff neck
- Sinus pain, ear pain, or headache
- Swelling or redness anywhere

Fever is especially important because it's often the first sign of an infection in people with cancer. You should have a thermometer to check your temperature – you can't rely on how you feel to know when you have a fever. Patients may be told to call their doctor or nurse if they have a temperature of 100.5º F or higher, or if they have other signs and symptoms of infection. **Don't take medicines to reduce your fever (such as Tylenol®, Advil®, Motrin®, or aspirin) without checking with your doctor first.** Ask your doctor what you should do and when you should call. Be sure you know how to reach your health care team after hours, including nights and weekends.

Key things you need to know

It's important for people with cancer and their families and friends to know these things:

- Your risk for infection
- How long your immune system is likely be weak after treatment
- How to take your temperature the right way, when to check it, and how often to check it
- When to report a fever or other signs and symptoms of infection to the doctor or nurse
- The importance of hand washing and hygiene for the patient and the people they come in contact with
- How to take good care of your mouth and check for sores and signs of infection
- How to clean cuts, scrapes, or other breaks in the skin and keep them clean to help prevent infection
- The importance of cleaning around the anus after each bowel movement, using moist towelettes or baby wipes
- Good care of IVs and central venous catheters (CVCs, like ports and PICC lines) (See *Central Venous Catheters* for more on this.)
- Where to look for signs of infection (skin, mouth, and CVC sites)
- The importance of good nutrition, a balanced diet, and drinking plenty of fluids
- The importance of sleep and exercise
- The need to take medicines as prescribed
- Being sure the doctor knows about all medicines you're taking (prescription, over-the-counter, vitamins, herbs, and supplements) – keep a list and update it at each doctor visit
- Ways to prevent dryness of the skin and mucous membranes

- You need to talk with your health care team or doctor before getting vaccinated (immunized) and before getting close to children or adults who have recently had vaccinations. (See *Vaccin*ation *During Cancer Treatment* for more on this.)

Review these points with your doctor or nurse before and during treatment to get the information you need. Double check with them on how you should handle these things and find out if there are any special steps you should take during cancer treatment.

How does your body normally resist infections?

Your body has many ways to protect itself from infections. It helps to understand the normal ways your body does this, and how cancer and cancer treatment change this process. This may help you better understand why infections can develop so quickly and be so serious in people with cancer.

Skin and mucous membranes

The skin is your body's largest organ and its most important barrier against infections. It's your first line of defense in protecting internal tissues from harmful germs. When there's a break in your skin, it's easier for germs to get into your body and cause infection.

Mucous membranes, which form the moist, pink lining layer of the mouth, throat, nose, eyelids, urethra, vagina, and digestive system, also act as a partial barrier against infection. These membranes normally help protect us from germs in the air we breathe, our environment, and in our food and drink.

Cancer treatments (such as chemotherapy, radiation therapy, or surgery) and certain procedures (like putting in catheters or IVs, or getting shots) can damage the skin or mucous membranes. This makes it easier for germs to get in.

The immune system and blood cells

If germs get through the skin or mucous membranes, the job of protecting the body shifts to your immune system. Your immune system is a complex network of cells, signals, and organs that work together to help kill germs that cause infections. Many of these are special blood cells that travel in the blood until they find germs to attack. Others spend part of their time in the blood and the rest of their time in immune system organs.

Blood cells and how they're made

Blood cells are made in the spongy liquid center of the bones, called *bone marrow*, from cells called *stem cells*. Stem cells grow into different kinds of mature blood cells. These mature cells are released into the blood to do their work. There are 3 major kinds of blood cells.

- **Red blood cells** (RBCs or *erythrocyte*s) carry oxygen to cells throughout the body.
- **Platelets** (*thrombocytes*) help make clots to plug up holes that form in blood vessels from injuries such as cuts, scrapes, or bruises.
- **White blood cells** (WBCs or *leukocytes*) help fight germs that get into the body.

Read *Understanding Your Lab Test Results* to learn more about these blood cells and the tests used to measure them.

White blood cells help fight infection

White blood cells are part of the immune system. (Red cells and platelets are not.) There are different types of white blood cells, and they each have a key role in the body's defense against germs:

- Neutrophils
- Lymphocytes (which include T-lymphocytes and B-lymphocytes)
- Monocytes
- Macrophages

Neutrophils are key infection-fighters.

Normally, most of our white blood cells are *neutrophils*. Neutrophils form a very important defense against most types of infection. For most people with cancer, having a low neutrophil count is the biggest risk factor for getting a serious infection. Ask your doctor if your cancer treatment will cause your neutrophil count to drop.

The section called "Low white blood cell (neutrophil) counts and the risk of infection" has more information on neutrophil counts, how the count is figured out, and what it means.

Lymphocytes can make antibodies; they mark, signal, and destroy germs.

Some treatments, most often those given during bone marrow transplant, can cause a shortage of lymphocytes. B and T lymphocytes help fight viruses, but have different jobs:

- B-lymphocytes make special proteins called *antibodies* that recognize and kill certain germs. They also can mark germs to be destroyed by other cells.
- T-lymphocytes make signaling substances called *cytokines* that tell other cells what to do. They also destroy cells infected by viruses.

Monocytes and macrophages help recognize invaders, and kill fungi and parasites.

- They help lymphocytes recognize germs.
- They can surround and digest germs that have been coated by antibodies (the proteins made by B-lymphocytes).
- They help fight bacteria, fungi, and parasites.

What makes people with cancer more likely to get infections?

Some types of cancer can damage the immune and blood systems or change the way they work. For instance, lymphoma (Hodgkin and non-Hodgkin) and certain types of leukemia start in

immune system cells. They change the immune system cells so that cells that once protected your body begin to interfere with the normal way your immune system works. Many other types of cancer can also affect the immune system.

In most cases it's not the cancer itself but the cancer treatment that changes the immune system. Treatments can cause short- or long-term damage. For example, long-term damage happens when immune system organs such as the spleen are removed. A *splenectomy* (surgery to remove the spleen) is sometimes done to remove cancer or learn how much it has spread. On the other hand, radiation therapy, immunotherapy, and chemotherapy, either alone or in combination can lead to short-term immune system damage. Bone marrow or stem cell transplant uses very strong treatments to kill cancer cells. This treatment also kills immune system cells, which can worsen and prolong the risk of infection. Sometimes this damage can last for months after treatment ends.

Some people with cancer have a higher risk of infection because of the changes in their body's defense systems. Cancer and cancer treatments can affect these systems in different ways. People with cancer might be more likely to get infections because of:

- The cancer itself
- Certain types of cancer treatment
- Poor nutrition

All of these can increase your risk of infection by causing low white blood cell counts and a weak immune system (discussed in a later section).

Cancer itself can increase infection risk

Cancer cells can get into the bone marrow where blood cells are made. (See "How does the body normally resist infections?" for more on bone marrow and blood cells.) The cancer cells then compete with the normal bone marrow cells for space and nutrients. If too many normal bone marrow cells are destroyed or pushed out of the bone marrow, the few cells that are left won't be able to make enough white blood cells (WBCs) to fight infection.

Cancer can also damage other parts of the immune system. A tumor can grow through the skin or mucous membranes, breaking natural barriers and allowing germs to get in. Tumors may also reduce blood flow to the normal tissues by pressing on them or their blood supply. Tumors in the lungs may block normal mucus drainage, which can lead to infections. And tissues that have been damaged by cancer are more prone to infections.

Cancer cells can also release chemicals that change normal immune cells. This is a well-known effect of many cancers that start in immune system cells, such as lymphomas, leukemias, and multiple myeloma. It can happen with other cancers, too.

Cancer treatments can increase infection risk

Most cancer treatments used today can increase the risk of infection.

Surgery

Any type of major surgery can suppress the immune system within hours of surgery. Anesthesia (the drugs used to make the patient sleep) may play a role. It might take from 10 days to many months for an immune system to recover completely.

Surgery also breaks the skin and mucous membranes and can expose internal tissues to germs. The wound caused by surgery (the *incision*) is a common place for infection.

Because surgery is often used to diagnose, stage, or treat people with cancer, it's important to know that surgery can increase the risk of certain infections. Things that raise the risk of infection after surgery include:

- How long the person is in the hospital
- The extent of the surgery (how much cutting was done)
- How long the operation took
- The amount of bleeding during surgery
- The person's nutritional status
- Prior cancer treatment, such as chemotherapy or radiation or medical problems such as diabetes, or heart or lung problems

People with cancer may get antibiotics before and for a short time after having surgery to help protect them from infection.

Chemotherapy

Chemotherapy (often called chemo) is the most common cause of a weakened immune system in people getting cancer treatment. The effects on the immune system depend on many things, including:

- Which chemo drugs are used
- Chemo dose (how much of each drug is given at once
- How often chemo is given
- Past cancer treatments
- The person's age (older people are more likely to get infections, with or without cancer)
- The person's nutritional status
- The type of cancer
- How much cancer there is (the stage of the cancer)

Some drugs affect the bone marrow and immune system more than others. But chemo drugs can have different effects on how well the body makes white blood cells, red blood cells, and platelets. In most cases, white blood cells are the ones most affected by chemo. (See the section called "How

does the body normally resist infections?" for more on the bone marrow and blood cells.) After treatment ends, your blood cell counts usually go back to normal over time.

Radiation therapy

Radiation therapy's effects on bone marrow cells can be much like the effects of chemo. It also can cause low white blood cell counts, which increases the risk for infections.

Many things affect how radiation therapy affects the immune system, such as:

- The total radiation dose
- The radiation schedule
- The part of the body being treated with radiation
- How much of the body is treated with radiation

Total body irradiation or TBI (where a person's entire body is treated with radiation) is the only type of radiation likely to cause very low blood counts. This type of radiation may be used during the bone marrow or stem cell transplant process.

Radiation is most often given to just one part of the body, so the whole immune system isn't damaged by it. Still, depending on the dose and the part of the body being treated with radiation, the skin or mucous membranes may be damaged, so you're less able to keep germs out.

Today, radiation treatments are most often given over many sessions rather than in one large dose. This helps decrease the amount of skin and tissue damage, immune suppression, and the risk of infections.

Immunotherapy or biotherapy

Immunotherapy is also known as *biotherapy* or *biologic therapy*. It's given to make your immune system better able to recognize and attack cancer cells. This can be done by helping your own immune system work harder or smarter, or by giving you things like man-made immune system proteins. Immunotherapy is sometimes used by itself to treat cancer, but it's often used along with or after another type of treatment to add to its effects.

These treatments promote immune reactions against cancer cells, but sometimes they change the way the immune system works. Because of this, people who get biologic therapies may be at risk for immune suppression.

When certain white blood cell (lymphocyte) levels are low, the chance of getting certain serious viral and fungal infections becomes very high. Other white blood cell counts may drop, too. Most of the time they return to normal after treatment stops, but the lymphocyte counts can stay low for months. (For more on this, see our document called *Immunotherapy*.)

Hematopoietic stem cell transplant (bone marrow transplant)

Hematopoietic stem cell transplant (HSCT) is the term now used to include *bone marrow transplant* (BMT), *peripheral blood stem cell transplant* (PBSCT), and *umbilical cord blood stem*

cell transplant (UCBSCT). These transplants allow doctors to use very high doses of chemo and/or total body irradiation (TBI) to try to kill all the cancer cells in the body.

In the process of killing the cancer cells, the blood-forming stem cells of the patient's normal bone marrow are also killed. Because of this, stem cells (either from the blood or bone marrow) are removed from the patient and saved before the high-dose chemo is given. Or, stem cells may be taken from a donor or banked umbilical cord blood. Once the cancer cells are killed, the saved or donated stem cells are given to the patient so that blood cells can be made and the immune system rebuilt.

High-dose chemo used with TBI causes more severe immune weakness that lasts for a longer time. It can also damage the skin and mucous membranes and make them less able to keep germs out of the body.

For more information on these types of transplants, see our document called *Stem Cell Transplant (Peripheral Blood, Bone Marrow, and Cord Blood Transplants).*

Poor nutrition can affect infection risk in people with cancer

All cells need nutrients to grow and work. Lack of vitamins, minerals, calories, and protein can weaken your immune system and make it less able to find and destroy germs. This means people who are poorly nourished (*malnourished*) are more likely to develop infections. People who are malnourished either do not take in enough calories and nutrients, or the body can't use the food it takes in. Either way, it can weaken your immune system.

People with cancer often need extra calories and protein to support their immune system cells and other tissues. For example, recovery from surgery increases the body's need for nutrients.

People with cancer might be poorly nourished for many reasons:

- The cancer itself can make it hard to eat or digest food. This is common in people with cancers of the digestive system, mouth, or throat.
- Cancer treatments, like radiation therapy and chemotherapy, can cause nausea and a loss of appetite.
- Cancer cells use up nutrients, leaving less to meet the needs of normal, healthy tissues.

People with cancer often need help from dietitians or doctors to get enough calories and nutrients. Dietary supplements, tube feedings, or even intravenous (IV, through a vein) feedings may help in some cases.

Good nutrition, stress management, and good self-care might help improve the immune function of people with cancer, which may help prevent some infections. Your doctor might have you meet with a dietitian to plan what you should eat and to get help managing eating problems. Nutrition counseling should include the importance of getting enough calories, protein, and vitamins. This is tailored to each person's food intake and nutrition problems. Learn more about what to eat during cancer treatment in *Nutrition for the Person With Cancer*.

Low white blood cell (neutrophil) counts and the risk of infection

Chemotherapy, radiation therapy, surgery, stem cell or bone marrow transplant, steroids, or the cancer itself can suppress or weaken the immune system. These treatments can lower the number of white blood cells (WBCs) and other immune system cells. Treatment can also cause these cells to not work as well as they should. This is called *immunosuppression*. It's much easier to get an infection when there aren't enough WBCs to destroy germs, especially the type of WBCs called *neutrophils.*

Neutrophils are a very important defense against most types of infection. When looking at your risk of getting an infection, doctors look at the number of neutrophils you have. A low neutrophil count is called *neutropenia.* The doctor may say you are *neutropenic.*

It's possible for your total WBC count to be in the normal range while your neutrophil count is low. But because neutrophils normally make up the largest part of the total white blood cell count, the WBC count is usually low when the neutrophil count is low.

What is an absolute neutrophil count?

You might hear your doctor or nurse talk about your *absolute neutrophil count* or *ANC*. This is the number of neutrophils you have in a certain amount of blood. Your health care team will use your ANC to get an idea of how well your immune system might work during treatment. You might want to keep track of your ANC so you'll know when you have a higher risk of getting an infection.

Some labs put this number on your complete blood count (CBC) report, but it isn't always labeled "ANC," so you may need to ask your doctor or nurse for help finding it. Sometimes the lab will only report different types of neutrophils as a percentage of white blood cells, and then your health care team will calculate your ANC. You can also calculate it yourself.

Figuring out your ANC

The numbers for your ANC are taken from the results of a blood test called the *differential white blood cell (WBC) count*. You can ask about the results of your blood tests or get copies of your test results from your doctor or nurse.

To find out your ANC, multiply the percentage of neutrophils by the total number of WBCs. (Neutrophils are sometimes called *segs* or *polys*, and young neutrophils may be called *bands* on your lab report. If bands are listed as a percentage of WBCs, add them to the neutrophils before multiplying.)

You can figure out your ANC using this formula:

$$[(\% \text{ of neutrophils} + \% \text{ of bands}) \div 100] \times \text{WBC count} = \text{ANC}$$

So, for example, if a patient's WBC count is 1,000 and the percentage of neutrophils is 70%, and there are no bands, then the ANC is 700, which is calculated like this:

$$[(70 + 0) \div 100] \times 1{,}000$$

$(70 \div 100) \times 1{,}000$

$0.7 \times 1{,}000 = 700$

Another example is if the patient's WBC is 1,300, with 60% neutrophils and 5% bands. The bands are added with the neutrophils (60 + 5), and the ANC is 845:

$[(60 + 5) \div 100] \times 1{,}300$

$(65 \div 100) \times 1{,}300$

$0.65 \text{ x } 1300 = 845$

What does the absolute neutrophil count mean?

An ANC less than 1,000 means that you have a low number of neutrophils and your immune system is weak. Ask your doctor or nurse to tell you exactly what your numbers mean.

The lower the ANC drops and the longer it stays low, the higher your risk of getting a serious infection. If the ANC drops below 500 for a few days, you are at a very high risk of getting an infection. If your ANC is 100 or less for more than a week, your risk of serious infection is extremely high.

In a person with a healthy immune system, the usual signs of infection are fever, pus, pain, swelling, and redness. As the ANC gets lower, many of these signs may not show up when an infection starts. This is because these signs are caused by neutrophils fighting off germs, and you don't have enough neutrophils to produce the signs. This can make it hard to know if you have an infection. The good thing is that another WBC, called the monocyte, can still cause fever in the person who has neutropenia. In people with severe neutropenia, a fever may be the only sign of an infection.

If your ANC is 1,000 or lower and you have a fever of 100.5° F (38° C) or higher when taken by mouth, your doctor will likely assume that you have an infection. Antibiotic treatment is usually started right away, often before the cause of the infection can even be found. Until they can pinpoint the exact bug, doctors learn what they can about the infection to narrow down the treatment options. But they still look for the exact cause so that they can choose the treatment that's most likely to work – even if it means changing to different antibiotics than what they started with.

See *Causes (Germs) and Treatment of Infections in People with Cancer* to learn more about this.

To learn more

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.

More on infection and cancer

Preventing Infections in People With Cancer

Causes (Germs) and Treatment of Infections in People with Cancer

Vaccination During Cancer Treatment

Should I Get a Flu Shot?

Smallpox Vaccine and Cancer

More on cancer treatment

A Guide to Chemotherapy (also in Spanish)

Understanding Radiation Therapy: A Guide for Patients and Families (also in Spanish)

A Guide to Cancer Surgery (also in Spanish)

Stem Cell Transplant (Peripheral Blood, Bone Marrow, and Cord Blood Transplants) (also in Spanish)

Understanding Your Lab Test Results

Nutrition for the Person With Cancer During Treatment: A Guide For Patients and Families (also in Spanish)

Central Venous Catheters (also in Spanish)

For caregivers and family members

Caring for the Patient With Cancer At Home: A Guide for Patients and Families (also in Spanish)

What It Takes to Be a Caregiver

Helping Children When a Family Member Has Cancer: Dealing With Treatment (also in Spanish)

Books

Your American Cancer Society also has books that you might find helpful. Call us at 1-800-227-2345 or visit our bookstore online at cancer.org/bookstore to find out about costs or to place an order.

National organizations and websites*

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

Centers for Disease Control and Prevention (CDC)
Toll-free number: 1-800-232-4636 (1-800-CDC-INFO)
TTY: 1-888-232-6348
Website: www.cdc.gov

> Offers reliable information on infections, prevention, and other health information (also offered in Spanish)

National Cancer Institute
Toll-free number: 1-800-422-6237 (1-800-4-CANCER)
TTY: 1-800-332-8615
Website: www.cancer.gov

> Offers information on cancer and its treatment, a drug dictionary of common medicines used in cancer treatment, and coping with cancer (also offered in Spanish)

**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 cancer-related information and support. Call us at **1-800-227-2345** or visit www.cancer.org.

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