

**Source: Mayo Clinic Website –**

<https://www.mayoclinic.org/diseases-conditions/leukemia/symptoms-causes/svc-20374373>

## **Leukemia**

### **Overview**

Leukemia is cancer of the body's blood-forming tissues, including the bone marrow and the lymphatic system.

Many types of leukemia exist. Some forms of leukemia are more common in children. Other forms of leukemia occur mostly in adults.

Leukemia usually involves the white blood cells. Your white blood cells are potent infection fighters — they normally grow and divide in an orderly way, as your body needs them. But in people with leukemia, the bone marrow produces an excessive amount of abnormal white blood cells, which don't function properly.

Treatment for leukemia can be complex — depending on the type of leukemia and other factors. But there are strategies and resources that can help make your treatment successful.

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### **Symptoms**

Leukemia symptoms vary, depending on the type of leukemia. Common leukemia signs and symptoms include:

- Fever or chills
- Persistent fatigue, weakness
- Frequent or severe infections
- Losing weight without trying
- Swollen lymph nodes, enlarged liver or spleen
- Easy bleeding or bruising
- Recurrent nosebleeds
- Tiny red spots in your skin (petechiae)
- Excessive sweating, especially at night
- Bone pain or tenderness

### **When to see a doctor**

Make an appointment with your doctor if you have any persistent signs or symptoms that worry you.

Leukemia symptoms are often vague and not specific. You may overlook early leukemia symptoms because they may resemble symptoms of the flu and other common illnesses.

Sometimes leukemia is discovered during blood tests for some other condition.

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## Causes

Scientists don't understand the exact causes of leukemia. It seems to develop from a combination of genetic and environmental factors.

### How leukemia forms

In general, leukemia is thought to occur when some blood cells acquire changes (mutations) in their genetic material or DNA. A cell's DNA contains the instructions that tell a cell what to do. Normally, the DNA tells the cell to grow at a set rate and to die at a set time. In leukemia, the mutations tell the blood cells to continue growing and dividing.

When this happens, blood cell production becomes out of control. Over time, these abnormal cells can crowd out healthy blood cells in the bone marrow, leading to fewer healthy white blood cells, red blood cells and platelets, causing the signs and symptoms of leukemia.

### How leukemia is classified

Doctors classify leukemia based on its speed of progression and the type of cells involved.

The first type of classification is by how fast the leukemia progresses:

- **Acute leukemia.** In acute leukemia, the abnormal blood cells are immature blood cells (blasts). They can't carry out their normal functions, and they multiply rapidly, so the disease worsens quickly. Acute leukemia requires aggressive, timely treatment.
- **Chronic leukemia.** There are many types of chronic leukemias. Some produce too many cells and some cause too few cells to be produced. Chronic leukemia involves more-mature blood cells. These blood cells replicate or accumulate more slowly and can function normally for a period of time. Some forms of chronic leukemia initially produce no early symptoms and can go unnoticed or undiagnosed for years.

The second type of classification is by type of white blood cell affected:

- **Lymphocytic leukemia.** This type of leukemia affects the lymphoid cells (lymphocytes), which form lymphoid or lymphatic tissue. Lymphatic tissue makes up your immune system.
- **Myelogenous (my-uh-LOHJ-uh-nus) leukemia.** This type of leukemia affects the myeloid cells. Myeloid cells give rise to red blood cells, white blood cells and platelet-producing cells.

**Types of leukemia** - The major types of leukemia are:

- **Acute lymphocytic leukemia (ALL).** This is the most common type of leukemia in young children. ALL can also occur in adults.
- **Acute myelogenous leukemia (AML).** AML is a common type of leukemia. It occurs in children and adults. AML is the most common type of acute leukemia in adults.
- **Chronic lymphocytic leukemia (CLL).** With CLL, the most common chronic adult leukemia, you may feel well for years without needing treatment.
- **Chronic myelogenous leukemia (CML).** This type of leukemia mainly affects adults. A person with CML may have few or no symptoms for months or years before entering a phase in which the leukemia cells grow more quickly.
- **Other types.** Other, rarer types of leukemia exist, including hairy cell leukemia, myelodysplastic syndromes and myeloproliferative disorders.

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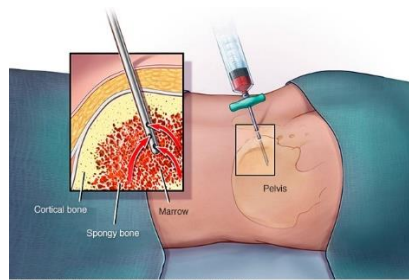
## Risk factors

Factors that may increase your risk of developing some types of leukemia include:

- **Previous cancer treatment.** People who've had certain types of chemotherapy and radiation therapy for other cancers have an increased risk of developing certain types of leukemia.
- **Genetic disorders.** Genetic abnormalities seem to play a role in the development of leukemia. Certain genetic disorders, such as Down syndrome, are associated with an increased risk of leukemia.
- **Exposure to certain chemicals.** Exposure to certain chemicals, such as benzene — which is found in gasoline and is used by the chemical industry — is linked to an increased risk of some kinds of leukemia.
- **Smoking.** Smoking cigarettes increases the risk of acute myelogenous leukemia.
- **Family history of leukemia.** If members of your family have been diagnosed with leukemia, your risk of the disease may be increased.

However, most people with known risk factors don't get leukemia. And many people with leukemia have none of these risk factors.

## Diagnosis



**Bone marrow exam**

Doctors may find chronic leukemia in a routine blood test, before symptoms begin. If this happens, or if you have signs or symptoms that suggest leukemia, you may undergo the following diagnostic exams:

- **Physical exam.** Your doctor will look for physical signs of leukemia, such as pale skin from anemia, swelling of your lymph nodes, and enlargement of your liver and spleen.
  - **Blood tests.** By looking at a sample of your blood, your doctor can determine if you have abnormal levels of red or white blood cells or platelets — which may suggest leukemia. A blood test may also show the presence of leukemia cells, though not all types of leukemia cause the leukemia cells to circulate in the blood. Sometimes the leukemia cells stay in the bone marrow.
  - **Bone marrow test.** Your doctor may recommend a procedure to remove a sample of bone marrow from your hipbone. The bone marrow is removed using a long, thin needle. The sample is sent to a laboratory to look for leukemia cells. Specialized tests of your leukemia cells may reveal certain characteristics that are used to determine your treatment options.
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## Treatment

Treatment for your leukemia depends on many factors. Your doctor determines your leukemia treatment options based on your age and overall health, the type of leukemia you have, and whether it has spread to other parts of your body, including the central nervous system.

Common treatments used to fight leukemia include:

- **Chemotherapy.** Chemotherapy is the major form of treatment for leukemia. This drug treatment uses chemicals to kill leukemia cells.

Depending on the type of leukemia you have, you may receive a single drug or a combination of drugs. These drugs may come in a pill form, or they may be injected directly into a vein.

- **Targeted therapy.** Targeted drug treatments focus on specific abnormalities present within cancer cells. By blocking these abnormalities, targeted drug treatments can cause cancer cells to die. Your leukemia cells will be tested to see if targeted therapy may be helpful for you.
- **Radiation therapy.** Radiation therapy uses X-rays or other high-energy beams to damage leukemia cells and stop their growth. During radiation therapy, you lie on a table while a large machine moves around you, directing the radiation to precise points on your body.

You may receive radiation in one specific area of your body where there is a collection of leukemia cells, or you may receive radiation over your whole body. Radiation therapy may be used to prepare for a bone marrow transplant.

- **Bone marrow transplant.** A bone marrow transplant, also called a stem cell transplant, helps reestablish healthy stem cells by replacing unhealthy bone marrow with leukemia-free stem cells that will regenerate healthy bone marrow.

Prior to a bone marrow transplant, you receive very high doses of chemotherapy or radiation therapy to destroy your leukemia-producing bone marrow. Then you receive an infusion of blood-forming stem cells that help rebuild your bone marrow.

You may receive stem cells from a donor or you may be able to use your own stem cells.

- **Immunotherapy.** Immunotherapy uses your immune system to fight cancer. Your body's disease-fighting immune system may not attack your cancer because the cancer cells produce proteins that help them hide from the immune system cells. Immunotherapy works by interfering with that process.
- **Engineering immune cells to fight leukemia.** A specialized treatment called chimeric antigen receptor (CAR)-T cell therapy takes your body's germ-fighting T cells, engineers them to fight cancer and infuses them back into your body. CAR-T cell therapy might be an option for certain types of leukemia.
- **Clinical trials.** Clinical trials are experiments to test new cancer treatments and new ways of using existing treatments. While clinical trials give you or your child a chance to try the latest cancer treatment, treatment benefits and risks may be uncertain. Discuss the benefits and risks of clinical trials with your doctor.