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About Multiple Myeloma

Overview

If you have been diagnosed with multiple myeloma or are worried about it, you likely have a lot of questions. Learning some basics is a good place to start.

- [What Is Multiple Myeloma?](#)

Research and Statistics

See the latest estimates for new cases of multiple myeloma and deaths in the US and what research is currently being done.

- [Key Statistics About Multiple Myeloma](#)
 - [What's New in Multiple Myeloma Research?](#)
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What Is Multiple Myeloma?

Cancer starts when cells begin to grow out of control. Cells in nearly any part of the body can become cancer, and can spread to other areas. To learn more about how cancers start and spread, see [What Is Cancer?](#)¹

Multiple myeloma is a cancer of plasma cells. Normal plasma cells are found in the bone marrow and are an important part of the immune system. The immune system is made up of several types of cells that work together to fight infections and other

diseases. Lymphocytes (lymph cells) are one of the main types of white blood cells in the immune system and include T cells and B cells. Lymphocytes are in many areas of the body, such as lymph nodes, the bone marrow, the intestines, and the bloodstream.

When B cells respond to an infection, they mature and change into plasma cells. Plasma cells make the antibodies (also called **immunoglobulins**) that help the body attack and kill germs. Plasma cells, are found mainly in the bone marrow. Bone marrow is the soft tissue inside bones. In addition to plasma cells, normal bone marrow is also the home for other blood cells such as red cells, white cells, and platelets.

In general, when plasma cells become cancerous and grow out of control, this is called multiple myeloma. The plasma cells make an abnormal protein (antibody) known by several different names, including monoclonal immunoglobulin, monoclonal protein (M-protein), M-spike, or paraprotein.

There are, however, other plasma cell disorders that also have abnormal plasma cells but do not meet the criteria to be called active multiple myeloma. These other plasma cell disorders include:

- Monoclonal gammopathy of uncertain significance (MGUS)
- Smoldering multiple myeloma (SMM)
- Solitary plasmacytoma
- Light chain amyloidosis.

Multiple myeloma features

Low blood counts

In multiple myeloma, the overgrowth of plasma cells in the bone marrow can crowd out normal blood-forming cells, leading to [low blood counts](#)².

- This can cause [anemia](#)³ (a shortage of red blood cells). People with anemia become weak and fatigued.
- Multiple myeloma can also cause the level of platelets in the blood to become low (called **thrombocytopenia**). This can lead to increased bleeding and bruising.
- Another condition that can develop is **leukopenia** (a shortage of normal white blood cells). This can lead to problems fighting [infections](#)⁴.

Bone and calcium problems

Myeloma cells also interfere with cells that help keep bones strong. Bones are constantly being remade to keep them strong. Two kinds of bone cells work together to keep bones healthy and strong:

- **Osteoclasts** break down old bone
- **Osteoblasts** lay down new bone

Myeloma cells make a substance that tells the osteoclasts to speed up dissolving the bone. So old bone is broken down without new bone to replace it, making the bones weak and easy to break. Fractured bones are a major problem in people with myeloma. This increase in bone break-down can also raise calcium levels in the blood. Problems caused by high calcium levels are discussed in [Signs and Symptoms of Multiple Myeloma](#)⁵.

Infections

Abnormal plasma cells cannot protect the body from infections. As mentioned before, normal plasma cells produce antibodies that attack germs. In multiple myeloma, the myeloma cells crowd out the normal plasma cells, so that antibodies to fight the infection can't be made. The antibody made by the myeloma cells does not help fight infections. That's because the myeloma cells are just many copies of the same plasma cell – all making copies of the same exact (or monoclonal) antibody.

Kidney problems

Myeloma cells make an antibody that can harm the kidneys, leading to kidney damage and even kidney failure.

Other Plasma Cell Disorders

Monoclonal gammopathy

A monoclonal gammopathy is when plasma cells make too many copies of the same antibody. It is usually found on a routine blood test when looking for other conditions. Although people with multiple myeloma have a monoclonal gammopathy, not everyone with monoclonal gammopathy has multiple myeloma. It can also occur in other diseases, such as Waldenstrom macroglobulinemia and some lymphomas. It can also occur in a disorder known as monoclonal gammopathy of undetermined significance

(MGUS), which does not cause problems like multiple myeloma does. However, some people with MGUS will eventually go on to develop multiple myeloma or other diseases.

Monoclonal gammopathy of undetermined significance

In monoclonal gammopathy of undetermined significance (MGUS), abnormal plasma cells make many copies of the same antibody (called a monoclonal protein). However, these plasma cells do not form an actual tumor or mass and do not cause any of the problems seen in multiple myeloma. MGUS usually does not affect a person's health. It doesn't cause weak bones, high calcium levels, kidney problems, or low blood counts. It's most often found when a routine blood test finds a high level of protein in the blood and further testing shows the protein is a monoclonal antibody. In MGUS, the number of plasma cells may be increased, but they still make up less than 10% of the cells in the bone marrow.

MGUS is not considered cancer, but it is sometimes called pre-malignant because some people with MGUS will eventually develop cancers such as multiple myeloma, lymphoma, or amyloidosis. Each year, about 1% of people with MGUS develops one of these diseases. The risk is higher in people whose protein levels are particularly high. Patients with MGUS don't need treatment, but they are watched closely to see if they get a disease that does need to be treated, such as multiple myeloma.

Solitary plasmacytomas

A plasmacytoma is a type of abnormal plasma cell growth that is cancerous. Rather than many tumors in different locations as in multiple myeloma, there is only one tumor, hence the name solitary plasmacytoma.

A solitary plasmacytoma often develops in a bone. When a plasmacytoma starts in other tissues (such as the lungs or other organs), it is called a solitary **extramedullary or extraosseous plasmacytoma**. Solitary plasmacytomas are most often treated with radiation therapy. Sometimes surgery may be used. As long as no other plasmacytomas are found later on, the patient's outlook is usually excellent. However, since many people with a solitary plasmacytoma will develop multiple myeloma, these people are watched closely for signs of this disease.

Smoldering multiple myeloma (SMM)

Smoldering multiple myeloma (SMM) is an early or asymptomatic (no symptoms) myeloma that is not causing any problems. People with smoldering myeloma have some signs of multiple myeloma, such as any of the following:

- A large amount of plasma cells in the bone marrow
- A high level of monoclonal immunoglobulin (monoclonal protein) in the blood
- A high level of light chains (small protein segments also called Bence Jones protein) in the urine.

But, they have normal blood counts, normal calcium levels, normal kidney function, no bone or organ damage, and no signs of amyloidosis.

People with smoldering multiple myeloma do not need treatment right away, because the disease can take anywhere from many months to years to become active (symptomatic) myeloma. Some people may have very slow disease that never becomes active myeloma. SMM is an area of active research. There are SMM that have high risk features that put them at a greater chance of turning into active myeloma and studies are being done to see if they should be reclassified as “active” myeloma or if they should start treatment sooner. People with SMM are also watched closely for signs of myeloma.

Light chain amyloidosis

Light chain amyloidosis is also a disorder of abnormal plasma cell growth, but with lower amounts of abnormal plasma cells in the bone marrow compared to multiple myeloma.

Monoclonal proteins (antibodies) are made up of joined protein chains – 2 short light chains and 2 longer heavy chains. In light chain amyloidosis, abnormal plasma cells make too many light chains which are shorter and weigh less than the heavy chains. The light chains build up in tissues as an abnormal protein known as amyloid.

The buildup of amyloid in certain organs can enlarge them and affect the way they work. For example, when amyloid builds up in the heart, it can cause an irregular heart beat and cause the heart to enlarge and get weaker. A weak heart can lead to a condition called congestive heart failure, with symptoms like shortness of breath and swelling in the legs. Amyloid in the kidneys can cause them to work poorly. This may not cause symptoms early on, but the poor kidney function may be found on blood tests. If it gets worse, it can lead to kidney failure. See [Signs and Symptoms of Multiple Myeloma](#)^{6,7}.

Other names for light chain amyloidosis include **AL** and **primary amyloidosis**.

Light chain amyloidosis is only one of the diseases where amyloid builds up and causes problems. Amyloidosis can also be caused by a genetic (hereditary) disease called **familial amyloidosis**. Long-standing (chronic) infection and/or inflammation can also cause amyloidosis. This is known as **secondary** or **AA amyloidosis**. These other kinds

of amyloidosis are not covered here.

Waldenstrom macroglobulinemia (WM)

The cancer cells in people with WM are similar to those of multiple myeloma and [non-Hodgkin lymphoma](#)⁸ (NHL). Multiple myeloma is considered a cancer of plasma cells, and non-Hodgkin lymphoma is a cancer of lymphocytes. WM cells have features of both plasma cells and lymphocytes.

WM cells make large amounts of a certain type of antibody (immunoglobulin M, or IgM), which is known as a macroglobulin. Each antibody (protein) made by the WM cells is the same, so it is called a monoclonal protein, or just an M protein. The buildup of this M protein in the body can lead to many of the [symptoms](#)⁹ of WM, including excess bleeding, problems with vision, and nervous system problems. Even though WM has a monoclonal gammopathy and is sometimes grouped into other plasma cell disorders, it is considered a type of NHL. Another name for WM is lymphoplasmacytic lymphoma. Treatment for WM includes drugs used to treat multiple myeloma and NHL.

For more details, see [Waldenstrom Macroglobulinemia](#)¹⁰.

Hyperlinks

1. www.cancer.org/cancer/cancer-basics/what-is-cancer.html
2. www.cancer.org/treatment/understanding-your-diagnosis/tests/understanding-your-lab-test-results.html
3. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/low-blood-counts/anemia.html
4. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/infections.html
5. www.cancer.org/cancer/multiple-myeloma/detection-diagnosis-staging/signs-symptoms.html
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8. www.cancer.org/cancer/non-hodgkin-lymphoma.html
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10. www.cancer.org/cancer/waldenstrom-macroglobulinemia.html

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Key Statistics About Multiple Myeloma

Multiple myeloma is a relatively uncommon cancer. In the United States, the lifetime risk of getting multiple myeloma is 1 in 132 (0.76%).

The American Cancer Society's estimates for multiple myeloma in the United States for 2019 are:

- About 32,110 new cases will be diagnosed (18,130 in men and 13,980 in women).
- About 12,960 deaths are expected to occur (6,990 in men and 5,970 in women).

Visit the [American Cancer Society's Cancer Statistics Center](#)¹ for more key statistics.

Hyperlinks

1. <https://cancerstatisticscenter.cancer.org/>

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Howlader N, Noone AM, Krapcho M, Miller D, Bishop K, Kosary CL, Yu M, Ruhl J, Tatalovich Z, Mariotto A, Lewis DR, Chen HS, Feuer EJ, Cronin KA (eds). SEER Cancer Statistics Review, 1975-2014, National Cancer Institute. Bethesda, MD, https://seer.cancer.gov/csr/1975_2014/, based on November 2016 SEER data submission, posted to the SEER web site, April 2017.

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What's New in Multiple Myeloma Research?

Important research into multiple myeloma is being done in university hospitals, medical centers, and other institutions around the world. Each year, scientists find out more about what causes the disease and how to improve treatment. Many new drugs are being tested.

Researchers have found that bone marrow-support tissues and bone cells produce growth factors that increase the growth of myeloma cells. In turn, the myeloma cells produce substances that cause bone cells to undergo changes that weaken the bones. These discoveries are helping researchers develop new drugs to block these growth factors, slow down the cancer, and reduce bone destruction.

Smoldering multiple myeloma

Even though most patients with smoldering multiple myeloma have a low risk of turning into active myeloma, there are certain patients with features that make them at higher risk of developing active myeloma. New research is showing that by treating these patients sooner than waiting for symptoms may delay when active myeloma starts and may also improve survival.

Minimal residual disease

Minimal residual disease is a term used when tiny amounts of myeloma cancer cells are still present in the bone marrow after treatment. Patients who have no cancer cells left after treatment appear to have better survival rates than patients who still have even very small amounts of cancer cells. New technologies are working to find one myeloma cell in a million normal cells. Studies are also looking into whether getting rid of every myeloma cancer cell (having no minimal residual disease) should be a goal of therapy.

Chimeric antigen receptor (CAR) T-cell therapy

Your immune system helps keep track of all the substances normally found in your body. Any new substance the immune system doesn't recognize raises an alarm, causing the immune system to attack it. Chimeric antigen receptor T-cell therapy (CAR T-cell therapy) is a promising new way to get immune cells called **T cells (a type of white blood cell)** to fight cancer by changing them in the lab so they can find and

destroy cancer cells. Recent studies have shown CAR T-cell therapy with the BCMA protein to be very promising even in myeloma patients who have previously been treated with many drugs.

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Multiple Myeloma Causes, Risk Factors, and Prevention

Risk Factors

A risk factor is anything that affects your chance of getting a disease such as cancer. Learn more about the risk factors for multiple myeloma.

- [Risk Factors for Multiple Myeloma](#)
- [What Causes Multiple Myeloma?](#)

Prevention

For some types of cancer, risk factors are known for the majority of cases. For example, smoking causes most lung cancers. This provides an opportunity for prevention.

With multiple myeloma, few cases are linked to [risk factors](#) that can be avoided, so there is no known way to prevent most multiple myelomas from developing.

Risk Factors for Multiple Myeloma

A risk factor is anything that changes a person's chance of getting a disease such as cancer. Different cancers have different risk factors. For example, exposing skin to strong sunlight is a risk factor for skin cancer. Smoking is a risk factor for lung cancer and many other cancers. But risk factors don't tell us everything. People who have no risk factors can still get the disease. Also, having a risk factor, or even several, does not

mean that a person will get the disease.

Here are a few risk factors that could affect someone's chance of getting multiple myeloma.

Age

The risk of developing multiple myeloma goes up as people get older. Less than 1% of cases are diagnosed in people younger than 35. Most people diagnosed with this cancer are at least 65 years old.

Gender

Men are slightly more likely to develop multiple myeloma than women.

Race

Multiple myeloma is more than twice as common in African Americans than in white Americans. The reason is not known.

Family history

Multiple myeloma seems to run in some families. Someone who has a sibling or parent with myeloma is more likely to get it than someone who does not have this family history. Still, most patients have no affected relatives, so this accounts for only a small number of cases.

Obesity

Being [overweight or obese](#)¹ increases a person's risk of developing myeloma.

Having other plasma cell diseases

People with monoclonal gammopathy of undetermined significance (MGUS) or solitary plasmacytoma are at higher risk of developing multiple myeloma than someone who does not have these diseases.

Hyperlinks

1. www.cancer.org/cancer/cancer-causes/diet-physical-activity/body-weight-and-cancer-risk.html
2. https://seer.cancer.gov/csr/1975_2014/

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What Causes Multiple Myeloma?

Scientists still do not know exactly what causes most cases of multiple myeloma. However, they have made progress in understanding how certain changes in DNA can make plasma cells become cancerous. DNA is the chemical that carries the instructions for nearly everything our cells do.

- Some genes (parts of our DNA) contain instructions for controlling when our cells grow and divide. These genes that promote cell growth are called **oncogenes**.
- Others genes that slow down cell growth or make cells die at the right time are called **tumor suppressor genes**.

Cancers can be caused by mistakes, or defects, in the DNA called **mutations** that turn on oncogenes or turn off tumor suppressor genes.

Recent studies have found that abnormalities of some oncogenes (such as *MYC*) develop early in the course of plasma cell tumors. Changes in other oncogenes (such as the *RAS* genes) are more often found in myeloma cells in the bone marrow after treatment, and changes in tumor suppressor genes (such as the gene for *p53*) are associated with spread to other organs.

Myeloma cells also show abnormalities in their chromosomes. In human cells, DNA is packaged into chromosomes. Although normal human cells contain 46 chromosomes, some cancer cells may have extra chromosomes (called a duplication) or have all or part of a chromosome missing (called a deletion). One common finding in myeloma cells is that parts of chromosome number 17 are missing. These deletions appear to make the myeloma more aggressive and resistant to treatment.

In about half of all people with myeloma, part of one chromosome has switched with part of another chromosome in the myeloma cells. This is called a translocation. When this occurs in a crucial area next to an oncogene, it can turn the oncogene on.

Researchers have found that patients with plasma cell tumors have important abnormalities in other bone marrow cells and that these abnormalities may also cause excess plasma cell growth. Certain cells in the bone marrow called **dendritic cells** release a hormone called interleukin-6 (IL-6), which stimulates normal plasma cells to grow. Excessive production of IL-6 by these cells appears to be an important factor in development of plasma cell tumors.

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Can Multiple Myeloma Be Prevented?

For certain types of cancer, risk factors are known for the most of the cases. For example, smoking causes most lung cancers. This provides an opportunity for prevention. For other cancers, such as cervical cancer, pre-cancers can be detected early by a screening test (such as the Pap test) and treated before they develop into an invasive cancer.

With multiple myeloma, few cases are linked to risk factors that can be avoided. There is no known way to prevent multiple myeloma from developing in those people with monoclonal gammopathy of undetermined significance or solitary plasmacytomas. Research is investigating if treating certain high risk smoldering multiple myeloma may keep it from becoming active multiple myeloma.

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Multiple Myeloma Early Detection, Diagnosis, and Staging

Detection and Diagnosis

Catching cancer early often allows for more treatment options. Some early cancers may have signs and symptoms that can be noticed, but that is not always the case.

- [Can Multiple Myeloma Be Found Early?](#)
- [Signs and Symptoms of Multiple Myeloma](#)
- [Tests to Find Multiple Myeloma](#)

Stages and Outlook (Prognosis)

After a cancer diagnosis, staging provides important information about the extent of cancer in the body and anticipated response to treatment.

- [Multiple Myeloma Stages](#)
- [Survival Rates by Stage for Multiple Myeloma](#)

Questions to Ask About Multiple Myeloma

Here are some questions you can ask your cancer care team to help you better understand your diagnosis and treatment options.

- [Questions to Ask About Multiple Myeloma](#)

Can Multiple Myeloma Be Found Early?

It's difficult to diagnose multiple myeloma early. Often, multiple myeloma causes no symptoms until it reaches an advanced stage. Sometimes, it might cause vague symptoms that at first seem to be caused by other diseases. Sometimes, multiple myeloma is found early when a routine blood test shows an abnormally high amount of protein in the blood.

People with MGUS (monoclonal gammopathy of unknown significance) or solitary plasmacytoma are at risk of developing multiple myeloma and have regular bloodwork to monitor for it. Multiple myeloma may be diagnosed sooner in those people than those who did not have MGUS or a solitary plasmacytoma.

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Signs and Symptoms of Multiple Myeloma

Some patients with multiple myeloma have no symptoms at all. Others can have common symptoms of the disease including:

Bone problems

- Bone pain, which can be in any bone, but is most often in the back, the hips, and skull
- Bone weakness, either all over (osteoporosis), or where there is a plasmacytoma
- Broken bones (fractures), sometimes from only a minor stress or injury

Low blood counts

Shortages of red blood cells, white blood cells, and blood platelets are common in multiple myeloma and might lead to other symptoms.

- Anemia: A reduced number of red blood cells that can cause weakness, a reduced ability to exercise, shortness of breath, and dizziness.
- Leukopenia: Too few white blood cells that can lower resistance to infections such as pneumonia.
- Thrombocytopenia: When blood platelet counts are low which may cause serious bleeding even with minor scrapes, cuts, or bruises. .

High blood levels of calcium

High levels of calcium in the blood (called **hypercalcemia**) can cause:

- Extreme thirst, leading to drinking a lot
- Urinating (peeing) a lot
- Dehydration
- Kidney problems and even kidney failure
- Severe constipation,
- Abdominal (belly) pain
- Loss of appetite
- Weakness
- Feeling drowsy
- Confusion

If the level of calcium gets high enough, you can even slip into a coma.

Nervous system symptoms

If myeloma weakens the bones in the spine, they can collapse and press on spinal nerves. This is called **spinal cord compression** and can cause

- Sudden severe back pain
- Numbness, most often in the legs
- Muscle weakness, most often in the legs.

This is a medical emergency and you should contact your doctor right away or go to the emergency room. If spinal cord compression is not treated right away, there is a possibility of permanent paralysis.

Nerve damage

Sometimes, the abnormal proteins produced by myeloma cells are toxic to nerves. This damage can lead to weakness and numbness and sometimes a “pins and needles” sensation. This is also called peripheral neuropathy.

Hyperviscosity

In some patients, large amounts of myeloma protein can cause the blood to “thicken.” This thickening is called **hyperviscosity**. It can slow blood flow to the brain and cause:

- Confusion
- Dizziness
- Symptoms of a stroke, like weakness on one side of the body and slurred speech

Patients with these symptoms should call their doctor. Removing the protein from the blood using a procedure called plasmapheresis can rapidly reverse this problem. (Note: This is not something that can be treated with drugs known as “blood thinners.”)

Kidney problems

Myeloma protein can damage the kidneys. Early on, this doesn’t cause any symptoms, but signs of kidney damage may be seen on a blood test or a urine test. As the kidneys start to fail, they lose the ability to get rid of excess salt, fluid, and body waste products. This can lead to symptoms such as:

- Weakness
- Shortness of breath
- Itching
- Leg swelling.

Infections

Myeloma patients are much more likely to get infections. When someone with myeloma gets an infection, they may be slow to respond to treatment. That person may stay sick for a long time. Pneumonia is a common and serious infection seen in myeloma patients.

Signs and symptoms of light chain amyloidosis

Patients with amyloidosis (discussed in [What Is Multiple Myeloma?](#)¹) can have some of the same problems as patients with myeloma, such as kidney problems and nerve damage. They can also have other problems, such as:

- **Heart problems:** The heart may enlarge and become weaker. In some people, the heart becomes so weak that fluid builds up in the lungs, making them feel short of breath. Fluid may also build up in the legs and feet (edema). This is called congestive heart failure.
- **Enlarged liver:** The person may feel the liver below the right ribs. When this gets large it can press on the stomach so the person feels full after eating only a small amount of food.
- **Enlarged tongue:** When amyloid builds up in the tongue it can get larger. This can lead to problems swallowing and problems breathing during sleep (sleep apnea).
- **Skin changes:** Changes in the color or texture, easy bruising, and bleeding into the skin around the eyes (“raccoon eyes”)
- **Kidney problems**
- **Carpal tunnel syndrome:** Which causes numbness and weakness in the hands.

Hyperlinks

1. www.cancer.org/cancer/multiple-myeloma/about/what-is-multiple-myeloma.html

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Tests to Find Multiple Myeloma

If symptoms suggest that a person might have multiple myeloma, more tests are done.

Lab tests

Blood counts

The [complete blood count](#)¹ (CBC) is a test that measures the levels of red cells, white

cells, and platelets in the blood. If there are too many myeloma cells in the bone marrow, some of these blood cell levels can be low. The most common finding is a low red blood cell count ([anemia²](#)).

Blood chemistry tests

Levels of blood creatinine, albumin, calcium, and other electrolytes will be checked.

- Creatinine levels show how well your kidneys are working. High levels mean that the kidneys are not functioning well. This is common in people with myeloma.
- Albumin is a protein found in the blood. Low levels can be seen in myeloma.
- Calcium levels may be high in people with advanced myeloma. High calcium levels (hypercalcemia) can cause symptoms of fatigue, weakness, and confusion.

A blood test to measure lactic dehydrogenase (LDH) levels might also be done. It can be a useful indicator of a patient's prognosis (outlook). High levels mean the disease is more advanced and may have a worse prognosis.

Urine tests

A routine urine sample is typically taken to look for myeloma protein that has filtered through the kidney. You most likely also will be asked to give a sample of urine that has been collected over a 24-hour period, so it can measure how much myeloma protein is present. These tests are called urine protein electrophoresis (UPEP) and urine immunofixation.

Quantitative immunoglobulins

This test measures the blood levels of the different antibodies (also called immunoglobulins). There are several different types of antibodies in the blood: IgA, IgD, IgE, IgG, and IgM. The levels of these immunoglobulins are measured to see if any are abnormally high or low. In multiple myeloma, the level of one type may be high while the others are low.

Electrophoresis

The antibody produced by myeloma cells is abnormal because it is monoclonal (all the exact same). Serum protein electrophoresis (SPEP) is a test that measures the antibodies in the blood and can find a monoclonal antibody. Another test, called immunofixation or immunoelectrophoresis, is used to determine the exact type of

abnormal antibody (IgG, IgA or some other type). Finding a monoclonal antibody in the blood may be the first step in diagnosing multiple myeloma. This abnormal protein is known by several different names, including **monoclonal immunoglobulin**, **monoclonal protein (M protein)**, **M spike**, or **paraprotein**.

Antibodies are made up of chains of protein : 2 long (heavy) chains and 2 shorter (light) chains. Sometimes pieces of the abnormal myeloma protein are filtered through the kidney into the urine. This urine protein, known as **Bence Jones protein**, is the part of the antibody called the light chain. The tests used for finding a monoclonal antibody in urine are called urine protein electrophoresis (UPEP) and urine immunofixation. These are done most often on urine that has been collected over a 24-hour period, not just on a routine urine sample.

Serum free light chains

This blood test can measure the light chain levels in the blood and is done when looking for myeloma or light chain amyloidosis.

This is most helpful in the rare cases of myeloma in which no M protein is found by SPEP. Since the SPEP measures the levels of intact (whole) antibodies, it cannot measure the amount of light chains only.

This test also calculates the light chain ratio which is used to see if there is one type of light chain more than the other. There are 2 kinds of light chains: kappa and lambda. Normally, they are present in equal amounts in the blood, giving a ratio of 1 to 1. If there is more of one type of light chain than the other, the ratio will be different, which can be a sign of myeloma.

Beta-2 microglobulin

This is another protein made by the myeloma cells. Although this protein itself doesn't cause problems, it can be a useful indicator of a patient's prognosis (outlook). High levels mean the disease is more advanced and may have a worse prognosis.

Types of Biopsies

Bone marrow biopsy

People with multiple myeloma have too many plasma cells in their bone marrow. The procedure used to check the bone marrow is called a **bone marrow biopsy** and

aspiration. It can be done either at the doctor's office or at the hospital.

In bone marrow aspiration, the back of the pelvic bone is numbed with local anesthetic. Then, a needle is inserted into the bone, and a syringe is used to remove a small amount of liquid bone marrow. This causes a brief sharp pain. For the biopsy, a needle is used to remove a tiny splinter of bone and marrow. Patients may feel some pressure during the biopsy. There is some soreness in the biopsy area when the numbing medicine wears off. Most patients can go home immediately after the procedure.

The bone marrow tissue is examined in the lab to see the appearance, size, and shape of the cells, how the cells are arranged and to determine if there are myeloma cells in the bone marrow and, if so, how many. The aspirate (the liquid part of the bone marrow) may also be sent for other tests, including immunohistochemistry and flow cytometry, and chromosome analyses, including karyotype and fluorescent in situ hybridization (also known as FISH).

- **Immunohistochemistry:** a part of the biopsy sample is treated with special proteins which cause color changes and help identify myeloma cells.
- **Flow cytometry:** A sample of bone marrow is treated with special proteins that stick only to certain cells. This can help determine if those cells are abnormal and if they are myeloma cells, lymphoma cells, some other cancer, or a non-cancerous disease.
- **Cytogenetics:** A test that evaluates chromosomes (long strands of DNA) in normal bone marrow cells and myeloma cells. Some myeloma cells may have too many chromosomes, too few chromosomes, or other chromosome abnormalities (such as translocations and deletions). Finding these changes can sometimes help in predicting a person's prognosis (outlook). Cytogenetic testing usually takes about 2 to 3 weeks to get a result.
- **Fluorescent in situ hybridization (FISH):** It uses special fluorescent dyes that only attach to specific parts of chromosomes. It can find most chromosome changes (such as translocations and deletions) that can be seen in the lab in standard cytogenetic tests, as well as some changes too small to be seen with usual cytogenetic testing. It's very accurate and results are often available within a couple of days.

Fine needle aspiration biopsy

Fine needle aspiration (FNA) uses a very thin needle and a syringe to withdraw a small amount of tissue from a tumor or lymph node. The doctor can aim the needle while feeling an enlarged lymph node near the surface of the body. If the abnormal area (tumor) is deep in the body, the needle can be guided while it's watched on a computed tomography (CT) scan (see discussion of imaging tests later in this section). The main advantage of FNA is that it doesn't require surgery. The disadvantage is that in some cases the thin needle cannot remove enough tissue for a definite diagnosis.

Core needle biopsy

This test is similar to FNA, but a larger needle is used and a larger tissue sample is removed.

If an area looks abnormal on an x-ray, a biopsy may be needed to confirm that it's a plasmacytoma. Most often, a needle biopsy (fine or core) is used.

Imaging tests

[Imaging tests](#)³ use sound waves, x-rays, magnetic fields, or radioactive substances to create pictures of the inside of your body. Imaging tests may be done for a number of reasons, such as:

- To look at suspicious areas that might be cancer
- To learn how far cancer has spread
- To help determine if treatment is working

Bone x-rays

X-rays can detect bone destruction caused by the myeloma cells. Often doctors will do a series of x-rays that includes most of the bones. This is called a **bone survey** or **skeletal survey**.

CT scan (Computed tomography scan)

A CT scan uses x-rays taken from different angles, which are combined by a computer to make detailed pictures of the organs. Sometimes, this test can help tell if your bones have been damaged by myeloma. It can also be used to guide a biopsy needle into an area of concern.

Magnetic resonance imaging (MRI) scans

Like CT scans, MRI scans show detailed images of soft tissues in the body. But MRI scans use radio waves and strong magnets instead of x-rays. A contrast material called gadolinium may be injected into a vein before the scan to see details better.

MRI scans are very helpful in looking at bones, the brain, and the spinal cord. Because MRI can find plasmacytomas that can't be seen on regular x-rays, they can be helpful if the patient has pain in a bone but nothing abnormal is seen on the x-ray. MRI can also be used to look at the bone marrow in patients with multiple myeloma.

Positron emission tomography (PET) scans

For this test, a form of radioactive sugar is put into a vein and travels throughout the body. Cancer cells absorb high amounts of this sugar. A special camera then takes pictures that show the areas where the sugar collected throughout the body. A PET scan is often combined with a CT scan (known as a **PET/CT scan**).

When a patient appears to have a solitary plasmacytoma, a PET scan may be used to look for other plasmacytomas. Like MRI scans, PET scans can find plasmacytomas that can't be seen on regular x-rays, so they are helpful if the patient has pain in a bone but the x-ray result is negative.

Echocardiogram (ECHO)

Amyloidosis often affects the heart, so if your doctor diagnoses or suspects you have this disorder, an echocardiogram (ECHO) may be ordered. This test is basically an ultrasound of the heart. It uses sound waves to look at the heart muscle and how well it's working. The echocardiogram can see if the heart size is normal and if it is pumping normally. It also is especially helpful if amyloid is suspected because amyloid in the heart muscle looks different from normal heart muscle.

Diagnosing Multiple Myeloma

Multiple myeloma is often diagnosed based on tests, the patient's symptoms and the doctor's physical exam of the patient. A diagnosis of multiple myeloma requires either:

1. A plasma cell tumor (proven by biopsy) OR at least 10% plasma cells in the bone marrow AND
2. At least one of the following:

- High blood calcium level
- Poor kidney function
- Low red blood cell counts (anemia)
- Holes in the bones from tumor found on imaging studies (CT, MRI, PET scan)
- Increase in one type of light chain in the blood so that one type is 100 times more common than the other
- 60% or more plasma cells in the bone marrow

Smoldering myeloma

This term is used to mean early myeloma that is not causing any symptoms. People with smoldering myeloma have some signs of multiple myeloma, such as any of the following:

- Plasma cells in the bone marrow between 10% and 60%
- High level of monoclonal immunoglobulin (M protein) in the blood
- High level of light chains in the urine (also called Bence Jones protein)

But they have normal blood counts, normal calcium levels, normal kidney function, no bone or organ damage, and no signs of amyloidosis.

Light chain amyloidosis

A diagnosis of light chain amyloidosis is made when the patient has ALL of the following:

- Signs and symptoms of amyloidosis
- A biopsy that shows amyloid in any tissue (fat, bone marrow, or organ such as the heart)
- A positive test showing the amyloid protein is a light chain and not a heavy chain
- Abnormal plasma cells in the bone marrow, high levels of M protein in the blood, or high levels of M protein in the urine.

Amyloid can build up in any tissue, and a biopsy may be able to diagnose this disease. Sometimes it can be seen on a bone marrow biopsy. The biopsy done most often to look for amyloid uses a needle to remove some fat from the wall of the abdomen (belly). This is after the skin over the biopsy site is numbed with medicine. A doctor uses a

special stain on the removed fat to look for amyloid.

Because amyloid often affects the heart and kidneys, they may also be biopsied to look for amyloid. This is rarely needed to find out if a patient has light chain amyloidosis, but it is sometimes done in someone with amyloid if it isn't clear that their heart or kidney problems are caused by the amyloid or some other problem.

Other tests are often done as well, to help confirm that the patient has light chain amyloidosis and not some other kind. These include a bone marrow biopsy, serum free light chains, and electrophoresis of the urine (these were discussed earlier in this section).

Hyperlinks

1. www.cancer.org/treatment/understanding-your-diagnosis/tests/understanding-your-lab-test-results.html
2. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/low-blood-counts/anemia.html
3. www.cancer.org/treatment/understanding-your-diagnosis/tests/imaging-radiology-tests-for-cancer.html

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Multiple Myeloma Stages

After someone is diagnosed with cancer, doctors will try to figure out if it has spread, and if so, how far. This process is called **staging**. The stage of a cancer describes how much cancer is in the body. It helps determine how serious the cancer is and how best to [treat](#)¹ it. Doctors also use a cancer's stage when talking about survival statistics.

The Revised International Staging System

Multiple myeloma is staged using the Revised International Staging System (RISS) based on 4 factors:

- The amount of albumin in the blood

- The amount of beta-2-microglobulin in the blood
- The amount of LDH in the blood
- The specific gene abnormalities (cytogenetics) of the cancer.

RISS Stage Group	Factors
I	Serum beta-2 microglobulin is less than 3.5 (mg/L) AND Albumin level is 3.5 (g/dL) or greater AND Cytogenetics are considered “not high risk” * AND LDH levels are normal
II	Not stage I or III
III	Serum beta-2 microglobulin is 5.5 (mg/L) or greater AND Cytogenetics are considered “high-risk” * AND/OR LDH levels are high

*The bone marrow may be sent for tests to look at the chromosomes in the cancer cells. This test may also be called **cytogenetics**. Certain chromosome changes can mean a poorer outlook. For example, loss of a piece of chromosome 17 is linked to a poorer outcome. Another genetic abnormality that predicts a poor outcome is an exchange of material from chromosomes 4 and 14. This is called a **translocation**. A translocation involving chromosomes 14 and 16 is also linked to a poorer outcome. These 3 specific chromosome changes are considered **high risk**. Other chromosome abnormalities are considered **standard risk** or not high risk.

Cancer staging can be complex, so ask your doctor to explain it to you in a way you understand.

Factors other than stage that affect survival

Kidney function

The blood creatinine level shows how healthy the kidneys are. Kidneys eliminate this chemical from the body. When they are damaged by the monoclonal immunoglobulin, blood creatinine levels rise, predicting a worse outlook.

Age

Age is also important. In the studies of the international staging system, older people with myeloma do not live as long.

Overall Health

Overall health can affect the outlook of someone with myeloma. Poorly controlled health conditions, such as diabetes or heart disease, for example, can predict a worse prognosis.

Hyperlinks

1. www.cancer.org/cancer/multiple-myeloma/treating.html

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American Joint Committee on Cancer. Plasma Cell Myeloma and Plasma Cell Disorders. In: *AJCC Cancer Staging Manual*. 8th ed. New York, NY: Springer; 2017:973.

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Survival Rates by Stage for Multiple Myeloma

Survival rates tell you what percentage of people with the same type and stage of cancer are still alive a certain amount of time (usually 5 years) after they were diagnosed. They can't tell you how long you will live, but they may help give you a better understanding about how likely it is that your treatment will be successful. Some people will want to know the survival rates for their cancer, and some people won't.

What is a 5-year survival rate?

Statistics on the outlook for a certain type of cancer are often given as 5-year survival rates. The 5-year survival rate is the percentage of people who live at least 5 years after being diagnosed with cancer. For example, a 5-year survival rate of 90% means that an estimated 90 out of 100 people who have that cancer are still alive 5 years after being diagnosed. Keep in mind, however, that many of these people live much longer than 5 years after diagnosis.

Remember that all survival rates are estimates – your outlook can vary based on a number of factors specific to you.

Survival rates don't tell the whole story

Survival rates are often based on previous outcomes of large numbers of people who had the disease, but they can't predict what will happen in any particular person's case. There are a number of limitations to remember:

- The numbers below are among the most current available. But to get 5-year survival rates, doctors have to look at people who were treated at least 5 years ago. As treatments are improving over time, people who are now being diagnosed with multiple myeloma may have a better outlook than these statistics show.
- These statistics are based on when the cancer was first diagnosed. They do not apply to cancers that later come back or spread, for example.
- The outlook for people with multiple myeloma varies by the stage (extent) of the cancer – in general, the survival rates are higher for people with earlier stage cancers. But other factors can also affect a person's outlook, such as their age and overall health, and how well the cancer responds to treatment. The outlook for each

person is specific to his or her circumstances.

Your doctor can tell you how these numbers apply to you.

Survival rates for multiple myeloma

Remember, these survival rates are only estimates – they can't predict what will happen to any individual person. We understand that these statistics can be confusing and may lead you to have more questions. Talk to your doctor to better understand your specific situation.

The numbers below are the approximate median survival using the Revised International Staging System of just over 3,000 myeloma patients treated between 2005 and 2012. These survival times are measured from the point that treatment, such as chemotherapy, first started. Since 2000 the percent of patients living five years after diagnosis has been increasing. Treatment since then has improved considerably and modern survival results are likely to be better.

Revised International Staging System Median Survival

Stage I	Has not been reached
Stage II	83 months
Stage III	43 months

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Questions to Ask About Multiple Myeloma

It's important to have frank, open discussions with your cancer care team. They want to answer all of your questions, so that you can make informed treatment and life decisions. For instance, consider these questions:

When you're told you have multiple myeloma

- Where is the cancer located?
- Has the cancer spread beyond where it started?
- What is the cancer's [stage](#)(extent), and what does that mean?
- Will I need other [tests](#)¹ before we can decide on treatment?
- Do I need to see any other doctors or health professionals?
- If I'm concerned about the costs and insurance coverage for my diagnosis and treatment, who can help me?

When deciding on a treatment plan

- What are my [treatment](#)² options?
- What do you recommend and why?
- How much experience do you have treating this type of cancer?
- Should I get a [second opinion](#)³? How do I do that? Can you recommend someone?
- What would the goal of the treatment be?
- How quickly do we need to decide on treatment?
- What should I do to be ready for treatment?
- How long will treatment last? What will it be like? Where will it be done?
- What risks or side effects are there to the treatments you suggest? Are there things I can do to reduce these side effects?
- How might treatment affect my daily activities? Can I still work full time?
- What are the chances the cancer will [recur](#)⁴ (come back) with these treatment plans?
- What will we do if the treatment doesn't work or if the cancer recurs?
- What if I have transportation problems getting to and from treatment?

During treatment

Once treatment begins, you'll need to know what to expect and what to look for. Not all of these questions may apply to you, but asking the ones that do may be helpful.

- How will we know if the treatment is working?
- Is there anything I can do to help manage side effects?
- What symptoms or [side effects](#)⁵ should I tell you about right away?
- How can I reach you on nights, holidays, or weekends?
- Do I need to change what I eat during treatment?
- Are there any limits on what I can do?
- Can I [exercise during treatment](#)⁶? If so, what kind should I do, and how often?
- Can you suggest a mental health professional I can see if I start to feel overwhelmed, depressed, or distressed?
- What if I need social support during treatment because my family lives far away?

After treatment

- Do I need a special diet after treatment?
- Are there any limits on what I can do?
- What other symptoms should I watch for?
- What kind of exercise should I do now?
- What type of follow-up will I need after treatment?
- How often will I need to have follow-up exams and imaging tests?
- Will I need any blood tests?
- How will we know if the cancer has [come back](#)⁷? What should I watch for?
- What will my options be if the cancer comes back?

Along with these sample questions, be sure to write down some of your own. For instance, you might want more information about recovery times. Or you may want to ask about [clinical trials](#)⁸.

Keep in mind that doctors aren't the only ones who can give you information. Other health care professionals, such as nurses and social workers, can answer some of your questions. To find out more about speaking with your health care team, see [The Doctor-Patient Relationship](#)⁹.

Hyperlinks

1. www.cancer.org/treatment/understanding-your-diagnosis/tests.html
2. www.cancer.org/cancer/multiple-myeloma/treating.html
3. www.cancer.org/treatment/finding-and-paying-for-treatment/choosing-your-treatment-team/seeking-a-second-opinion.html
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Treating Multiple Myeloma

Local treatments

Some treatments are called *local therapies*. This means they treat the tumor without affecting the rest of the body. These treatments are more likely to be useful for earlier stage (less advanced) cancers, although they might also be used in some other situations.

- [Surgery for Multiple Myeloma](#)
- [Radiation Therapy for Multiple Myeloma](#)

Systemic treatments

Multiple myeloma can also be treated using drugs, which can be given by mouth or directly into the bloodstream. These systemic therapies can reach cancer cells anywhere in the body.

- [Drug Therapy for Multiple Myeloma](#)
- [Stem Cell Transplant for Multiple Myeloma](#)
- [Supportive Treatments for Patients With Multiple Myeloma](#)

Common treatment approaches

Depending on the stage of the cancer, whether or not you are a candidate for a stem cell transplant, and other factors, different types of treatment may be combined at the same time or used after one another.

- [Treatment Options for Multiple Myeloma, by Stage](#)

Who treats multiple myeloma?

Based on your treatment options, you might have different types of doctors on your treatment team. These doctors could include:

- An **orthopedic surgeon**: a doctor who uses surgery to treat diseases of the bones
- A **radiation oncologist**: a doctor who treats cancer with radiation therapy
- A **medical oncologist**: a doctor who treats cancer with medicines such as chemotherapy or targeted therapy
- A **bone marrow transplant specialist**: A cancer doctor who specializes in performing bone marrow transplants

You might have many other specialists on your treatment team as well, including physician assistants (PAs), nurse practitioners (NPs), nurses, psychologists, nutritionists, social workers, and other health professionals.

- [Health Professionals Associated With Cancer Care¹](#)

Making treatment decisions

It's important to discuss all of your treatment options, including their goals and possible side effects, with your doctors to help make the decision that best fits your needs. It's also very important to ask questions if there's anything you're not sure about.

If time permits, it is often a good idea to seek a second opinion. A second opinion can give you more information and help you feel more confident about the treatment plan you choose.

- [Questions to Ask About Multiple Myeloma²](#)
- [Seeking a Second Opinion³](#)

Thinking about taking part in a clinical trial

Clinical trials are carefully controlled research studies that are done to get a closer look at promising new treatments or procedures. Clinical trials are one way to get state-of-the-art cancer treatment. In some cases they may be the only way to get access to newer treatments. They are also the best way for doctors to learn better methods to treat cancer. Still, they're not right for everyone.

If you would like to learn more about clinical trials that might be right for you, start by

asking your doctor if your clinic or hospital conducts clinical trials.

- [Clinical Trials](#)⁴

Considering complementary and alternative methods

You may hear about alternative or complementary methods that your doctor hasn't mentioned to treat your cancer or relieve symptoms. These methods can include vitamins, herbs, and special diets, or other methods such as acupuncture or massage, to name a few.

Complementary methods refer to treatments that are used along with your regular medical care. Alternative treatments are used instead of a doctor's medical treatment. Although some of these methods might be helpful in relieving symptoms or helping you feel better, many have not been proven to work. Some might even be harmful.

Be sure to talk to your cancer care team about any method you are thinking about using. They can help you learn what is known (or not known) about the method, which can help you make an informed decision.

- [Complementary and Alternative Medicine](#)⁵

Help getting through cancer treatment

Your cancer care team will be your first source of information and support, but there are other resources for help when you need it. Hospital- or clinic-based support services are an important part of your care. These might include nursing or social work services, financial aid, nutritional advice, rehab, or spiritual help.

The American Cancer Society also has programs and services – including rides to treatment, lodging, and more – to help you get through treatment. Call our National Cancer Information Center at 1-800-227-2345 and speak with one of our trained specialists.

- [Find Support Programs and Services in Your Area](#)⁶

Choosing to stop treatment or choosing no treatment at all

For some people, when treatments have been tried and are no longer controlling the cancer, it could be time to weigh the benefits and risks of continuing to try new

treatments. Whether or not you continue treatment, there are still things you can do to help maintain or improve your quality of life.

Some people, especially if the cancer is advanced, might not want to be treated at all. There are many reasons you might decide not to get cancer treatment, but it's important to talk to your doctors and you make that decision. Remember that even if you choose not to treat the cancer, you can still get supportive care to help with pain or other symptoms.

- [If Cancer Treatments Stop Working](#)⁷
- [Palliative or Supportive Care](#)⁸

The treatment information given here is not official policy of the American Cancer Society and is not intended as medical advice to replace the expertise and judgment of your cancer care team. It is intended to help you and your family make informed decisions, together with your doctor. Your doctor may have reasons for suggesting a treatment plan different from these general treatment options. Don't hesitate to ask him or her questions about your treatment options.

Drug Therapy for Multiple Myeloma

Chemotherapy

Chemotherapy (chemo) is the use of drugs to destroy or control cancer cells. These drugs can be taken by mouth or given in a vein or a muscle. They enter the bloodstream and reach almost all areas of the body.

Chemo drugs used to treat multiple myeloma include:

- Melphalan
- Vincristine (Oncovin)
- Cyclophosphamide (Cytosan)
- Etoposide (VP-16)
- Doxorubicin (Adriamycin)
- Liposomal doxorubicin (Doxil)
- Bendamustine (Treanda)

Often one of these drugs is combined with other types of drugs like corticosteroids and immuno-modulating agents (drugs that will change the patient's immune response). If a [stem cell transplant](#) is planned, most doctors avoid using certain drugs, like melphalan, that can damage bone marrow.

Chemo side effects

Chemo drugs kill cancer cells but also can damage normal cells. They are given carefully to avoid or reduce the [side effects](#)¹ of chemotherapy. These side effects depend on the type and dose of drugs given and the how long they are taken. Common side effects of chemotherapy include:

- Hair loss
- Mouth sores
- Loss of appetite
- Nausea and vomiting
- Low blood counts

Chemotherapy often leads to [low blood counts](#)², which can cause the following:

- [Infection](#)³: An increased risk of serious infection (from low white blood cell counts)
- Easy bruising or bleeding (from low blood platelets)
- [Anemia](#)⁴: Feeling excessively tired or short of breath (low red blood cells)

Most side effects are temporary and go away after treatment is finished.

If you have side effects, your cancer care team can suggest steps to ease them. For example, drugs can be given along with the chemo to prevent or reduce nausea and vomiting.

In addition to these temporary side effects, some chemo drugs can permanently damage certain organs such as the heart or kidneys. The possible risks of these drugs are carefully balanced against their benefits, and the function of these organs is carefully monitored during treatment. If serious organ damage occurs, the drug that caused it is stopped and sometimes replaced with another.

For more information about chemotherapy and its side effects, see [Chemotherapy](#)⁵.

Corticosteroids (steroids)

Corticosteroids, such as dexamethasone and prednisone, are an important part of the treatment of multiple myeloma. They can be used alone or combined with other drugs as a part of treatment. Corticosteroids are also used to help decrease the nausea and vomiting that chemo might cause.

Common side effects of these drugs include

- High blood sugar
- Increased appetite and weight gain
- Problems sleeping
- Changes in mood (some people become irritable or “hyper”)

When used for a long time, corticosteroids also suppress the immune system. This increases the risk of serious infections. Steroids can also weaken bones.

Most of these side effects go away over time after the drug is stopped.

Immunomodulating agents

The way immunomodulating agents affect the immune system isn't entirely clear. Three immunomodulating agents are used to treat multiple myeloma. The first of these drugs to be developed, thalidomide, caused severe birth defects when taken during pregnancy. Because the other immunomodulating agents are related to thalidomide, there's concern that they could also cause birth defects. That's why all of these drugs can only be obtained through a special program run by the drug company that makes them.

Because these drugs can increase the risk of serious blood clots, they are often given along with aspirin or a blood thinner.

Thalidomide (Thalomid) was first used decades ago as a sedative and as a treatment for morning sickness in pregnant women. When it was found to cause birth defects, it was taken off the market. Later, it became available again as a treatment for multiple myeloma. Side effects of thalidomide can include drowsiness, fatigue, severe constipation, and painful nerve damage ([neuropathy](#)⁶). The neuropathy can be severe, and might not go away after the drug is stopped. There is also an increased risk of serious blood clots that start in the leg and can travel to the lungs.

Lenalidomide (Revlimid) is similar to thalidomide. It works well in treating multiple myeloma. The most common side effects of lenalidomide are thrombocytopenia (low platelets) and low white blood cell counts. It can also cause painful nerve damage. The risk of blood clots is not as high as that seen with thalidomide, but it is still increased.

In patients, where the myeloma is in remission after either a stem cell transplant or initial treatment, lenalidomide may be given for maintenance therapy to prolong the remission.

Pomalidomide (Pomalyst) is also related to thalidomide and is used to treat multiple myeloma. Some common side effects include low red blood cell counts (anemia) and low white blood cell counts. The risk of nerve damage is not as severe as it is with the other immunomodulating drugs, but it's also linked to an increased risk of blood clots.

Proteasome inhibitors

Proteasome inhibitors work by stopping enzyme complexes (proteasomes) in cells from breaking down proteins important for controlling cell division. They appear to affect tumor cells more than normal cells, but they are not without side effects.

Bortezomib (Velcade) was the first of this type of drug to be approved, and it's often used to treat multiple myeloma. It may be especially helpful in treating myeloma patients with kidney problems. It's injected into a vein (IV) or under the skin, once or twice a week.

Common side effects of this drug include nausea and vomiting, tiredness, diarrhea, constipation, fever, decreased appetite, and lowered blood counts. The platelet count (which can cause easier bruising and bleeding) and the white blood cell count (which can increase the risk of serious infection) are most often affected. Bortezomib can also cause nerve damage (peripheral neuropathy) that can lead to problems with numbness, tingling, or even pain in the hands and feet. The risk of nerve damage is less when the drug is given under the skin. Some patients develop shingles (herpes zoster) while taking this drug. To help prevent this, your doctor may have you take an anti-viral medicine (like acyclovir) while you take bortezomib.

In patients where the myeloma was put into remission after either a stem cell transplant or initial treatment, bortezomib may also be given for maintenance therapy to prolong the remission.

Carfilzomib (Kyprolis) is a newer proteasome inhibitor that can be used to treat multiple myeloma in patients who have already been treated with other drugs that didn't

work. It's given as an injection into a vein (IV), often in a 4-week cycle. To prevent problems like allergic reactions during the infusion, the steroid drug dexamethasone is often given before each dose in the first cycle.

Common side effects include tiredness, nausea and vomiting, diarrhea, shortness of breath, fever, and low blood counts. The blood counts most often affected are the platelet counts (which can cause easier bruising and bleeding) and the red blood cell count (which can lead to tiredness, shortness of breath, and being pale). People on this drug can also have more serious problems, such as pneumonia, heart problems, and kidney or liver failure.

Ixazomib (Ninlaro) is a proteasome inhibitor that is a capsule taken by mouth, typically once a week for 3 weeks, followed by a week off. This drug is usually given after other drugs have been tried.

Common side effects of this drug include nausea and vomiting, diarrhea, constipation, swelling in the hands or feet, back pain, and a lowered blood platelet count (which can cause easier bruising and bleeding). This drug can also cause nerve damage (peripheral neuropathy) that can lead to problems with numbness, tingling, or even pain in the hands and feet.

Histone deacetylase (HDAC) inhibitors

HDAC inhibitors are a group of drugs that can affect which genes are active or turned on inside cells. They do this by interacting with proteins in chromosomes called histones.

Panobinostat (Farydak) is an HDAC inhibitor that can be used to treat patients who have already been treated with bortezomib and an immunomodulating agent. It is a capsule, typically taken 3 times a week for 2 weeks, followed by a week off. This cycle is then repeated.

Common side effects include diarrhea (which can be severe), feeling tired, nausea, vomiting, loss of appetite, swelling in the arms or legs, fever, and weakness. This drug can also affect blood cell counts and the blood levels of certain minerals (such as potassium, sodium, and calcium). Less common but still serious side effects can include bleeding inside the body, liver damage, and changes in heart rhythm, which can sometimes be life threatening.

Monoclonal antibodies

Antibodies are proteins made by the body's immune system to help fight infections. Man-made versions (monoclonal antibodies), can be designed to attack a specific target, such as proteins on the surface of myeloma cells.

Daratumumab (Darzalex) is a monoclonal antibody that attaches to the CD38 protein, which is found on myeloma cells. This is thought to both kill the cancer cells directly and to help the immune system attack them also. This drug is used mainly in combination with other types of drugs, although it can also be used by itself in patients who have already had several other treatments for their myeloma. It's given as an infusion into a vein (IV).

This drug can cause a reaction in some people while it is being given or within a few hours afterward, which can sometimes be severe. Symptoms can include coughing, wheezing, trouble breathing, tightness in the throat, a runny or stuffy nose, feeling dizzy or lightheaded, headache, rash, and nausea.

Other side effects can include fatigue, nausea, back pain, fever, and cough. This drug can also lower blood cell counts, which can increase the risk of infections and bleeding or bruising.

Elotuzumab (Empliciti) is a monoclonal antibody that attaches to the SLAMF7 protein, which is found on myeloma cells. This is thought to help the immune system attack the cancer cells. This drug is used mainly in patients who have already had other treatments for their myeloma. It's given as an infusion into a vein (IV).

This drug can cause a reaction in some people while it is being given or within several hours afterward, which can sometimes be severe. Symptoms can include fever, chills, feeling dizzy or lightheaded, rash, wheezing, trouble breathing, tightness in the throat, or a runny or stuffy nose.

Other common side effects with this drug include fatigue, fever, loss of appetite, diarrhea, constipation, cough, nerve damage resulting in weakness or numbness in the hands and feet (peripheral neuropathy), upper respiratory tract infections, and pneumonia.

Using these drugs together to treat multiple myeloma

Although a single drug may be used to treat multiple myeloma, it is preferable to use at least 2 or 3 different kinds of drugs in combination because the cancer responds better. For example:

- Lenalidomide (or pomalidomide or thalidomide) and dexamethasone
- Carfilzomib (or ixazomib or bortezomib), lenalidomide, and dexamethasone
- Bortezomib (or carfilzomib), cyclophosphamide, and dexamethasone
- Elotuzumab (or daratumumab), lenalidomide, and dexamethasone
- Bortezomib, liposomal doxorubicin, and dexamethasone
- Panobinostat, bortezomib, and dexamethasone
- Elotuzumab, bortezomib, and dexamethasone
- Melphalan and prednisone (MP), with or without thalidomide or bortezomib
- Vincristine, doxorubicin (Adriamycin), and dexamethasone (called VAD)
- Dexamethasone, cyclophosphamide, etoposide, and cisplatin (called DCEP)
- Dexamethasone, thalidomide, cisplatin, doxorubicin, cyclophosphamide, and etoposide (called DT-PACE), with or without bortezomib

The choice and dose of drug therapy depend on many factors, including the stage of the cancer, the age and kidney function of the patient as well as how frail the patient may be. If a stem cell transplant is planned, most doctors avoid using certain drugs, like melphalan, that can damage the bone marrow.

Bisphosphonates for bone disease

Myeloma cells can weaken and even break bones. Drugs called bisphosphonates can help bones stay strong by slowing down this process. They can also help reduce pain in the weakened bone(s). Sometimes, pain medicines such as NSAIDs or narcotics will be given along with bisphosphonates to help control or lessen the pain. Bone pain can be a difficult symptom to treat during and after treatment for myeloma.

The standard for treating bone problems in people with myeloma are pamidronate (Aredia), zoledronic acid (Zometa) and denosumab (Xgeva, Prolia). These drugs are given intravenously (IV or into a vein). Most patients are treated once a month at first, but they may be able to be treated less often later on if they are doing well. Treatment with a bisphosphonate helps prevent further bone damage in multiple myeloma patients.

These treatments can have a rare but serious side effect called osteonecrosis of the jaw (ONJ). Patients complain of pain and doctors find that part of the jaw bone has died. This can lead to an open sore that doesn't heal. It can also lead to tooth loss in that area. The jaw bone can also become infected. Doctors aren't sure why this happens or how best to prevent it, but having jaw surgery or having a tooth removed can trigger this problem. Avoid these procedures while you are taking a bisphosphonate. Many doctors recommend that patients have a dental checkup before starting treatment. That way,

any dental problems can be taken care of before starting the drug. If ONJ does occur, the doctor will stop the bisphosphonate treatment.

One way to avoid these dental procedures is to maintain good oral hygiene by flossing, brushing, making sure that dentures fit properly, and having regular dental checkups. Any tooth or gum infections should be treated right away. Dental fillings, root canal procedures, and tooth crowns do not seem to lead to ONJ.

Hyperlinks

1. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects.html
2. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/low-blood-counts.html
3. www.cancer.org/treatment/treatments-and-side-effects/treatment-types/chemotherapy/chemotherapy-side-effects.html
4. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/low-blood-counts/anemia.html
5. www.cancer.org/treatment/treatments-and-side-effects/treatment-types/chemotherapy.html
6. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/peripheral-neuropathy.html

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Radiation Therapy for Multiple Myeloma

Radiation therapy uses high-energy rays or particles to kill cancer cells. Radiation may be used to treat areas of bone damaged by myeloma that have not responded to chemotherapy and/or other drugs and are causing pain or may be near breaking. It's also the most common treatment for solitary plasmacytomas.

If myeloma severely weakens the vertebral (back) bones, these bones can collapse and put pressure on the spinal cord and spinal nerves. Symptoms include a sudden change in sensation (such as numbness or tingling), sudden weakness of leg muscles, or sudden problems with urination or moving the bowels. This is a medical emergency; patients with these symptoms should call their doctor right away. Prompt treatment with radiation therapy and/or surgery is often needed to prevent paralysis.

The type of radiation therapy most often used to treat multiple myeloma or solitary plasmacytoma is called external beam radiation therapy. The radiation is aimed at the cancer from a machine outside the body. Having radiation therapy is much like having a diagnostic x-ray except that each treatment lasts longer, and the course of treatment can continue for several weeks.

[Side effects](#)¹ of radiation can include:

- Skin changes in the area being treated, which can range from redness to blistering and peeling
- Fatigue (tiredness)
- Nausea
- Diarrhea (if the belly or pelvis is being treated)
- Low blood counts

These symptoms improve once treatment is over.

More information about radiation therapy

To learn more about how radiation is used to treat cancer, see [Radiation Therapy](#)².

To learn about some of the side effects listed here and how to manage them, see [Managing Cancer-related Side Effects](#)³.

Hyperlinks

1. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects.html
2. www.cancer.org/treatment/treatments-and-side-effects/treatment-types/radiation.html
3. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects.html

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Surgery for Multiple Myeloma

Surgery is sometimes used to remove single plasmacytomas, but it's rarely used to treat

multiple myeloma. When spinal cord compression causes paralysis, severe muscle weakness, or numbness, emergency surgery may be needed. Surgery to attach metal rods or plates can help support weakened bones and may be needed to prevent or treat fractures.

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Stem Cell Transplant for Multiple Myeloma

In a stem cell transplant, the patient gets high-dose chemotherapy to kill the cells in the bone marrow. Then the patient receives new, healthy blood-forming stem cells. When stem cell transplants were first developed, the new stem cells came from bone marrow, and so this was known as a bone marrow transplant. Now, stem cells are more often collected from blood (a peripheral blood stem cell transplant).

Stem cell transplant is commonly used to treat multiple myeloma. Before the transplant, drug treatment is used to reduce the number of myeloma cells in the patient's body. (See [Drug Therapy for Multiple Myeloma](#).)

Stem cell transplants (SCT) can be autologous or allogeneic.

Autologous transplants

For an autologous stem cell transplant, the patient's own stem cells are removed from his or her bone marrow or peripheral blood before the transplant. The cells are stored until they are needed for the transplant. Then, the person with myeloma gets treatment such as high-dose chemotherapy, sometimes with radiation, to kill the cancer cells. When this is complete, the stored stem cells are given back to the patient into their blood through a vein.

This type of transplant is a standard treatment for patients with multiple myeloma. Although an autologous transplant can make the myeloma go away for a time (even years), it doesn't cure the cancer, and often the myeloma returns.

Some doctors recommend that patients with multiple myeloma have 2 autologous

transplants, 6 to 12 months apart. This approach is called **tandem transplant**. Studies show that this may help some patients more than a single transplant. The drawback is that it causes more side effects and as a result can be riskier.

Allogeneic transplants

In an allogeneic stem cell transplant, the patient gets blood-forming stem cells from another person – the donor. The best treatment results occur when the donor’s cells are closely matched to the patient’s cell type and the donor is closely related to the patient, such as a brother or sister. Allogeneic transplants are much riskier than autologous transplants, but they may be better at fighting the cancer. That’s because transplanted (donor) cells may actually help destroy myeloma cells. This is called a **graft vs. tumor effect**. In studies of multiple myeloma patients, those who got allogeneic transplants often did worse in the short term than those who got autologous transplants. At this time, allogeneic transplants are not considered a standard treatment for myeloma, but may be done as a part of a [clinical trial](#)¹.

Side effects

The early [side effects](#)² from a stem cell transplant (SCT) are similar to those from chemotherapy and [radiation](#), only more severe. One of the most serious side effects is low blood counts, which can lead to risks of serious infections and bleeding.

The most serious side effect from allogeneic transplants is **graft-versus-host disease** (or GVHD). This occurs when the new immune cells (from the donor) see the patient’s tissues as foreign and attack them. GVHD can affect any part of the body and can be life threatening.

For more information about stem cell transplants, including details about the processes and side effects, see [Stem Cell Transplant for Cancer](#)³.

Hyperlinks

1. www.cancer.org/treatment/treatments-and-side-effects/clinical-trials.html
2. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects.html
3. www.cancer.org/treatment/treatments-and-side-effects/treatment-types/stem-cell-transplant.html

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Supportive Treatments for Patients With Multiple Myeloma

Intravenous immunoglobulin (IVIG)

Patients with multiple myeloma often have low levels of the normal antibodies (immunoglobulins) needed to fight [infection](#)¹. This can lead to problems with lung and/or sinus infections that keep coming back. The patient's level of antibodies in the blood can be tested, and if it's low, antibodies from donors can be given into a vein (IV) to raise the levels and help prevent infections. The antibodies given are called IVIG or intravenous immunoglobulin. IVIG is often given once a month at first, but may be able to be given less often based on blood tests of antibody levels.

Treatment for low blood cell counts

Some patients develop low red blood cell counts ([anemia](#)²) from multiple myeloma or its treatment. They feel tired, light headed, or short of breath while walking. Anemia that's causing symptoms can be treated with blood transfusions. These are often given on an outpatient basis.

Erythropoietin (Procrit[®]) and darbepoietin (Aranesp[®]) are drugs that can help improve anemia from low red blood cells and reduce the need for blood transfusions in some patients who are getting [chemotherapy](#). But these drugs are used much less often because they have been linked to poorer survival in some patients with lymphoid cancers, such as multiple myeloma.

Plasmapheresis

Plasmapheresis can be used to remove myeloma protein from the blood. It's helpful when certain myeloma proteins build up, thicken the blood, and interfere with circulation (called hyperviscosity).

Most often, this procedure is done through a large catheter placed in a vein in the neck, under the collarbone, or in the groin. This catheter is hooked up to a machine, and blood flows into the machine. The machine separates the blood cells from the blood plasma (liquid part of the blood), and then returns the blood cells to the patient with either salt solution or donor plasma. The plasma that's removed contains the abnormal antibody protein produced by the myeloma cells and is discarded.

Although plasmapheresis lowers the abnormal protein level and can relieve symptoms for a time, it does not kill the myeloma cells. That means that without further treatment, the protein will just build-up again. For this reason, plasmapheresis is often followed by chemotherapy or some other type of drug treatment to kill the cells that make the protein.

Hyperlinks

1. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/infections.html
2. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/low-blood-counts/anemia.html

Last Medical Review: February 28, 2018 Last Revised: February 28, 2018

Treatment Options for Multiple Myeloma, by Stage

Solitary plasmacytomas

These are often treated with radiation therapy. If the plasma cell tumor is not in a bone, it may be removed with surgery. Chemotherapy (chemo) is only used if multiple myeloma develops.

Smoldering multiple myeloma

Smoldering myeloma patients can do well for years without treatment. For many patients, starting treatment early does not seem to help them live longer. These patients are watched closely without starting chemo or other treatments for myeloma.

Based on how abnormal the plasma cells look under the microscope and the levels of immunoglobulins, some patients with smoldering multiple myeloma have a high risk of progressing to active myeloma. In one study, treating these patients with lenalidomide (Revlimid) and dexamethasone before they developed symptoms or problems helped them live longer.

Active (symptomatic) myeloma

Patients with active myeloma or [light chain amyloidosis](#)¹ are often given a combination of 2 or 3 drugs. The drugs chosen depend on the patient's health (including their kidney function) and whether a [stem cell transplant](#) is planned.

Often, a combination containing bortezomib, lenalidomide, and dexamethasone is used. Combinations containing bortezomib are especially helpful in patients with kidney problems and those whose myeloma cells contain certain high-risk chromosome abnormalities.

Other combinations may be considered as well.

For more on these drugs and the more common combinations used, see [Drug Therapy for Multiple Myeloma](#).

Treatment for bone disease (bisphosphonates) is often started along with chemo. If the areas of damaged bone continue to cause symptoms, radiation therapy may be used.

Patients with multiple myeloma also receive supportive treatments, such as transfusions to treat [low blood cell counts](#)², and antibiotics and sometimes intravenous immunoglobulin (IVIG) for [infections](#)³.

A stem cell transplant may be part of treatment. Options for stem cell transplant are discussed in [Stem Cell Transplant for Multiple Myeloma](#).

Some patients are given additional cycles of treatment after transplant. This is called **consolidation treatment** and increases the chance of a complete response (where signs and symptoms of the disease go away).

Some patients (even some who didn't have a stem cell transplant) may be given long-term treatment with lenalidomide or bortezomib. This is known as **maintenance treatment**, and helps delay the return of the myeloma, but it can cause serious side effects.

Many drug combinations can be useful in treating myeloma. If a drug combination stops working (or the myeloma comes back), others can be tried.

Hyperlinks

1. www.cancer.org/cancer/multiple-myeloma/about/what-is-multiple-myeloma.html

2. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/low-blood-counts.html
3. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/infections.html

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After Multiple Myeloma Treatment

Living as a Cancer Survivor

For many people, cancer treatment often raises questions about next steps as a survivor.

- [Living as a Multiple Myeloma Survivor](#)

Cancer Concerns After Treatment

It is very common to have questions about cancer coming back or treatment no longer working.

- [Second Cancers After Multiple Myeloma](#)

Living as a Multiple Myeloma Survivor

For some people with multiple myeloma, treatment can remove or destroy the cancer. The end of treatment can be both stressful and exciting. You may be relieved to finish treatment, but it's hard not to worry about cancer coming back. This is very common if you've had cancer.

For other people, the cancer might never go away completely. Some people may get regular treatment with [chemotherapy and other drugs](#)¹, [radiation therapy](#)², or other treatments to try and help keep the cancer in check. Learning to live with cancer that

does not go away can be difficult and very stressful. Life after multiple myeloma means returning to some familiar things and making some new choices.

Follow-up care

During and after treatment, it's very important to go to all follow-up appointments. During these visits, your doctors will ask about symptoms, examine you, and order blood tests or [imaging studies](#)³ such as CT scans or x-rays. Follow-up is needed to see if the cancer has come back, if more treatment is needed, and to check for any [side effects](#)⁴. This is the time for you to talk to your cancer care team about any changes or problems you notice and any questions or concerns you have.

Almost any cancer treatment can have side effects. Some last for a few weeks to several months, but others can be permanent. Don't hesitate to tell your cancer care team about any symptoms or side effects that bother you so they can help you manage them.

Ask your doctor for a survivorship care plan

Talk with your doctor about developing a [survivorship care plan](#)⁵ for you. This plan might include:

- A suggested schedule for follow-up exams and tests
- A schedule for other tests you might need in the future, such as early detection (screening) tests for other types of cancer, or tests to look for long-term health effects from your cancer or its treatment
- A list of possible late- or long-term side effects from your treatment, including what to watch for and when you should contact your doctor
- Diet and physical activity suggestions
- Reminders to keep your appointments with your primary care provider (PCP), who will monitor your general health care

Keeping health insurance and copies of your medical records

Even after treatment, it's very important to keep health insurance. Tests and doctor visits cost a lot, and even though no one wants to think about their cancer coming back, this could happen.

At some point after your cancer treatment, you might find yourself seeing a new doctor who doesn't know about your medical history. It's important to keep copies of your medical records to give your new doctor the details of your diagnosis and treatment. Learn more in [Keeping Copies of Important Medical Records](#)⁶.

Can I lower my risk of multiple myeloma progressing or coming back?

If you have (or have had) multiple myeloma, you probably want to know if there are things you can do that might lower your risk of the cancer growing or coming back, such as exercising, eating a certain type of diet, or taking nutritional supplements.

Adopting healthy behaviors such as [not smoking](#)⁷, [eating well](#)⁸, [getting regular physical activity](#)⁹, and [staying at a healthy weight](#)¹⁰ might help, but no one knows for sure. However, we do know that these types of changes can have positive effects on your health that can extend beyond your risk of myeloma or other cancers.

About dietary supplements

So far, no [dietary supplements](#)¹¹ (including vitamins, minerals, and herbal products) have been shown to clearly help lower the risk of cancer progressing or coming back. This doesn't mean that no supplements will help, but it's important to know that none have been proven to do so.

Dietary supplements are not regulated like medicines in the United States – they do not have to be proven effective (or even safe) before being sold, although there are limits on what they're allowed to claim they can do. If you're thinking about taking any type of nutritional supplement, talk to your health care team. They can help you decide which ones you can use safely while avoiding those that might be harmful.

If the cancer comes back

If the cancer does recur at some point, your treatment options will depend on where the cancer is located, what treatments you've had before, and your health. For more information on how recurrent cancer is treated, see [Treatment Choices for Multiple Myeloma, by Stage](#).¹²

For more general information on recurrence, you may also want to see [Understanding Recurrence](#)¹³.

Second cancers after treatment

People who've had multiple myeloma can still get other cancers. In fact, multiple myeloma survivors are at higher risk for getting some other types of cancer. Learn more in [Second Cancers After Multiple Myeloma](#).

Getting emotional support

Some amount of feeling depressed, anxious, or worried is normal when multiple myeloma is a part of your life. Some people are affected more than others. But everyone can benefit from help and support from other people, whether friends and family, religious groups, support groups, professional counselors, or others. Learn more in [Life After Cancer](#)¹⁴.

Hyperlinks

1. www.cancer.org/cancer/multiple-myeloma/treating/chemotherapy.html
2. www.cancer.org/cancer/multiple-myeloma/treating/radiation.html
3. www.cancer.org/treatment/understanding-your-diagnosis/tests/imaging-radiology-tests-for-cancer.html
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Second Cancers After Multiple Myeloma

Cancer survivors can be affected by a number of health problems, but often their greatest concern is facing cancer again. If a cancer comes back after treatment it is called a [recurrence](#)¹. But some cancer survivors may develop a new, unrelated cancer later. This is called a second cancer. No matter what type of cancer you have had, it is still possible to get another (new) cancer, even after surviving the first.

Unfortunately, being treated for cancer doesn't mean you can't get another cancer. People who have had cancer can still get the same types of cancers that other people get. In fact, certain types of cancer and cancer treatments can be linked to a higher risk of certain second cancers.

Survivors of multiple myeloma can get any type of second cancer, but they have an increased risk of:

- [Acute myeloid leukemia \(AML\)](#)²
- [Myelodysplastic syndrome \(MDS\)](#)³

Follow-up after multiple myeloma treatment

Patients with multiple myeloma need to see their doctors regularly. Treatment often doesn't cure this cancer, but can cause it to regress or go away for a time. If the cancer comes back or worsens, treatment may begin again. Let your doctor know about any new symptoms or problems, because they could be caused by the myeloma or by a new disease or second cancer.

Can I lower my risk of getting a second cancer?

There are steps you can take to lower your risk and stay as healthy as possible. For example, multiple myeloma survivors should do their best to stay away from all [tobacco products](#)⁴ and [tobacco smoke](#)⁵, as smoking increases the risk of many cancers.

To help maintain good health, multiple myeloma survivors should also:

- Achieve and maintain a [healthy weight](#)⁶
- Adopt a [physically active lifestyle](#)⁷
- Consume a [healthy diet](#)⁸, with an emphasis on plant foods
- Limit consumption of [alcohol](#)⁹ to no more than 1 drink per day for women or 2 per day for men

These steps may also lower the risk of some cancers.

See [Second Cancers in Adults](#)¹⁰ for more information about causes of second cancers.

Hyperlinks

1. www.cancer.org/treatment/survivorship-during-and-after-treatment/understanding-recurrence.html
2. www.cancer.org/cancer/acute-myeloid-leukemia.html
3. www.cancer.org/cancer/myelodysplastic-syndrome.html
4. www.cancer.org/healthy/stay-away-from-tobacco.html
5. www.cancer.org/cancer/cancer-causes/tobacco-and-cancer/secondhand-smoke.html
6. www.cancer.org/cancer/cancer-causes/diet-physical-activity/body-weight-and-cancer-risk.html
7. www.cancer.org/cancer/cancer-causes/diet-physical-activity.html
8. www.cancer.org/cancer/cancer-causes/diet-physical-activity.html
9. www.cancer.org/cancer/cancer-causes/diet-physical-activity/alcohol-use-and-cancer.html
10. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/second-cancers-in-adults.html

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Our team is made up of doctors and oncology certified nurses with deep knowledge of cancer care as well as journalists, editors, and translators with extensive experience in medical writing.

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