

# MULTIPLE MYELOMA DISEASE OVERVIEW



MULTIPLE MYELOMA  
Research Foundation

[themmrf.org](http://themmrf.org)

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## ABOUT THE MULTIPLE MYELOMA RESEARCH FOUNDATION

The Multiple Myeloma Research Foundation (MMRF) was established in 1998 by identical twin sisters Kathy Giusti and Karen Andrews shortly after Kathy's diagnosis with multiple myeloma. Kathy and Karen soon learned that little progress against this disease had been made in decades and that myeloma patients had few treatment options. They decided that it was time to accelerate change. Their mission was to ensure more access to better treatments and bring the promise of a cure for every myeloma patient.

Since its founding, the MMRF has remained steadfast in the pursuit of its mission. It is now the leading cancer research organization focused on the development and delivery of more precise therapies, and it is aggressively pursuing a world without myeloma. Working with its partners in industry, research, government, and academia, the MMRF has helped launch 15 new drugs in the past 18 years, an achievement that has almost tripled the life expectancy for myeloma patients. The MMRF is a patient-focused organization that stands with the entire myeloma community and is speeding the discovery of cures through precision medicine. Driven by data and innovative research, the MMRF is committed to empowering every patient with precisely what he or she needs to prevent or defeat multiple myeloma.

As the multiple myeloma community's most trusted source of information, the MMRF supports patients from the time of diagnosis throughout the course of the disease. All information on the MMRF website ([www.themmr.org](http://www.themmr.org)) is organized by disease stage, so patients can get the information they need, when they need it.

To learn more about the MMRF, visit [www.themmr.org](http://www.themmr.org).

To speak to a Patient Navigator at the Patient Navigation Center, call **1-888-841-MMRF (6673)** or email [patientnavigator@themmr.org](mailto:patientnavigator@themmr.org).

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## INTRODUCTION

This booklet is designed to help patients with multiple myeloma—and their friends, families, and caregivers—better understand this disease: what myeloma is and how it develops within the body. Words that may be unfamiliar are **bolded** and defined in the Glossary (page 28). It is our hope and belief that learning about multiple myeloma will provide you the knowledge and confidence you need to be more involved in making decisions about your treatment.

Multiple myeloma is a treatable cancer. In the last 18 years, there have been significant advances in myeloma diagnosis, treatment, and **supportive care**. In this time, 15 new drugs have been approved by the US Food and Drug Administration for use in the treatment of myeloma, and survival rates of myeloma patients have tripled. In 2015 alone, four new myeloma drugs were introduced—an unprecedented development for any disease. Many other new therapies are under investigation, bringing ever closer the promise of a cure.

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The companion booklets (***Multiple Myeloma Treatment Overview, Autologous Stem Cell Transplantation, Multiple Myeloma Immunotherapy, and The Path to Precision Medicine***) and the MMRF website ([www.themmr.org](http://www.themmr.org)) provide more information about current and emerging therapies for myeloma.

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The information in this booklet is not intended to replace the services or advice of trained health care professionals. Please consult with your health care team regarding specific questions relating to your health, especially questions about myeloma diagnosis or treatment.

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## OVERVIEW

Patients with **active multiple myeloma** typically have a preceding phase of disease characterized by changes in the cells and materials present in the **bone marrow**, but no symptoms or organ damage. This is referred to as either **monoclonal gammopathy of undetermined significance (MGUS)** or **smoldering multiple myeloma (SMM)** (also called asymptomatic myeloma)—collectively known as **myeloma precursor conditions**—depending on the nature of the changes in the bone marrow (**Box**).

### *Precursors to active multiple myeloma*

#### **Monoclonal gammopathy of undetermined significance (MGUS)**

MGUS is an abnormal growth of **plasma cells**, which results in an excess of **monoclonal protein** (or **M protein**), a substance produced by plasma cells that is detectable in the blood. In MGUS, the plasma cells have not formed a tumor or multiple bone lesions, no symptoms have occurred, and the other criteria for a myeloma diagnosis are absent. MGUS almost always precedes myeloma and is associated with a risk of progression to myeloma of approximately 1% per year.

MGUS occurs in about 1% of the general population and in about 3% of healthy individuals older than 50. Because MGUS does not cause symptoms or damage to the body, no treatment is needed. However, MGUS progresses to active multiple myeloma or another **malignant** plasma cell disease (lymphoma or amyloidosis) in about 20% to 25% of individuals over the course of their lifetime. MGUS can also be associated with other diseases, including **osteoporosis**.

Patients with MGUS do not actually have active myeloma, but they are usually monitored for signs of progression to myeloma.

### Smoldering (asymptomatic) multiple myeloma (SMM)

SMM is a stage between MGUS and active myeloma that is associated with a higher risk of progression to myeloma: approximately 10% per year. In individuals with SMM, the level of M protein in the blood and plasma cells in the bone marrow is higher than in MGUS. The patient has no symptoms or signs of active disease such as bone lesions or **anemia**.

Individuals with SMM have close follow-up (also called observation), with visits to the doctor and/or testing approximately every 3 months.

Treatment directed at myeloma is started once the disease has progressed to active myeloma.

Some patients with SMM are more likely to develop active myeloma than others; this is referred to as high-risk SMM, and identifying and treating these patients could potentially slow or prevent that progression from occurring. Currently, **clinical trials** are studying whether patients with high-risk SMM do better when they receive earlier treatment and what type of treatment is best.



### IDENTIFYING MYELOMA PRECURSOR CONDITIONS

Researchers are investigating ways to slow or prevent active myeloma from developing in patients who have high-risk myeloma precursor conditions. Screening studies to identify these patients earlier in their disease course, such as the **PCROWD** and **PROMISE** studies, are under way.

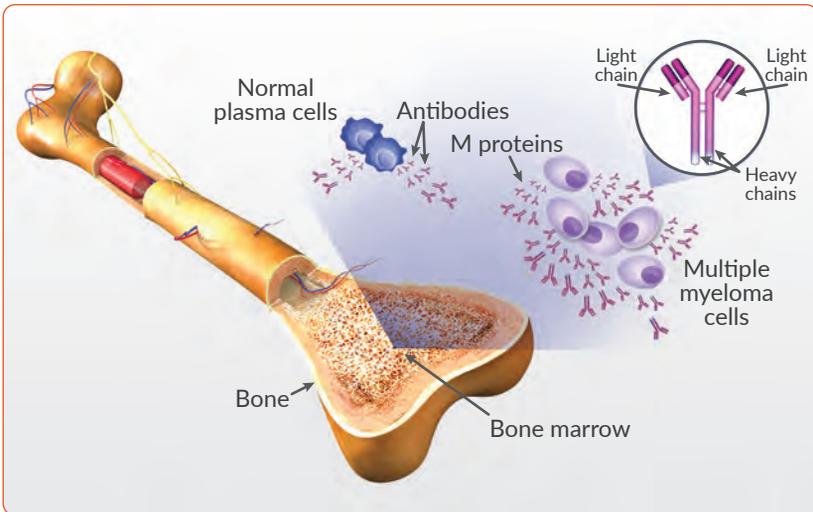
Data collected from these individuals will help researchers to identify specific clinical factors that may be associated with progression to active myeloma.

## ACTIVE MYELOMA

### What Is Multiple Myeloma?

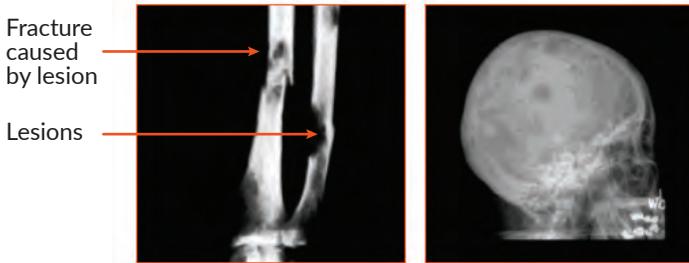
Multiple myeloma is a blood cancer that develops in the bone marrow (**Figure 1**), the soft, spongy tissue found in the center of many bones and the location where blood cells are produced. In myeloma, plasma cells, which are normal cells that produce **antibodies** (or **immunoglobulins**), transform into cancerous myeloma cells. Myeloma cells produce large quantities of M proteins (which are actually abnormal forms of immunoglobulins), as well as incomplete parts of antibodies (called **light chains** or **Bence Jones proteins**). These cancer cells crowd out and inhibit the production of normal blood cells in the bone marrow.

**Figure 1. Multiple myeloma in the body.**



In addition, groups of myeloma cells cause other cells in the bone marrow to remove the solid part of the bone and cause **osteolytic lesions**, or soft spots in the bone, weakening the bones and increasing the risk of fractures (**Figure 2**). Although common, lesions or other signs of bone loss do not occur in all patients with myeloma.

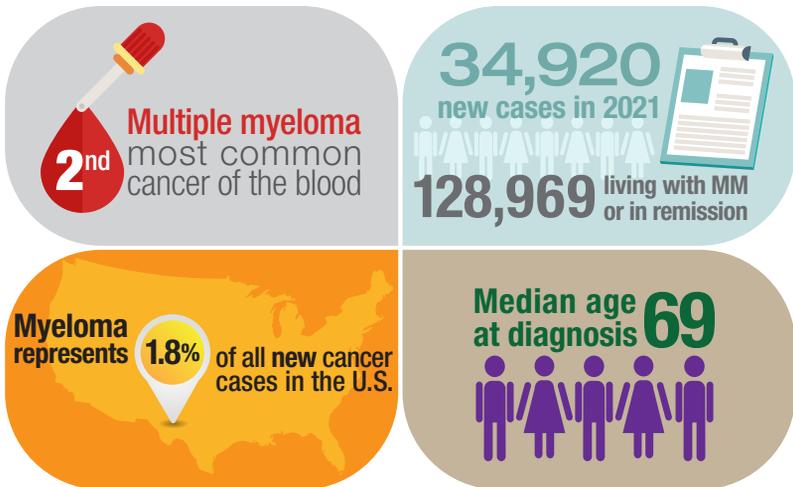
Figure 2. Bone disease in multiple myeloma.



### How Common Is Multiple Myeloma?

More than 100,000 people in the United States are living with multiple myeloma today, and the American Cancer Society estimates that multiple myeloma will be diagnosed in 34,920 people in 2021 (Figure 3). Multiple myeloma is second to non-Hodgkin's lymphoma as the most common blood cancer and represents 1.8% of all cancers.

Figure 3. Prevalence of multiple myeloma in the United States.



In general, myeloma is a disease of people who are older (the average age at diagnosis is 69). People in any decade of life are at some risk, and risk definitely increases with age. Multiple myeloma is more common among men than women. African Americans are twice as likely to develop multiple myeloma.

The number of patients living with multiple myeloma has increased over the last few years. It's not because the number of patients diagnosed with myeloma has increased significantly, but rather because people are living longer with multiple myeloma.

The reason people are living longer with multiple myeloma is that a number of new therapies have been developed, and this has had a significant impact on survival.

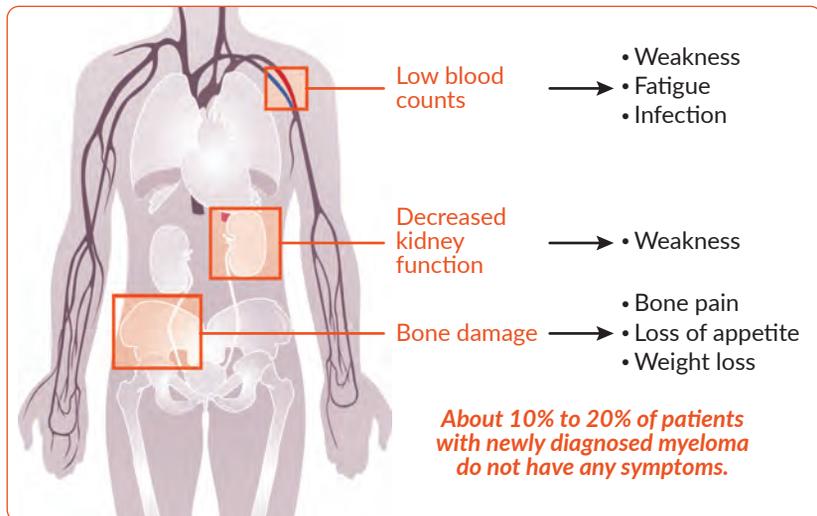
### What Causes Multiple Myeloma?

To date, no cause for myeloma has been identified. Research suggests that the disease could possibly be related to a decline in the immune system, certain occupations, exposure to certain chemicals, and exposure to radiation. However, these connections are not strong. In most cases, multiple myeloma develops in individuals who have no known risk factors. Multiple myeloma may be the result of several factors acting together. It is uncommon for myeloma to develop in more than one member of a family.

### How Does Multiple Myeloma Affect the Body?

Multiple myeloma affects the bone, the blood, and the kidneys (**Figure 4**).

**Figure 4. Common symptoms of myeloma patients.**



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### *Bone*

Bone loss is the most common effect of multiple myeloma, occurring in 85% of myeloma patients. The most commonly affected bones are the spine, pelvis, and rib cage.

Myeloma leads to bone loss in two ways. First, the myeloma cells form masses in the bone marrow that may disrupt the normal structure of the surrounding bone. Second, myeloma cells secrete substances that interfere with the normal process of bone repair and growth. Bone destruction can also increase the level of **calcium** in the bloodstream, a condition called **hypercalcemia** that may cause symptoms like thirst and confusion and can be a serious problem if appropriate treatment is not given immediately.

### *Blood*

The growing number of myeloma cells can interfere with the production of all types of blood cells.

A reduction in the number of **white blood cells** can increase the risk of infection. Decreased **red blood cell** production can result in anemia, which is present in approximately 60% of patients at diagnosis. A reduction in **platelets** can interfere with blood clotting.

### *Kidneys*

The accumulation of M protein and calcium in the blood can overwork the kidneys. The amount of urine produced may decrease, and the kidneys may fail to function normally. More than half of myeloma patients experience a decrease in their kidney function (also called renal function) at some point in the course of the disease.

### ***Symptoms of active myeloma***

There are often no symptoms in the early stages of myeloma. When symptoms are present, they may be vague and similar to those of other conditions.

Some of the more common symptoms are:

- Bone pain
- Fatigue
- Weakness
- Infection
- Loss of appetite and weight loss

Symptoms related to hypercalcemia or kidney problems may include:

- Increased or decreased urination
- Increased thirst
- Restlessness, eventually followed by extreme weakness and fatigue
- Confusion
- Nausea and vomiting



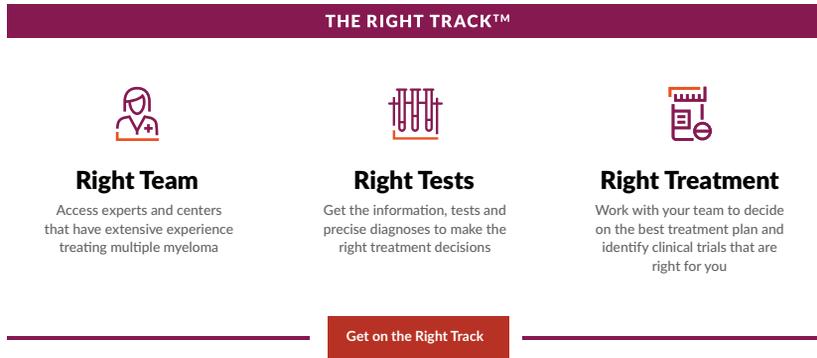
## **DIAGNOSING MULTIPLE MYELOMA**

Multiple myeloma is a highly diverse disease, meaning that it is different in every patient. There are at least eight different forms, or subtypes, of myeloma. Each subtype differs in terms of its genomic features, clinical features (that is, its symptoms and disease course), and **prognosis**. It is important for a patient suspected of having myeloma to first find a doctor who specializes in myeloma patient care—a myeloma specialist. Once a specialist is found, each patient must have all the appropriate tests conducted, as the results will help determine the extent of the disease, its prognosis, and the best options for treatment—including the possibility of a clinical trial—and monitoring. Finally, all patients should discuss with their myeloma specialist the option of sharing their data on registries (secure online platforms designed to record and store patient data) or via clinical studies such as the MMRF **CureCloud**<sup>®</sup>, which help clinicians and researchers identify trends, learn about the most effective treatments, and work toward bringing new therapies to patients. This process, developed by the MMRF in collaboration with four cancer research organizations using data from patients, is called The Right Track<sup>™</sup>. Following The Right Track with assistance from the MMRF's Patient Navigation Center will help patients

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obtain the best treatment and results for their specific type of myeloma (Figure 5). The first two steps of The Right Track are key when patients first learn they may have multiple myeloma.

**Figure 5. Key steps for the best possible care for patients with myeloma.**



## THE RIGHT TEAM

For diseases that are rare or particularly complicated, such as multiple myeloma, specialized medical understanding is especially important. When considering potential doctors, don't be afraid to ask about their experience treating multiple myeloma. Ideally, a hematologist who focuses on multiple myeloma will be aware of the latest research and up-and-coming treatment options. If seeing a hematologist is not possible, you can be treated by another specialist, such as a medical oncologist, who may consult with a hematologist about your care.

Often, specialists work out of specialized cancer treatment centers. Treatment centers that frequently see patients with multiple myeloma have been shown to produce better outcomes than centers that see fewer multiple myeloma patients.

You may not live close enough for a specialist at a cancer center to be your only source of treatment. Nevertheless, consulting with a specialist at important times and obtaining specific types of care at a specialized center may help you get the best care possible.

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### ***Should you get a second opinion?***

An increasingly important part of establishing a myeloma diagnosis is getting a second opinion from a myeloma specialist—a doctor who only sees myeloma patients. Obtaining a second opinion—getting that second set of eyes—can be crucial to confirming a myeloma diagnosis and helping a patient and his or her health care team move with confidence toward the management plan that will yield the best results.

Many health insurance companies authorize second opinions for myeloma patients.

An MMRF Patient Navigator in the MMRF Patient Navigation Center can help you find a myeloma specialist in your area.

Call **1.888.841.6673**, Monday to Friday from 9:00 AM to 7:00 PM ET or email **[patientnavigator@themmrf.org](mailto:patientnavigator@themmrf.org)**.



## THE RIGHT TESTS

During your doctor visits, it can seem like—whenever you turn around—someone from the health care team is asking for a blood or urine sample. Blood and urine tests are an essential part of diagnosing multiple myeloma (**Table 1**).

**Table 1. Diagnosing myeloma: common blood and urine tests.**

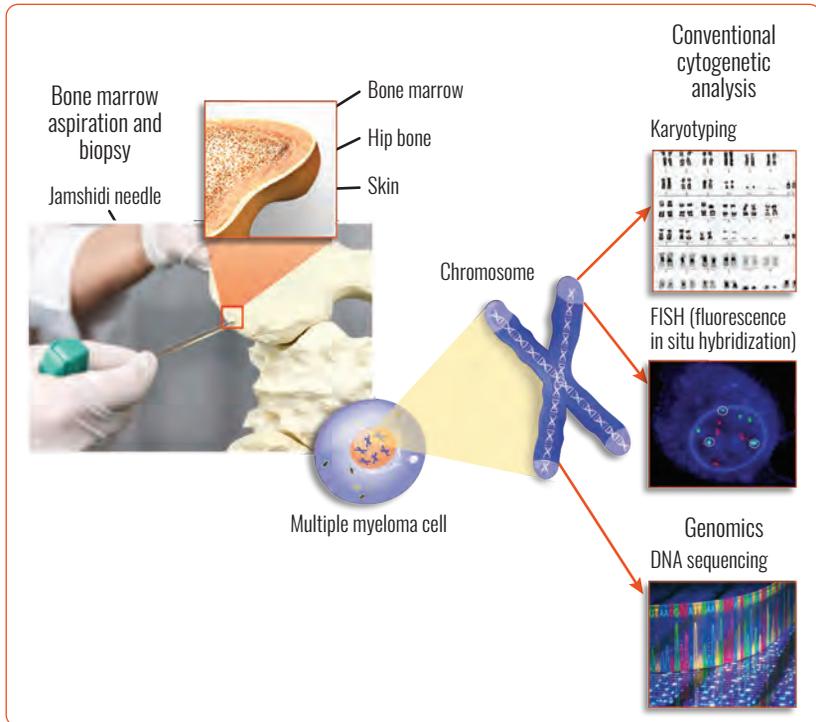
Sample	Test	What is assessed	What it means
Blood	<b>Complete blood count (CBC)</b>	Number of red blood cells, white blood cells, and platelets	Can indicate problems such as anemia, <b>neutropenia</b> (low white blood cells), or bleeding disorders (low platelets)
	<b>Complete metabolic panel (CMP)</b>	Levels of electrolytes, <b>albumin</b> , calcium, <b>LDH</b> , <b>BUN</b> , and <b>creatinine</b>	Indicates function of kidney and liver, bone status, and the extent of disease
	<b>Beta-2 microglobulin (β2M)</b>	β2M, a type of protein released by many cells	The level of β2M in the blood reflects kidney function and indicates the presence and severity of myeloma
	<b>Serum protein electrophoresis (SPEP)</b>	The presence and level of M protein; also called the M spike	Provides insight into the type of myeloma a patient has and helps doctors follow the disease's progression
	Immunofixation electrophoresis (IFE)	Identify the type of abnormal M proteins	Confirms the SPEP result and indicates which type of abnormal <b>antibody</b> is present (such as IgG or IgA)
Urine	Serum <b>free light chain (SFLC)</b> assay	Detects light chains	Indicates the type and level of light chain (kappa or lambda) that is associated with the M protein
	<b>Urine protein electrophoresis (UPEP)</b>	Detects Bence Jones proteins/light chains	Indicates the type and level of light chain (kappa or lambda) that is associated with the M protein

## Bone Marrow Biopsy

**Bone marrow biopsy**, in which a needle is inserted into the bone to extract a small amount of marrow for analysis, is conducted to determine the level of abnormal plasma cells (a level over 10% indicates that myeloma is present) and to identify **mutations** that may have contributed to development of the disease.

**Cytogenetic testing** (analysis that measures the number and structure of **chromosomes**) is performed on the extracted material by means of two tests: **karyotyping** and **fluorescence in situ hybridization** (or FISH) (**Figure 6**).

**Figure 6. Bone marrow biopsy tests.**



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### *Fluorescence in Situ Hybridization (FISH)*

The FISH analysis highlights the chromosomes that are present in the biopsy sample. This makes it possible to examine them in sufficient detail to identify the nature of any abnormalities, which can include **chromosomal translocations** (when a piece of one chromosome swaps places with a piece of another chromosome), **chromosomal deletions** (when a piece of a chromosome is missing), and an increase in the number of chromosomes (also called **hyperdiploidy**).

### *Genomics*

Researchers are continually working to better understand the biology of multiple myeloma and, through **genomic sequencing** (studies of the tumor cell **DNA**), have learned that there are many DNA alterations in myeloma cells. The ultimate goal of genomic research is to develop personalized treatments that are based on the DNA in the myeloma cells of individual patients. This therapeutic approach is called **precision medicine**. Today, we know that certain DNA alterations can be indicative of how aggressive the myeloma is.

Genomic sequencing is conducted by analyzing the DNA from the myeloma cells taken from a small amount of bone marrow. Tests are conducted as part of the initial diagnosis and may be repeated periodically. During a relapse, DNA test results can help guide treatment decisions or determine eligibility for clinical trials.

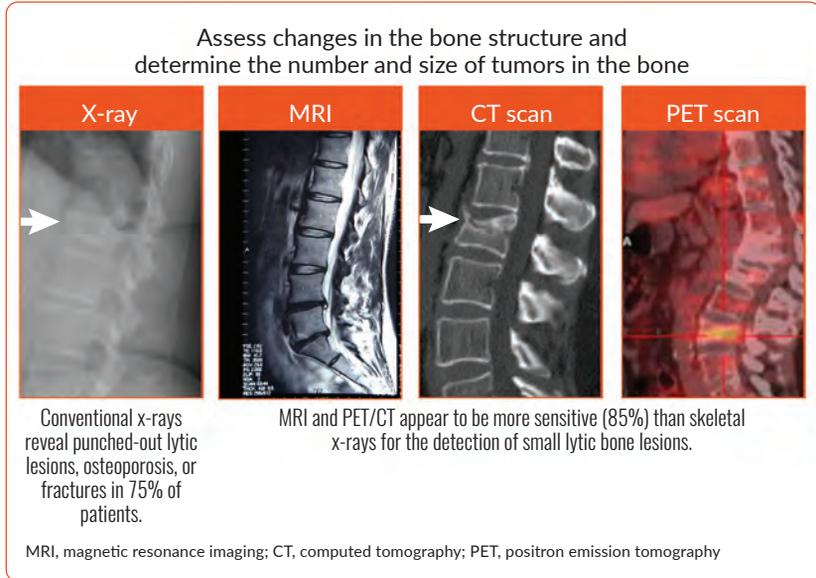
The development of personalized treatments based on genomics is an active area of research, and clinical trials are ongoing. This is not yet a standard of care.

### **Imaging**

Imaging technologies are used to locate and assess lytic lesions, or holes, in the bones—one hallmark of multiple myeloma. A series of x-rays (often called a complete skeletal survey) is taken and used to diagnose and monitor disease in patients with myeloma.

Other tests that are even more sensitive than x-rays are used when appropriate; these include **magnetic resonance imaging (MRI)**, **computed tomography (CT)**, and **positron emission tomography (PET) scans** (Figure 7).

**Figure 7. Types of imaging used to detect multiple myeloma.**



These imaging tests are also used to detect **extramedullary disease**—that is, the presence of myeloma outside of the bone marrow.

Some of these same tests used at diagnosis are repeated to monitor progress once treatment is started.

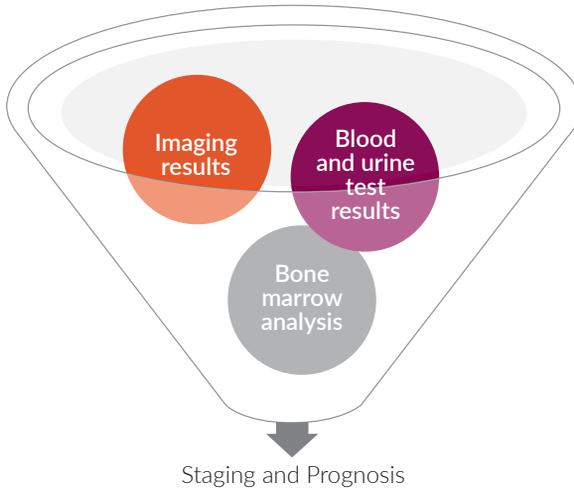
## STAGING AND RISK STRATIFICATION

Myeloma is classified based on the results of diagnostic testing. These results tell whether or not immediate treatment is needed. In addition, a stage is assigned to indicate the extent of disease.

Certain test results provide important information about prognosis (**Figure 8**). These prognostic indicators may also help decide when treatment should begin and aid in monitoring the disease. Many tests can be performed routinely in any laboratory, whereas others are performed only in specialized laboratories or a research setting.

Patient age and myeloma stage are important factors in predicting prognosis.

**Figure 8. Interpreting test results.**



Myeloma staging, which is the categorization of myeloma based on test results, is crucial to developing an effective treatment plan.

The **Revised International Staging System (R-ISS)** is the most commonly used staging system. It is based on the results of three blood tests (lactate dehydrogenase [LDH], beta-2 microglobulin [β2M], and albumin) and FISH testing of the bone marrow (**Figure 9**).

**Figure 9. Multiple myeloma staging system.**

R-ISS Stage	Criteria
I	ISS stage I (β2M <3.5 mg/L + albumin ≥3.5 g/dL) and standard-risk CA by iFISH and normal LDH
II	Not R-ISS stage I or III
III	ISS stage III (β2M ≥5.5 mg/L) and either high-risk CA by iFISH or high LDH

The R-ISS uses ISS stages, LDH levels, and detection of CA by FISH to determine stage

- Stages I, II, or III
- High risk CA by FISH:
  - del(17p)
  - t(4;14)
  - t(14;16)

Revised International  
Staging System  
(R-ISS)

β2M; beta-2 microglobulin; LDH, lactate dehydrogenase; CA, chromosomal abnormality; iFISH, interphase fluorescent in situ hybridization

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The more patients know about their myeloma, the better they are able to communicate with the health care team. The best way for patients to get answers is to talk to their doctors (**Figure 10**).

**Figure 10. Questions to ask your doctor.**



## LIVING WITH MULTIPLE MYELOMA

### SUPPORTIVE CARE AND MAINTAINING QUALITY OF LIFE

Myeloma often weakens bones, damages kidney function, and leads to anemia and infection. Additionally, the drugs used to treat myeloma often produce side effects. Therapies are available to address the symptoms of myeloma and the complications of its treatment; these are called supportive therapies or supportive care.



#### **Bone Health**

Bone damage (lesions and osteoporosis) is common in multiple myeloma, occurring in approximately 85% of patients. Weakened bones can result in fractures and compression of the spinal cord, and there is the potential for spinal cord collapse.

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### *Maintaining Bone Health*

Eating calcium-rich foods, taking calcium and vitamin D supplements (only as recommended by a doctor), and performing weight-bearing exercise (with caution) can help to maintain bone health.

### *Bisphosphonates and Other Medications*

**Bisphosphonates** (such as Zometa) are drugs that can decrease bone pain, reduce the likelihood of fracture, and prevent myeloma bone disease from getting worse. Some of the more potent bisphosphonates are also used to treat hypercalcemia (elevated calcium levels in the blood), another common problem in myeloma. Research has shown that bisphosphonates can increase survival time; they are prescribed in the majority of myeloma patients.

Xgeva (denosumab) is another medication used to help stop bone damage caused by myeloma. Though it works in a similar way to bisphosphonates, Xgeva is from a different class of drugs called **monoclonal antibodies**.

Bisphosphonates are given **intravenously** every three to four weeks, and Xgeva is administered under the skin (**subcutaneously**).

Like all drugs, bisphosphonates and Xgeva carry risks of side effects.

Some studies indicate that long-term use of bisphosphonates and Xgeva may be associated with a risk of developing **osteonecrosis of the jaw (ONJ)**, a painful condition in which bone erosion and bone death occurs in the mouth and jaw, potentially resulting in an open sore that leaves the jawbone exposed.

To reduce the chance of developing ONJ, patients are advised to maintain their oral health. Interrupting or stopping bisphosphonates may be considered in severe cases.

### **Recommendations for reducing the risk of ONJ**

- Complete major dental work before beginning treatment for bone disease
- Practice good oral hygiene
- Schedule regular dental visits
- Let your dentist know that you are receiving treatment for bone disease
- Keep your doctor informed of dental issues/need for dental work
- Be attentive! ONJ seems to be related to the length of time patients are on treatment for bone disease



Bisphosphonates may cause reduced kidney function (renal impairment) and, as a result, myeloma patients with existing kidney impairment usually receive reduced doses of bisphosphonates when starting treatment. Prior to receiving a dose of bisphosphonate, patients undergo blood tests to monitor levels of creatinine (a protein that can indicate if there is a problem with kidney function) to reduce the risk of developing kidney impairment. Also, it is important for patients to stay hydrated.

Some studies have suggested that bisphosphonates have an anti-myeloma effect. Therefore, experts recommend that bisphosphonate therapy be considered in all patients receiving initial myeloma treatment, even if bone damage is not seen on imaging tests.

For patients who cannot take bisphosphonates (because, for example, they have renal insufficiency), Xgeva may be a good choice. This monoclonal antibody offers anti-myeloma and bone-sparing benefits similar to those seen with bisphosphonates and has little or no effects on the kidney.

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If you have bone disease, tell your health care team about treatments you receive from other care providers such as chiropractors, massage therapists, and holistic medicine practitioners. Inform all providers of any treatments you receive for your bone disease.

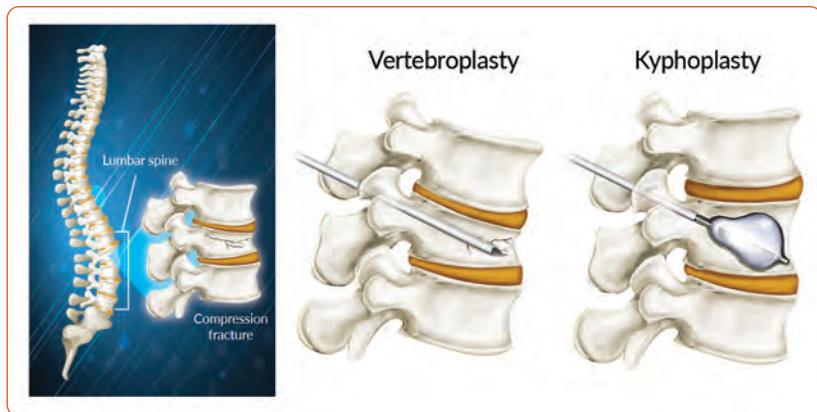
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## Orthopedic Interventions

Orthopedic interventions may be required to help control pain or maintain function or mobility. These may include physical therapy, splinting of bones, surgery to prevent or treat fractures, or procedures to repair compression fractures of the spine. Two minimally invasive surgical procedures, **vertebroplasty** and **balloon kyphoplasty**, are used to reinforce the vertebra of the spine and usually can be done without hospitalization.

Vertebroplasty involves the injection of a cement-like material to reinforce the vertebra. Balloon kyphoplasty involves the insertion of an inflatable balloon to restore the height of the compressed vertebra, followed by injection of bone cement to maintain the re-established height (**Figure 11**); this procedure has the potential to provide relatively rapid relief (approximately one month following the procedure).

**Figure 11. Orthopedic procedures to stabilize the spine.**



## Radiation Therapy

Low-dose **radiation therapy** is sometimes used to reduce bone pain. It is directed to specific bone lesions that are causing problems. However, it can affect the bone marrow and result in reduced blood counts, which may cause anemia, a weakened immune system, and blood clotting problems.



### **Anemia**

Sixty percent of myeloma patients have anemia when initially diagnosed. Further, some of the medications used to treat myeloma can lower red blood cell counts, resulting in anemia.

Anemia has many symptoms, including fatigue, depression/mood changes, difficulty breathing, weight loss, rapid heartbeat, nausea, dizziness, and difficulty sleeping. Patients who experience these symptoms should inform their doctors so blood counts can be checked for anemia.

The first step in treating anemia is to identify and treat any causes of anemia other than myeloma or myeloma medications (for example, deficiencies in iron, folate, or vitamin B12 can also cause anemia). Moderate or severe anemia is usually treated with medications to stimulate production of red blood cells. Some patients with severe anemia may require blood transfusions.



### **Infection and Low White Blood Cell Counts**

Because levels of white blood cells may be reduced—due either to disease or therapy—myeloma patients may be more susceptible to infections. Additionally, the abnormal antibodies produced by myeloma cells can crowd out normal antibodies and weaken the immune system.

To reduce the risk of infections, patients are advised to get flu and pneumonia vaccinations. Patients who have experienced serious recurrent infections may receive an intravenous antibody treatment. Because some myeloma drugs increase the risk of developing fungal infections or herpes, patients receiving these drugs may be prescribed antifungal or herpes-prevention drugs, as appropriate.



### **Kidney Impairment**

More than half of patients with myeloma experience kidney problems at some point in the course of their disease. Kidney impairment can also be caused by other conditions, such as hypertension and diabetes, and some medications can affect the kidney as well.

Blood tests can detect certain proteins (such as creatinine) that are indicative of reduced kidney function. A decrease in the amount of urine is one sign of kidney problems, and patients should let their doctors know if they experience any changes in their urination.

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Patients who develop kidney problems should make sure to drink plenty of fluids and avoid taking non-steroidal anti-inflammatory drugs such as Aleve (naproxen) and Advil/Motrin (ibuprofen) or other drugs that can affect kidney function.

In some cases, a procedure called **plasmapheresis** may help slow or prevent kidney failure. The large amount of M protein produced by myeloma cells can cause the blood to become thick, which can affect the kidneys. With plasmapheresis, blood and fluid are withdrawn and the excess M protein is separated out. The fluid is then infused back into the patient.

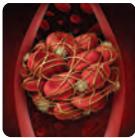
### HOW MULTIPLE MYELOMA TREATMENT AFFECTS THE BODY

Like all medications, the drugs used to treat multiple myeloma have the potential to cause side effects. Side effects can vary with different drugs, dosages, and regimens, but certain types are more common in myeloma patients.

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Side effects can often be managed by adding other medicines or reducing the dose or frequency of myeloma therapy. It is important to let your health care team know when you experience any side effects.

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#### Blood Clots

Patients with myeloma, particularly those who are newly diagnosed and/or have had blood clots in the past, are at increased risk of developing blood clots. Older age, family history, certain medical conditions, obesity, and long periods of immobilization (such as hospitalization and long airplane rides) also increase the risk for blood clots.

Several myeloma drugs are associated with an increased risk of **deep vein thrombosis (DVT)**, a type of serious blood clot. In some cases, the risk of developing blood clots can be managed with additional medications.



### Peripheral Neuropathy

Peripheral **neuropathy** is a condition that affects the nerves, resulting in pain, tingling, burning sensations, and numbness in the hands and feet. Peripheral neuropathy may be caused by multiple myeloma or its treatments. Other conditions, such as diabetes, can also cause neuropathy. The presence of existing neuropathy is a consideration in the selection of which myeloma therapy is given. In such cases, regimens that are less likely to produce or worsen peripheral neuropathy may be preferable.

Strategies for managing peripheral neuropathy include proper foot care and medications that help relieve nerve pain. There are accounts suggesting that certain vitamins or other supplements may be helpful, but these are unproven and should only be taken after consultation with a doctor. If weakness is also present, physical therapy may be added to the treatment regimen. In some cases, referral to a neurologist may be appropriate.



### Gastrointestinal Effects

Commonly used myeloma drugs may cause a variety of gastrointestinal problems, such as constipation, diarrhea, and nausea/vomiting. Medications, as well as changes in diet, may be helpful in addressing or preventing some of these effects. It is also important for the patient to drink plenty of fluids.

#### *Constipation*

When a patient is taking a myeloma drug that has been associated with the development of constipation, the doctor may recommend a stool softener and/or laxatives. Other strategies that may help manage or prevent constipation are drinking plenty of fluids, eating a high-fiber diet, and staying active. Patients should inform their health care team if they have had no normal bowel movement after three days.

#### *Diarrhea*

For patients who experience diarrhea, a doctor will recommend either an over-the-counter or prescription antidiarrheal medication. Drinking plenty of fluids is also usually recommended.

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In some cases, diarrhea can be serious and may indicate infection or dehydration. Patients should immediately call their doctors if any of the following occur:

- Six or more loose bowel movements per day for more than two days in a row
- Blood in the stool
- Cannot urinate for at least 12 hours
- Fever
- Loss of 5 pounds or more after the diarrhea starts
- Abdominal swelling and/or pain
- Feeling dizzy or light-headed when moving to a standing position

### *Nausea and Vomiting*

For patients who experience nausea or vomiting, a doctor will prescribe an **antiemetic** medication. Eating small meals throughout the day and drinking at least eight glasses of fluids in small amounts may be helpful, as well.



#### **Cardiac Events**

Although it is not common, cardiovascular side effects (including high blood pressure or congestive heart failure) can occur with some myeloma drugs. Patients receiving these drugs are closely monitored.



#### **Vision-Related Events**

Certain myeloma drugs can cause changes in a part of the eye called the cornea that can result in changes in vision.



#### **Cellular Therapy Events**

Patients receiving immunotherapy that uses immune effector cells may experience a common side effect called **cytokine release syndrome (CRS)**, as well as some nervous system side effects (neurotoxicity).

### **CRS**

CRS is an infection-like syndrome in which a patient experiences fevers, chills, and low blood pressure after receiving an infusion of immune cells. CRS is believed to result from a surge in the immune response, which is mainly driven by a cytokine (a protein produced by immune cells) called interleukin-6 (IL-6). Fortunately, there is a drug available that interferes with IL-6 and can stop CRS.

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### *Neurotoxicity*

Some patients experience mild symptoms like confusion, but in some cases patients experience severe symptoms like delirium or seizures. These side effects—which are referred to as **immune effector cell-associated neurotoxicity syndrome (ICANS)**—are less common and less understood than CRS, and most resolve over time.

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More information on treatment-related side effects is provided in our companion booklets, ***Multiple Myeloma Treatment Overview Overview*** and ***Autologous Stem Cell Transplantation***.

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## MMRF PATIENT SUPPORT AND RESOURCES

The MMRF is dedicated to supporting the myeloma community by providing a broad range of resources for myeloma patients and their family members and caregivers. The MMRF is available to help guide you through your multiple myeloma journey every step of the way.



### YOUR QUESTIONS ANSWERED

Speak to an MMRF Patient Navigator at the Patient Navigation Center for answers to your questions about disease management, treatments, clinical trials, and assistance with finding financial and other available resources.

Telephone: 1.888.841.6673

Monday–Friday, 9:00 AM to 7:00 PM ET

Email: [patientnavigator@themmrf.org](mailto:patientnavigator@themmrf.org)

Connect with an MMRF Myeloma Mentor™:

[themmrf.org/resources/myeloma-mentors](https://themmrf.org/resources/myeloma-mentors)

This is a phone-based program offering the opportunity for patients and/or caregivers to connect one-on-one with a trained patient and/or caregiver mentor to share their patient journeys and experiences.

### FIND AND PARTICIPATE IN A CLINICAL TRIAL

Search for a clinical trial in your area or let an MMRF Patient Navigator help guide you through the process.

Clinical Trial Search: [themmrf.org/resources/clinical-trial-finder](https://themmrf.org/resources/clinical-trial-finder)

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The MMRF would like to thank Jesus G. Berdeja, MD, Director of Multiple Myeloma Research and Senior Investigator, Hematologic Malignancies at the Sarah Cannon Research Institute in Nashville, Tennessee, and Faith E. Davies, MBBCh, MRCP, MD, FRCPath, Director of the Clinical Myeloma Program at the Perlmutter Cancer Center at New York University Langone Health in New York, New York, and our patient advocates Allan and Deb Osborne of Millis, Massachusetts, and Cindy Chmielewski of Lawrenceville, New Jersey, for their contributions to this booklet.

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## GLOSSARY

**active multiple myeloma** Multiple myeloma in which the percentage of plasma cells in the bone marrow is greater than 10% and in which the patient shows one or more CRAB symptoms (see definition at *CRAB*)

**albumin** Major protein found in the blood; albumin level can indicate a person's overall health and nutritional status

**anemia** Decrease in the number of red blood cells in the blood

**antibody** Protein produced by plasma cells that helps protect the body from infection and disease (also called *immunoglobulin*)

**antiemetic** Drug that prevents or relieves nausea and vomiting

**balloon kyphoplasty** Procedure used to treat fractures in the spine (see *kyphoplasty*)

**Bence Jones protein** Short protein (immunoglobulin light chain) that is produced by myeloma cells and found in the urine

**beta-2 microglobulin ( $\beta$ 2M)** Protein normally found on the surface of various cells in the body; levels of  $\beta$ 2M in the blood are elevated in inflammatory conditions and in certain blood cell disorders, such as myeloma

**bisphosphonate** Type of drug used to treat osteoporosis and bone disease

**blood urea nitrogen (BUN)** Byproduct of protein metabolism that is normally filtered out of the blood and found in the urine; elevated levels in the blood can indicate decreased kidney function

**bone marrow** Soft, spongy tissue found in the center of many bones and site of blood cell production

**bone marrow biopsy** Removal of a sample of bone marrow for examination; performed using a needle

**calcium** Mineral that is important in bone formation; elevated serum levels occur when there is bone destruction

**chromosomal deletion** Chromosomal abnormality in which a segment of a chromosome is missing; del(17p) is an example of a chromosomal deletion

**chromosomal translocation** Chromosomal abnormality in which segments of two chromosomes switch positions; t(4;14) and t(11;14) are examples of chromosomal translocations

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**chromosome** Thread-like structure in a living cell that contains DNA (genetic information)

**clinical trial** A study of the safety and effectiveness of a therapeutic agent using consenting human subjects

**complete blood count (CBC)** Blood test that measures the number of red blood cells, white blood cells, and platelets in the blood and the relative proportions of the various types of white blood cells

**complete metabolic panel (CMP)** Blood test that measures levels of albumin, calcium, lactate dehydrogenase (LDH), blood urea nitrogen (BUN), and creatinine to assess bone status, the extent of disease, and the function of the kidneys and liver (also known as *chemistry profile*)

**computed tomography (CT)** Imaging technique that uses a computer to generate three-dimensional x-ray pictures (also referred to as *computerized axial tomography [CAT]*)

**CRAB** Acronym for the following group of clinical indicators of organ damage: increased calcium level, renal (kidney) failure, anemia, bone lesions; the presence of one or more of these indicators can help establish a diagnosis of multiple myeloma

**creatinine** Product of energy metabolism of muscle that is normally filtered out of the blood and found in the urine; elevated levels in the blood can indicate decreased kidney function

**CureCloud** A direct-to-patient research effort aimed at enrolling 5,000 individuals from whom comprehensive molecular and immune analyses will be generated from blood samples and the resulting data aggregated with the correlating clinical information

**cytogenetic testing (chromosome analysis)** Laboratory test that measures the number and structure of chromosomes (see *karyotyping*)

**cytokine release syndrome (CRS)** A common, infection-like side effect following infusion of CAR T cells in which a patient experiences fevers, chills, and low blood pressure

**deep vein thrombosis (DVT)** Condition where a blood clot forms in one of the deep veins in the body, usually in the legs or lower abdomen

**DNA** Genetic material of the cell located in the chromosomes

**electrophoresis** Laboratory test used to measure the levels of proteins in the blood or urine; uses an electrical current to sort proteins by their charge

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**extramedullary disease** Myeloma cells found in other organs of the body beyond the bone marrow

**fluorescence in situ hybridization (FISH)** Laboratory technique used to measure the number of copies of a specific DNA segment in a cell and the structure of chromosomes

**free light chain (FLC)** Small molecules found in antibodies

**genomic sequencing** Study of DNA sequences of myeloma cells to detect mutations and to see how DNA changes over time

**hypercalcemia** Presence of elevated levels of calcium in the blood; occurs as a result of bone destruction

**hyperdiploidy** Extra copies of one or more chromosomes

**immune effector cell-associated neurotoxicity syndrome (ICANS)** Common side effect of the nervous system observed after CAR T-cell treatment that can include confusion or delirium, expressive aphasia, motor weakness, tremor, headache, seizures, and reduced level of consciousness

**immunoglobulin (Ig)** Protein that helps protect the body from infection (also called *antibody*)

**intravenous (IV)** Administration of a drug directly into a vein

**karyotyping** A test that looks at the number and structure of a patient's chromosomes to identify genetic problems

**kyphoplasty** Procedure used to treat spinal compression fractures; in this procedure a balloon is inserted into the area of compression and inflated to elevate the collapsed section; the resulting space is then filled with bone cement, which strengthens the area

**lactate dehydrogenase (LDH)** Enzyme found in body tissues; elevated levels in the blood indicate tissue damage and may occur in myeloma

**light chains** The shorter of two protein chains that make up an antibody, characterized as either kappa or lambda type; light chains produced by myeloma cells are also referred to as *Bence Jones proteins* when they occur in the urine

**magnetic resonance imaging (MRI)** Scanning technique that uses magnetic energy to provide detailed images of bone and soft tissue

**malignant** Cancerous, continuing to divide

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**monoclonal antibody** Antibody that is produced in a laboratory and used to diagnose and treat some diseases

**monoclonal (M) protein** Abnormal antibody found in large quantities in the blood and urine of individuals with myeloma

**monoclonal gammopathy of undetermined significance (MGUS)** A condition that can occur before a patient develops or shows any symptoms of cancer; indicated by the presence of M protein in the serum or urine, MGUS may eventually progress to myeloma

**mutation** A defect or error in a gene

**myeloma precursor conditions** Any of the preceding phases of active multiple myeloma, called monoclonal gammopathy of undetermined significance (MGUS) or smoldering multiple myeloma (SMM), which are characterized by changes in the cells and the presence of materials in the bone marrow, but no symptoms or organ damage

**neuropathy** Disorder of the nerves that can disrupt sensation or cause burning/tingling; when the hands and feet are affected, it is referred to as *peripheral neuropathy*

**neutropenia** Below-normal number of neutrophils (type of white blood cell that destroys bacteria)

**osteolytic lesion** Soft spot in the bone where bone tissue has been destroyed; appears as a hole on a standard x-ray

**osteonecrosis of the jaw (ONJ)** Death or destruction of bone tissue in the jaw due to trauma, loss of blood supply, or disease; can be associated with long-term bisphosphonate treatment in myeloma patients

**osteoporosis** Bone loss typically associated with old age; can occur in myeloma

**PCROWD study** A clinical trial conducted to identify changes in the cells of patients with myeloma precursor conditions (MGUS or SMM) (visit [www.enroll.pcrowd.org](http://www.enroll.pcrowd.org))

**plasma cell** Antibody-secreting immune cell that develops from a B cell; in myeloma, it is this cell that has become cancerous or abnormal

**plasmapheresis** Method of removing blood plasma from the body by withdrawing blood, separating it into plasma and cells, and transfusing the cells back into the bloodstream; it is often performed when treating autoimmune conditions and may be used in myeloma

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**platelets** Small cell fragments in the blood that help it to clot

**positron emission tomography (PET)** Imaging technique in which radioactive glucose (sugar) is used to highlight cancer cells

**precision medicine** Highly specialized approach to myeloma therapy in which DNA test results are used to guide treatment

**prognosis** Prediction of the course and outcome of a disease

**PROMISE study** A clinical trial conducted to identify new ways to prevent multiple myeloma in individuals with its precursor conditions (MGUS or SMM) (visit [www.enroll.promisestudy.org](http://www.enroll.promisestudy.org))

**radiation therapy (or radiotherapy)** Use of high-energy rays; sometimes used to relieve bone pain

**red blood cell** Blood cell that carries oxygen

**Revised International Staging System (R-ISS)** System for using laboratory test results to determine the severity of multiple myeloma

**serum protein electrophoresis (SPEP)** Test used to measure proteins in the blood or serum; uses an electrical current to separate proteins by their charge

**smoldering (asymptomatic) multiple myeloma (SMM)** Myeloma characterized by increased M protein and slightly increased numbers of plasma cells in the bone marrow and an absence of symptoms; patients with SMM are monitored and only treated if their disease progresses

**subcutaneous (SC)** Administration of a drug under the skin

**supportive care** Treatment that addresses the symptoms and complications of a disease rather than the disease itself; examples in myeloma include bisphosphonates, growth factors, antibiotics, orthopedic interventions, and pain control measures

**urine protein electrophoresis (UPEP)** Test used to detect and measure proteins in the urine, especially Bence Jones protein; uses an electrical current to separate proteins by their charge

**vertebroplasty** Procedure used to treat fractures of the spine

**white blood cell** One of the major cell types in the blood; attacks infection and cancer cells as part of the immune system



# MMRF RESOURCES IN PERSON OR ONLINE



## **Attend** a Multiple Myeloma Patient Summit

Learn about standard and emerging therapies including stem cell transplants, promising clinical trials, and more for optimal disease management. Attend a complimentary symposium for all the information you need to make well-informed decisions about your treatment and care.

To register or to view the complete calendar, visit:  
[themmrf.org/resources/education-programs](https://themmrf.org/resources/education-programs)



## **View** Past Programs on Demand

Access our archive of recorded Patient Summit symposia and webcasts. Hear expert perspectives on key clinical research and the rapidly evolving myeloma treatment landscape.

All available online, and free, at:  
[themmrf.org/resources/education-programs](https://themmrf.org/resources/education-programs)



## **Find** a Clinical Trial Near You

Clinical trials are critically important to developing new myeloma treatments and better understanding the biology of the disease. The more people who enroll, the faster we can find answers. Patients who enroll in clinical trials have the opportunity to be among the first to receive the newest drugs or drug combinations in development and receive close monitoring.

To find a clinical trial near you, visit:  
[themmrf.org/resources/clinical-trial-finder](https://themmrf.org/resources/clinical-trial-finder)

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