



MULTIPLE MYELOMA  
Research Foundation

# MULTIPLE MYELOMA LEARN YOUR LABS

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## ABOUT THE **MMRF**

The Multiple Myeloma Research Foundation (MMRF) is the largest nonprofit in the world solely focused on accelerating a cure for each and every multiple myeloma patient. We drive the development and delivery of next-generation therapies, leverage data to identify optimal and more personalized treatment approaches, and empower myeloma patients and the broader community with information and resources to extend their lives.

Central to our mission is our commitment to advancing health equity so that all myeloma patients can benefit from the scientific and clinical advances we pursue. Since our inception, the MMRF has committed over \$500 million for research, opened nearly 100 clinical trials, and helped bring 15+ FDA-approved therapies to market, which have tripled the life expectancy of myeloma patients.

To learn more about the MMRF, visit [themmrf.org](https://themmrf.org).

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

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# INTRODUCTION

As a patient with **multiple myeloma**, you will undergo a number of tests throughout your diagnosis and treatment. Having the right tests is important: the results help your doctor confirm a diagnosis of myeloma, assess the extent of your disease, and monitor your progress once you start treatment.

This booklet describes these tests and what they mean for you and your health care team. Words that may be unfamiliar are **bolded** and defined in the Glossary (page 14).

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 provider regarding specific questions relating to your health, especially questions about myeloma diagnosis or treatment.

## COMMON TESTS USED IN MYELOMA CARE

Testing for multiple myeloma includes a range of blood tests, urine tests, scans, and bone or **bone marrow** tests.

### BLOOD TESTS

Blood tests can tell the health care team a great deal about the status of your myeloma.

#### Complete blood count

A **complete blood count (CBC)**, as the name suggests, reveals the number of different cells and components in your blood—**red blood cells**, **white blood cells**, and **platelets**. By comparing your CBC test results with the ranges for a typical healthy person, your health care team can determine the extent to which multiple myeloma is interfering with the normal production of blood cells.

Your red blood cell count is typically determined by measuring **hemoglobin**, a protein in red blood cells that carries oxygen throughout your body, although some cancer centers measure **hematocrit** or red blood cell count. When the level of any of these is low, it means that there are not enough red blood cells in the blood, which is an indication that myeloma cells are interfering with blood cell production in the bone marrow. A low red blood cell count, low hemoglobin, or low hematocrit level (**anemia**) is common in myeloma and can cause fatigue.

When the number of a specific type of white blood cell called a **neutrophil** becomes very low (**neutropenia**), your body is less able to fight off infections. Your doctor will monitor your neutrophil count closely.

A low platelet count (**thrombocytopenia**) may cause any cut you get to bleed for a longer time, because blood cannot clot properly.

### Complete blood count.

<b>Sample</b>	Blood
<b>What is measured</b>	The level of hemoglobin and the number of red blood cells, white blood cells, and platelets
<b>Component*</b>	<b>Normal range†</b>
Red blood cells	Women: $3.90$ to $5.03 \times 10^{12}/L$ Men: $4.32$ to $5.72 \times 10^{12}/L$
Hemoglobin	Women: $12.1$ to $15.1$ g/dL Men: $13.8$ to $17.2$ g/dL
White blood cells	Total: $3.5$ to $10.5 \times 10^9/L$ Neutrophils (as absolute neutrophil count [ANC]): $1.7$ to $7.0 \times 10^9/L$ <b>Monocytes:</b> $0.2$ to $1.0 \times 10^9/L$ <b>Lymphocytes:</b> $1.0$ to $3.0 \times 10^9/L$
Platelets	$150$ to $450 \times 10^9/L$

\*Additional components not listed here may be analyzed, but they are not typically used for diagnosing or managing myeloma.

†Normal ranges vary slightly from one institution to another.

### Comprehensive metabolic panel

As myeloma cells grow and crowd out the normal blood cells in your bone marrow, the surrounding bone can also be affected. In addition, myeloma cells boost the activity of other cells that are responsible for breaking down bone (**osteoclasts**). The accumulation of **monoclonal (M) protein** and calcium (caused by bone destruction) in the blood can overwork and damage the kidneys, because M protein is filtered by the kidneys.

A **comprehensive metabolic panel** (also called a chemistry profile) measures the levels of several materials in your blood; these include **albumin**, calcium, **blood urea nitrogen (BUN)**, and **creatinine**. The results are used to assess how well the kidneys and liver are functioning and to determine the extent of your multiple myeloma.

Albumin is a protein in blood that transports substances and is an indicator of overall health. Low levels of albumin (**hypoalbuminemia**) may indicate

advanced disease, though it may also be indicative of poor nutrition or other diseases like **amyloidosis**.

Bone damage caused by myeloma leads to the leaking of calcium into the bloodstream (**hypercalcemia**). Ultimately, damaged bones can cause pain and put you at risk of fractures, spinal cord compression, and vertebral (back) bone collapse.

Creatinine and BUN are waste products that are normally produced by your body and eliminated in urine. High levels of these in the blood could be an early sign of kidney disease.

### Complete metabolic panel/chemistry profile.

Sample	Blood
What is measured	Levels of electrolytes, albumin, calcium, BUN, and creatinine
Component*	Normal range†
Albumin	3.4 to 5.4 g/dL
BUN (blood urea nitrogen)	6 to 20 mg/dL
Calcium	8.5 to 10.2 mg/dL
Chloride	96 to 106 mEq/L
Creatinine	0.6 to 1.3 mg/dL
Potassium	3.7 to 5.2 mEq/L
Sodium	135 to 145 mEq/L

\*Additional components not listed here may be analyzed, but they are not typically used for diagnosing or managing myeloma.

†Normal ranges vary slightly from one institution to another.

### Lactate dehydrogenase

**Lactate dehydrogenase (LDH)** is an important enzyme that is found in all the cells in your body. In general, when levels of LDH in your blood are unusually high, it could indicate tissue damage from an injury, disease, or infection. In the case of myeloma, it could mean that myeloma cells are rapidly dividing—a sign of aggressive disease. The LDH value—along with other blood test results generated at diagnosis—helps your doctor stage your myeloma and determine your **prognosis**.

### Lactate dehydrogenase.

Sample	Blood
What is measured	LDH
Component	Normal range*
LDH	105 IU/L to 333 IU/L

\*Normal ranges vary slightly from one institution to another.

## Beta 2-microglobulin

**Beta 2-microglobulin (β2M)** is a protein found on the surface of myeloma cells. When elevated levels of β2M are found in your blood, it indicates the presence and severity of multiple myeloma. Higher levels of β2M in your blood indicate a greater extent of disease, which helps your doctor determine the stage of your myeloma.

### Beta-2 microglobulin.

<b>Sample</b>	Blood
<b>What is measured</b>	β2M
<b>Component</b>	<b>Normal range*</b>
β2M	0.70 to 1.80 µg/mL

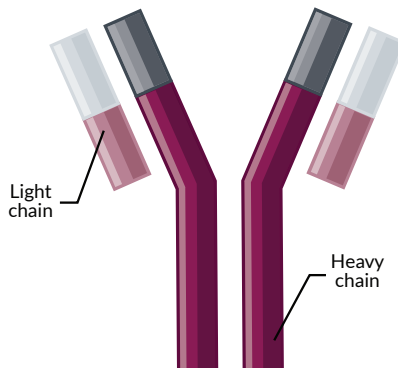
\*Normal ranges vary slightly from one institution to another.

## Electrophoresis

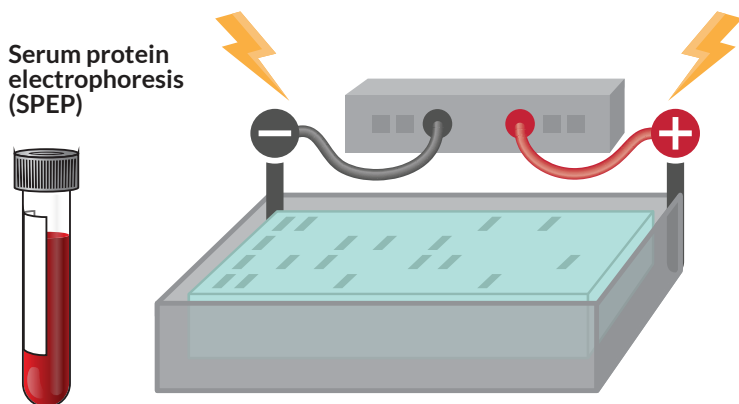
**Antibodies**, also called **immunoglobulins (Igs)**, are proteins produced by **plasma cells**. They help your body recognize something (like bacteria or viruses) as foreign and trigger your immune system to eliminate it. There are five different types of antibodies in our bodies: IgA, IgG, IgM, IgD, and IgE.

Antibodies have a distinct shape, formed by two long proteins (heavy chains) and two shorter proteins (**light chains**). Antibody light chains (also called **Bence Jones proteins**) are classified as either kappa or lambda, and are differentiated based on their antibody combinations to define specific types of myeloma (eg, IgGK, IgGL). Determining the levels and types of these antibodies, which are overproduced by myeloma cells, can be helpful in detecting myeloma.

### Immunoglobulin components.



A test called **serum protein electrophoresis (SPEP)** uses an electrical charge to separate proteins in a blood sample. It is used to detect the presence and levels of various proteins, including M protein (abnormal antibody protein produced by myeloma cells), in your blood.



Your M protein level—referred to as an M spike—indicates that you might have multiple myeloma or one of the conditions (**myeloma precursor conditions**) that are known to lead to it. With multiple myeloma treatment, the M protein levels usually fall. If you have already received treatment, an increase in the M protein level can be a sign that you are relapsing, meaning that your myeloma is coming back or that your current treatment is no longer effective. For this reason, blood M protein levels are useful in monitoring how effective your treatment has been.

#### Serum protein electrophoresis.

<b>Sample</b>	Blood
<b>What is measured</b>	M protein
<b>Component</b>	<b>Normal range*</b>
Albumin	3.8 to 5 g/dL
Alpha-1	0.1 to 0.3 g/dL
Alpha-2	0.6 to 1 g/dL
Beta	0.7 to 1.4 g/dL
Gamma	0.7 to 1.6 g/dL
M protein	0

\*Normal ranges vary slightly from one institution to another.

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For more information about myeloma precursor conditions, refer to the companion booklet *Multiple Myeloma Precursor Conditions* and the MMRF website, [themmr.org](http://themmr.org).

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**Immunofixation electrophoresis** (also called immunoelectrophoresis) is another test that uses an electrical current to separate proteins in a blood sample. This test identifies the type of antibodies present in your blood (for example, IgM, IgG, IgA, IgD, or IgE) and helps classify your disease.

#### Quantitative immunoglobulins.

Sample	Blood
What is measured	Levels and types of antibodies
Component	Normal range*
IgA	90 to 386 mg/dL
IgG	603 to 1613 mg/dL
IgM	20 to 172 mg/dL
IgD	0 to 14 mg/dL
IgE	6 to 495 IU/mL

\*Normal ranges vary slightly from one institution to another.

#### Serum free light chain assay

The serum free light chain assay measures antibody light chains, which are not detected by the SPEP.

Normally, a person without myeloma has roughly the same number of kappa and lambda light chains, so a serum free light chain assay would show a ratio of one.

Because myeloma cells mainly produce only one type of light chain, assay results that show a higher level of either kappa or lambda light chains can be a sign that you have myeloma or a related disease.

Sometimes, myeloma cells only make light chains, a condition called **free light chain myeloma** that affects 15% of people with multiple myeloma. In rare cases, myeloma cells do not make any immunoglobulin proteins, a condition called **non-secretory myeloma**. It can be challenging to diagnose patients with non-secretory myeloma, because they have no M spike.



During multiple myeloma treatment, the level of the light chain made by the myeloma cells decreases, and the ratio of kappa and lambda light chains should return to normal, so the serum free light chain assay is also a good way to monitor how effective your treatment is.

### Serum free light chain assay.

<b>Sample</b>	Blood
<b>What is measured</b>	Levels of light chains
<b>Component</b>	<b>Normal range*</b>
Kappa ( $\kappa$ ) free light chains	3.3 to 19.4 mg/L
Lambda ( $\lambda$ ) free light chains	5.71 to 26.3 mg/L
Ratio of kappa ( $\kappa$ )/lambda ( $\lambda$ )	0.26 to 1.65

\*Normal ranges vary slightly from one institution to another and may be reported as mg/dL.

## URINE TESTS

There are also several tests that can be performed on urine samples that are useful in myeloma management.

### Urinalysis

Urinalysis refers to any of several tests done on a urine sample. These tests are used to assess many aspects of your health and include chemical analyses (measuring levels of blood, glucose, protein, and other substances that might be present in the urine) and sometimes visual examination of the urine through a microscope. Abnormal findings may suggest that you have a urinary tract infection or that you may be dehydrated.

### Urinalysis.

<b>Sample</b>	Urine
<b>What is measured</b>	Blood, glucose, protein, and other substances present in urine
<b>Component</b>	<b>Normal range*</b>
Color	Yellow (light/pale to dark/deep amber)
Clarity/turbidity	Clear or cloudy
pH	4.5 to 8
Specific gravity	1.005 to 1.025
Glucose	Up to 130 mg/24 hours
Ketones	None
Nitrites	Negative
Leukocyte esterase	Negative

\*Normal ranges vary slightly from one institution to another.

## Urine protein electrophoresis

**Urine protein electrophoresis (UPEP)** determines the levels of specific proteins, including M protein and antibody light chains, in the urine. The presence of these proteins indicates multiple myeloma.

### Urine protein electrophoresis.

<b>Sample</b>	Urine
<b>What is measured</b>	Levels of light chains
<b>Component</b>	<b>Normal range*</b>
Total protein	6.4 to 8.3 g/dL
Albumin	3.5 to 5.0 g/dL
Alpha-1 globulin	0.1 to 0.3 g/dL
Alpha-2 globulin	0.6 to 1.0 g/dL
Beta globulin	0.7 to 1.2 g/dL
Gamma globulin	0.7 to 1.6 g/dL
M protein	0 to 0.001%

\*Normal ranges vary slightly from one institution to another.

## BONE MARROW BIOPSY

Along with blood and urine tests, bone marrow tests provide valuable information about the status of your myeloma. Tests conducted on bone marrow help the health care team diagnose multiple myeloma and are used to monitor the disease during treatment.

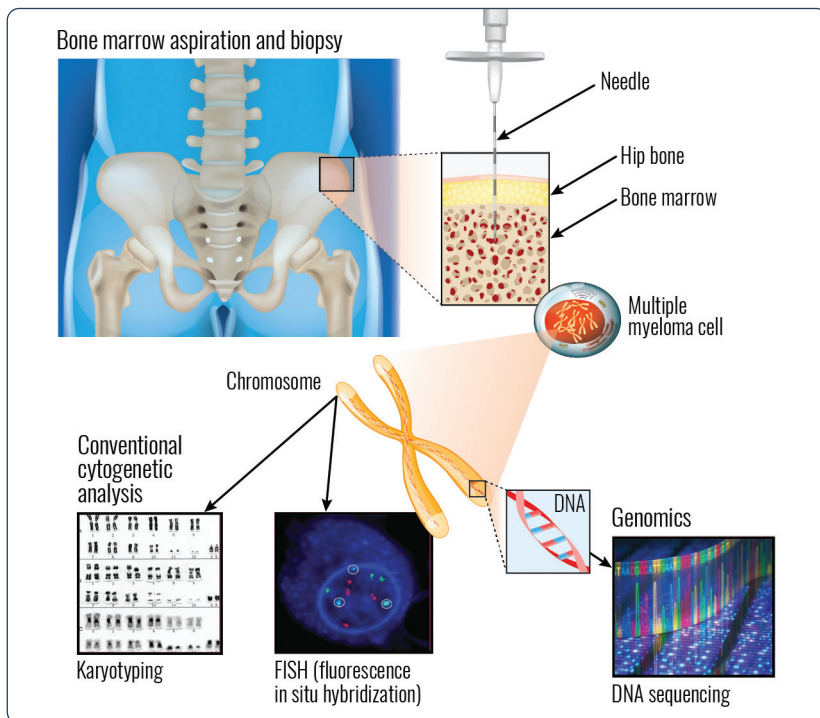
In a **bone marrow biopsy**, your doctor will remove a small piece of bone that contains marrow—the spongy tissue that is found inside bones. For a bone marrow aspiration, your doctor will remove a small amount of liquid bone marrow, which contains marrow cells. Both of these samples are usually taken from the back of the pelvic (hip) bone using a large needle. Pain is typically managed with premedication and a local anesthetic prior to this procedure. You may be partially or completely sedated during the procedure. Your health care team will let you know in advance how the procedure is conducted at their site.

These tests are important for several reasons. First, they can be used to determine the number and percentage of normal plasma cells and myeloma cells in your bone marrow. A level of myeloma cells in the bone marrow that exceeds 10% confirms a diagnosis of multiple myeloma; a higher percentage indicates more extensive disease.

Second, myeloma cells that are collected from your bone marrow can be used to perform **cytogenetic analysis** and **genomic sequencing**, which is vital in determining your risk level and potentially informing your treatment plan.

Bone marrow biopsy testing is always done at the time of diagnosis and might be repeated after certain treatments (such as after high-dose chemotherapy and autologous stem cell transplant) or when it is suspected that your myeloma has **relapsed**.

### Bone marrow biopsy testing



### Fluorescence in situ hybridization

One of the main tests performed on bone marrow samples is **fluorescence in situ hybridization (FISH)**. This test provides information about the number and structure of your **chromosomes**.

For FISH testing, myeloma cells collected from the bone marrow biopsy are treated with special dyes that attach to specific parts of chromosomes, which makes it possible to detect changes in myeloma cells. Of particular importance

is determining the nature of any structural changes in these chromosomes—for example, whether parts of any chromosomes are missing (**chromosomal deletions**), whether any chromosomes have been duplicated (**hyperdiploidy**), or if pieces of different chromosomes have swapped places (**chromosomal translocations**). When portions of a chromosome are duplicated, it is referred to as a **chromosomal amplification or gain**. Certain changes in the chromosomes are associated with the development of myeloma, but only a few of these changes are considered high risk and will affect your care. These include:

- A translocation between chromosomes 4 and 14 (written as t[4;14])
- A translocation between chromosomes 14 and 16 (written as t[14;16])
- Deletion of part of chromosome 17 (written as del[17p])
- Deletion of part of chromosome 1 (written as del[1p])
- Extra gene copies (or gain) in part of chromosome 1 (written as +1q)

### Karyotyping

Another test that may be done on bone marrow samples is **karyotyping**, which involves looking at the size, shape, and number of chromosomes in a sample. Some of the information provided by karyotyping overlaps information provided by FISH, like hyperdiploidy, deletions, or translocations. FISH may be more sensitive in detecting some aberrations but is not as widely available.

### Genomic sequencing

As a patient with myeloma, it is strongly recommended that you undergo genomic sequencing when possible. Multiple myeloma genomic sequencing is the process of examining the **DNA** of individual myeloma cells.

The DNA in myeloma cells is made up of the same molecules as the DNA in normal cells, but in myeloma cells the DNA sequence has been changed; these changes are called **mutations**. When these mutations develop, the proteins produced by the mutated DNA in those cells can no longer do the job they're supposed to do and instead behave abnormally (for example, causing myeloma cells to continue to grow and multiply out of control).

Genomic sequencing allows a doctor to understand how your tumor grows, how it is trying to avoid detection by the immune system, and even how it might respond to specific therapies.

From a genetic perspective, not all multiple myeloma is the same. There are many possible mutations, and the treatment options available to you may be influenced by the specific mutations you have.

Genomic sequencing can give you and your care team information about your prognosis, your treatment options, and how your myeloma is changing in response to treatment. Ask your doctor if genomic sequencing is available.

### Minimal (measurable) residual disease testing

Using cells taken from a bone marrow biopsy, your doctor may be able to monitor **minimal (measurable) residual disease (MRD)**, which measures any myeloma cells that remain in your body after a complete response has been achieved following treatment.

Techniques used to measure MRD include flow cytometry tests (such as **next-generation flow**) and **next-generation sequencing** tests like the commercially available clonoSEQ assay. These tests have varying levels of sensitivity but may be able to detect one myeloma cell out of 100,000 normal cells—or even one myeloma cell out of 1,000,000 normal cells.

Studies suggest that patients who achieve MRD negativity (no myeloma cells are detected in the sample) following treatment experience longer time without disease recurrence and may live longer than those who are still MRD positive (myeloma cells detected in the sample).

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For more information about MRD, refer to the companion booklet *Multiple Myeloma Treatment Overview* and the MMRF website, [themmrf.org](http://themmrf.org).

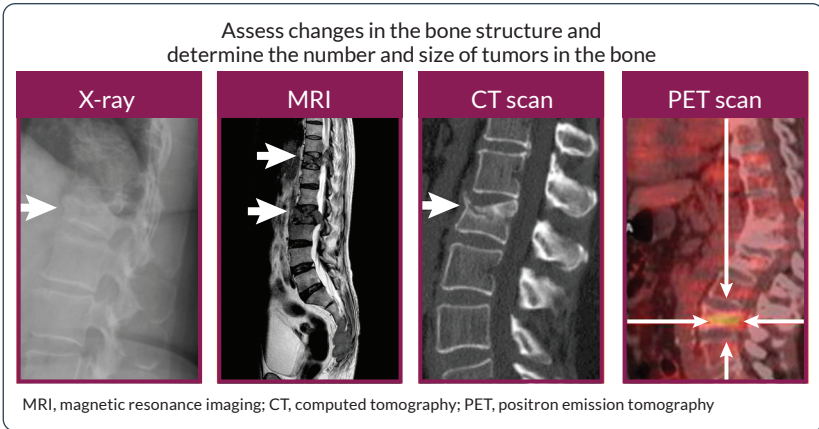
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### IMAGING STUDIES

As multiple myeloma gets worse, it can cause small holes (**osteolytic lesions**) to develop in your bones. A number of imaging tests are used to locate and measure these lesions, including bone (skeletal) survey, x-ray, **magnetic resonance imaging (MRI)**, **computed tomography (CT)**, and **positron emission tomography (PET)**. For diagnosis and monitoring, MRI and PET are more sensitive for detecting active osteolytic lesions.

These tests assess changes in your bone structure and determine the number and size of tumors in your bones. Higher levels of bone changes suggest the presence of multiple myeloma. Some of these tests can also detect multiple myeloma that is outside the bone marrow (**extramedullary disease**).

### Types of imaging used to detect multiple myeloma.



The MMRF would like to thank Joshua Richter, MD, Associate Professor of Medicine, Hematology and Oncology, in the Myeloma Division at the Tisch Cancer Institute at the Icahn School of Medicine at Mount Sinai and the Director of Myeloma at the Blavatnik Family Chelsea Medical Center at Mount Sinai and our patient advocate Andrew Gordon of Harrisburg, Pennsylvania for their contributions to this booklet.

# 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 Finder: [themmrf.org/resources/clinical-trial-finder](https://themmrf.org/resources/clinical-trial-finder)

The MMRF has partnered with Lazarex Cancer Foundation to help patients access clinical trials by helping with travel expenses. Patients who qualify will be reimbursed for out-of-pocket travel expenses for themselves and a travel companion. To learn more about this program, contact the MMRF Patient Navigation Center (1-888-841-6673 or [patientnavigator@themmrf.org](mailto:patientnavigator@themmrf.org)).

## SUPPORT THE MMRF

Help support the MMRF's efforts to accelerate research and find a cure! Participate in an event or donate today.

Telephone: 1-203-229-0464

**Donate now/Take action:** Visit [themmrf.org/get-involved](https://themmrf.org/get-involved)

## GLOSSARY

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

**amyloidosis** Disorder in which abnormal protein is deposited in organs and tissues

**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*)

**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

**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

**chromosomal amplification/gain** Chromosomal abnormality in which a section of a chromosome is added; 1q+ is an example of a chromosomal amplification

**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

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

**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

**comprehensive metabolic panel** Blood test that measures levels of albumin, calcium, 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 **c**alcium level, **r**enal (kidney) failure, **a**nemia, **b**one 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

**cytogenetic analysis** Laboratory test that measures the number and structure of chromosomes. This analysis includes fluorescence in situ hybridization (FISH) and karyotyping

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

**extramedullary disease** The presence of myeloma cells outside 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

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

**hematocrit** The calculated percentage of red blood cells in your blood

**hemoglobin** Protein that transports oxygen in the blood

**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

**hypoalbuminemia** Condition in which the body does not produce enough albumin

**immunofixation electrophoresis** Test used to measure proteins in the blood or serum; uses an electrical current to separate proteins by their charge (also called *immuno-electrophoresis*)

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

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

**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

**light chain myeloma** Myeloma in which the malignant plasma cells produce only light chains

**lymphocyte** Type of white blood cell made up of two main types, B cells and T cells

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

**minimal (measurable) residual disease (MRD)** Presence of small numbers of myeloma cells in the bone marrow during or after treatment, even when the patient shows no symptoms or signs of disease

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

**monocyte** Type of white blood cell that helps the body fight infection

**multiple myeloma** Disease 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)

**mutation** A defect or error in DNA

**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 in the bone marrow, but no symptoms or organ damage

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

**neutrophil** Type of white blood cell in the immune system that helps the body fight infection

**next-generation flow** Highly sensitive test that uses bone marrow samples to detect minimal residual disease

**next-generation sequencing** Highly sensitive test that uses genomic assessment of bone marrow samples to detect minimal residual disease

**non-secretory myeloma** Myeloma in which malignant plasma cells do not make or release antibodies

**osteoclast** Type of cell that breaks down bone

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

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

**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

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

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

**relapse** Progression of myeloma after an initial response to therapy

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

**thrombocytopenia** Decrease in the number of platelets (small cell fragments in the blood that help it to clot)

**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

**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 Summits 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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State: \_\_\_\_\_

ZIP: \_\_\_\_\_

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Or sign up at **themmrf.org**

I AM A:

- Myeloma Patient
- Myeloma Patient Caregiver
- Myeloma Patient Family Member (non-caregiver)
- Health Care Professional or Researcher
- Biopharma, Medical Device, or Health Care Technology Industry Professional

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Hours: **Mon–Fri, 9 AM–7 PM ET**  
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