Understanding Your Multiple Myeloma Lab Tests

In this resource, you will find:

Considerations for discussions with your healthcare team
Questions you may want to consider asking yourself and your care team

Lab test tracker
A worksheet where you can enter your test results and track them over time

Test information
Descriptions of each of the tests that may be required as part of your care plan

This resource is not provided to replace discussions with your healthcare provider. If you have any questions about your test results or treatment plan, discuss them with your healthcare provider.

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HEALTHCARE DISCUSSIONS

It's important for you to partner with your healthcare team by sharing your treatment and lifestyle goals. Here are topics and questions you may want to consider asking yourself and your healthcare team:

Ask Yourself

- Do you have travel plans in the near future or are planning to schedule?
- Are you able to easily get to and from appointments with your healthcare team?
- Are you currently employed and do you hope to continue working?
- Are there any other lifestyle priorities you'd like to share with your healthcare team?

Ask Your Healthcare Team

- What are my treatment goals?
- How will I know if my multiple myeloma is responding to treatment?
- How often will I need to come into the office for treatment and monitoring?
- Will I be able to make plans to travel with the treatment I am currently taking?
- What side effects can I expect from my treatment, and how can they be managed?
- What symptoms or side effects should prompt me to contact you immediately?
- How will I know if my multiple myeloma stops responding to my current treatment?
- If my multiple myeloma stops responding to treatment, how quickly should my treatment plan change?
- What are my next best treatment options?

- Can you recommend any local or online groups for multiple myeloma support?
- Should I consider making any changes to my work or personal life plans?

UNIT MEASURES

Use these definitions to help understand the reference ranges for different lab tests.

d	A day
dL	A deciliter is equal to one tenth of a liter
g	A gram is a unit of measurement of mass, or the total amount of matter in an object
kU	A kilo unit is equal to one thousand units
L	A liter is a unit of measurement of volume. Volume is a measurement of the total space occupied by a substance, mainly liquids
mcg	A microgram is equal to one millionth of a gram. May also be expressed as µg
mg	A milligram is equal to one thousandth of a gram
min	A minute
mL	A milliliter is equal to one thousandth of a liter
U	A unit
uL	A microliter is equal to one millionth of a liter

LAB TEST TRACKER

This worksheet can serve as a personal record of your lab test results. Reference ranges—values that are considered normal in healthy individuals—are provided below as a guide. Note that these ranges vary among laboratories. The laboratory performing the test should provide you with the reference range associated with the test result. To learn more about each test, see the sections following the worksheets in this resource guide. If you have any questions about your test results, do not hesitate to discuss them with your healthcare team. (Reference ranges provided are for adults only.)

Complete Blood Cell (CBC) Count

		Dates of laboratory tests			
		Date	Date	Date	Date
Measurement	**Reference Range**	**Mark the test values in the column below each date**			
White blood cells (WBCs)[1]	3.4-9.6 X 10^9/L				
Absolute neutrophil count (ANC)[2]	1.56-6.45 X 10^9/L				
Red blood cells (RBCs)[1]	Biological males: 4.35-5.65 X 10^{12}/L Biological females: 3.92-5.13 X 10^{12}/L				
Hemocrit[1]	Biological males: 38.3-48.6 percent Biological females: 35.5-44.9 percent:				
Hemoglobin (Hgb)[1]	Biological males: 13.2-16.6 g/dL Biological females: 11.6-15 g/dL				
Platelets[1]	Biological males: 135-317 X 10^9/L Biological females: 157-371 X 10^9/L				
Absolute lymphocytes[3]	≥15 years 1.18-3.74 x 10^3/uL				
Absolute monocytes[3]	≥15 years 0.24-0.82 x 10^3/uL				
Absolute eosinophils[3]	≥15 years 0.04-0.54 x 10^3/uL				
Absolute basophils[3]	≥15 years 0.01-0.08 x 10^3/uL				
Notes					

LAB TEST TRACKER

Chemistry Profile

		Dates of laboratory tests			
		Date	Date	Date	Date
Measurement	**Reference Range**	**Mark the test values in the column below each date**			
Blood urea nitrogen (BUN)[4]	6-24 mg/dl				
Creatine[5]	Biological males: 0.74-1.35 mg/dL Biological females: 0.59-1.04 mg/dL				
Calcium[6]	18-59 years: 8.6-10.0 mg/dL 60-90 years: 8.8-10.2 mg/dL				
Glucose[7]	70-140 mg/dL				
Protein, total[8]	6.3-7.9 g/dL				
Beta2-microglobulin (B2M)[9]	1.21-2.70 mcg/mL				
Notes					

M Spike[10,11]

		Dates of laboratory tests			
		Date	Date	Date	Date
Measurement	**Reference Range**	**Mark the test values in the column below each date**			
Serum protein electrophoresis (SPEP)	Any M spike presence may be abnormal				
Serum protein mass spectrometry (if applicable)	Any M spike presence may be abnormal				
Notes					

Other

		Dates of laboratory tests			
		Date	Date	Date	Date
Measurement	**Reference Range**	**Mark the test values in the column below each date**			
Lactate dehydrogenase (LDH)[12]	Biological males: 135-225 U/L Biological females: 135-214 U/L				
Notes					

Quantitative Immunoglobulins (Igs)

		Dates of laboratory tests			
		Date	Date	Date	Date
Measurement	**Reference Range**	**Mark the test values in the column below each date**			
IgG[13]	767-1,590 mg/dL				
IgA[13]	61-356 mg/dL				
IgM[13]	37-286 mg/dL				
IgD[14]	≤10 mg/dL				
IgE[15]	≤214 kU/L				
Notes					

Serum Immunofixation (IFE)

		Dates of laboratory tests			
		Date	Date	Date	Date
Measurement	**Reference Range**	**Mark the test values in the column below each date**			
IFE[16]	Types: IgG, IgA, IgM, IgD, IgE, then kappa lambda				
Notes					

LAB TEST TRACKER

Serum Free Light Chain Assay[17]

		Dates of laboratory tests			
		Date	Date	Date	Date
Measurement	**Reference Range**	**Mark the test values in the column below each date**			
Kappa free light chain	0.33-1.94 mg/dL				
Lambda free light chain	0.57-2.63 mg/dL				
Kappa/lambda free light chain ratio	0.26-1.65 mg/dL				
Notes					

24-Hour Urine Analysis

		Dates of laboratory tests			
		Date	Date	Date	Date
Measurement	**Reference Range**	**Mark the test values in the column below each date**			
24-hour urine total protein (≥18 years)[18]	<229 mg/d				
M spike, urine[19]	≥500 mg/d				
Urine immunofixation (UPEP)[20]	No monoclonal protein detected				
Creatine clearance[21]	Biological males: 97-137 mL/min Biological females: 88-128 mL/min				
Urine protein electrophoresis[22]	<150 mg/d				
Notes					

Minimal Residual Disease (MRD)[23]

		Dates of laboratory tests			
		Date	Date	Date	Date
Measurement	**Reference Range**	**Mark the test values in the column below each date**			
MRD	Any value above zero indicates MRD				
Notes					

Additional Tests

		Dates of laboratory tests			
		Date	Date	Date	Date
Measurement	Reference Range	Mark the test values in the column below each date			

Notes

LAB TEST TRACKER

Additional Tests

		Dates of laboratory tests			
		Date	Date	Date	Date
Measurement	Reference Range	Mark the test values in the column below each date			

Notes

Additional Tests

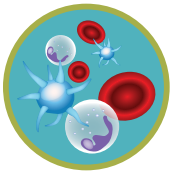
		Dates of laboratory tests			
		Date	Date	Date	Date
Measurement	**Reference Range**	**Mark the test values in the column below each date**			

Notes

TEST INFORMATION

This section explains the tests listed in the booklet and what the lab values might tell you about your multiple myeloma, the impact of treatments, and possible side effects.

BLOOD TESTS

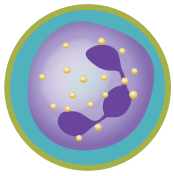


Complete blood count (CBC)[1]

A CBC measures the number of red blood cells, white blood cells, and platelets in the blood. Your body produces blood cells in the bone marrow. The increase in myeloma cells in the bone marrow can crowd out normal cells, leading to low blood counts. Blood cell counts are carefully monitored to diagnose and track your multiple myeloma, as well as the effect of treatment.

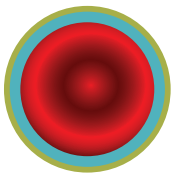
White blood cells (WBCs)[1]

Normal range: 3.4-9.6 × 10^9/L
WBCs help fight infections. Low levels of WBCs mean you are less able to fight infection.



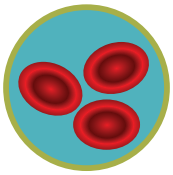
Neutrophils[2,24]

1.56-6.45 @ 10^9/L
Neutrophils are a type of WBC responsible for much of the body's protection against infection. A reduction in neutrophils increases the risk for infection, which is why a neutrophil count is closely monitored throughout treatment.



Red blood cells (RBCs)[1,25]

RBCs carry oxygen to body tissues. How much oxygen your body tissues get depends on how many RBCs you have and how well they work. The RBC count, hematocrit, and hemoglobin are all tests to measure the amount of RBCs in your blood.



RBC count[1]

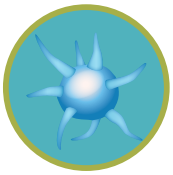
Normal range: male: 4.35-5.65 × 10^{12}/L; female: 3.92-5.13 × 10^{12}/L
A low RBC count, also called anemia, can cause fatigue and weakness.

Hematocrit[1]

Normal range: male: 38.3%-48.6%; female: 35.5%-44.9%
This measures the proportion of RBCs to the fluid (or plasma) in your blood.

Hemoglobin (Hgb)[1,25]

Normal range: male: 13.2-16.6 g/dL; female: 11.6-15 g/dL
Hemoglobin is a protein in RBCs that carries oxygen in the blood to all parts of your body.



Platelets[1]

Normal range: male: 135-317 x 10^9/L; female: 157-371 x 10^9/L
Platelets help your blood to clot.

Chemistry profile[26]

A blood chemistry profile measures the level of different substances in your blood. Blood chemistry levels provide insight into the function of different organs (kidney, liver, etc) that multiple myeloma and its treatments may affect.

Blood urea nitrogen (BUN) serum[4]

Normal range: 6-24 mg/dL
BUN is a measure of the level of urea nitrogen in your blood. Elevated BUN levels may be a sign of kidney dysfunction.

Creatinine, serum[27]

Normal range: male: 0.74-1.35 mg/dL; female: 0.59-1.04 mg/dL
Creatinine is a waste product of creatine—a chemical made by the body to supply energy mainly to muscles. If kidney function is not normal, creatinine levels may be increased in your blood.

Calcium, total, serum[6,28]

Normal range: 18-59 years: 8.6-10.0 mg/dL; 60-90 years: 8.8-10.2mg/dL
Calcium plays an important role in bone mineralization, blood clotting, as well as proper functioning of the heart and nervous system. Elevated levels of calcium may be an indicator of bone damage due to multiple myeloma.

Glucose, serum[29]

Normal range: 70-140 mg/dL
Blood sugar, or glucose, is the main sugar found in your blood. Your blood carries glucose to all of your body's cells to use for energy.

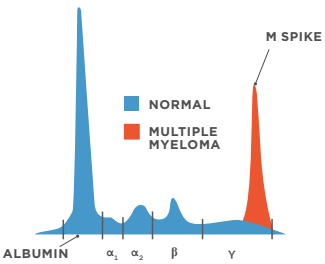
Protein, total, serum[30]

Normal range: 6.3-7.9 g/dL
The level of protein in the blood is measured by a total serum protein test. Proteins are critical for cell and tissue growth. Abnormal protein levels can indicate many health conditions. This includes multiple myeloma, which can cause protein to build up abnormally.

Beta2-microglobulin (B2M), serum[9]

Normal range: 1.21-2.70 mcg/mL
High levels of the B2M protein can mean the multiple myeloma is more advanced and may indicate a poor prognosis.

Serum protein electrophoresis (SPEP)[31,32]



Also known as immunoglobulins (Igs), antibodies are proteins produced by your immune system. They target and neutralize foreign substances, such as viruses and bacteria. Each Ig is made up of smaller units called heavy and light chains. SPEP tests measure the amount of heavy chain monoclonal proteins made by myeloma cells. The results are plotted on a chart. The monoclonal protein spike, or M spike, looks like a peak on the chart.

BLOOD TESTS

Quantitative immunoglobulin (QIg)[32]

While SPEP indicates how much monoclonal protein there is, a quantitative immunoglobin test is necessary to determine the Ig type.

IgG[33]

Normal range: 767-1590 mg/dL
IgG antibodies are widespread in the body. Your body uses IgG antibodies to fight bacterial and viral infections.

IgA[33]

Normal range: 61-356 mg/dL
IgA antibodies are mainly present in body secretions. They are the chief antibodies in the mucous membranes of the gastrointestinal and respiratory tract, as well as in saliva and tears.

IgM[33]

Normal range: 37-286 mg/dL
Your body produces IgM antibodies to help the immune system fight infections in the blood. They are the first or primary Ig produced following exposure to an antigen (a foreign substance).

IgD[33]

Normal range: ≤10 mg/dL
The role of IgD is not completely understood, and IgD is not routinely measured.

IgE[33]

Mean level: ≤214 kU/L
These antibodies play a role in allergies and parasites.

M spike (myeloma gamma globulin)[10,19]

The presence of any M spike is abnormal and shows the presence of an abnormal clone of plasma cells. If the amount of protein is ≥30 g/L and/or there are other disease symptoms, the patient may have myeloma.

Serum immunofixation (IFE)[34]

An IFE can confirm the results of an SPEP and identify the monoclonal proteins with more specificity.

Serum free light chain assay[35]

Light chains are proteins made by plasma cells and can link together to form Igs. This test measures the number of free light chains, meaning those that are not part of a whole Ig. A higher or lower than normal number of free light chains can indicate a plasma cell disorder.

Serum free kappa light chains[31]

Normal range: 0.33-1.94 mg/dL
Multiple myeloma may be indicated by increased kappa free light chains and an increased kappa/lambda ratio.

Serum free lambda light chains[31]

Normal range: 0.57-2.63 mg/dL
Multiple myeloma may be indicated by increased lambda free light chains and a decreased kappa/lambda ratio.

Serum free kappa/lambda ratio[31]

Normal range: 0.26-1.65
An abnormal kappa/lambda ratio may indicate excess production of the kappa or lambda light chain due to multiple myeloma.

URINE TESTS

24-hour urine analysis[36,37]

Urinalysis involves a number of tests—including physical, chemical, and microscopic tests—that detect and measure various compounds in your urine. This test offers a more accurate assessment than a random urine protein electrophoresis (UPEP) because by collecting the urine over 24 hours, it can account for changes in the composition of the urine throughout the day.

24-hour urine total protein[18]

Normal range: <229 mg/24 hours
Protein in urine typically comes from plasma. As the name implies, this test measures the total amount of protein urine collected over a 24-hour period. Higher than normal amounts can indicate a problem.

Urine protein electrophoresis[37]

Normal range: <150 mg/d
A urine protein electrophoresis is a test that analyzes the proteins in a urine sample. This test can help with initial diagnosis and disease monitoring.

Urine immunofixation[38]

Urine immunofixation can help identify light and heavy chain components of monoclonal proteins.

IMAGING TESTS

X-ray/bone survey[39,40]

X-ray imaging creates pictures of the inside of your body. The images show the parts of your body in different shades of black and white. Since multiple myeloma will cause decreased bone density and appear as “punched-out” bone lesions, X-rays can help in the diagnosis.

Magnetic resonance imaging (MRI)[10]

MRI uses strong magnets and radio waves to look at organs and structures inside your body. Healthcare professionals use MRI scans to diagnose multiple myeloma. A contrast fluid called gadolinium may be injected into your vein so details are easier to see in the images. MRIs can be particularly helpful when someone living with multiple myeloma has bone pain but X-rays appear normal. MRIs can also be used to look at bone marrow.

PET scan[10]

PET scan is an imaging test that uses a radioactive substance to look for disease in the body. It can reveal the locations of cancer cells in different parts of the body. Radioactive glucose is put into your veins, which will be absorbed by cancer cells. Then, a special camera can detect the locations and activity of the cells.

BONE MARROW TESTS

Bone marrow aspirate and biopsy[41]

These tests are used to diagnose, monitor, and evaluate the prognosis of multiple myeloma by sampling the cell types found in bone marrow.

Bone marrow is the soft tissue in our bones that produces blood cells. It's made up of a honeycomb network of fibers that are filled with liquid where blood cells grow.

A bone marrow aspiration uses a needle that goes into the honeycomb network to collect the fluid and cells so they can be examined under a microscope. A specialist will look at the number of each type of cell, how much they have matured, and their appearance.

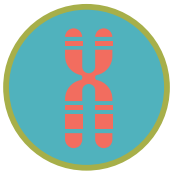
A bone marrow biopsy collects a cylindrical core that preserves the honeycomb structure of the marrow.

In addition to all the things a specialist can check with an aspirate, a biopsy also allows them to check for something called cellularity. This is a measurement that looks at the volume of blood cells versus other kinds of cells such as fats. A bone marrow biopsy also helps specialists spot changes to the bone, such as osteoporosis and fibrosis.

Specialists can also use the samples collected during bone marrow aspirates and biopsies to conduct other tests.

CYTOGENETIC TESTING[42]

Another important kind of testing for people with multiple myeloma is called cytogenetic testing. It involves looking at the genetics of your cancer cells by searching for changes in deoxyribonucleic acid (DNA), including broken, missing, extra, or rearranged chromosomes.



Karyotyping[43]

Karyotyping is a traditional form of cytogenic testing that involves arranging, pairing, and organizing chromosomes to find abnormalities. In this technique, a blood or bone marrow sample is taken and stained with special dyes so the chromosomes can be seen more easily. The person performing the test then takes pictures of the chromosomes, lining them up into pairs based on each chromosome's pattern of light and dark areas. Once they are identified and organized, the chromosomes are evaluated to see if there are the right number of each and if there are any structural issues.

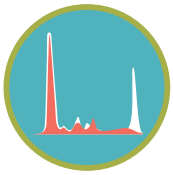
Fluorescence in situ hybridization (FISH)[43]

FISH is another type of cytogenic testing. In this testing method, healthcare providers look for DNA sequences that represent abnormalities associated with multiple myeloma. A bone marrow sample is taken, and strands of DNA with chromosomal abnormalities are then added to the marrow. These strands are stained using fluorescent dyes so they can be easily located. If the bone marrow sample shares a matching DNA sequence with one of these fluorescent strands, the two will stick together, indicating the patient has those chromosomal abnormalities. FISH tests can find most of the same things as a karyotype test, but they can also find things that are too small to be seen with usual cytogenetic methods.

MINIMAL RESIDUAL DISEASE (MRD)[44]

After treatment, you may be tested to see whether any disease remains. If a small number of myeloma cells are detected in the body, that person is said to be MRD-positive, meaning they have minimal residual disease. If no cancer cells are detected, the person is MRD-negative. Some tests are better at finding cancer cells than others; however, particularly when there are not a lot of cells to spot. Healthcare professionals are always searching for tests that are more sensitive, meaning they are better able to detect cancer cells even at very low concentrations. Some people may have no physical symptoms but still have MRD. These tests are currently being evaluated as a potential surrogate for detecting relapse versus a bone marrow aspirate or biopsy. There are several recommended methods to test for MRD. These use samples from bone marrow aspirates and biopsies.

MASS SPECTROMETRY[11,45,46]



Mass spectrometry is a technique that determines the chemicals in a sample. It works by classifying ions in a sample by their mass and charge. In multiple myeloma, mass spectrometry can be used to take a very detailed look at what's in your blood. Importantly, mass spectrometry can determine when an M spike is due to myeloma or therapeutic monoclonal antibodies. Research suggests mass spectrometry might be as sensitive as bone marrow biopsies for testing MRD.

Discuss any questions you have about your lab tests or treatment plan with your healthcare team.

NOTES

Topic

Date

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