This booklet explains common tests for patients with multiple myeloma. Your doctor uses them to help diagnose and assess your multiple myeloma, and monitor your progress and side effects.

Reference ranges in this booklet are adapted from Mayo Clinic Laboratory Test Reference Values. The ranges listed on your report may be different. Contact your healthcare team to address any specific questions you may have related to your laboratory tests.
This worksheet can serve as a personal record to better understand your lab test results. Reference ranges—values that are considered normal in healthy individuals—are provided below as guides. Note that ranges vary among laboratories.

### Reference ranges

<table>
<thead>
<tr>
<th>Test</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>White blood cells (WBCs)</td>
<td>3.5-10.5 × 10^9/L</td>
<td></td>
</tr>
<tr>
<td>WBCs (neutrophils)</td>
<td>1.7-7.0 × 10^9/L</td>
<td></td>
</tr>
<tr>
<td>Red blood cells (RBCs)</td>
<td>4.32-5.72 × 10^12/L</td>
<td>Males: 38-50.0%</td>
</tr>
<tr>
<td>Hematocrit</td>
<td>Males: 38.3-50.0%</td>
<td></td>
</tr>
<tr>
<td>Hemoglobin (Hgb)</td>
<td>Males: 13.5-17.5 g/dL</td>
<td>Females: 12.0-15.5 g/dL</td>
</tr>
<tr>
<td>Platelets</td>
<td>150-450 × 10^9/L</td>
<td></td>
</tr>
<tr>
<td>Glucose, serum (fasting)</td>
<td>70-100 mg/dL</td>
<td></td>
</tr>
<tr>
<td>Blood urea nitrogen (BUN), serum</td>
<td>7-20 mg/dL</td>
<td></td>
</tr>
<tr>
<td>Creatinine, serum</td>
<td>0.6-1.3 mg/dL</td>
<td></td>
</tr>
<tr>
<td>Protein, total, serum</td>
<td>6.3-7.9 g/dL</td>
<td></td>
</tr>
<tr>
<td>Calcium, total, serum</td>
<td>8.9-10.1 mg/dL</td>
<td></td>
</tr>
<tr>
<td>Beta2-microglobulin, serum</td>
<td>1.21-2.7 mcg/mL</td>
<td></td>
</tr>
<tr>
<td>M spike (myeloma gamma globulin)</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

### Date of laboratory test

The laboratory performing the test should provide the associated reference range with the test results. To learn more about each test, refer to the sections inside the booklet. Your healthcare team will review your tests with you at your next appointment.
Complete blood count (CBC)
A CBC measures the number of red blood cell levels, white blood cells, and the total amount of platelets in the blood. Your body produces blood cells in the bone marrow. Since the overgrowth of plasma cells in the bone marrow can crowd out normal cells, leading to low blood counts, blood cells must be carefully monitored.

Red blood cells (RBC)
Normal range: male: 4.32-5.72 × 10¹²/L; female: 3.9-5.03 × 10¹²/L
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. A low RBC count, or anemia, can make you have shortness of breath and feel tired.

White blood cells (WBCs)
Normal range: 3.5-10.5 × 10⁹/L
WBCs help fight infections. A low WBC count reduces your body’s ability to fight disease.

WBC (neutrophils)
Normal range: 1.7-7.0 × 10⁹/L
Neutrophils are a type of WBC responsible for much of the body’s protection against infection. Neutrophils are produced in the bone marrow and released into the bloodstream to travel to wherever they are needed. Since a reduced count of neutrophils increases the risk for infection, a neutrophil count must be closely monitored throughout treatment.

Hemoglobin (Hgb)
Normal range: male: 13.5-17.5 g/dL; female: 12.0-15.5 g/dL
Hemoglobin is a protein in RBCs that carries oxygen in your blood to all parts of your body. Low hemoglobin levels may show that myeloma cells occupy too much of the bone marrow and that not enough space is left for the normal marrow cells that produce RBCs.

Platelets
Normal range: 150-450 × 10⁹/L
Platelets are blood cells that help blood to clot. If your blood has a low number of platelets, you can be at risk for serious bleeding. If your blood has too many platelets, you may have a higher risk of blood clots.
Chemistry profile
A blood chemistry profile can measure the level of different substances in your blood. Resulting levels provide insight to the function of different organs (kidney, liver, etc) that multiple myeloma and chemotherapy may affect.

Glucose, serum
Normal range: 70-100 mg/dL when fasting
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.

Blood urea nitrogen (BUN)
Normal range: 7-20 mg/dL
BUN is a measure of the level of urea in your blood. Urea nitrogen is what forms when protein breaks down. BUN levels must be carefully monitored in multiple myeloma patients since too much urea nitrogen in their blood puts them at an increased risk for kidney disease.

Creatinine, serum
Normal range: 0.6-1.3 mg/dL
Creatinine is a chemical waste product of creatine. Creatine is a chemical made by the body and is used to supply energy mainly to muscles. If kidney function is not normal, creatinine level increases in your blood. The evaluation of the BUN and creatinine ratio is an indicator of kidney function.

Protein, total, serum
Normal range: 6.3-7.9 g/dL
The total level of protein in the blood is measured by a total serum protein test. If the test results show abnormal protein levels, then multiple myeloma, kidney, liver, blood, and other autoimmune diseases may be indicated.

Calcium
Normal range: 8.9-10.1 mg/dL
All cells need calcium in order to work. The calcium blood test measures the level of calcium in the blood. If high levels of blood calcium are revealed, that may indicate kidney and bone damage.
**Beta2-microglobulin (B2M)**

**Normal range:** 1.21-2.7 mcg/mL

B2M is a protein produced by the malignant cells. Although this protein itself doesn’t cause problems, it can be a useful indicator of a patient’s prognosis (outlook). High levels mean the disease is more advanced and may be a worse prognosis.

**Serum protein electrophoresis (SPEP)**

The way your body fights infection is with antibody proteins (Igs), which are produced by normal plasma cells. Myeloma is a cancer of the plasma cells in the bone marrow. In multiple myeloma, the plasma cells produce an abnormal protein called monoclonal protein, or M protein.

SPEP is used to separate and identify the presence and levels of M protein in the blood. Each type of plasma cell produces only 1 type of Ig.

**M spike (myeloma gamma globulin)**

A large peak, or M spike, marks large amounts of M protein. The amounts of normal Igs may also decrease.

**Serum quantitative immunoglobulins (Igs)**

To measure levels of the major classes of Igs in the blood, this test detects and reveals an excessive amount of one of the Ig types. Electrophoresis can then determine if this comes from clones of a cancerous plasma cell.

**IgG**

**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**

**Normal range:** 61-356 mg/dL

IgA antibodies are mainly present in body secretions and are the chief antibodies in the mucous membranes of the gastrointestinal and respiratory tract, and in saliva and tears.
IgM

**Normal range: 37-286 mg/dL**

Your body produces IgM antibodies to help the immune system fight infections. IgM antibodies are found in blood and involved in combating blood infections. They are the first or primary Ig produced following exposure to an antigen.

IgE

**Mean level: 13.2 kU/L**

These antibodies play a role in allergic reactions and may be found in the lungs, skin, and mucous membranes.

IgD

**Normal range: 10 mg/dL or less**

Normally found in very small amounts, the exact role of this antibody is not yet completely understood.

Serum immunofixation (IFE)

The IFE identifies proteins called Igs in blood. Igs are antibodies that help your body fight infection. If the presence of an M protein excess is identified by the SPEP, the IFE will determine what subtype of M protein is present. Too much of the same Ig is usually due to different types of blood cancer. The adjacent diagram represents the different antibody classes (Igs) on an IFE.

Serum free light chain assay

Smaller units called heavy chains and light chains make up Igs. Produced within the plasma cells, these heavy and light chains bind together to form whole Igs. Typically producing more light chains than required, the plasma cells then enter the blood as free light chains. The activity of myeloma or plasma cell growth is linked to the amount of free light chains in the blood. The presence of an M protein is consistent with the excess production of 1 type of light chain (kappa or lambda).
Urinalysis is the physical, chemical, and microscopic examination of urine. It involves a number of tests to detect and measure various compounds that pass through the urine.

### Serum free kappa light chains

**Normal range:** 0.39–1.94 mg/dL

Multiple myeloma or another plasma cell disorder may be indicated by increased kappa free light chains and an increased kappa/lambda ratio.

### Serum free lambda light chains

**Normal range:** 0.57–2.63 mg/dL

Multiple myeloma or another plasma cell disorder may be indicated by increased lambda free light chains and a decreased kappa/lambda ratio.

### Serum free kappa/lambda ratio

**Normal range:** 0.26–1.65

Abnormal kappa/lambda ratio may indicate excess production of the kappa or lambda light chain due to multiple myeloma.

### 24-hour urine analysis

Urine is collected over a 24-hour period

### 24-hour urine total protein

**Normal range:** <115 mg/12 hours

The total amount of protein being released in your urine will be measured over a 24-hour period.

### Urine protein electrophoresis (UPEP)

A urine protein electrophoresis is a test that estimates how much of certain proteins you have in your urine. The arrow in this diagram corresponds to the M spike (M protein) in the urine.
**Urine immunofixation**

Urine immunofixation is a test to look for proteins in urine. The test is most often used to check levels of M proteins. In some myeloma cases, light chains are secreted that are so small that they can only be detected in urine. The adjacent diagram shows an abnormal monoclonal protein band (arrow).

**Creatinine clearance**

**Normal range:** male: 77-160 mL/min/BSA; female: 56-131 mL/min/BSA

Creatinine is a breakdown product of creatine, which is an important part of muscle. The creatinine clearance test helps provide information about how well the kidneys are working. The test compares the creatine level in urine with the creatine level in blood.

**X-ray/bone survey**

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)**

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. The adjacent diagram shows an MRI of the lower spine. The X-ray image shows myeloma lesions in the bone marrow.
PET scan

PET scan is an imaging test that uses a radioactive substance called a tracer 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 biopsy

Your doctor may order this test if you have abnormal types or numbers of red or white blood cells or platelets on a CBC. People with multiple myeloma have too many plasma cells in their bone marrow. For this test, a doctor or nurse will numb the pelvis and a needle is used to extract some solid bone and some bone marrow. Then, a microscope is used to examine the bone marrow tissue to determine the presence and number of myeloma cells. This test can be done in the hospital or doctor’s office, and most people can go home as soon as the test is over.

Bone marrow fluid extraction, in particular, can cause brief, but sharp, pain. You’ll be fully awake during the procedure, but the biopsy site will be numbed to reduce pain.

Glossary

g—A gram (g) is a unit of measurement of mass, or the total amount of matter in an object.
mg—A milligram (mg) is equal to one thousandth of a gram (g).
L—A liter (L) is a unit of measurement of volume. Volume is a measurement of the total space occupied by a substance, mainly liquids.
dL—A deciliter (dL) is equal to one-tenth of a liter.
Bone marrow biopsy—The removal of marrow from inside bone. Bone marrow is the soft tissue inside bones that helps form blood cells. It is found in the hollow part of most bones.
Electrophoresis—Electrophoresis is a process used in laboratories to separate molecules by size and electrical charge.
Plasmacytoma—A plasmacytoma is a tumor of malignant plasma cells that has formed in the bones.
Questions to ask your healthcare team

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