



UNDERSTANDING YOUR MULTIPLE MYELOMA LAB TESTS



This lab tracker booklet explains common tests for patients with multiple myeloma. If you have any questions about your test results, discuss them with your healthcare team.



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 guides. Note that ranges vary among laboratories.



Date of laboratory test					
	Reference ranges	Mark the test values in the column below each date			
COMPLETE BLOOD COUNT (CBC)^{1,2} Pages 4-5					
White blood cells (WBCs)	3.5-10.5 × 10 ⁹ /L				
Neutrophils	1.56-6.45 × 10 ⁹ /L				
Red blood cells (RBCs)	Males: 4.32-5.72 × 10 ¹² /L Females: 3.90-5.03 × 10 ¹² /L				
Hematocrit	Males: 38.8%-50.0% Females: 34.9%-44.5%				
Hemoglobin (Hgb)	Males: 13.5-17.5 g/dL Females: 12.0-15.5 g/dL				
Platelets	150-450 × 10 ⁹ /L				
CHEMISTRY PROFILE³⁻⁸ Pages 6-8					
Blood urea nitrogen (BUN), serum	7-20 mg/dL				
Creatinine, serum	Males: 0.74-1.35 mg/dL Females: 0.59-1.04 mg/dL				
Calcium, total, serum	8.8-10.2 mg/dL				
Glucose, serum (fasting)	≤126 mg/dL				
Protein, total, serum	6.3-7.9 g/dL				
Beta2-microglobulin (B2M), serum	1.21-2.70 mcg/mL				
SERUM PROTEIN ELECTROPHORESIS (SPEP)⁹ Pages 8-9					
M spike (myeloma gamma globulin)	Any M spike presence may be abnormal				



Unit measures: 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; 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.



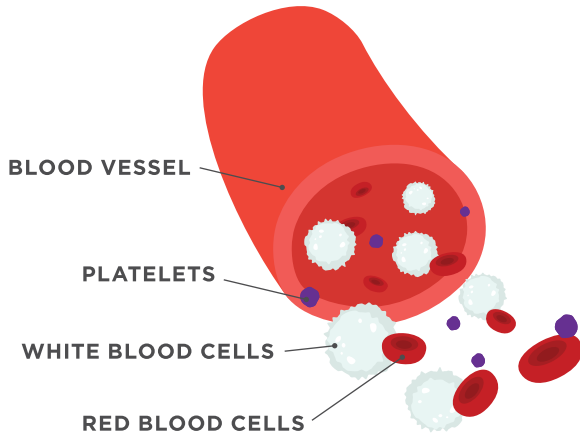
The laboratory performing the test should provide you with the reference range associated with the test results. To learn more about each test, refer to the sections inside this booklet. If you have any questions about your test results, discuss them with your healthcare team.

Date of laboratory test					
	Reference ranges	Mark the test values in the column below each date			
SERUM QUANTITATIVE IMMUNOGLOBULINS (Igs)¹⁰⁻¹² Pages 9-10					
IgG	767-1590 mg/dL				
IgA	61-356 mg/dL				
IgM	37-286 mg/dL				
IgD	≤10 mg/dL				
IgE	≤214 kU/L				
SERUM IMMUNOFIXATION (IFE)¹³ Page 11					
IFE	N/A				
SERUM FREE LIGHT CHAIN ASSAY¹⁴ Pages 11-12					
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				
24-HOUR URINE ANALYSIS^{4,15-17} Pages 13-14					
24-hour urine total protein	<229 mg/24 hours				
M spike, urine	≤500 mg/24 hours for asymptomatic patients				
Urine immunofixation	N/A				
Creatinine clearance	Males: 77-160 mL/min/BSA Females: 56-131 mL/min/BSA				

N/A=not applicable.

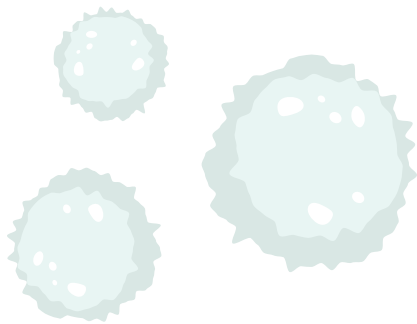
GLOSSARY

This section provides explanations to help you understand the lab tests listed in this lab tracker booklet. It also explains what the lab values tell about the progress of the disease, effect of treatment, and indications of possible side effects.



Complete blood count (CBC)¹⁸⁻²⁰

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 overgrowth of myeloma plasma cells in the bone marrow can crowd out normal cells, leading to low blood counts. Blood cell counts are carefully monitored to track disease and treatment effects.



White blood cells (WBCs)^{1,21}

Normal range: $3.5-10.5 \times 10^9/L$

WBCs help fight infections. A low WBC count reduces your body's ability to fight disease.



Neutrophils^{2,21,22}

Normal range: $1.56-6.45 \times 10^9/L$

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 reduction in neutrophils increases the risk for infection, a neutrophil count must be closely monitored throughout treatment.



Red blood cells (RBCs)¹

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 count¹

**Normal range: male: $4.32-5.72 \times 10^{12}/L$;
female: $3.90-5.03 \times 10^{12}/L$**

A low RBC count, also called anemia, can make you have shortness of breath and feel tired.

Hematocrit¹

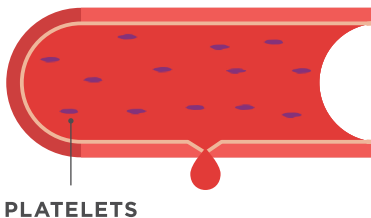
**Normal range: male: 38.8%-50.0%;
female: 34.9%-44.5%**

Proportion of RBCs to the fluid (or plasma) in your blood.

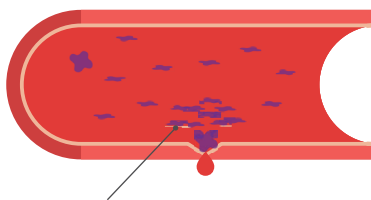
Hemoglobin (Hgb)^{1,23}

**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 the blood to all parts of your body.



PLATELETS



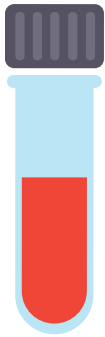
PLATELETS FORM CLOTS
TO STOP BLEEDING

Platelets^{1,20}

Normal range: $150-450 \times 10^9/L$

Platelets help your blood to clot.



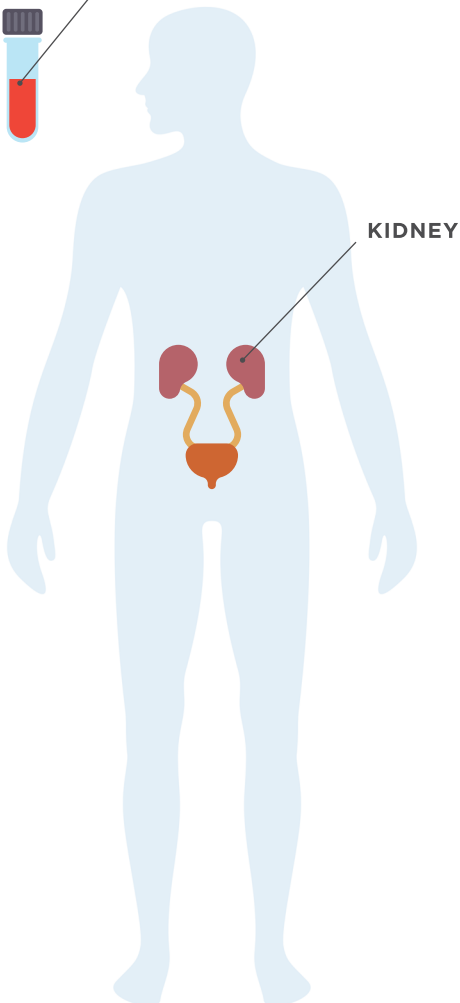


A BLOOD SAMPLE IS
TAKEN FOR A BLOOD
CHEMISTRY PROFILE

Chemistry profile¹⁸

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

A BLOOD SAMPLE IS TAKEN



Blood urea nitrogen (BUN) serum^{3,24}

Normal range: 7-20 mg/dL

BUN is a measure of the level of urea in your blood. BUN levels must be carefully monitored in multiple myeloma. Elevated BUN levels may be a sign of kidney dysfunction.

Creatinine, serum^{4,25}

**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^{5,26}

Normal range: 8.8-10.2 mg/dL

All cells need calcium in order to work. Elevated levels of calcium may be an indicator of bone damage due to multiple myeloma.

Glucose, serum^{6,27}

Normal range: ≤ 126 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.

Protein, total, serum^{7,28}

Normal range: 6.3-7.9 g/dL

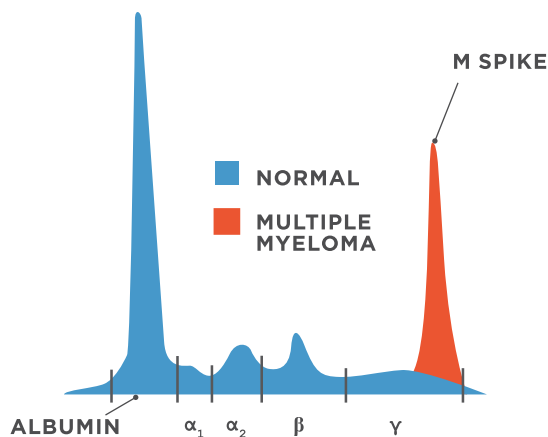
The level of protein in the blood is measured by a total serum protein test. If the test results show abnormal protein levels, then multiple myeloma, kidney, liver, blood, and other autoimmune diseases may be indicated.



Beta2-microglobulin (B2M), serum⁸

Normal range: 1.21-2.70 mcg/mL

B2M is a protein produced by malignant cells. It can be a useful indicator of a patient's prognosis (outlook). High levels mean the disease is more advanced and may indicate a poor prognosis.



Serum protein electrophoresis (SPEP)^{9,19,29,30}

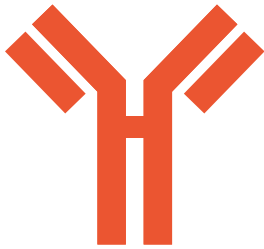
Antibodies are part of the immune system, which helps your body fight infection. They are produced by normal plasma cells. Myeloma is a cancer of the plasma cells in the bone marrow. In multiple myeloma, one plasma cell goes bad and makes multiple copies of itself (clones). Each copy makes the same antibody protein or M spike. 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 immunoglobulin.

M spike (myeloma gamma globulin)^{9,16,30}

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 quantitative immunoglobulins (Igs)³⁰

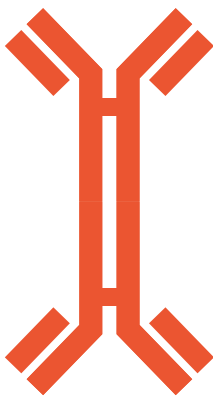
This test measures the levels of the major classes of Igs in the blood, and can reveal excessive amounts of any of the Ig types. Electrophoresis can then determine if this comes from clones of a cancerous plasma cell.



IgG^{10,31}

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^{10,32}

Normal range: 61-356 mg/dL

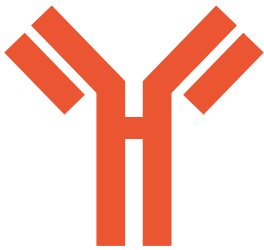
IgA antibodies are mainly present in body secretions and are the chief antibodies in the mucous membranes of the gastrointestinal and respiratory tract, and in saliva and tears.



IgM^{10,33,34}

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^{12,35}

Normal range: ≤10 mg/dL

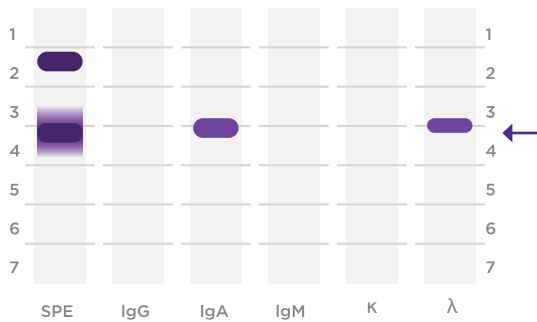
Normally found in very small amounts, this antibody is thought to function in allergic responses.



IgE^{11,36}

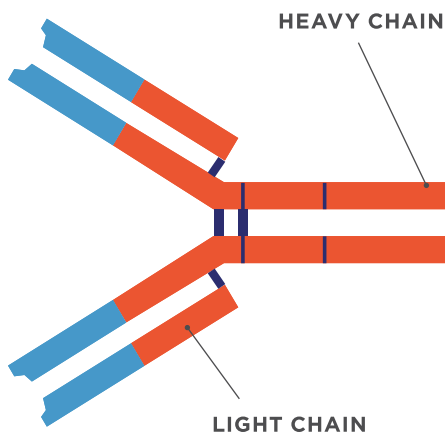
Mean level: ≤214 kU/L

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



Serum immunofixation (IFE)^{37,38}

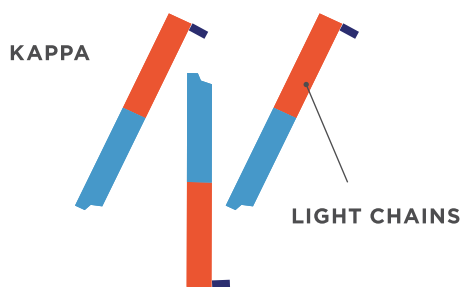
The IFE identifies proteins called Igs in blood. Igs are antibodies that help your body fight infection. If the presence of an M protein excess is identified by the SPEP, the IFE will determine what subtype of M protein is present. Too much of 1 type of Ig is usually tied to specific types of blood cancer. The adjacent diagram represents the different antibody classes (Igs) seen on an IFE.



Serum free light chain assay^{9,30}

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 presence of an M protein is consistent with the excess production of 1 type of light chain (kappa or lambda).

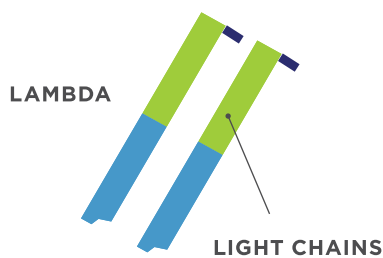




Serum free kappa light chains^{14,30}

Normal range: 0.33-1.94 mg/dL

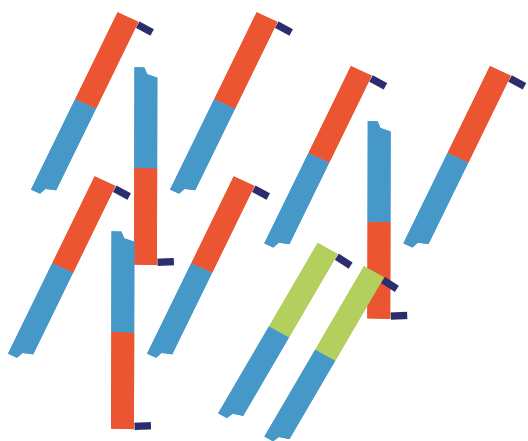
Multiple myeloma may be indicated by increased kappa free light chains and an increased kappa/lambda ratio.



Serum free lambda light chains^{14,30}

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^{14,30}

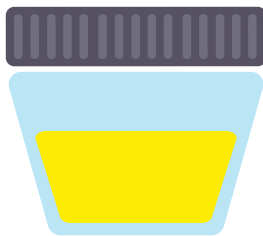
Normal range: 0.26-1.65

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

24-hour urine analysis³⁹

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.

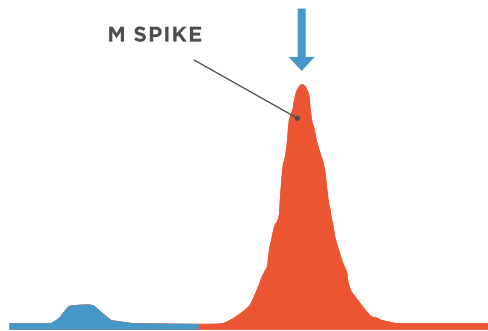
URINE IS COLLECTED
OVER A 24-HOUR
PERIOD



24-hour urine total protein^{15,40}

Normal range: <229 mg/24 hours

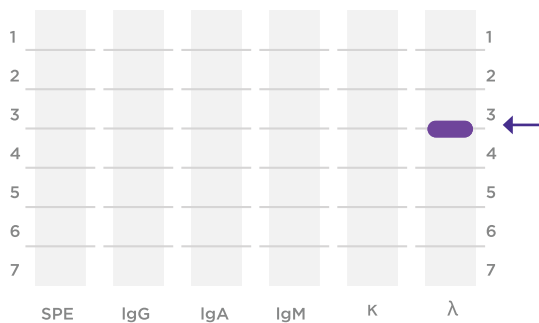
The total amount of protein being released in your urine will be measured over a 24-hour period on an IFE.



Urine protein electrophoresis (UPEP)^{16,30}

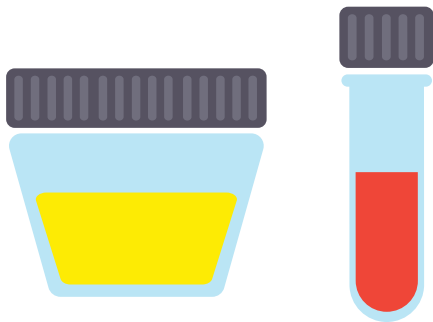
Normal range: ≤500 mg/24 hours for asymptomatic patients

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, as seen in the UPEP.



Urine immunofixation^{17,41}

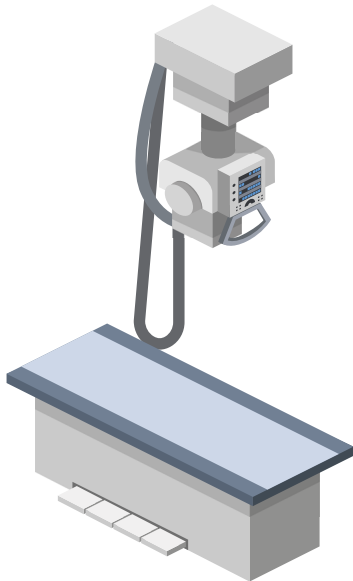
Urine immunofixation is a test most often used to check for the presence of M proteins. In some myeloma cases, the light chains are secreted so small that they can be detected only in urine with this test. The adjacent diagram shows an abnormal monoclonal protein band (arrow) compared with other normal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



Creatinine clearance^{25,42}

**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 creatinine level in urine with the creatinine level in blood.



X-ray/bone survey^{30,43}

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.

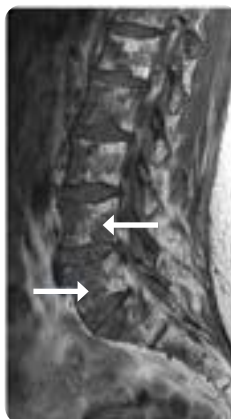


**BONE X-RAY OF
MULTIPLE MYELOMA
PATIENT**



Magnetic resonance imaging (MRI)³⁰

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 image below shows an MRI of the lower spine. The image shows myeloma lesions in the bone marrow.



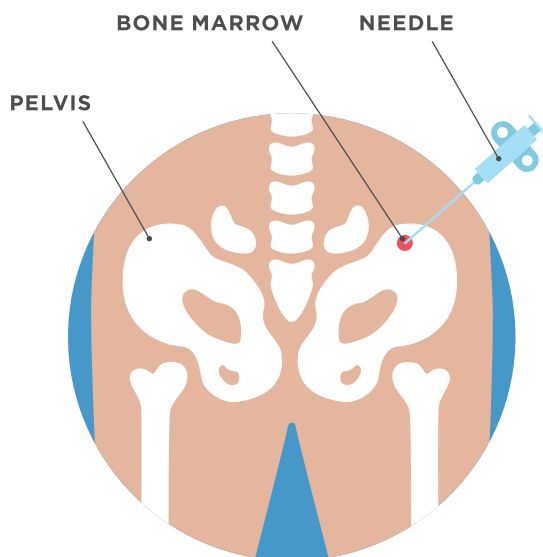


PET scan³⁰

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 biopsy³⁰



Your doctor may order this test if he/she suspects myeloma or another blood-related disease. People with multiple myeloma have too many plasma cells in their bone marrow. For this test, a doctor or nurse will numb the back of the pelvis and use a needle 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.



References

1. Complete blood count (CBC). Mayo Clinic website. <https://www.mayoclinic.org/tests-procedures/complete-blood-count/about/pac-20384919?p=1>. Accessed October 19, 2018.
2. CBC with differential, blood. Mayo Clinic Laboratories website. <https://www.mayomedicallaboratories.com/test-catalog/Clinical+and+Interpretive/9109>. Accessed October 22, 2018.
3. Blood urea nitrogen (BUN) test. Mayo Clinic website. <http://www.mayoclinic.org/tests-procedures/blood-urea-nitrogen/about/pac-20384821>. Accessed April 26, 2018.
4. Creatinine clearance, serum and 24-hour urine. Mayo Clinic Laboratories website. <https://www.mayomedicallaboratories.com/test-catalog/Clinical+and+Interpretive/113357>. Accessed October 19, 2018.
5. Calcium, total, serum. Mayo Clinic Laboratories website. <https://www.mayomedicallaboratories.com/test-catalog/Clinical+and+Interpretive/601514>. Accessed October 19, 2018.
6. Glucose, random, serum. Mayo Clinic Laboratories website. <https://www.mayomedicallaboratories.com/test-catalog/Clinical+and+Interpretive/89115>. Accessed October 19, 2018.
7. Electrophoresis, protein, serum. Mayo Clinic Laboratories website. <https://www.mayomedicallaboratories.com/test-catalog/Clinical+and+Interpretive/8159>. Accessed April 26, 2018.
8. Beta-2-microglobulin, serum. Mayo Clinic Laboratories website. <https://www.mayomedicallaboratories.com/test-catalog/Clinical+and+Interpretive/9234>. Accessed April 25, 2018.
9. Multiple myeloma. Lab Tests Online website. <https://labtestsonline.org/conditions/multiple-myeloma>. Accessed April 26, 2018.
10. Immunoglobulins (IgG, IgA, and IgM), serum. Mayo Clinic Laboratories website. <https://www.mayomedicallaboratories.com/test-catalog/Clinical+and+Interpretive/8156>. Accessed April 25, 2018.
11. Immunoglobulin D (IgD), serum. Mayo Clinic Laboratories website. <https://www.mayomedicallaboratories.com/test-catalog/Clinical+and+Interpretive/9272>. Accessed April 26, 2018.
12. Immunoglobulin E (IgE), serum. Mayo Clinic Laboratories website. <https://www.mayomedicallaboratories.com/test-catalog/Clinical+and+Interpretive/8159>. Accessed April 25, 2018.
13. Immunofixation only, serum. Mayo Clinic Laboratories website. <https://www.mayomedicallaboratories.com/test-catalog/Clinical+and+Interpretive/32436>. Accessed October 24, 2018.
14. Immunoglobulin free light chains, serum. Mayo Clinic Laboratories website. <https://www.mayomedicallaboratories.com/test-catalog/Clinical+and+Interpretive/84190>. Accessed April 25, 2018.
15. Protein, total, 24 hour, urine. Mayo Clinic Laboratories website. <https://www.mayomedicallaboratories.com/test-catalog/Clinical+and+Interpretive/8261>. Accessed April 25, 2018.
16. Rajkumar SV, Dimopoulos MA, Palumbo A, et al. International Myeloma Working Group updated criteria for the diagnosis of multiple myeloma. *Lancet Oncol*. 2014;15(12):e538-548.
17. Immunofixation - urine. MedlinePlus website. <https://medlineplus.gov/ency/article/003593.htm>. Accessed April 26, 2018.
18. Understanding your lab test results. American Cancer Society website. <https://www.cancer.org/treatment/understanding-your-diagnosis/tests/understanding-your-lab-test-results.html>. Accessed April 26, 2018.
19. What is multiple myeloma? American Cancer Society website. <https://www.cancer.org/cancer/multiple-myeloma/about/what-is-multiple-myeloma.html>. Accessed April 26, 2018.
20. Components of blood. Merck Manual website. <https://www.merckmanuals.com/home/blood-disorders/biology-of-blood/components-of-blood>. Accessed January 1, 2019.
21. Low white blood cell (neutrophil) counts and the risk of infection. American Cancer Society website. <http://www.cancer.org/treatment/treatmentsandsideeffects/physicalsideeffects/infectionsinpeoplewithcancer/infectionsinpeoplewithcancer/infections-in-people-with-cancer-low-w-b-c-and-weak-immune-sys>. Accessed April 25, 2018.
22. Neutrophils. MedlinePlus website. (04/2018). <http://www.medlineplus.gov/ency/imagepages/19864.htm>. Accessed April 26, 2018.
23. Hemoglobin test. Mayo Clinic website. <http://www.mayoclinic.org/tests-procedures/hemoglobin-test/basics/definition/prc-20015022>. Accessed April 26, 2018.
24. BUN (blood urea nitrogen). MedlinePlus website. <https://medlineplus.gov/labtests/bunbloodureanitrogen.html>. Accessed April 26, 2018.
25. Creatinine blood test. MedlinePlus website. <https://medlineplus.gov/ency/article/003475.htm>. Accessed April 26, 2018.
26. Calcium blood test. MedlinePlus website. <http://medlineplus.gov/ency/article/003477.htm>. Accessed April 26, 2018.
27. Search results for blood sugar. MedlinePlus website. <https://vsearch.nlm.nih.gov/vivismo/cgi-bin/query-meta?v%3Aproject=medlineplus&v%3Asources=medlineplus-bundle&query=blood+sugar>. Accessed April 26, 2018.
28. Total protein. MedlinePlus website. <http://www.medlineplus.gov/ency/article/003483.htm>. Accessed April 26, 2018.
29. O'Connell TX, Horita TJ, Kasravi B. Understanding and interpreting serum protein electrophoresis. *Am Fam Physician*. 2005;71(1):105-112.
30. Tests to find multiple myeloma. American Cancer Society website. <https://www.cancer.org/cancer/multiple-myeloma/detection-diagnosis-staging/testing.html>. Accessed April 26, 2018.
31. Immunoglobulin G (IgG). Lab Tests Online website. <https://labtestsonline.org/glossary/igg>. Accessed April 26, 2018.
32. Immunoglobulin A (IgA). Lab Tests Online website. <https://labtestsonline.org/glossary/iga>. Accessed April 26, 2018.
33. Alberts B, Johnson A, Lewis J, et al. B cells and antibodies. In: *Molecular Biology of the Cell*. 4th ed. <https://www.ncbi.nlm.nih.gov/books/NBK26884/>. Accessed January 22, 2019.
34. Immunoglobulin M (IgM). Lab Tests Online website. <https://labtestsonline.org/glossary/igm>. Accessed April 26, 2018.
35. Immunoglobulin E (IgE). Lab Tests Online website. <https://labtestsonline.org/glossary/ige>. Accessed April 26, 2018.
36. Immunoglobulin D (IgD). Lab Tests Online website. <https://labtestsonline.org/glossary/igd>. Accessed April 26, 2018.
37. Immunofixation blood test. MedlinePlus website. <https://medlineplus.gov/ency/article/003543.htm>. Accessed April 26, 2018.
38. Wu Y, Yang X, Wang T, Wang H, Li Z. Identification of M protein from filter paper using serum protein and immunofixation electrophoresis. *Am J Clin Pathol*. 2012;138(4):604-608.
39. Urinalysis (urine test). MedicineNet website. <https://www.medicinenet.com/urinalysis/article.htm>. Accessed April 26, 2018.
40. Urine protein and urine protein to creatinine ratio. Lab Tests Online website. <https://labtestsonline.org/tests/urine-protein-and-urine-protein-creatinine-ratio>. Accessed April 26, 2018.
41. Tracy E, Andrews DM, Constantine MA, Zhu Y. Differences identified between serum and urine immunofixation electrophoresis. *Clin Chim Acta*. 2015;439:68-70.
42. Creatinine clearance, serum and 24-hr urine. Mayo Clinic Laboratories website. <https://www.mayomedicallaboratories.com/test-catalog/Overview/113357>. Accessed April 26, 2018.
43. Ak R, Akođlu EÜ, Onur ÖE. Diffuse punched out lesions in multiple myeloma. *Bull Emerg Trauma*. 2016;4(3):180-181.



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