

# **ASSESSMENT OF NUTRITIONAL STATUS:**

## Biochemical assessment

# Basic Metabolic Panel

The basic metabolic panel (BMP) is a frequently ordered panel of 8 tests that gives a healthcare practitioner important information about the current status of a person's [metabolism](#), including health of the kidneys, blood glucose level, and electrolyte and [acid/base balance](#). Abnormal results, and especially combinations of abnormal results, can indicate a problem that needs to be addressed.

- The BMP includes the following tests:
- [Glucose](#) - energy source for the body; a steady supply must be available for use, and a relatively constant level of glucose must be maintained in the blood.
- [Calcium](#) - one of the most important minerals in the body; it is essential for the proper functioning of muscles, nerves, and the heart and is required in blood clotting and in the formation of bones.
- *Electrolytes*
- [Sodium](#) - vital to normal body processes, including nerve and muscle function
- [Potassium](#) - vital to cell metabolism and muscle function
- [CO<sub>2</sub> \(carbon dioxide, bicarbonate\)](#) - helps to maintain the body's acid-base balance ([pH](#))
- [Chloride](#) - helps to regulate the amount of fluid in the body and maintain the acid-base balance
- *Kidney Tests*
- [BUN \(blood urea nitrogen\)](#) - waste product filtered out of the blood by the kidneys; conditions that affect the kidney have the potential to affect the amount of urea in the blood.
- [Creatinine](#) – waste product produced in the muscles; it is filtered out of the blood by the kidneys so blood levels are a good indication of how well the kidneys are working.

# Comprehensive Metabolic Panel

- A comprehensive metabolic panel is a blood test that measures your sugar (glucose) level, [electrolyte](#) and fluid balance, [kidney](#) function, and liver function.
- Glucose is a type of sugar your body uses for energy. Electrolytes keep your body's fluids in balance. They also help keep your body working normally, including your heart rhythm, muscle contraction, and brain function. The kidneys help keep the right balance of water, salts, and minerals in the blood. They also filter out waste and other unneeded substances from the blood. The liver helps with digestion and produces some vitamins and other substances that the body needs. It also controls the amounts of glucose, protein, and fat in the blood and releases substances that keep your [immune system](#) healthy.
- Your doctor may order a comprehensive metabolic panel as part of a regular health examination. Your doctor may use this test to check on a medical condition, such as high blood pressure, or to help diagnose a medical condition, such as [diabetes](#).
- This panel measures the blood levels of albumin, blood urea nitrogen, calcium, carbon dioxide, chloride, creatinine, glucose, potassium, sodium, total bilirubin and protein, and liver enzymes (alanine aminotransferase, alkaline phosphatase, and aspartate aminotransferase).

# Complete Blood Count (CBC)

- The complete blood count (CBC) is one of the most commonly ordered blood tests. To understand this test, it is important to know that blood consists of two major parts: plasma and cellular elements. The plasma is the part of the blood that is liquid which allows the blood to flow easily. The other part of the blood consists of blood cells.
- The major cells in the blood are white blood cells (WBC), red blood cells (RBC), and platelets. Each of these types of cells carries out specific and important functions.
- The complete blood count test measures the quantity of all the different types of cells in the blood. It also provides some valuable information on other parameters related to each type of blood cell.

The following lists some of the typical values of the components of the complete blood count:

- **WBC (white blood cell)** count signifies the number of white blood cells in the blood and usually ranges between 4,300 and 10,800 cells per cubic millimeter (cmm).
- **RBC (red blood cell)** count measures the number of red blood cells in a volume of blood and usually ranges between 4.2 to 5.9 million cells per cmm.
- **Hemoglobin (Hbg)** measures the amount of the hemoglobin molecule in a volume of blood and normally is 13.8 to 17.2 grams per deciliter (g/dL) for men and 12.1 to 15.1 g/dL for women.
- **Hematocrit (Hct)** signifies the percentage of the whole blood occupied by red blood cells and usually ranges between 45%-52% for men and 37%-48% for women.
- **Mean corpuscular volume (MCV)** is the measurement of the average size or volume of a typical red blood cell in a blood sample and usually ranges between 80 to 100 femtoliters (a fraction of one-millionth of a liter).
- **Mean corpuscular hemoglobin (MCH)** measures the amount of hemoglobin in an average red blood cell and usually ranges between 27 to 32 picograms (a small fraction of a gram).
- **Mean corpuscular hemoglobin concentration (MCHC)** measures the average hemoglobin concentration in a volume of blood, and it usually ranges between 32%-36%.
- **Red cell distribution width (RDW)** measures the variability in the red blood cells' size and shape and usually ranges between 11 to 15.
- **Platelet count** measures the number of platelets in a volume of blood and usually ranges between 150,000 to 400,000 per cmm.
- **Mean platelet volume (MPV)** measures the average size of platelets in a volume of blood. The normal range is between 6 to 12 femtoliters (a very small fraction of a liter).

# Urine Analysis

- A urinalysis is a group of physical, chemical, and microscopic tests. The tests detect and/or measure several substances in the urine, such as byproducts of normal and abnormal [metabolism](#), cells, cellular fragments, and [bacteria](#).
- Urine is produced by the kidneys, two fist-sized organs located on either side of the spine at the bottom of the ribcage. The kidneys filter wastes out of the blood, help regulate the amount of water in the body, and conserve [proteins](#), [electrolytes](#), and other compounds that the body can reuse. Anything that is not needed is eliminated in the urine, traveling from the kidneys through ureters to the bladder and then through the [urethra](#) and out of the body. Urine is generally yellow and relatively clear, but each time a person urinates, the color, quantity, concentration, and content of the urine will be slightly different because of varying constituents.
- Many disorders may be detected in their early stages by identifying substances that are not normally present in the urine and/or by measuring abnormal levels of certain substances. Some examples include glucose, protein, bilirubin, red blood cells, white blood cells, crystals, and bacteria. They may be present because:
  - There is an elevated level of the substance in the blood and the body responds by trying to eliminate the excess in the urine.
  - [Kidney disease](#) is present.
  - There is a [urinary tract infection](#) present, as in the case of bacteria and white blood cells.

# Assessment of Anemia

- **Complete blood count (CBC).** A CBC is used to count the number of blood cells in a sample of your blood. For anemia, it will be interested in the levels of the red blood cells contained in blood (hematocrit) and the hemoglobin in blood.
- Normal adult hematocrit values vary among medical practices but are generally between 40% and 52% for men and 35% and 47% for women. Normal adult hemoglobin values are generally 14 to 18 grams per deciliter for men and 12 to 16 grams per deciliter for women.
- **A test to determine the size and shape of your red blood cells.** Some of red blood cells might also be examined for unusual size, shape and color.
- **Additional diagnostic tests**
- Occasionally, it can be necessary to study a sample of your bone marrow to diagnose anemia.

# Review Of Systems (ROS)

- A **review of systems (ROS)**, also called a **systems enquiry** or **systems review**, is a technique used by healthcare providers for eliciting a [medical history](#) from a patient. It is often structured as a component of an [admission note](#) covering the organ systems, with a focus upon the subjective [symptoms](#) perceived by the patient (as opposed to the objective [signs](#) perceived by the clinician). Along with the [physical examination](#), it can be particularly useful in identifying conditions that do not have precise diagnostic tests.

## Examples

- Whatever [system](#) a specific condition may seem restricted to, it may be reasonable to review all the other systems in a comprehensive history. Different sources describe slightly different systems of organizing the organ systems. However, the following are examples of what can be included. Unspecified and other symptoms can't consider for both HPI and ROS:



# Glucose tolerance test(GTT)

The **glucose tolerance test** is a [medical test](#) in which [glucose](#) is given and [blood](#) samples taken afterward to determine how quickly it is cleared from the blood. The test is usually used to test for [diabetes](#), [insulin resistance](#), impaired [beta cell](#) function, and sometimes [reactive hypoglycemia](#) and [acromegaly](#), or rarer disorders of [carbohydrate metabolism](#). In the most commonly performed version of the test, an *oral glucose tolerance test* (OGTT), a standard dose of glucose is ingested by mouth and blood levels are checked two hours later. Many variations of the GTT have been devised over the years for various purposes, with different standard doses of glucose, different routes of administration, different intervals and durations of sampling, and various substances measured in addition to blood glucose.

- **Procedure**[\[edit\]](#)
- A zero time (baseline) blood sample is drawn.
- The patient is then given a measured dose (below) of glucose solution to drink within a 5-minute time frame.
- Blood is drawn at intervals for measurement of glucose ([blood sugar](#)), and sometimes [insulin](#) levels. The intervals and number of samples vary according to the purpose of the test. For simple diabetes screening, the most important sample is the 2 hour sample and the 0 and 2 hour samples may be the only ones collected. A laboratory may continue to collect blood for up to 6 hours depending on the protocol requested by the physician.

# Glycosylated Hb

- **Glycated hemoglobin (A1C, hemoglobin A1c, HbA1c, or less commonly HgbA1c, haemoglobin A1c, HbA<sub>1c</sub>, Hb1c, etc.)** is a form of [hemoglobin](#) (abbreviated Hb) that is chemically linked to a sugar. The usual sugar is [glucose](#). The formation of the sugar-Hb linkage indicates the presence of excessive sugar in the bloodstream, often indicative of [diabetes](#). A1C is of particular interest because it is easy to detect.
- The process by which sugars attach to Hb is called [glycation](#). HbA<sub>1c</sub> is a measure of the beta-N-1-deoxy fructosyl component of hemoglobin.
- It is measured primarily to determine the three-month average [blood sugar level](#) and can be used as a diagnostic test for [diabetes mellitus](#) and as an assessment test for [glycemic control](#) in people with diabetes. The test is limited to a three-month average because the average lifespan of a red blood cell is four months. Since individual red blood cells have varying lifespans, the test is used as a limited measure of three months. Normal levels of glucose produce a normal amount of glycated hemoglobin. As the average amount of plasma glucose increases, the fraction of glycated hemoglobin increases in a predictable way. In diabetes, higher amounts of glycated hemoglobin, indicating poorer control of blood glucose levels, have been associated with [cardiovascular disease](#), [nephropathy](#), [neuropathy](#), and [retinopathy](#).

## Principle in medical diagnostics of Glycosylated Hb

- Glycation of proteins is a frequent occurrence, but in the case of hemoglobin, a nonenzymatic condensation reaction occurs between glucose and the N-end of the [beta chain](#). This reaction produces a [Schiff base](#) ( $R-N=CHR'$ , R = beta chain,  $CHR'$ = glucose-derived), which is itself converted to 1-deoxyfructose. This second conversion is an example of an [Amadori rearrangement](#). When blood glucose levels are high, [glucose](#) molecules attach to the hemoglobin in [red blood cells](#). The longer hyperglycemia occurs in blood, the more glucose binds to hemoglobin in the red blood cells and the higher the glycosylated hemoglobin.
- Once a hemoglobin molecule is glycosylated, it remains that way. A buildup of glycosylated hemoglobin within the red cell, therefore, reflects the average level of glucose to which the cell has been exposed during its [life-cycle](#). Measuring glycosylated hemoglobin assesses the effectiveness of therapy by monitoring long-term serum glucose regulation.
- A1c is a weighted average of blood glucose levels during the life of the red blood cells (117 days for men and 106 days in women<sup>[12]</sup>). Therefore, glucose levels on days nearer to the test contribute substantially more to the level of A1c than the levels in days further from the test.<sup>[13]</sup>
- This is also supported by data from clinical practice showing that HbA1c levels improved significantly after 20 days from start or intensification of glucose-lowering treatment.<sup>[14]</sup>
- Measurement

# Differential diagnosis of B12 and folate

Vitamin B12 and folate deficiencies are a lack of these two B complex [vitamins](#) that the body needs for several important functions. They are required to make normal [red blood cells \(RBCs\)](#), repair tissues and cells, synthesize [DNA](#) (the genetic material in cells). B12 is also important for normal nerve cell function. B12 and folate (also known as folic acid or vitamin B9) are nutrients that cannot be produced in the body and must be supplied through the diet.

## Laboratory Tests

- [B12 blood level](#). If low, a deficiency is indicated, but it does not identify the cause. A low level of [intrinsic factor](#) may be a cause, for example. This test also may be ordered to monitor the effectiveness of treatment.
- [Folate level](#). Either [serum](#) or RBC folate levels may be tested; if either is low, it indicates a deficiency. The tests may also be ordered to monitor the effectiveness of treatment. Pregnant women may be given this test at prenatal checkups.
- [CBC](#). This group of tests is ordered routinely to evaluate the health of blood cells. It determines the number of cell types and can give an indication of the physical characteristics of some of the cells. With both B12 and folate deficiencies, the amount of hemoglobin and the red blood cell count may be low and the RBCs are abnormally large (macrocytic or megaloblastic), resulting in an anemia. White blood cells and platelets also may be decreased.
- [Methylmalonic acid \(MMA\)](#). This test may be ordered to help detect mild or early B12 deficiency.
- [Homocysteine](#). This test is seldom ordered but may be elevated in both B12 and folate deficiency.