



Laboratory Studies

Generally, it is advisable for every patient to have annual laboratory tests to establish a baseline for monitoring, usually conducted by their primary care provider (PCP). These tests often comprise a complete blood count (CBC), comprehensive metabolic panel (CMP), thyroid-stimulating hormone (TSH) test, lipid panel, hemoglobin A1C (HA1C), urinalysis (UA), urine drug screen (Utox), and human chorionic gonadotropin (HcG) test for women. Depending on the medications a patient is taking, more frequent testing may be necessary.

Here is a quick reference guide (a more detailed review is available below the chart). Laboratory study results will vary for normal ranges depending on the different source(s). These values represent a general representation for exam purposes. In actual practice, you will utilize the reference ranges identified by your organization(s).

Lab Test	Normal Values
White Blood Cells (WBC)	4.5-11.0 x 10 ⁹ /L
Red Blood Cells (RBC)	Male: 4.3-5.9 x 10 ¹² /L, Female: 3.5-5.5 x 10 ¹² /L
Hemoglobin (HGB)	Male: 8.7-11.2 mmol/L, Female: 7.4-9.9 mmol/L
Hematocrit (HT)	Male: 0.41-0.53, Female: 0.36-0.46
Mean Corpuscular Volume (MCV)	80-100 fL
Mean Corpuscular Hemoglobin (MCH)	0.39-0.54 fmol/cell
Mean Corpuscular Hemoglobin Concentration (MCHC)	4.81-5.58 mmol Hb/L
Platelets	150-400 x 10 ⁹ /L
HbA1c	Non-diabetic: <5.7%, Pre-diabetes: 5.7%-6.4%, Diabetic: ≥6.5%
Sodium	135-145 mmol/L
Potassium	3.5-5.0 mmol/L
Chloride	98-106 mmol/L
Bicarbonate (CO ₂)	23-30 mmol/L

Calcium	8.8-10.5 mg/dL
Magnesium	1.3-2.1 mg/dL
Phosphate	2.5-4.5 mg/dL
Glucose (fasting)	70-99 mg/dL
Albumin	3.4-5.4 g/dL
Total Protein	6.0-8.3 g/dL
Blood Urea Nitrogen (BUN)	7-20 mg/dL
Creatinine	0.6-1.2 mg/dL
Alanine Transaminase (ALT)	5-35 U/L
Aspartate Transaminase (AST)	5-40 U/L
Alkaline Phosphatase (ALP)	44-147 U/L
Bilirubin	Direct: <0.3 mg/dL, Total: 0.1-1.2 mg/dL
Free Thyroxine (FT4)	0.8-1.8 ng/dL
Thyroid-Stimulating Hormone (TSH)	0.5-5.0 mIU/L
Total Cholesterol	<200 mg/dL
HDL Cholesterol	≥60 mg/dL
LDL Cholesterol	<100 mg/dL (diabetics: <70 mg/dL)
Triglycerides	<150 mg/dL

CBC (Complete Blood Count):

- Monitor for agranulocytosis, leukopenia, infection, and anemia.
- Anemia may lead to fatigue, often mistaken for depression.
 - In general, the reference ranges are:
 - ◆ White Blood Cells (WBC): Range: $4.5-11.0 \times 10^9/L$.
 - ◆ Red Blood Cells (RBC):
 - Male Range: $4.3-5.9 \times 10^{12}/L$.
 - Female Range: $3.5-5.5 \times 10^{12}/L$.
 - ◆ Hemoglobin (HGB):
 - Male Range: 8.7-11.2 mmol/L.
 - Female Range: 7.4-9.9 mmol/L.
 - ◆ Hematocrit (HT):
 - Male Range: 0.41-0.53
 - Female Range: 0.36-0.46
 - ◆ Mean Corpuscular Volume (MCV): Range: 80-100 fL.
 - ◆ Mean Corpuscular Hemoglobin (MCH): Range: 0.39-0.54 fmol/cell.
 - ◆ Mean Corpuscular Hemoglobin Concentration (MCHC): Range: 4.81-5.58 mmol Hb/L.
 - ◆ Platelets: Range: $150-400 \times 10^9/L$.

Impact of Medications:

- Antipsychotics and anticonvulsants may cause neutropenia.
- Depakote (divalproex) and Tegretol (carbamazepine) can lead to thrombocytopenia (platelets $<150,000$).
- Monitoring schedule for Depakote and Tegretol: baseline platelets, 2 weeks post-initiation, then every 6 months or annually, with closer monitoring for the elderly or those with bleeding disorders.
- Tegretol may rarely cause leukopenia, typically within the first month.

Specific Conditions:

- Neutropenia is defined as an absolute neutrophil count (ANC) of $<1,500$.
- Agranulocytosis is a potentially fatal condition with ANC <500 , associated with clozapine and carbamazepine.

- Lithium may cause an increase in white blood cell count (leukocytosis), which is benign and not related to dosage; it may be used to counteract neutropenia.

SSRIs:

- Impair platelet aggregation, but do not affect platelet counts.
 - No reliable lab value to monitor bleeding risk from SSRIs.
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Hemoglobin A1c (HbA1c):

- A test used to measure the average level of blood sugar (glucose) over the past two to three months. It reflects the glucose that has bound to the hemoglobin part of the red blood cells. The HbA1c test is commonly used to diagnose and manage diabetes.
 - Antipsychotic medications (and sometimes antidepressant and other psychotropic medications), commonly used to treat serious mental health conditions, can significantly affect metabolic parameters such as glucose metabolism and lipid profiles. This can lead to increased risks of diabetes, high cholesterol, and significant weight gain.
 - The normal range for HbA1c for adults without diabetes is typically less than 5.7%.
 - Pre-diabetes is indicated by an HbA1c between 5.7% and 6.4%.
 - Diabetes is diagnosed when the HbA1c level is 6.5% or higher. For individuals who have diabetes, the goal is often to keep the HbA1c below 7% to effectively manage their condition and reduce the risk of complications.
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CMP (Comprehensive Metabolic Profile):

- Monitors electrolyte balances, kidney function, and liver function, essential for patients on potentially nephrotoxic or hepatotoxic medications, or those with conditions like diabetes or cirrhosis.

Key Components and Considerations:

- **Electrolytes:**
 - **Sodium:** Normal range is 135-145 mmol/L.
 - ◆ **Symptoms of Hyponatremia (sodium < 130):** Malaise, nausea, headache, lethargy, confusion, pedal edema. SSRIs can induce hyponatremia, particularly concerning in elderly patients. It's advisable to check for hyponatremia if an elderly patient recently started on SSRIs and reports symptoms like dizziness, fatigue, or cramping.

- ◆ **Trileptal (oxcarbazepine):** Monitor for hyponatremia during the first few weeks due to SIADH (Syndrome of Inappropriate Antidiuretic Hormone Secretion).
- **Potassium:** Normal range is 3.5-5.0 mmol/L.
 - ◆ **Symptoms of Hyperkalemia:** Weakness, fatigue, muscle cramps, arrhythmias.
 - ◆ **Symptoms of Hypokalemia:** Muscle weakness, cramps, arrhythmias, and constipation. Diuretics commonly cause hypokalemia and require monitoring.
- **Chloride:** Normal range is 98-106 mmol/L.
 - ◆ **Significance:** Changes in chloride levels can indicate issues such as dehydration, fluid loss, or kidney dysfunction.
- **Bicarbonate (CO₂):** Normal range is 23-30 mmol/L.
 - ◆ **Symptoms of Metabolic Acidosis:** Hyperventilation, fatigue, anorexia.
 - ◆ **Topamax (topiramate):** Watch for reduced bicarbonate levels and metabolic acidosis, which can also lead to kidney stones.
- **Calcium:** Important for detecting metabolic and hormonal imbalances. Normal range is 8.8-10.5 mg/dL.
- **Magnesium:** This electrolyte plays a critical role in nerve, muscle, and enzymatic functions.
 - ◆ The normal range for serum magnesium is typically 1.3-2.1 mg/dL.
 - ◆ Low magnesium levels can cause symptoms such as muscle cramps, seizures, and cardiac arrhythmias.
 - ◆ High levels might lead to lethargy, muscle weakness, and irregular heartbeat.
- **Phosphate:** Phosphate is essential for energy production, bone formation, and cell signaling.
 - ◆ The normal serum phosphate levels are usually 2.5-4.5 mg/dL.
 - ◆ Abnormal levels can be indicative of issues like kidney disease, bone metabolism disorders, or hormonal imbalances.
 - ◆ Low phosphate levels may result in muscle weakness and bone pain, whereas high levels could lead to itching and joint pain.
- **Glucose:** Screen for blood sugar levels, which can indicate diabetes or other health issues.

- The normal fasting glucose range is 70-99 mg/dL. Regular monitoring is important, especially for patients with risk factors for diabetes or those experiencing symptoms related to high or low blood sugar levels.
- **Albumin and Total Protein:** Indicators of nutritional status and liver function. Normal Albumin range is 3.4-5.4 g/dL and Total Protein range is 6.0-8.3 g/dL.
- **Kidney Function Tests:**
 - **Blood Urea Nitrogen (BUN):** Normal range is 7 to 20 mg/dL.
 - **Creatinine:** Normal range is 0.6 to 1.2 mg/dL.
 - ◆ **Lithium Usage:** Draw BUN and Creatinine at baseline, two weeks post-initiation, and then annually to monitor kidney function.
- **Liver Function Tests:**
 - **Alanine Transaminase (ALT):** This enzyme is found primarily in the liver. Elevated levels can indicate liver damage. The normal range is typically about 5 to 35 units per liter (U/L), but this can vary slightly depending on the lab and method used.
 - **Aspartate Transaminase (AST):** AST is an enzyme found in several parts of the body, including the liver, heart, and muscles. Like ALT, high levels can suggest cellular liver damage. Normal values are usually between 5 to 40 U/L, although this range can also vary by laboratory.
 - **Alkaline Phosphatase (ALP):** This enzyme is present in all body tissues but is primarily important in the liver, bile ducts, and bone. Elevated levels can suggest liver or bone disorders. The normal range is about 44 to 147 U/L.
 - **Bilirubin:** This is a waste product processed by the liver from old red blood cells. It's a component of bile, which is used to help digest fats. Direct (also called conjugated) bilirubin: less than 0.3 mg/dL (less than 5.1 μ mol/L) Total bilirubin: 0.1 to 1.2 mg/dL (1.71 to 20.5 μ mol/L). Elevated bilirubin levels can indicate liver dysfunction or other conditions like hemolysis (breakdown of red blood cells).
 - ◆ Monitor these levels to assess liver health, especially crucial for patients on medications with known hepatotoxic risks, such as statins or acetaminophen.
 - ◆ **Depakote (Valproic Acid):** Monitor liver function by drawing tests at baseline, 2 weeks after starting treatment, and then annually. This monitoring is crucial because Depakote can potentially cause liver damage.
 - ◆ **Alcoholism:** Chronic alcohol consumption can lead to elevated liver enzymes, indicating liver stress or damage. Regular LFTs are recommended for individuals with a history of alcoholism.

- ◆ **Cymbalta (Duloxetine):** This medication causes an elevation in ALT in about 1% of patients, making it important to monitor liver enzymes during treatment.
 - ◆ **MAOI Phenelzine:** There is a risk of liver failure associated with this medication, which necessitates careful monitoring of liver function.
 - ◆ **Statins:** These cholesterol-lowering medications can cause an increase in ALT, which should be monitored through regular liver function tests to manage potential hepatotoxicity effectively.
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TSH (Thyroid Stimulating Hormone): TSH is crucial for diagnosing and monitoring thyroid conditions, which can often present with symptoms like psychiatric disorders.

- **Free Thyroxine (FT4):** The normal range is typically between 0.8 to 1.8 nanograms per deciliter (ng/dL). FT4 is the unbound portion of the thyroxine in the bloodstream, which is biologically active and able to enter body tissues.
- **Thyroid-Stimulating Hormone (TSH):** The normal values range from 0.5 to 5.0 milli-international units per liter (mIU/L). TSH is produced by the pituitary gland and stimulates the thyroid gland to produce T4 (and to a lesser extent T3).
- **Symptoms of Hypothyroidism:** Includes cognitive and physical slowing, fatigue, cold intolerance, and hair loss. Hypothyroidism can also lead to mood disorders, often mimicking depression.
- **Symptoms of Hyperthyroidism:** Characterized by nervousness, tremor, sweating, diarrhea, and rapid or irregular heartbeat.
 - **Monitoring:**
 - ◆ **Lithium Treatment:** Draw a TSH panel at baseline, 2 weeks after initiation, at 6 months, and then annually. Lithium can affect thyroid function, often leading to hypothyroidism.
 - ◆ **Additional Tests:**
 - **FT4 (Free T4):** Often ordered alongside TSH to assess the amount of unbound T4 available for use by tissues, as most T4 in serum is bound and inactive. This helps provide a clearer picture of thyroid function.
 - **T3:** Consider measuring T3 if there's a consideration to augment treatment for depression with T3 hormone.
 - **Interpreting Results:**
 - ◆ **High TSH Levels:** Typically suggest hypothyroidism, indicating that the thyroid is not producing enough hormones, prompting the pituitary gland to release more TSH.

- ◆ **Free T4 Levels:** Important for evaluating the actual hormonal output of the thyroid, with low levels typically corroborating a diagnosis of hypothyroidism when TSH is high.
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Lipid Panel: Used to monitor and assess the risk of dyslipidemia, which is a major component of metabolic syndrome. This is particularly significant in patients taking antipsychotic medications, which can contribute to an increased risk of metabolic complications.

- **Total Cholesterol:** The optimal level is below 200 mg/dL. This is considered desirable and indicates a lower risk of heart disease.
 - **High-Density Lipoprotein (HDL) Cholesterol:** Often referred to as "good" cholesterol, an optimal HDL level is 60 mg/dL or higher. Higher levels of HDL cholesterol are associated with a reduced risk of heart disease.
 - **Low-Density Lipoprotein (LDL) Cholesterol:** Known as "bad" cholesterol, the optimal level is below 100 mg/dL. For individuals with diabetes or other risk factors for heart disease, a more stringent target below 70 mg/dL is often recommended.
 - **Triglycerides:** The optimal level for triglycerides is below 150 mg/dL. Elevated triglyceride levels can increase the risk of heart disease.
 - **Symptoms of Metabolic Syndrome:**
 - ◆ Large waist circumference.
 - ◆ Hyperlipidemia (high levels of lipids in the blood).
 - ◆ Low HDL ("good" cholesterol) levels.
 - ◆ Hypertension (HTN).
 - ◆ Glucose intolerance.
 - **Monitoring Schedule:**
 - **Baseline Assessment:** Important to establish before initiating antipsychotic therapy.
 - **Follow-Up:** Conduct another lipid panel 3 months after starting any medication that may contribute to metabolic syndrome to evaluate the medication's impact and adjust treatment if necessary.
 - **Interventions:**
 - **Exercise Recommendations:** Engage in moderate to vigorous exercise for 4-5 hours per week. This level of physical activity is known to have significant cardiovascular benefits and can help manage or mitigate some of the risks associated with metabolic syndrome.
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Urine Drug Screen (Utox):

- A urine drug screen (Utox) is a test that detects the presence of drugs and their metabolites in urine. This type of test is commonly used for various purposes, including medical screening, employment checks, and legal or forensic information. The Utox can test for a range of substances, including but not limited to, opioids, amphetamines, cannabinoids, cocaine, and benzodiazepines. It helps determine the recent use of prescription medications or illegal drugs. Results can be qualitative (positive or negative) or quantitative (measuring specific levels of substances).
- False positives in urine drug screens can occur due to various factors such as the consumption of certain foods, medications, or supplements that interfere with the test.
 - **Amphetamine/Methamphetamine:** False positives may be caused by Selegiline, Vicks Inhaler, Bupropion, TCAs, Amantadine, Benzphetamine, Brompheniramine, Chlorpromazine, diet pills, Desipramine, Ephedrine nasal inhaler, Labetalol, Poppy seeds, Promethazine, Pseudoephedrine, Ranitidine, Trazodone, Verapamil, Metformin, Ofloxacin, Bupropion, and Fluoxetine.
 - **Barbiturates:** NSAIDs can lead to false positives.
 - **Benzodiazepines:** False positives might be triggered by Oxaprozin, Sertraline, Daypro, and NSAIDs.
 - **Cannabinoids:** False positives can be caused by NSAIDs, Sustiva, Dronabinol, Efavirenz, Hemp oil, and Pantoprazole.
 - **PCP:** Venlafaxine, Dextromethorphan, Diphenhydramine, NSAIDs, Imipramine, Ketamine, Meperidine, Mesoridazine, and Tramadol might be misidentified as PCP.
 - **LSD:** Amitriptyline, Bupropion, Diltiazem, Fluoxetine, Trazodone, Labetalol, and Sertraline can lead to false positives.
 - **Cocaine:** Consuming Coco leaf tea can show up as cocaine.
 - **Methadone:** Clomipramine, Diphenhydramine, Quetiapine, Thioridazine, and Tramadol may cause false positives.
- ◆ Patient education: Disclosing all consumed substances, including medications, supplements, and even certain foods, is crucial when undergoing a drug test to ensure accurate interpretation of results.

Detected Drug	Possible Causes of False Positives
Amphetamine/Methamphetamine	Selegiline, Vicks Inhaler, Bupropion, TCAs, Amantadine, Benzphetamine, Brompheniramine, Chlorpromazine, Diet pills, Desipramine, Ephedrine nasal inhaler, Labetalol, Poppy seeds, Promethazine, Pseudoephedrine, Ranitidine, Trazodone, Verapamil, Metformin, Ofloxacin, Fluoxetine
Barbiturates	NSAIDs
Benzodiazepines	Oxaprozin, Sertraline, Daypro, NSAIDs
Cannabinoids	NSAIDs, Sustiva, Dronabinol, Efavirenz, Hemp oil, Pantoprazole
PCP	Venlafaxine, Dextromethorphan, Diphenhydramine, NSAIDs, Imipramine, Ketamine, Meperidine, Mesoridazine, Tramadol
LSD	Amitriptyline, Bupropion, Diltiazem, Fluoxetine, Trazodone, Labetalol, Sertraline
Cocaine	Coco Leaf Tea
Methadone	Clomipramine, Diphenhydramine, Quetiapine, Thioridazine, Tramadol