

## Quick Guide to Laboratory Values

Use this convenient cheat-sheet to help you monitor laboratory values related to fluid and electrolyte status, acid-base balance, and hematology. Remember, normal value ranges may vary according to techniques used in different laboratories.

SERUM ELECTROLYTES	
Electrolyte (Range)	Nursing Considerations
<b>Calcium (Ca<sup>2+</sup>)</b> 8.5-10.5 mg/dL	<p><b>Hypocalcemia</b></p> <ul style="list-style-type: none"> <li>• Signs and symptoms             <ul style="list-style-type: none"> <li>○ Tetany (neuromuscular irritability) is the hallmark symptom (may include paresthesia, bronchospasm, laryngospasm, carpopedal spasm [Trousseau’s sign], Chvostek’s sign [facial muscle contractions elicited by tapping facial nerve on ipsilateral side], tingling sensations of the fingers, mouth, and feet, increased deep tendon reflexes [DTRs], generalized seizures).</li> <li>○ Psychiatric manifestations such as emotional instability, depression, anxiety, hallucinations and psychosis.</li> <li>○ ECG changes may include prolonged QT interval and arrhythmias.</li> <li>○ Papilledema with or without intracranial hypertension.</li> <li>○ Anxiety, depression, fatigue.</li> <li>○ Can also be asymptomatic.</li> </ul> </li> <li>• Implement seizure precautions and close monitoring for cardiac arrhythmias and respiratory depression.</li> <li>• Treatment: initiate intravenous calcium repletion</li> </ul> <p><b>Hypercalcemia</b></p> <ul style="list-style-type: none"> <li>• Signs and symptoms             <ul style="list-style-type: none"> <li>○ Lethargy, confusion, nausea, vomiting, anorexia, constipation, muscle weakness, depressed DTRs, polyuria, polydipsia, dehydration</li> </ul> </li> <li>• Severe hypercalcemia can provoke supraventricular or ventricular arrhythmias. Monitor cardiac rate and rhythm.</li> <li>• Increase mobilization, provide adequate hydration either with IV fluids or encouragement of oral intake.</li> <li>• Watch for digitalis toxicity.</li> </ul>

<p><b>Chloride (Cl<sup>-</sup>)</b> 97-107 mEq/L</p>	<p><b>Hypochloremia</b></p> <ul style="list-style-type: none"> <li>• Signs and symptoms <ul style="list-style-type: none"> <li>○ Muscle spasms, alkalosis, and depressed respirations</li> </ul> </li> <li>• May be precipitated or exacerbated by GI losses (vomiting, diarrhea).</li> </ul> <p><b>Hyperchloremia</b></p> <ul style="list-style-type: none"> <li>• Monitor for metabolic acidosis.</li> <li>• Associated with large volume 0.9% normal saline resuscitation.</li> </ul>
<p><b>Magnesium (Mg<sup>2+</sup>)</b> 1.8-3 mg/dL</p>	<p><b>Hypomagnesemia</b></p> <ul style="list-style-type: none"> <li>• Signs and symptoms <ul style="list-style-type: none"> <li>○ Cardiac/ventricular arrhythmias (ventricular arrhythmias (torsades de pointes) and atrial fibrillation), tetany, tremor, weakness, apathy, delirium, seizures, and coma</li> </ul> </li> <li>• Risk factors: chronic diarrhea, PPI use, alcoholism, diuretic use</li> <li>• Monitor cardiac rate and rhythm.</li> <li>• Monitor for digitalis toxicity.</li> <li>• Often associated with hypokalemia. Treat both simultaneously.</li> </ul> <p><b>Hypermagnesemia</b></p> <ul style="list-style-type: none"> <li>• Signs and symptoms <ul style="list-style-type: none"> <li>○ Early symptoms: nausea, vomiting, flushing</li> <li>○ Cardiac manifestations: hypotension, bradycardia, complete heart block, cardiac arrest</li> <li>○ Neurologic manifestations: lethargy/somnolence, decreased DTRs, muscle paralysis, coma, respiratory muscle weakness (shallow respirations, apnea)</li> </ul> </li> <li>• Avoid magnesium-containing medications in patients with compromised renal function.</li> <li>• Monitor cardiac rate and rhythm.</li> <li>• Monitor neurologic status, including DTRs.</li> </ul>
<p><b>Phosphate (PO<sub>4</sub><sup>-</sup>)</b> 2.5-4.5 mg/dL</p>	<p><b>Hypophosphatemia</b></p> <ul style="list-style-type: none"> <li>• Signs and symptoms (rare unless PO<sub>4</sub><sup>-</sup> less than 1mg/dL) <ul style="list-style-type: none"> <li>○ Muscle weakness, rhabdomyolysis</li> </ul> </li> <li>• Treatment indicated when PO<sub>4</sub><sup>-</sup> less than 2mg/dL.</li> <li>• Oral replacement preferred.</li> <li>• IV indicated if PO<sub>4</sub><sup>-</sup> less than 1mg/dL; administer slowly.</li> <li>• When administering IV phosphate products, measure serum</li> </ul>

	<p>phosphate levels every 6-8 hours.</p> <ul style="list-style-type: none"> <li>• Monitor for hypocalcemia, renal failure, arrhythmias, and diarrhea (with oral replacement).</li> <li>• Acute or chronic hypophosphatemia can cause rhabdomyolysis.</li> </ul> <p><b>Hyperphosphatemia</b></p> <ul style="list-style-type: none"> <li>• Signs and symptoms <ul style="list-style-type: none"> <li>○ Typically, asymptomatic</li> <li>○ Clinical features are due to accompanying hypocalcemia (see above)</li> <li>○ Severe hyperphosphatemia can be life threatening.</li> </ul> </li> <li>• Risk factors include advanced renal insufficiency, rhabdomyolysis, tumor-lysis syndrome, and over ingestion of phosphate containing laxatives)</li> <li>• Soft tissue calcification can be a long-term complication of chronically elevated serum phosphate levels.</li> </ul>
<p><b>Potassium (K<sup>+</sup>)</b> 3.5-5 mEq/L</p>	<p><b>Hypokalemia</b></p> <ul style="list-style-type: none"> <li>• Signs and symptoms <ul style="list-style-type: none"> <li>○ Muscle cramps/weakness, rhabdomyolysis, respiratory muscle weakness, decreased bowel motility, cardiac arrhythmias, hypotension, mental status changes, speech changes.</li> </ul> </li> <li>• Characteristic ECG findings include ST segment depression, flattened T wave and U wave.</li> <li>• Monitor cardiac rate and rhythm.</li> <li>• Common causes include GI losses (diarrhea/vomiting) and diuretic therapy. <ul style="list-style-type: none"> <li>○ Educate patient on using laxatives and diuretics only as prescribed.</li> </ul> </li> <li>• Monitor potassium levels in patients on digoxin; hypokalemia will potentiate its effects.</li> <li>• Prolonged hypokalemia can lead to structural and functional changes in the kidneys.</li> </ul> <p><b>Hyperkalemia</b></p> <ul style="list-style-type: none"> <li>• Signs and symptoms <ul style="list-style-type: none"> <li>○ Irritability/anxiety, paresthesia, ascending muscle weakness, cardiac arrhythmias, cardiac conduction abnormalities, lethargy, GI symptoms (nausea and intestinal colic)</li> </ul> </li> <li>• Characteristic ECG findings include tall, peaked T waves with shortened QT interval, prolonged PR interval, wide QRS</li> </ul>

	<p>complex and in severe cases, ventricular standstill.</p> <ul style="list-style-type: none"> <li>• Monitor cardiac rate and rhythm.</li> <li>• Avoid potassium-sparing diuretics, potassium supplements, or salt substitutes in patients with renal insufficiency.</li> <li>• Use ACE inhibitors cautiously, as they cause K<sup>+</sup> retention.</li> </ul>
<p><b>Sodium (Na<sup>+</sup>)</b> 135-145 mEq/L</p>	<p><b>Hyponatremia</b></p> <ul style="list-style-type: none"> <li>• Signs and symptoms <ul style="list-style-type: none"> <li>○ Neurologic: lethargy, weakness, irritability, confusion, tremors, myoclonus, seizures</li> <li>○ Other: hypotension, GI symptoms (anorexia, nausea, vomiting, abdominal cramping)</li> <li>○ Cerebral edema can occur in rapid reduction of serum sodium concentration</li> </ul> </li> <li>• Correction should be slow (4 to 6 mEq/L in first 24 hours) to avoid osmotic demyelination syndrome; monitor serum Na<sup>+</sup> levels and neurologic status frequently.</li> <li>• Avoid large water supplements to patients receiving isotonic tube feedings.</li> <li>• Implement seizure precautions in severe cases.</li> <li>• Monitor fluid losses and gains.</li> </ul> <p><b>Hypernatremia</b></p> <ul style="list-style-type: none"> <li>• Signs and symptoms <ul style="list-style-type: none"> <li>○ Excessive thirst, dehydration, dry mucous membranes, oliguria, mental status changes including lethargy, disorientation, restlessness, elevated body temperature.</li> <li>○ Can cause rapid decrease in brain volume potentially leading to rupture of the cerebral veins, subarachnoid hemorrhages, and possibly irreversible neurologic damage.</li> </ul> </li> <li>• Monitor fluid losses and gains; urine and plasma osmolality may assist in establishing etiology.</li> <li>• Give sufficient free water with tube feedings or salt-free IV fluids to keep serum Na<sup>+</sup> and BUN within normal limits.</li> </ul>
<b>ACID-BASE STATUS</b>	
<b>Arterial Blood Gas (ABG) Component (Range)</b>	<b>Nursing Considerations</b>
<p><b>pH</b> 7.35-7.45</p>	<ul style="list-style-type: none"> <li>• Identification of the specific acid–base disturbance is important in identifying the underlying cause of the disorder</li> </ul>

	<p>and determining appropriate treatment.</p> <ul style="list-style-type: none"> <li>• A pH less than 7.35 indicates acidosis and a pH greater than 7.45 indicates alkalosis.</li> </ul>
<p><b>PaCO<sub>2</sub></b> 35-45 mmHg</p>	<ul style="list-style-type: none"> <li>• The PaCO<sub>2</sub> is influenced almost entirely by respiratory activity.</li> <li>• When the PaCO<sub>2</sub> is low, carbonic acid leaves the body in excessive amounts; when the PaCO<sub>2</sub> is high, there are excessive amounts of carbonic acid in the body.</li> </ul>
<p><b>HCO<sub>3</sub><sup>-</sup></b> 22-26 mEq/L</p>	<ul style="list-style-type: none"> <li>• The bicarbonate level of the ABG reflects the bicarbonate level of the body.</li> <li>• The kidneys are involved in either reabsorbing bicarbonate or excreting bicarbonate, depending upon what is needed to maintain acid-base balance.</li> </ul>
<b>RENAL FUNCTION</b>	
<b>Laboratory Value (Range)</b>	<b>Nursing Considerations</b>
<p><b>Blood urea nitrogen (BUN)</b> 10-20 mg/dL</p>	<ul style="list-style-type: none"> <li>• Increased BUN may be seen in patients with impaired renal function.</li> <li>• Increased BUN may be caused by hypotension/shock, heart failure, salt and water depletion, dehydration, diabetic ketoacidosis, gastrointestinal hemorrhage, and burns.</li> </ul>
<p><b>Creatinine</b> 0.7-1.4 mg/dL</p>	<ul style="list-style-type: none"> <li>• Increased creatinine levels may be seen in patients with impaired renal function due to decreased blood flow to the kidney (heart failure, shock, liver disease, dehydration), urinary tract obstruction, intrinsic kidney disease (i.e., glomerulonephritis), or certain medications.</li> <li>• Acute kidney injury (AKI) is diagnosed when baseline creatinine increases abruptly by 0.3 mg/dL or more, even if creatinine remains in the normal range.</li> </ul>
<b>HEMATOLOGIC STUDIES</b>	
<b>Laboratory Value (Range)</b>	<b>Nursing Considerations</b>
<p><b>Hemoglobin</b> Males: 13-18 g/dL Females: 12-16 g/dL</p>	<ul style="list-style-type: none"> <li>• Increased hemoglobin levels may be caused by hypoxia, high altitude living, or hemoconcentration of the blood from dehydration.</li> <li>• Decreased levels of hemoglobin (anemia) may be due to hemorrhage/blood loss, hemodilution, nutritional deficiencies, chronic disease, underlying malignancy,</li> </ul>

	hereditary disorders, or a hemolytic reaction.
<b>Hematocrit</b> <i>*Typically, three times the hemoglobin level</i> Males: 42-52% Females: 35-47%	<ul style="list-style-type: none"> <li>Increased hematocrit values are seen in severe fluid volume deficit and shock (when hemoconcentration rises considerably).</li> <li>Decreased hematocrit values are seen with blood loss, hemolytic reactions after transfusion of incompatible blood, fluid overload, and in similar conditions in which decreased levels of hemoglobin are seen.</li> </ul>
<b>Platelet count</b> 150,000-450,000/mm <sup>3</sup>	<ul style="list-style-type: none"> <li>Increased platelet levels (thrombocythemia or thrombocytosis) may be caused by a bone marrow disorder or malignancy, infection or inflammation, anemia, previous splenectomy, or certain medications.</li> <li>Decreased platelet levels (thrombocytopenia) may be a result of bone marrow suppression, sepsis, sequestration from an enlarged spleen, increased platelet destruction (seen with autoimmune syndromes or drug-induced reactions), or decreased platelet production (related to infections or malignancy). Liver disease, renal disorders, and pregnancy can also cause thrombocytopenia.</li> </ul>
<b>COAGULATION STUDIES</b>	
<b>Laboratory Value</b> (Range)	<b>Nursing Considerations</b>
<b>Prothrombin time (PT)</b> 9.5-12 seconds	<ul style="list-style-type: none"> <li>The PT measures the activity of the extrinsic pathway of the clotting cascade.</li> <li>Prothrombin is a protein made by the liver.</li> <li>Elevated PT may indicate liver dysfunction, Vitamin K deficiency, or coagulation factor deficiency (e.g., factor VII)</li> </ul>
<b>Partial thromboplastin time (activated) (PTT)</b> 20-39 seconds	<ul style="list-style-type: none"> <li>The PTT is a measure of the activity of the intrinsic pathway of the clotting cascade.</li> <li>The PTT is used to monitor the effects of unfractionated heparin.</li> </ul>
<b>International normalized ratio (INR)</b> 1.0; 2-3.5 for patients taking warfarin sodium (varies based on diagnosis)	<ul style="list-style-type: none"> <li>The INR is used to monitor the effectiveness of warfarin therapy.</li> <li>As INR increases, time for blood to clot increases.</li> </ul>
<b>PROTEIN</b>	
<b>Laboratory Value</b> (Range)	<b>Nursing Considerations</b>

<b>Total protein</b> 6-8 g/100 mL	<ul style="list-style-type: none"> <li>• Proteins influence the colloid osmotic pressure.</li> <li>• Includes albumin and globulin.</li> </ul>
<b>Albumin</b> 3.5-5 g/100 mL	<ul style="list-style-type: none"> <li>• Makes up 60% of total protein.</li> <li>• Keeps fluid from leaking out of blood vessels.</li> <li>• Changes in serum albumin affect total serum calcium.</li> <li>• Decreased albumin can be due to malnutrition or liver disease and can lead to edema, ascites, and pulmonary edema.</li> </ul>
<b>SERUM OSMOLALITY</b>	
<b>Laboratory Value</b> (Range)	<b>Nursing Considerations</b>
<b>Osmolality</b> 280-300 mOsm/L water	<ul style="list-style-type: none"> <li>• Increased osmolality may be caused by severe dehydration, free water loss, diabetes insipidus, hypernatremia, hyperglycemia, stroke or head injury, renal tubular necrosis, or ingestion of methanol or ethylene glycol (antifreeze).</li> <li>• Decreased osmolality may be caused by volume excess, SIADH, renal failure, diuretic use, adrenal insufficiency, hyponatremia, overhydration, or paraneoplastic syndrome associated with lung cancer.</li> </ul>
<b>URINE TESTS</b>	
<b>Laboratory Value</b> (Range)	<b>Nursing Considerations</b>
<b>pH (urine)</b> 4.6-8.2	<ul style="list-style-type: none"> <li>• Decreased urine pH may be caused by metabolic acidosis, diabetic ketoacidosis, or diarrhea.</li> <li>• Increased urine pH may be caused by respiratory alkalosis, potassium depletion, or chronic renal failure.</li> </ul>
<b>Specific gravity (urine)</b> 1.010-1.025	<ul style="list-style-type: none"> <li>• The urine specific gravity range depends on the patient's state of hydration and varies with urine volume and the load of solutes to be excreted.</li> <li>• Increased urine specific gravity may be seen with dehydration, vomiting, diarrhea, infection, and heart failure.</li> <li>• Decreased urine specific gravity can occur with renal damage.</li> </ul>

**References:**

Farinde, A. (2019, May 14). Lab values, normal adult. *Medscape*. <https://emedicine.medscape.com/article/2172316-overview>

Hinkle, J., & Cheever, K. (2018). *Brunner & Suddarth's Textbook of Medical-Surgical Nursing, Fourteenth Edition*. Philadelphia: Lippincott Williams & Wilkins.

Mount, D. B. (2024, February 12). Clinical manifestations and treatment of hypokalemia in adults. *UpToDate*. <https://www.uptodate.com/contents/clinical-manifestations-and-treatment-of-hypokalemia-in-adults>

Mount, D. B. (2022, December 7). Clinical manifestations of hyperkalemia in adults. *UpToDate*. <https://www.uptodate.com/contents/clinical-manifestations-of-hyperkalemia-in-adults>

Sterns, R.H. (2023, January 23). Manifestations of hyponatremia and hypernatremia in adults. *UpToDate*. [Manifestations of hyponatremia and hypernatremia in adults - UpToDate](https://www.uptodate.com/contents/manifestations-of-hyponatremia-and-hypernatremia-in-adults)

Yu, A. S., & Aditi, G. (2022, May 19). Hypermagnesemia: Causes, symptoms, and treatment. *UpToDate*. <https://www.uptodate.com/contents/hypermagnesemia-causes-symptoms-and-treatment>

Yu, A. S., & Stubbs, J. R. (2023, April). Hypophosphatemia: Evaluation and treatment. *UpToDate*. <https://www.uptodate.com/contents/hypophosphatemia-evaluation-and-treatment>