CBC and Chemistry Informational Guide

Purpose

This handout provides a concise educational reference for common CBC and chemistry/metabolic laboratory tests. It is **not** intended to diagnose any condition. It is **not** to be used in place of consultation with a medical professional.

Important Use Notes

- Reference ranges vary by laboratory, age, sex, pregnancy status, and clinical setting.
- Isolated abnormal results are often nonspecific.
- Lab values should always be interpreted with symptoms, medications, medical history, hydration status, fasting status, exam findings, and trends over time.

Complete Blood Count (CBC)

Test	What It Measures	Low Values May Suggest	High Values May Suggest	Practical Notes
RBC count	Number of red blood cells per volume of blood	Anemia Blood loss Hemolysis Marrow failure Nutrient deficiency (iron, B12, folate, B6, etc)	Dehydration Testosterone use Smoking High altitude Polycythemia Thalassemia Chronic hypoxia (sleep apnea, lung pathology)	Review with hemoglobin, hematocrit, and other RBC indices.
Hemoglobin (Hgb)	Oxygen-carrying protein in red blood cells	Anemia Blood loss Hemolysis Marrow failure Nutrient deficiency Thalassemia	Dehydration Testosterone use Smoking High altitude Polycythemia Chronic hypoxia	One of the main markers used to assess anemia. Low hemoglobin/hematocrit suggests anemia; high values may reflect dehydration or increased red cell mass.
Hematocrit (Hct)	Percentage of blood volume made up of red blood cells	Anemia Blood loss Hemolysis Thalassemia Overhydration	Dehydration Testosterone use Smoking High altitude Polycythemia Chronic hypoxia	Usually parallels hemoglobin. High hematocrit with elevated BUN or sodium may support a dehydration pattern.
MCV (Mean corpuscular volume)	Average red blood cell size	Microcytic pattern: Iron deficiency Thalassemia Some chronic inflammatory states	Macrocytic pattern: B12/folate deficiency Alcohol use Hypothyroidism Bone marrow disorders Liver disease	Useful for classifying anemia. Low MCV suggests a microcytic (small) pattern High MCV suggests a macrocytic (large) pattern.
MCH (Mean corpuscular hemoglobin)	Average hemoglobin amount per red blood cell	Iron deficiency Thalassemia Microcytosis	B12/folate deficiency Alcohol use Liver disease Hypothyroidism Macrocytosis	Best interpreted with other RBC indices. Often follows MCV trends.

MCHC (Mean corpuscular hemoglobin concentration)	Hemoglobin concentration within red blood cells	Iron deficiency Thalassemia	Hereditary spherocytosis Dehydration Liver disease	Best used as a supportive RBC index rather than interpreted alone. Review with other RBC indices.
RDW (Red cell distribution width)	Variation in red blood cell size	Limited clinical significance when low	Increased RBC size variation Iron deficiency B12/folate deficiency Response to anemia treatment	Most useful with MCV. High RDW with low MCV is a common iron deficiency pattern.
WBC count	Total white blood cell count	Bone marrow suppression Autoimmune conditions Viral illness Medications	Infection Inflammation Extreme/acute stress Corticosteroids Leukemia/lymphoma Myeloproliferative disorders Autoimmune disorders	Nonspecific when isolated. Best evaluated with differential, the breakdown of various WBC types
Neutrophils	First WBC to respond to infection/injury (especially bacterial infections)	Medications Autoimmune conditions B12/folate deficiency Viral infection Bone marrow suppression	Bacterial infection Inflammation Corticosteroids Viral infection to lesser extent	Most abundant WBC. High neutrophils commonly support a bacterial infection or inflammatory pattern.
Lymphocytes	WBC subset that fights viral infections & creates immune memory/regulates immune responses	Corticosteroids Chemotherapy Autoimmune conditions Immune deficiency states Bone marrow disease	Viral infections Recovery from infection Autoimmune conditions Chronic inflammation Select bacterial infections Blood Cancers	Lymphocyte elevation may fit a viral or immune dysfunction pattern. Review considering symptoms and total WBC.
Monocytes	Phagocytic WBC subset	Usually limited significance in isolation	Infections Hematologic disorders Inflammatory Conditions Autoimmune conditions	Mild elevations may be nonspecific but can be seen in chronic inflammatory or infectious patterns.
Eosinophils	WBCs associated with allergy and parasitic responses	May be normal in healthy individuals	Allergy Food allergies Asthma Parasitic infection Pulmonary conditions Drug reactions Fungal infection	Elevated eosinophils may fit allergic, parasitic, or drug-reaction patterns.
Basophils	Rare WBC subset involved in inflammatory and hypersensitivity pathways	May be normal in healthy individuals	Allergies Inflammatory conditions Hypothyroidism Myeloproliferative disorders	Small changes may not be meaningful. Persistent elevation deserves a broader clinical context.

Platelet count	Number of platelets	Bone marrow pathology Vit. B12/folate deficiency Liver disease Hemolytic anemia Immune thrombocytopenia Splenic sequestration Enlarged spleen Medications	Reactive thrombocytosis Inflammation Iron deficiency Recent blood loss Malignancy Myeloproliferative disease	Important in bleeding/clotting assessment. High platelets may be reactive, especially in inflammation or iron deficiency.
MPV	Average platelet size	May reflect reduced marrow platelet production. Bone marrow is not producing enough platelets or they are being destroyed.	May reflect increased platelet turnover or younger larger platelets. Bone marrow is producing new platelets rapidly.	Supportive only; best considered together with platelet count.

Chemistry / Metabolic Tests

Test	What It Measures	Low Values May Suggest	High Values May Suggest	Practical Notes
Glucose, fasting	Blood sugar level	Antidiabetic Medication Malnutrition Fasting Poor adrenal function Ketogenic state Reactive hypoglycemia	Diabetes Stress hyperglycemia Endocrine disorders Corticosteroid use Non-fasting state	Fasting status matters
BUN	Urea nitrogen; kidney perfusion/filtration and protein catabolism marker	Low protein intake Severe liver dysfunction Overhydration Malnutrition	Kidney impairment Catabolic state Muscle breakdown Dehydration High protein intake Upper GI bleeding Congestive Heart Failure	High BUN to creatinine ratio may indicate dehydration, reduced renal perfusion, or GI bleeding patterns. Not primarily a liver function test.
Creatinine	Waste product filtered by kidneys Follows progression of kidney disease	Low muscle mass Low protein intake pregnancy in some settings	Kidney impairment Dehydration Increased muscle mass Very high protein intake Renal obstruction Congestive Heart Failure Some drugs Muscle damage	Best reviewed with eGFR and trend. Elevated creatinine with or without elevated BUN may indicate kidney dysfunction.
BUN/Creatinine ratio	Relationship between BUN and creatinine	Low ratio may occur with Low protein intake Severe liver disease Pregnancy	High ratio may occur with Dehydration GI bleeding Impaired Kidney Function Reduced renal perfusion (heart failure)	When BUN and Creatinine are within normal range, BUN/Creatinine ratio out of the normal range is not usually a concern.

Uric acid	Purine metabolism product.	Often limited significance Overhydration Malnutrition Low purine diet	Gout Kidney dysfunction Dehydration Inflammation High purine diet	Elevation may fit gout, dehydration, and reduced kidney clearance. Also used to evaluate uric acid kidney stone formation.
Sodium	Major extracellular electrolyte; water balance	Overhydration Diuretics SIADH Adrenal insufficiency Excess sweating, diarrhea or vomiting	Dehydration Diabetes insipidus Some medications Excessive salt intake Hyper-cortisol states Hyperaldosteronism	Usually reflects water balance more than salt intake. High sodium may indicate dehydration; low sodium often reflects excess water relative to sodium.
Potassium	Major intracellular electrolyte; cardiac and muscle function	Diarrhea/vomiting Potassium wasting diuretics Poor intake Hyperinsulinemia Hypercortisol states	Kidney impairment Tissue injury Hypoaldosteronism Adrenal insufficiency Some drugs Potassium sparing Diuretics Heart failure Potassium supplements Hemolysis	Abnormal values may be urgent. Always review promptly in clinical context. **Alterations in potassium also common with improper lab specimen handling.**
Chloride	Electrolyte involved in fluid and acid-base balance	Vomiting, diarrhea Some diuretics Excessive sweating Low salt intake Hypercortisol states	Dehydration Kidney impairment Excessive salt intake	Best when viewed with sodium and bicarbonate as part of acid-base and volume patterns.
Bicarbonate / CO2	Metabolic component of acid-base balance	Metabolic acidosis (eg ketoacidosis, kidney disease, diarrhea, heart failure) Respiratory alkalosis (eg hyperventilation)	Metabolic alkalosis (eg vomiting) Respiratory acidosis (eg COPD, hypoventilation)	High and low CO2 can indicate acid-base imbalances. Most useful as part of an acid-base pattern rather than in isolation.
Calcium	Serum calcium Can be a segregate for parathyroid hormone activity	Vitamin D deficiency Magnesium deficiency Malabsorption/low intake Hypoparathyroidism Hypoalbuminemia Hyperphosphatemia	Hyperparathyroidism Excess vitamin D Hyperthyroidism Malignancy	Total calcium is affected by albumin. Serum albumin should be considered when calcium is low.
Phosphorus	Serum phosphate	vitamin D deficiency Hyperparathyroidism Antacids Malnutrition Diuretics	Kidney disease Hypoparathyroidism Excessive vitamin D Low serum calcium	Review in renal, endocrine, and nutritional context.
Total protein	Albumin plus globulins	Liver disease Malnutrition Malabsorption IBD Liver disease	Dehydration Increased globulins chronic inflammation Plasma-cell disorders (causes excessive globulin production)	Broad marker only. See Albumin and Globulin for more specificity.

Albumin	Main serum protein made by liver	Liver disease malnutrition renal or GI protein loss Inflammation	Dehydration	Important for oncotic pressure and calcium interpretation. Low albumin may fit liver disease, inflammation, or protein-loss patterns.
Globulin	Comprised of antibodies and carrier proteins (eg SHBG)	Immune deficiency Suppression medications Liver disease Malnutrition Renal or GI protein loss	Chronic inflammation Multiple myeloma Plasma-cell disorders (causes excessive globulin production)	High globulin paired with anemia is cause for a workup for multiple myeloma
A/G ratio	Albumin relative to globulins	Low ratio: low albumin or high globulins	High ratio: relatively low globulins or dehydration	Review with albumin and globulin context. May help identify broader protein abnormality patterns.
Bilirubin	Heme breakdown product processed by liver	Low values usually not clinically emphasized	Hemolysis Gilbert syndrome Hepatitis/liver disease Biliary obstruction	Elevated bilirubin may fit liver, biliary, or hemolysis patterns. Best considered with other liver and CBC markers
Alkaline phosphatase (ALP)	Enzyme from bile ducts and bone	Sometimes limited significance May reflect zinc deficiency	Cholestatic liver disease Biliary obstruction Bone growth/turnover Healing fracture Hyperparathyroidism Hyperthyroidism Bone metastasis or cancer	Source may be liver or bone. Consider ALP Isoenzyme to identify source if needed.
LDH	Nonspecific tissue injury / cell turnover marker	Limited significance when low	Hemolysis Tissue injury Liver disease Malignancy Inflammation	Very nonspecific. Elevated LDH fits tissue injury or cell turnover patterns but requires context. Consider LDH Isoenzyme test to help identify source
AST (Aspartate aminotransferase)	Monitors liver/gallbladder health and muscle injury	Can be low in healthy individuals Consider: B6 deficiency Low muscle mas Malnutrition	Liver disease/injury Fatty liver Alcohol Medications (eg statins) Niacin or RYR Hepatitis A,B,C Pancreatitis Gallbladder duct obstruction Muscle damage RBC lysis Extreme exercise Myocardial infarction	ALT is usually higher than AST in liver disease except: AST:ALT >2 consider alcoholic liver disease AST:ALT >5 consider muscle injury If Alk Phos elevated, consider biliary concerns

ALT (Alanine transaminase)	Monitors liver/gallbladder health	Can be low in healthy individuals Consider: B6 deficiency	Liver disease/injury Fatty liver Alcohol Medications (eg statins) Niacin or RYR Hepatitis A,B,C Pancreatitis Gallbladder duct obstruction Elevated but less than AST: Muscle damage Extreme exercise Myocardial infarction	ALT is usually higher than AST in liver disease except: AST:ALT >2 consider alcoholic liver disease AST:ALT >5 consider muscle injury If Alk Phos elevated, consider biliary concerns
Iron	Screening marker iron related conditions including anemia hemochromatosis	Iron deficiency anemia Chronic blood loss Hypothyroid Menstruation	Hemolytic anemia Hepatitis Iron supplementation Iron toxicity Thalassemia Hemochromatosis	Clinical decisions should NOT be made on iron level alone. Follow up with ferritin testing and/or iron panel.