



## CBC/CHEMISTRY (SMAC) APPENDIX


The normal ranges on CBC/SMAC blood work are usually fairly broad, and do not necessarily reflect optimal health or performance. A normal value on a laboratory test simply means that the value falls in the accepted range the lab encounters most frequently—averages that are based on results from a usually less-than-optimally-functioning population. Of course, it does NOT mean that function cannot be improved.


Fundamentally, our bodies strive to maintain levels of the various components in the blood within very narrow limits. If this does not occur, it does not *necessarily* mean our patient has a definable disease; it could mean their body, diet, lifestyle, environment, supplementation, and a variety of other factors amenable to early intervention might be in need of a tune-up. This is the time to prevent an area of potential dysfunction from developing into pathology. By the time a patient falls outside the range of normal on a typical CBC/SMAC report, there is without question a pathologic or severe functional problem somewhere.


The narrower CBC/SMAC ranges presented below are considered “optimal” or “ideal” ranges. The accompanying guidelines and commentary are what we feel values outside these ranges might mean. This information is meant to supplement your clinical experience, physical examination skills, history and case taking skills, and any additional testing that is normally performed in your practice. It is not meant to replace the need for any or all of these critical areas of patient management.

MEASURED COMPONENT	IDEAL RANGE	DECREASED LEVEL MIGHT INDICATE	SEE CLINICAL REPERTORY FOR	INCREASED LEVELS MIGHT INDICATE	SEE CLINICAL REPERTORY FOR
Glucose	70-110 mg/dL (USA)  4.0-6.2 mmol/L	1. Decreased ability of liver to produce/store glycogen (e.g., cirrhosis, alcoholism) 2. Pancreatic disorders 3. Hypopituitarism 4. Hypothyroidism	Hypoglycemia, Hypothyroidism, Pancreatitis, Cirrhosis, Fatty Liver	1. Early stage of insulin resistance 2. Early stage of diabetes 3. Early stage of fatty liver 4. Obesity 5. Cortisol resistance	Insulin Resistance, Diabetes Mellitus, Fatty Liver
Triglycerides	70-120 mg/dL (USA)  0.7-1.4 mmol/L	1. Excessive oxidative stress 2. Chemical/Heavy Metal Overload 3. Liver Dysfunction 4. Diet deficient in carbohydrates	Detoxification, Cirrhosis, Fatty Liver	1. Early stage of insulin resistance 2. Early stage of diabetes 3. Early stage of fatty liver 4. Endocrine hypofunction or endocrine "resistance" 5. Type IV dyslipoproteinemia 6. Hypothyroidism	Insulin Resistance, Diabetes Mellitus Hyperlipidemia, Fatty Liver, Hypothyroidism.
Cholesterol (total-fasting) Note: While this range is probably ideal for the majority of individuals, variation does occur and cholesterol should be looked at in conjunction with other lipid subfractions, triglycerides, Lipoprotein(a), and fasting glucose, before any conclusions are drawn.	180-200 mg/dL (USA)  4.6-5.2 mmol/L	1. Excessive oxidative stress 2. Chemical/Heavy Metal Overload 3. Liver Dysfunction 4. Diet deficient in carbohydrates 5. Viral hepatitis 6. Hyperthyroidism	Detoxification, Cirrhosis, Fatty Liver, Hepatitis, Hyperthyroidism	1. Early stage of insulin resistance 2. Early stage of diabetes 3. Early stage of fatty liver 4. Endocrine hypofunction or endocrine "resistance" 5. Type IV dyslipoproteinemia 6. Hypothyroidism 7. Acute biliary obstruction 8. Pancreatitis	Insulin Resistance, Diabetes Mellitus, Hyperlipidemia, Fatty Liver, Pancreatitis  

MEASURED COMPONENT	IDEAL RANGE	DECREASED LEVEL MIGHT INDICATE	SEE CLINICAL REPERTORY FOR	INCREASED LEVELS MIGHT INDICATE	SEE CLINICAL REPERTORY FOR
HDL	Above 55 mg/dL (USA)	<ol style="list-style-type: none"> <li>1. Excessive oxidative stress</li> <li>2. Chemical/Heavy Metal Overload</li> <li>3. Sedentary lifestyle</li> <li>4. Obesity</li> <li>5. Insulin resistance</li> <li>6. Fatty liver</li> <li>7. Starvation</li> <li>8. Diabetes mellitus</li> <li>9. Hypothyroidism</li> <li>10. Uremia</li> </ol>	Detoxification, Fatty Liver, Hyperlipidemia, Insulin Resistance, Diabetes, Hypothyroidism	<ol style="list-style-type: none"> <li>1. Insulin use</li> <li>2. Estrogen use</li> <li>3. Excessive alcohol intake</li> </ol>	N/A
Uric Acid	Male: 3.5-5.9 mg/dL (USA) 0.2-0.34 mmol/L Female: 3.0-5.5 mg/dL (USA) 0.17-0.32 mmol/L	<ol style="list-style-type: none"> <li>1. Improper red blood cell production</li> <li>2. Copper deficiency</li> </ol>	N/A	<ol style="list-style-type: none"> <li>1. Gout</li> <li>2. Elevated Homocysteine</li> <li>3. Rheumatoid Arthritis</li> <li>4. Atherosclerosis</li> <li>5. Liver dysfunction</li> </ol>	Detoxification, Rheumatoid Arthritis, Gout, Atherosclerosis.
Creatinine	0.8-1.1mg/dL (USA)  70-105 μmol/L	<ol style="list-style-type: none"> <li>1. Seen with rapid bone-growth (note: low levels not a problem in this case)</li> <li>2. Pregnancy (note: low levels not a problem in this case)</li> <li>3. Nutrient deficiency (arginine, glycine, and S-adenosylmethionine are required)</li> <li>4. Liver dysfunction</li> </ol>	Detoxification, Fatty Liver	<ol style="list-style-type: none"> <li>1. Renal dysfunction</li> <li>2. Elevated homocysteine</li> <li>3. Benign prostatic hypertrophy</li> <li>4. Insulin resistance</li> <li>5. Creatine supplementation (used by many weight lifters and athletes)</li> <li>6. Prostatitis (advanced)</li> </ol>	Insulin Resistance, Benign Prostatic Hyperplasia, Hyperhomocysteinemia
BUN	10-18 mg/dL (USA)  4.5-7.0 mmol/L	<ol style="list-style-type: none"> <li>1. Pregnancy (note: low levels not a problem in this case)</li> <li>2. Protein deficiency</li> <li>3. Hypochlorhydria</li> <li>4. Pancreatic insufficiency</li> <li>5. Malabsorption</li> <li>6. Liver dysfunction</li> </ol>	Hypochlorhydria, Detoxification, Crohn's Disease, Irritable Bowel Syndrome	<ol style="list-style-type: none"> <li>1. Renal dysfunction</li> <li>2. Boron deficiency</li> </ol>	N/A 


MEASURED COMPONENT	IDEAL RANGE	DECREASED LEVEL MIGHT INDICATE	SEE CLINICAL REPERTORY FOR	INCREASED LEVELS MIGHT INDICATE	SEE CLINICAL REPERTORY FOR
Sodium	135-142 mEq/L	<ol style="list-style-type: none"> <li>1. Adrenal dysfunction (hypoadrenal and cortisol resistance)</li> <li>2. Low salt intake</li> </ol>	Adrenal Insufficiency. (Some people seem to be "salt wasters;" i.e., they excrete a great deal more salt through their skin than an average person and so will need higher dietary intake.)	<ol style="list-style-type: none"> <li>1. Dehydration</li> <li>2. Renal dysfunction</li> </ol>	N/A
Potassium	4.0-4.5 mEq/L	<ol style="list-style-type: none"> <li>1. Adrenal hyperfunction</li> <li>2. Diuretic use</li> <li>3. Renal dysfunction</li> <li>4. Excessive licorice consumption</li> <li>5. Magnesium deficiency</li> </ol>	N/A	<ol style="list-style-type: none"> <li>1. Adrenal dysfunction (hypoadrenal and cortisol resistance)</li> <li>2. Ongoing tissue destruction (catabolic states)</li> </ol>	Adrenal Insufficiency
Chloride	100-106 mEq/L	<ol style="list-style-type: none"> <li>1. Adrenal dysfunction (hypoadrenal and cortisol resistance)</li> <li>2. Hypochlorhydria</li> </ol>	Adrenal Insufficiency, Hypochlorhydria	<ol style="list-style-type: none"> <li>1. Renal dysfunction</li> <li>2. Excessive intake of salt and/or aspirin</li> </ol>	N/A
Carbon Dioxide	25-30 mmHg	<ol style="list-style-type: none"> <li>1. B-Complex vitamin deficiencies</li> <li>2. Acidosis (possibly indicating a need for mineral salts, increased green food consumption)</li> <li>3. Sleep apnea or other breathing abnormalities</li> </ol>	Hypochlorhydria, Detoxification, Crohn's Disease,	<ol style="list-style-type: none"> <li>1. Hypochlorhydria</li> <li>2. Alkalosis</li> </ol>	<p>Hypochlorhydria</p> 

MEASURED COMPONENT	IDEAL RANGE	DECREASED LEVEL MIGHT INDICATE	SEE CLINICAL REPERTORY FOR	INCREASED LEVELS MIGHT INDICATE	SEE CLINICAL REPERTORY FOR
<p>Calcium</p> <p>Note: The possibility of circadian rhythm abnormality should be a primary consideration for levels either above or below normal.</p>	<p>9.4-10.0 mg/dL (USA)</p> <p>2.3-2.5 mmol/L</p>	<ol style="list-style-type: none"> <li>1. Pregnancy (note: low levels not a problem in this case)</li> <li>2. Osteoporosis</li> <li>3. Thyroid dysfunction</li> <li>4. Parathyroid dysfunction</li> <li>5. HPA-axis dysfunction</li> <li>6. Chemical/heavy metal toxicity</li> </ol>	<p>Osteoporosis, Hypothyroidism, Adrenal Insufficiency, Detoxification</p>	<ol style="list-style-type: none"> <li>1. Thyroid dysfunction</li> <li>2. HPA-axis dysfunction</li> <li>3. Parathyroid dysfunction</li> <li>4. Chemical/heavy metal toxicity</li> <li>5. Vitamin D excess</li> <li>6. Impaired cellular membrane health</li> </ol>	<p>Detoxification, Adrenal Insufficiency, Hypothyroidism. (Consider oxidative stress, EFA deficiency and other factors that can compromise membrane health.)</p>
<p>Phosphorous</p>	<p>3.4-4.0 mg/dL</p>	<ol style="list-style-type: none"> <li>1. Hypochlorhydria</li> <li>2. Low protein availability (malabsorption or low intake)</li> </ol>	<p>Hypochlorhydria</p>	<ol style="list-style-type: none"> <li>1. Rapid bone growth or repair (note high levels not a problem if this is the case)</li> <li>2. Renal dysfunction</li> <li>3. Parathyroid dysfunction</li> <li>4. Excessive dietary intake; e.g., phosphoric acid in soft drinks</li> </ol>	<p>N/A</p>
<p>Albumin</p> <p>Note: Albumin levels will transiently decrease subsequent to any acute stress such as surgery, burns, etc.</p>	<p>4.8-5.6 g/dL (USA)</p> <p>48-56 g/L</p>	<ol style="list-style-type: none"> <li>1. Chemical/Heavy metal toxicity</li> <li>2. Liver dysfunction</li> <li>3. Alcoholism</li> <li>4. Malnutrition</li> <li>5. Early warning sign of potential for autoimmune processes, inflammatory processes, TH1/TH2 cytokine imbalances</li> <li>6. Low T3 syndrome (decreased peripheral conversion of T4 to T3)</li> <li>7. Insulin resistance</li> <li>8. Obesity</li> <li>9. Fatty Liver</li> </ol>	<p>Detoxification, Fatty Liver, Hepatitis, Immunodepression, Cholelithiasis, Insulin Resistance</p>	<p>1. Dehydration</p>	<p>N/A</p> 

MEASURED COMPONENT	IDEAL RANGE	DECREASED LEVEL MIGHT INDICATE	SEE CLINICAL REPERTORY FOR	INCREASED LEVELS MIGHT INDICATE	SEE CLINICAL REPERTORY FOR
Globulin	2.4-2.9 g/dL (USA)  24-29 g/L	1. Inflammatory Digestive Processes 2. Immune Deficiencies	Ulcerative Colitis	1. Hypochlorhydria 2. Chemical/Heavy metal toxicity 3. Liver damage or dysfunction (hepatitis, fatty liver, cirrhosis) 4. Autoimmune processes 5. Ongoing tissue destruction 6. Exogenous Hormone administration	Detoxification, Hypochlorhydria, Hepatitis, Fatty Liver, Cirrhosis
Alkaline Phosphatase Note: a great deal of intra-individual variation can occur subsequent to genetic factors (e.g. Blood type A tends to be lower and Blood type O tends to have higher activity. Non-secretors have lower activity than Secretors.) Note: Serum alkaline phosphatase activities can increase dramatically after fatty meals so ensure fasting value.	60-120 units/L	1. Non-secretors 2. Blood type A (Type A non-secretors are especially prone) 3. Very low fat, low protein diets 4. Zinc deficiency 5. Hypothyroidism 6. Excess vitamin D intake 7. Pernicious anemia 8. Scurvy	Hypothyroidism	1. Type O (especially O secretors (Note: this is normal for these individuals)) 2. Bone turnover or loss 3. Any disease process that might impair bile formation of flow 4. Excessive fat and/or protein intake 5. Paget's Disease 6. Severe hypothyroidism 7. Healing fractures 8. Rickets	Hepatitis, Cholelithiasis, Cirrhosis, Fatty Liver, Detoxification  

MEASURED COMPONENT	IDEAL RANGE	DECREASED LEVEL MIGHT INDICATE	SEE CLINICAL REPERTORY FOR	INCREASED LEVELS MIGHT INDICATE	SEE CLINICAL REPERTORY FOR
AST/SGOT	10-30 units/L	<ol style="list-style-type: none"> <li>1. B6 deficiency</li> <li>2. Protein deficiency or malabsorption</li> <li>3. Alcoholism (B6 depletion)</li> <li>4. Any liver dysfunction that interferes with activation of B6 to its coenzyme form, P5P</li> </ol>	N/A	<ol style="list-style-type: none"> <li>1. Liver dysfunction (especially Fatty Liver when values are creeping higher but have not gone above normal lab values)</li> <li>2. Excessive muscle breakdown/turnover (can be secondary to weight training, injuries, or disease processes)</li> <li>3. Cardiac tissue stress, acute M.I., congestive heart failure</li> <li>4. Metastatic cancer</li> </ol>	Fatty Liver, Hepatitis, Cirrhosis, Cholelithiasis, Injury/Trauma, Detoxification, Congestive Heart Failure
ALT/SGPT	10-30 units/L	<ol style="list-style-type: none"> <li>1. B6 deficiency</li> <li>2. Protein deficiency or malabsorption</li> <li>3. Alcoholism (B6 depletion)</li> <li>4. Any liver dysfunction that interferes with activation of B6 to its coenzyme form, P5P</li> </ol>	N/A	<ol style="list-style-type: none"> <li>1. Liver dysfunction (especially Fatty Liver when values are creeping higher but have not gone above normal lab values)</li> <li>2. Congestive heart failure</li> <li>3. Salicylate toxicity</li> </ol>	Fatty Liver, Hepatitis, Cirrhosis, Cholelithiasis, Detoxification, Congestive Heart Failure
GGTP	10-30 units/L	<ol style="list-style-type: none"> <li>1. B6 deficiency</li> <li>2. Protein deficiency or malabsorption</li> <li>3. Alcoholism (B6 depletion)</li> <li>4. Any liver dysfunction that interferes with activation of B6 to its coenzyme form, P5P</li> </ol>	Fatty Liver, Cirrhosis, Hepatitis, Cholelithiasis	<ol style="list-style-type: none"> <li>1. Liver dysfunction (especially Fatty Liver when values are creeping higher but have not gone above normal lab values)</li> <li>2. Alcoholism</li> <li>3. Any process that can result in biliary stasis or obstruction</li> </ol>	Fatty Liver, Detoxification, Cholelithiasis, Congestive Heart Failure
LDH Note: If elevated run LDH isoenzyme panel to determine location of damaged tissue	150-200 units/L	<ol style="list-style-type: none"> <li>1. Reactive hypoglycemia</li> </ol>	Hypoglycemia	<ol style="list-style-type: none"> <li>1. Liver dysfunction</li> <li>2. Cardiac tissue stress/damage, acute M.I.</li> <li>3. Untreated pernicious anemia</li> </ol>	Fatty Liver, Cirrhosis, Congestive Heart Failure, Hepatitis, Cholelithiasis

MEASURED COMPONENT	IDEAL RANGE	DECREASED LEVEL MIGHT INDICATE	SEE CLINICAL REPERTORY FOR	INCREASED LEVELS MIGHT INDICATE	SEE CLINICAL REPERTORY FOR
Bilirubin	0.1-0.9 mg/dL (USA)  4-16 $\mu\text{mol/L}$	N/A	N/A	1. Gilbert's Syndrome 2. Liver dysfunction 3. Spleen dysfunction 4. Red blood cell destruction 5. Congestive heart failure 6. Sickle cell anemia	Fatty Liver Cirrhosis Hepatitis Cholelithiasis
RBC	Male: 4.2-5.0 million/ $\mu\text{L}/\text{mm}^3$ Female: 3.9-4.5 million/ $\mu\text{L}/\text{mm}^3$	1. Anemia 2. Bleeding conditions 3. Intestinal flora imbalance 4. Lead poisoning 5. Chronic disruptions of sleep/wake cycle or circadian rhythms 6. Excessive exercise 7. Malaria 8. Salicylate toxicity	Anemia, Detoxification	1. Dehydration 2. Polycythemia 3. Emphysema	N/A
Hematocrit	Male: 40-48% Female: 37-44%	See RBC	Anemia	See RBC	N/A
MCV	82-89 $\mu\text{m}^3$	1. Iron Deficiency 2. B-6 deficiency 3. Chronic blood loss	Hypoglycemia Anemia, microcytic	1. B12 deficiency 2. Folic acid deficiency 3. Any condition that might decrease absorption of the above (e.g. hypochlorhydria, intestinal flora imbalance, H2-inhibitor drug use, etc.)	Achlorhydria/ Hypochlorhydria Anemia, macrocytic
MCH	27-31.9 pg/cell	See MCV	See MCV	See MCV	See MCV
MCHC	32-36% hemoglobin/cell	See MCV	See MCV	See MCV	See MCV

MEASURED COMPONENT	IDEAL RANGE	DECREASED LEVEL MIGHT INDICATE	SEE CLINICAL REPERTORY FOR	INCREASED LEVELS MIGHT INDICATE	SEE CLINICAL REPERTORY FOR
Platelets: Low platelet count should result in further investigation for any underlying pathology or causes; however, many cases are idiosyncratic.	230,000-450,000 /mL	<ol style="list-style-type: none"> <li>1. Immune dysfunction</li> <li>2. Chemical/heavy metal toxicity</li> <li>3. Sleep/wake cycle disruptions</li> <li>4. Circadian rhythm dysfunction</li> <li>5. Alcoholism</li> <li>6. Deficiency of B12, folic acid, selenium, and/or iron.</li> <li>7. Excessive B3 or sulfhydryl supplementation</li> </ol>	Detoxification Insomnia Immunodepression	<ol style="list-style-type: none"> <li>1. Excessive antioxidant stress</li> <li>2. Polycythemia</li> <li>3. Acute blood loss</li> </ol>	N/A
WBC	5.0-8.0 thousand cells/ $\mu$ L/ $\text{mm}^3$	<ol style="list-style-type: none"> <li>1. Chronic viral or bacterial infection</li> <li>2. HIV</li> <li>3. CFIDS</li> <li>4. Immune dysfunction</li> <li>5. Chemical/Heavy metal toxicity</li> <li>6. Salmonella infection</li> <li>7. Rubella</li> <li>8. Use of some antibiotics and analgesics</li> </ol>	Chronic Fatigue Syndrome, Acquired Immunodeficiency Syndrome (AIDS/HIV), Immunodepression, Detoxification	<ol style="list-style-type: none"> <li>1. Acute Viral or Bacterial Infection</li> <li>2. Acute blood loss</li> <li>3. Renal failure</li> <li>4. Severe emotional stress</li> </ol>	Colds/Flu, Bronchitis, etc.
Neutrophils	50-70%	See WBC	See WBC	See WBC	See WBC
Non-segmented Neutrophils (Bands)	0-4%	N/A	N/A	Active Infection	See WBC 

MEASURED COMPONENT	IDEAL RANGE	DECREASED LEVEL MIGHT INDICATE	SEE CLINICAL REPERTORY FOR	INCREASED LEVELS MIGHT INDICATE	SEE CLINICAL REPERTORY FOR
Lymphocytes	25-40%	<ol style="list-style-type: none"> <li>1. Active Infection</li> <li>2. Increased Oxidative Stress</li> </ol>	Colds/Flu, Detoxification	<ol style="list-style-type: none"> <li>1. Chronic viral or bacterial infection</li> <li>2. HIV</li> <li>3. CFS</li> <li>4. Immune dysfunction</li> <li>5. Chemical/Heavy metal toxicity</li> <li>6. Rubella, Pertusis, mumps</li> <li>7. Leukemia</li> <li>8. Hepatitis</li> </ol>	Chronic Fatigue Syndrome, Acquired Immunodeficiency Syndrome (AIDS/HIV), Immunodepression, Detoxification, Hepatitis
Eosinophils Note: any reading	0-2%	N/A	N/A	<ol style="list-style-type: none"> <li>1. Parasites</li> <li>2. Allergies</li> <li>3. Food Sensitivities</li> <li>4. Chemical/Heavy Metal Sensitivities</li> <li>5. Hodgkin's Disease</li> <li>6. Pernicious anemia</li> <li>7. Ovarian &amp; bone tumors</li> </ol>	Detoxification, Allergy-general, Allergy-food, Allergy-inhalant, Cancer. Consider testing to identify parasites.
Basophils	0-1%	N/A	N/A	<ol style="list-style-type: none"> <li>1. Inflammation</li> <li>2. Parasites</li> <li>3. Acute trauma</li> </ol>	Inflammation, Injury/Trauma Consider testing for parasites and consider Sedimentation Rate

