



BASIC LAB WORK INTERPRETATION

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Module objective:

Help you interpret the results of basic lab work from a functional perspective





Module topics:

- Blood cell count
- 25-OH Vitamin D
- Blood lead

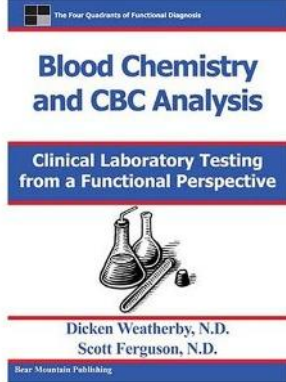


Preliminary comment:

- The interpretation presented are only related to possible functional involvement
- I have not included interpretation of gross abnormalities related to pathologies
- Remember that each lab can have his own "normal" reference range
- Keep in mind that "normal" may not "mean optimal"
- Summary on Page 40-41 of "History and Clinical Exam Mastery Guide"



Reference



Basic Lab Work Interpretation



WHITE BLOOD CELL COUNT

Basic Lab Work Interpretation



WHITE BLOOD CELL COUNT:

- White blood cells (leukocytes) are divided into 2 groups:
 1. Granulocytes (neutrophils, basophils and eosinophils)
 2. Agranulocytes (monocytes and lymphocytes)
- Leukocytes fight infections and produce antibodies
- Measures total white blood cell component of whole blood



WHITE BLOOD CELL COUNT:

Units	Standard US	Standard International
Conventional	$3.7 - 11.0 \times 10^3/\text{mm}^3$	$3.7 - 11.0 \times 10^9/\text{L}$
Optimal	$5.0 - 7.5 \times 10^3/\text{mm}^3$	$5.0 - 7.5 \times 10^9/\text{L}$
Alarm Range	$< 3.0 \text{ or } > 13.0 \times 10^3/\text{mm}^3$	$< 3.0 \text{ or } > 13.0 \times 10^9/\text{L}$



HIGH White blood cell count:

- Childhood diseases (measles, mumps, rubella, chickenpox)
- Acute viral infection
 - strong inflammatory response (elevated ESR)
 - increased lymphocytes (> 44) and normal neutrophils
 - increased monocytes indicate recovery phase
- Acute bacterial infection
 - strong inflammatory process (elevated ESR)
 - increased neutrophils (> 60) and normal lymphocytes

Basic Lab Work Interpretation



HIGH White blood cell count:

- Stress and adrenal production can increase total WBC
- Highly refined diets may slightly elevate WBC
- Other:
 - Intestinal parasites
 - Adrenal dysfunctions
 - Late pregnancy
 - Asthma and emphysema

Basic Lab Work Interpretation



LOW White blood cell count:

- Chronic viral infection
 - Strong inflammatory response (elevated ESR)
 - increased lymphocytes (> 44) and decreased neutrophils (<40)
 - increased monocytes indicate recovery phase
- Chronic bacterial infection
 - strong inflammatory process (elevated ESR)
 - increased neutrophils (> 60) and decreased lymphocytes (<24)



LOW White blood cell count:

- Decreased production due to toxicity
 - drugs and chemotherapeutic agents
 - heavy metals
 - radiations
- Pancreatic insufficiency
 - leukocytic auto-digestion



LOW White blood cell count:

- Raw food diet
 - slightly below normal WBC
- Other
 - Hepatitis
 - B12, B6, and folic deficiencies
 - Adrenal dysfunction
 - Intestinal parasites
 - Multiple food allergies

Basic Lab Work Interpretation



RED BLOOD CELL COUNT

Basic Lab Work Interpretation



RED BLOOD CELL COUNT:

- Oxygen and carbon dioxide exchange
- Ideal to evaluate for iron metabolism and anemia
- Screen for dehydration

Basic Lab Work Interpretation



RED BLOOD CELL COUNT:

Units	Standard US	Standard International
Conventional	M: 4.6 – 6.0 x 10 ⁶ /mm ³ F: 3.8 – 5.1 x 10 ⁶ /mm ³	M: 4.6 – 6.0 x 10 ⁹ /L F: 3.8 – 5.1 x 10 ⁹ /L
Optimal	M: 4.2 – 4.9 x 10 ⁶ /mm ³ F: 4.0 – 4.5 x 10 ⁶ /mm ³	M: 4.2 – 4.9 x 10 ⁹ /L F: 4.0 – 4.5 x 10 ⁹ /L
Alarm Range	M: < 3.8 or > 6.0 F: < 3.5 or > 5.0	M: < 3.8 or > 6.0 F: < 3.5 or > 5.0

Basic Lab Work Interpretation



HIGH Red blood cell count:

- Relative to decreased blood volume (dehydration, tobacco use, diuretics)
- Dehydration
- Vitamin C needs

Basic Lab Work Interpretation



LOW Red blood cell count:

- Iron-deficiency anemia
 - Look at iron metabolism (iron, ferritin and % transferin saturation)
- B12 / Folic acid anemia
 - decreased RBC with
 - decreased HCT (hematocrite) and/or HGB (Hemoglobin)
 - increased MCH and MCV

Basic Lab Work Interpretation



LOW Red blood cell count:

- Copper anemia
 - decreased RBC with
 - decreased HCT (hematocrite) and/or HGB (Hemoglobin)
 - normal to increased MCH and low to high MCV
 - confirm with RBC copper or hair analysis



HEMOGLOBIN



HEMOGLOBIN:

- Oxygen-carrying molecule of RBC
- Evaluate type and cause of anemia
- Screen for dehydration



HEMOGLOBIN:

Units	Standard US	Standard International
Conventional	M: 12.5 – 17.0 g/dl	M: 125 – 170 g/L
	F: 11.5 – 15.0 g/dl	F: 115 – 150 g/L
Optimal	M: 14.0 – 15.0 g/dl	M: 140 – 150 g/L
	F: 13.5 – 14.5 g/dl	F: 135 – 145 g/L
Alarm Range	M: < 10.0 or > 17.0	M: < 100 or > 170
	F: < 10.0 or > 17.0	F: < 100 or > 170



HIGH Hemoglobin:

- Dehydration
- Other:
 - Vitamin B6
 - Diarrhea
 - Adrenal dysfunction



LOW Hemoglobin:

- Iron-deficiency anemia
 - Look at iron metabolism (iron, ferritin and % transferin saturation)
 - Decreased HCT, MCH, MCV, and MCHC
- B12 / Folic acid anemia
 - decreased HCT (hematocrite) and RBC
 - increased MCH and MCV



LOW Red blood cell count:

- Copper anemia
 - decreased RBC with
 - decreased HCT (hematocrite)
 - normal to increased MCH and low to high MCV
 - confirm with RBC copper or hair analysis



LOW Hemoglobin:

- Vitamin B6 anemia
 - Not common
 - Decreased HCT, MCV, MCH, MCHC
 - normal to elevated iron
- Vitamin C needs
 - decreased HCT (hematocrite), MCH, MCHC and iron
 - increased MCV
- Digestive inflammation



HEMATOCRIT

Basic Lab Work Interpretation



HEMATOCRIT:

- % of the volume of RBC in a know volume of blood
- Type and causes of anemia

Basic Lab Work Interpretation



HEMATOCRIT:

Units	Standard US	Standard International
Conventional	M: 36 – 50 %	M: 0.36 – 0.50
	F: 34 – 44 %	F: 0.34 – 0.44
Optimal	M: 40 – 48 %	M: 0.4 – 0.48
	F: 37 – 44 %	F: 0.37 – 0.44
Alarm Range	M: < 32% or > 55%	M: < 0.32 or > 0.55
	F: < 32% or > 55%	F: < 0.32 or > 0.55

Basic Lab Work Interpretation



HIGH Hematocrit:

- Dehydration
- Other:
 - Vitamin B6
 - Diarrhea
 - Adrenal dysfunction

Basic Lab Work Interpretation



LOW Hematocrit:

- Iron-deficiency anemia
 - Look at iron metabolism (iron, ferritin and % transferin saturation)
 - Decreased HGB, MCH, MCV, and MCHC
- B12 / Folic acid anemia
 - decreased HGB and RBC
 - increased MCH and MCV



LOW Hematocrit:

- Copper anemia
 - decreased RBC with
 - decreased HGB
 - normal to increased MCH and low to high MCV
 - confirm with RBC copper or hair analysis



LOW Hematocrit:

- Vitamin B6 anemia
 - Not common
 - Decreased HCT, MCV, MCH, MCHC
 - normal to elevated iron
- Vitamin C needs
 - decreased HCT (hematocrite), MCH, MCHC and iron
 - increased MCV
- Digestive inflammation



MEAN CORPUSCULAR VOLUME (MCV)



MCV:

- Red Blood Cell index used to differentiate anemia
- Measurement of volume of average RBC in cubic micron
- Type and causes of anemia



MCV:

Units	Standard US	Standard International
Conventional	80 – 95 μ^3	80 – 95 fL
Optimal	82 – 89.9 μ^3	82 – 89.9 fL
Alarm Range	< 78 or > 95.5 μ^3	< 78 or > 95.5 fL



HIGH MCV:

- Vitamin B12 and/or folic acid deficiency
 - Increased MCH (> 31.9) and MCHC (> 35)
- Hypochlorhydria
 - Increased MCV, MCH and MCHC
 - especially with low serum iron
- Vitamin C need
 - Decreased HCT, HGB, MCH, MCHC, serum iron

Basic Lab Work Interpretation



LOW MCV:

- Iron-deficiency anemia
 - Look at iron metabolism (iron, ferritin and % transferin saturation)
 - Decreased HGB, HCT, MCH, and MCHC
- Vitamin B6 anemia
 - Decreased HCT, MCV, MCH, MCHC
 - Normal to elevated iron

Basic Lab Work Interpretation



LOW MCV:

- Other
 - intestinal parasites
 - heavy metal body burden



MEAN CORPUSCULAR HEMOGLOBIN (MCH)



MCH:

- Calculated measure
- Expression of average weight of hemoglobin per red blood cells
- Type and causes of anemia



MCH:

Units	Standard US	Standard International
Conventional	27 – 34 pg	27 – 34 pg
Optimal	28 – 31.9 pg	28 – 31.9 pg
Alarm Range	< 24 or > 34 pg	< 24 or > 34 pg



HIGH MCH:

- Vitamin B12 and/or folic acid deficiency
 - Increased MCV (> 90) and MCHC (> 34)
- Hypochlorhydria
 - Increased MCH, MCV and MCHC
 - especially with low serum iron



LOW MCH:

- Iron-deficiency anemia
 - Look at iron metabolism (iron, ferritin and % transferin saturation)
 - Decreased HGB, HCT, MCV, and MCHC
- Vitamin B6 anemia
 - Decreased HCT, MCV, MCH, MCHC
 - Normal to elevated iron



LOW MCH:

- Vitamin C need
 - Decreased HCT, HGB, MCV, MCHC, serum iron
- Heavy metal burden
 - Decreased MCH and MCHC, with increased uric acid
 - Confirm with toxic analysis
- Other
 - Intestinal parasites



MEAN CORPUSCULAR HEMOGLOBIN CONCENTRATION (MCHC)



MCHC:

- Calculated measure
- Expression of average concentration of hemoglobin per red blood cells
- Type and causes of anemia
- Great for monitoring anemia intervention



MCHC:

Units	Standard US	Standard International
Conventional	32 – 36 g/dl	0.32 – 0.36
Optimal	32 – 35 g/dl	0.32 – 0.35
Alarm Range		



HIGH MCHC:

- Vitamin B12 and/or folic acid deficiency
 - Increased MCV (> 90), MCH and MCHC (> 34)
- Hypochlorhydria
 - Increased MCH, MCV and MCHC
 - especially with low serum iron

Basic Lab Work Interpretation



LOW MCHC:

- Iron-deficiency anemia
 - Look at iron metabolism (iron, ferritin and % transferin saturation)
 - Decreased HGB, HCT, MCV, and MCH
- Vitamin B6 anemia
 - Decreased HCT, MCV, MCH, MCHC
 - Normal to elevated iron

Basic Lab Work Interpretation



LOW MCHC:

- Vitamin C need
 - Decreased HCT, HGB, MCV, MCH, serum iron
- Heavy metal burden
 - Decreased MCH and MCHC, with increased uric acid
 - Confirm with toxic analysis



PLATELET COUNT



PLATELET COUNT:

- Platelets play a role in blood clotting, vascular integrity and vasoconstriction
- Evaluate bleeding disorder



PLATELET COUNT:

Units	Standard US	Standard International
Conventional	155 – 385 X 10 ³ /mm ³	155 – 385 X 10 ⁹ /L
Optimal	155 – 385 X 10 ³ /mm ³	155 – 385 X 10 ⁹ /L
Alarm Range	< 50 or > 700	< 50 or > 700



HIGH PLATELET COUNT:

- Atherosclerosis
- Excessive antioxidant stress

Basic Lab Work Interpretation



LOW PLATELET COUNT:

- Infections (viral, rickettsial and bacterial)
- Heavy Metals
 - Check for decreased MCH and MCHC
 - Oxidative stress
 - B12, folic, selenium and/or iron deficiency
 - Excessive B3 supplementation
 - Sleep / wake cycle disruption

Basic Lab Work Interpretation



NEUTROPHILS

Basic Lab Work Interpretation



NEUTROPHILS:

- Essential role in bacterial infections
- Response to inflammation

Basic Lab Work Interpretation



NEUTROPHILS:

Units	Standard US	Standard International
Conventional	35 – 74%	35 – 74%
Optimal	40 – 60%	40 – 60%
Alarm Range	< 30 or > 80%	< 30 or > 80%

Basic Lab Work Interpretation



HIGH NEUTROPHILS:

- Childhood diseases (measles, mumps, rubella, chickenpox)
 - Increased early (>60%) and decreased later (<40%)
- Acute, localized and general bacterial infection
- Chronic viral or bacterial infections
 - Increased neutrophils with decreased total WBC count
- Inflammation
- Intestinal parasites

Basic Lab Work Interpretation



LOW NEUTROPHILS:

- Blood or bone marrow diseases

- Chronic viral infection
 - decreased neutrophils with increased lymphocytes
 - B12, B6, and folic anemia
 - Chronic intestinal parasites
 - Multiple food allergies

Basic Lab Work Interpretation



MONOCYTES

Basic Lab Work Interpretation



MONOCYTES:

- Body's second line of defense against infection
- Active during first 3 days of inflammatory response



MONOCYTES:

Units	Standard US	Standard International
Conventional	4 – 13 %	4 – 13 %
Optimal	< 7%	< 7%
Alarm Range	> 15 %	> 15%



HIGH MONOCYTES:

- Recovery phase of acute infection
- Liver dysfunction (rule out liver if no other explanation)
- Intestinal parasites
 - Increased monocytes, eosinophils and basophils

Basic Lab Work Interpretation



LOW MONOCYTES:

- Corticosteroid therapy

Basic Lab Work Interpretation



LYMPHOCYTES

Basic Lab Work Interpretation



LYMPHOCYTES:

- Coordinate cellular and humoral (antibodies) immune response
- Participate in early and late stage inflammatory response

Basic Lab Work Interpretation



LYMPHOCYTES:

Units	Standard US	Standard International
Conventional	14 – 46 %	14 – 46 %
Optimal	24 – 44 %	24 – 44 %
Alarm Range	< 20% or > 55%	< 20% or > 55%

Basic Lab Work Interpretation



HIGH LYMPHOCYTES:

- Later phase of childhood diseases
- Acute viral infections
 - Along with increased total WBC
- Infectious mononucleosis (EBV virus)
- Inflammation
- Systemic toxicity
- Intestinal parasites

Basic Lab Work Interpretation



LOW LYMPHOCYTES:

- Chronic viral or bacterial infection
- Early active infection
 - Increased total WBC, increased neutrophils
- Oxydative stress (free radical activity)
- Multiple food allergies

Basic Lab Work Interpretation



EOSINOPHILS

Basic Lab Work Interpretation



EOSINOPHILS:

- Affected by intestinal parasites and food/environmental sensitivities
- Remove breakdown of proteins (like Ab-Ag complexes)



EOSINOPHILS:

Units	Standard US	Standard International
Conventional	0 -7 %	0 -7 %
Optimal	< 3 %	< 3 %
Alarm Range		



HIGH EOSINOPHILS:

- Intestinal parasites
 - Increased eosinophils (>3), increased basophils (>1) and monocytes (>7)
- Food and environmental allergies/sensitivities

Basic Lab Work Interpretation



LOW EOSINOPHILS:

- Stress and increased adrenal steroid production

Basic Lab Work Interpretation



BASOPHILS

Basic Lab Work Interpretation



BASOPHILS:

- Phagocytic cells, contain histamine and heparin
- Important role in inflammation

Basic Lab Work Interpretation



BASOPHILS:

Units	Standard US	Standard International
Conventional	0 -3 %	0 -3 %
Optimal	0 – 1 %	0 – 1 %
Alarm Range	> 5%	> 5%

Basic Lab Work Interpretation



HIGH BASOPHILS:

- Intestinal parasites
 - Increased eosinophils (>3), increased basophils (>1) and monocytes (>7)
- Inflammation (non-specific)

Basic Lab Work Interpretation



LOW BASOPHILS:

- Corticosteroid therapy

Basic Lab Work Interpretation



25-OH Vitamin D

Basic Lab Work Interpretation



25-OH Vitamin D:

Excess	> 80 ng/mL	> 200 nmol/L
Optimal Range	40 – 65 ng/mL	100 – 160 nmol/L
Insufficient	20 – 40 ng/mL	50 – 100 nmol/L
Deficient	< 20 ng/mL	< 40 nmol/L

Basic Lab Work Interpretation



Blood Lead

Basic Lab Work Interpretation



Lead

- Developmental neurotoxins
- Interferes with neurotransmission, cellular migration, and synaptic plasticity during central nervous system development
- Exposure to lead has been associated with many cognitive and motor deficits (eg, deficiencies in reading and math skills, fine and gross motor skills, and memory) and distractibility and other characteristics of attention deficit hyperactivity disorder.

Basic Lab Work Interpretation



Lead

- Epidemiologic studies show associations between even low blood lead levels (BLLs) and lowered intelligence quotient (IQ)
- Higher BLLs (and higher lead body burdens measured by levels in bones and teeth) are associated with adolescent delinquent behaviour, poor educational outcomes, reduced adult brain volume, and increased criminal arrests

Basic Lab Work Interpretation



Lead

Measurement of lead body burden

Blood lead levels are measured and reported differently in Canada and the United States (Table 1). The US Centers for Disease Control and Prevention (CDC) action level for blood lead is 10 µg/dL (0.48 µmol/L). This level has been recently questioned, because many recent studies demonstrate neurodevelopmental effects below 10 µg/dL, with no lower threshold for injury identified, suggesting that the decline rate (dose-response curve) in IQ scores might be greater at lower doses.^{1,5,8,15-18}

Table 1. Measurement of blood lead levels in Canada and the United States

MEASUREMENT	CANADA	UNITED STATES
Units of measurement	µmol/L	µg/dL
Current action level	0.48 µmol/L	10 µg/dL
Proposed action level	0.24 µmol/L	5 µg/dL



Lead

- I systematically test in any child who was born in 3rd world country
- I test if lead shows on muscle testing and is not neutralized by detoxification