Pathology Summary Interpretation List

Metabolic Function		
Albumin Normal: 35-50 g/L Ideal range: 43 to 48g/L	Low	Liver failure, Alcoholism, malnutrition, Chemical or heavy metal toxicity, Inflammation, insulin resistance, obesity, deficiency of protease enzyme activity
	High	Dehydration
Globulin Normal: 20 to 39 g/L	Low	Inflammation, immune deficiency
	High	Chemical or heavy metal toxicity, Liver damage, Autoimmune disease
Total Protein TP Normal: 60 to 82 g/L	Low	Liver, Kidney disorder, severe malnutrition, conditions that cause malabsorption such as celiac disease or inflammatory bowel disease.
	High	Chronic inflammation or infections such as viral hepatitis or HIV, bone marrow disorders such as multiple myeloma
A/G Ratio a bit over 1 favouring albumin	Low	overproduction of globulin seen in multiple myeloma and autoimmune disease, underproduction of albumin seen in cirrhosis, loos of albumin with kidney disease.
	High	Underproduction of immunoglobulins such in genetic deficiencies and leukemias.
Blood urea nitrogen BUN Normal: 10 to 20 mg/dL or 2.5 to 8.0 mmol/L	Low	Hypochlorhydria, Dietary protein deficiency, Maldigestion, Malabsorption, Liver failure, Celiac disease
	High	Renal failure, Urinary tract obstruction, Congestive heart failure, Shock, Ketoacidosis, Dehydration, Acute myocardial infarction, Bleeding from the GI tract, Muscle wasting
BUN/creatinine Ratio Normal: 10:1 to 20:1 (men and older individuals may be a bit higher)	Low	**With low BUN:** Low-protein diet, Starvation, Overhydration, Severe liver disease, Repeated dialysis, Pregnancy **With high creatinine:** Rhabdomyolsis (severe muscle injury), Muscular patients who develop renal failure
	High	**With normal creatinine:** Heart failure, Salt depletion, Dehydration, Blood loss, Catabolic states (increased tissue breakdown), GI haemorrhage, High protein intake, Impaired kidney function, Drug interactions **With high creatinine:** Postrenal azotemia, Prerenal azotemia

Metabolic Function		
Creatinine Normal: 0.5 to 1.1 mg/dL for women 0.6 to 1.2 mg/dL for men or 40-85 umol/L	Low	Decreased muscle mass, Liver disease, Inadequate dietary protein
	High	Impaired kidney function, High consumption of red meat, Muscle disease(e.g. Muscular dystrophy, acromegaly, gigantism), Congestive heart failure, Dehydration
Uric acid Normal:0.15 - 0.45 mmol/L	Low	Low hematopoiesis, Copper deficiency, Overhydration, Severe liver damage, Malnutrition, Low protein intake
	High	Gout, Rheumatoid arthritis, Hepatic failure, Hyperhomocysteinemia, Impaired kidney function, Leukemia, Dehydration, Shock, Urinary tract obstruction, High protein intake
Glucose Normal: 70 to 99 mg/dL or 3.6 to 6.0 mmol/L	Low below:	Hypoglycemia, Insulin overdose, Pancreatic disorders, Endocrine disorders (early diabetes mellitus), Malnutrition, Liver damage (alcoholism)
	High above:	Diabetes mellitus, Increased circulating epinephrine (e.g. due to emotion, burns, shock, anaesthesia), Acute or chronic pancreatitis, Vitamin b1 deficiency, Drug interactions
HbA1c Optimal 6.0 %	Borderline: 6.0-6.5%	Metabolic syndrome, Insulin resistance
	High Above 6.5%	Diabetes
Insulin Normal: 2 to 10 mU/L	Low	Low ATP from poorly functioning mitochondria, low cyclic AMP, lower carb and protein consumption, low cyclic GMP, oxidative stress, circadian dysrhthm, lower vagus nerve stimulation, stress (high adrenaline inhibits insulin release), Hypoxia, lower Vitamin D receptor activation, Polymorphisms in LXR genes show reduced insulin secretion, lower vasopressin, higher cortisol levels
	High	Increases risk of thrombosis -blood clots, increases arterial plague formation, stimulates the production of insulin-like growth factor 1 (IGF-1), increases the risk of prostate, endometrial and breast cancer and make all cancers more likely to metastasis, increases risk of polycystic ovarian syndrome, inhibits glycogenolysis, gluconeogenesis and ketogenesis, inhibits conversion of T4 to the active form of T3

Metabolic Function		
Bilirubin, total (Conjugated +unconjugated) Normal: 0.1 to 1.9 mg/dL or smaller than 25 umol/L	Low	Low levels of bilirubin are generally not concerning and are not monitored Drug interferences (e.g. barbiturates)
	High	Gilbert's syndrome (problems in glucuronidation pathway), Chemical or heavy metal toxicity, Liver failure, Enhanced erythrocyte turnover, Congested heart failure, Sickle cell anaemia

Minerals		
Sodium Normal: 135 to 145 mmol/L	Low	Metabolic acidosis, Adrenal dysfunction, Alcoholic liver, Viral hepatitis, Drug reactions, Tumour, Scarring of the bile ducts.
	High	Dehydration, renal dysfunction
Potassium Normal: 3.7 to 5.2 mmol/L	Low	Adrenal hyperactivity, Magnesium deficiency, Excessive fluid loss due to sweating, vomiting, diarrhea, Pyloric obstruction, Malabsorption, Diabetic acidosis, Diuretics, Hypothyroidism
	High	Adrenal dysfunction, Acute renal failure, Dehydration
Chloride Normal: 98 to 106 mmol/L	Low	Adrenal dysfunction, Hypochlorhydria, Excessive sweating, Diarrhea, Congestive heart failure, Diabetic acidosis, Diuretics
	High	Renal failure, Excessive salt or aspirin intake, Dehydration, Diabetes insipidus, Hyperparathyroidism, Hyperventilation
Calcium Normal: 9.0 to 10.5 mmol/L the elderly score a bit lower	Low	Osteoporosis, Thyroid dysfunction, Parathyroid dysfunction, HPA axis dysfunction, Heavy metal toxicity, Magnesium deficiency, Vitamin D deficiency, Malabsorption, Hypoalbuminemia
	High	Thyroid or parathyroid dysfunction, Chemical or heavy metal toxicity, Excess vitamin D, Excess ingestion of vitamins A and D, Cancer, Bone fracture combined with bed rest,
Phosphorus Normal: 2.4 to 4.1 mmol/L	Low	Hypochlorhydria, Insufficient protein assimilation, Ricketts or osteomalacia, Vitamin D deficiency, Hyperinsulinemia, Antacids, Diuretics, Long-term steroid use, Severe malnutrition
	High	Renal or parathyroid dysfunction, Excessive phosphate intake, bone cancer, Low blood calcium levels, Diabetes mellitus with ketosis, Liver disease, cirrhosis
Bicarbonate Normal: 25 to 33 mmol/L	Low	Acidic blood, Acidogenic diets, Accelerated progression of chronic kidney disease, Increased rate of bone loss, Increased risk of cardiovascular & all cause mortality
	High	
Anion Gap Normal: 4 to 17 mmol/L **Calculation of Anion Gap:** (Na+K)-(CL-HCO3)= Anion Gap	Low	Low value most commonly seen when albumin low and immunoglobulins are increased as in multiple myeloma
	High	Metabolic acidosis

Minerals		
Iodine (Iodine urine spot test) Results depending on Lab	Low	Goiter, cretinism, Development delay, Impaired thyroid function, weight gain, low energy, depression, cardiovascular disease, cognitive decline, cancer, increased risk of breast cancer and cystic breast disease.
	High	Goiter, Elevated TSH levels, Hypothyroidism,

Vitamins		
Vitamin D Normal 50 to 70 ng/ml or 125 to 175 nmol/L	Low less than 50 ng/ml or 125 nmol/L	Low sun exposure, Vitamin D receptor impairment, people with increased skin pigmentation and elderly are at risk, conditions that affect ability to absorb fat (low fat soluble vitamin absorption), seen in all degenerative diseases including cancer, osteoporosis,
	High higher than 100 ng/ml or 250 nmol/L	overdose in supplementation
Vitamin B12 Normal: higher than 180 pmol/L	Low	Atrophic gastritis, Pernicious anemia, Conditions affecting small intestine such as Crohn's disease, celiac disease, bacterial growth, parasites, Heavy drinking, Lupus, Graves disease, Overuse of acid reducing drugs, Vegan diet
	High higher than 950 pg/ml or 701 pmol/l	Vitamin B12 supplementation, Functional and qualitative vitamin B12 deficiency, Liver disease, Kidney failure, A quantitative deficiency or lack of affinity of TCB for vitamin B12, tumours, malignancies, cChronic myeloid leukemias, Polycythemia vera
Folate RBC Normal: higher than 450 nmol/L	Low	Anemia, Increased cardiovascular risk, Low levels of white blood cells and platelets, Birth defects - Spina Bifida, Increased stroke risk, Stomach problems, Hair loss, High homocysteine levels
	High	High levels could show an MTHFR impairment problem, Pernicious anaemia, Intestinal blind loop syndrome, Increased food intake or supplementation

Lipid Panel		
Triglycerides Normal: 40 to 160 mg/dL or 0.6 to 2.0 mmol/L	Low	Oxidative stress, Chemical/metal toxicity, Liver dysfunction, Low dietary carbohydrates
	High	Insulin resistance, Diabetes, Fatty liver, Hypothyroidism
Cholesterol total Normal: 180 to 240 mg/dL or 4.0 to 6.2 mmol/L	Low	Oxidative stress, Chemical/metal toxicity, Liver dysfunction, Low dietary carbohydrates, Viral hepatits, Hyperthyroidism, due to mineral imbalances such as Manganese and zinc
	High	Insulin resistance, Diabetes, Fatty liver, Hypothyroidism, Acute biliary obstruction, Pancreatitis, Stress, Genetic disposition
HDL Normal: or 1.10 to 1.90 mmol/L	Low	oxidative stress. Chemical/metal toxicity, Sedentary lifestyle, Obesity, Insulin resistance, Fatty liver, Starvation, Diabetes, Hypothyroidism, Uremia
	High	Decreased risk of coronary heart disease, Factors that elevate HDL concentrations include chronic alcoholism, treatment with oral estrogen replacement therapy, extensive aerobic exercise, and treatment with niacin, statins, or fibrates.
LDL Normal: or 0.0 to 4.0 mmol/L	Low	Mostly in correlation with overall low cholesterol (see low total cholesterol)
	High	Increased risk for blood clots, stroke and heart disease, Familial hypercholesterolemia,
Chol/HDL Ratio Normal: or 0-4.5	Low	Decreased risk of coronary heart disease
	High	Increased risk for blood clots, stroke and heart disease

Iron Panel		
Iron Normal: 10 to 30 umol/L	Low	Iron deficiency anemia, Chronic blood loss, Anemia due to infection or chronic diseases, Nephrosis, Hypothyroid, Menstruation
	High	Iron excess, Hepatitis, Acute iron toxicity, Thalassemia, Hemochromatosis
Transferrin Normal: 2.10 to 3.80 g/L	Low	Hemochromatosis, poor production by the liver
	High	Iron-deficiency anemia, increased in pregnancy, oral contraceptives,
Ferritin Normal: Greater than 20 ng/mL	Low	Iron deficiency, anaemia,
	High: Greater than 400 ng/mL	Iron overload - Hemochromatosis, Trace mineral imbalance; Manganese, Zinc, Copper, High ferritin with an elevated C-Reactive Protein with a low transferrin % and anemia profile indicates that it is an inflammatory response. Maybe associated with increased heart disease risk, liver disease, diabetes arthritis, malignant disease. Alcohol abuse, acute hepatitis, infections
Transferrin Saturation Normal: 16 to 60 %	Low	Chronic iron deficiency (<27%) when there is normal to elevated TIBC and +/- a low Ferritin, maybe associated with low iron, protein, copper and vitamin C status
	High	Iron overload - Hemochromatosis,

Thyroid Panel		
TSH Optimal: 0.8 to 2.5 mIU/L	Low below 0.3 mIU/L	Hyperthroidism, Graves disease or diffuse toxic goiter, maybe associated with muscle wasting, subacute thyroiditis,
	High Above 3.0 mIU/L	Hypothyroidism
Free T4 Normal: 0.7 to 2.0	Low	Hypothyroidism
	High	Hyperthyroidism,
Free T3 Normal: 2.3 to 4.2	Low	liver problems, gut dysbiosis, selenium deficieny, stress, certain medications, pro-inflammatory cytokines when T4 normal and T3 low - conversion problem
	High	Stress, medication containing estrogens
reverse T3 Normal: 90 to 350 pg/mL	Low	
	High	High reverse T3 blocks the conversion of T4 to T3 caused by chronic stress - compromised adrenal gland function. Chronic illnesses such as diabetes, chronic fatigue syndrome, and fibromyalgia.
TPO / Thyroid antibodies Normal: <9.0 IU/mL	Low	
	High	Hashimoto's thyroiditis, lupus, rheumatoid arthritis, and pernicious anemia, Type1 Diabetes, Pregnancy, Thyroid cancer

Enzyme / Liver panel		
AST Normal: 10 to 40 IU/L (units per liter)	Low	Vitamin B6 or protein deficiency, Alcoholism, Liver disease
	High	Acute myocardial infarction, Liver disease, Skeletal muscle breakdown, Metastatic cancer, Acute viral hepatitis
ALT Normal: 7 to 56 IU/L (units per liter)	Low	Vitamin B6 or protein deficiency, Alcoholism, Liver disease
	High	Liver disease, Fatty liver, Congestive heart failure, Salicylate toxicity, Acute viral hepatitis
Alkaline phosphatase ALP Normal: 44 to 147 IU/L (international units per liter)	Low	Hypothyroidism, Pernicious anaemia, Scurvy, Low fat or low protein diet, Zinc deficiency, Excessive vitamin D intake
	High	Hepatitis, Liver cirrhosis, Liver cancer, Gallstones or blockage in bile duct, Elevated bone turnover/loss, Hypothyroidism, Paget's disease, rickets, Bile acid deficiency, Excessive dietary fat or protein Children with growth burst
GGT (gamma-glutamyl-transferase) Normal: smaller than 51 U/L	Low	Birth control pill can decease level,
	High	Acohol, drugs (Phenytoin, Phenobarbital), diabetes, flow of bile is blocked, swollen and inflamed liver, Lack of blood flow to the liver, Liver cancer, Lung disease, Pancreas disease, Cirrhosis, Use of drugs which are toxic for the liver

Inflammation Markers		
CRP	**Normal** Women less than 1.0 mg/dL Men less than 0.5 mg/dL	Ulcerative colitis often normal or only slightly elevated, Lupus erythematosus
	High 4.2 mg/dL , 6 times the risk of cardiac death	Inflammation Rheumatoid arthritis Juvenile idiopathic arthritis Ankylosing spondylitis Reactive arthritis Psoriatic arthritis Crohn's disease Rheumatic fever Vasculitis Behcet's syndrome Polyarteritis nodosa Pancreatitis Periodic fever syndromes, Bacterial endocarditis, Abscess Postoperative infection
hs-CRP (high sensitive C-reactive protein) hs-CRP: < 3 mg/L	High-sensitivity CRP is more precise than standard CRP when measuring baseline (ie, normal) concentrations and enables a measure of chronic inflammation.	
ESR Less valuable in assessing acute changes than CRP	**Normal** Men under 50 years: less than 15 mm/hr Men over 50 year: less than 20 mm/hr Women under 50 years: less than 20 mm/hr Women over 50 years: less than 30 mm/hr Children: Newborn: 0 to 2 mm/hr Newborn to puberty: 3 to 13 mm/hr	
	High ESR of over 100mm/hr needs immediate investigation.	Infections such as Tuberculosis, endocarditis or abscess. Malignancy such as Multiple myeloma and Metastatic cancer. Rheumatological such as Vasculitis, inflammatory arthritis, rheumatoid arthritis, crystal arthropathies.

Inflammation Markers		
Ferritin High: Greater than 400 ng/mL	High	Inflammation (acute phase response to tissue injury - e.g.. trauma, myocardial infarction, acute infections, burns, chronic inflammation (as in Crohn's disease, rheumatoid arthritis and malignancy), Chronic alcohol consumption, metabolic syndrome, obesity, diabetes, malignancy, infections.
Fibrinogen Reference range: 150-400 mg/dL.	Low	Acute or decompensated intravascular coagulation and fibrinolysis (disseminated intravascular coagulation [DIC]), advanced liver disease, L-asparaginase therapy, and therapy with fibrinolytic agents (eg, streptokinase, urokinase, tissue plasminogen activator).
	High	Inflammation (acute phase response to tissue injury - e.g.. trauma, myocardial infarction, acute infections, burns, chronic inflammation (as in Crohn's disease, rheumatoid arthritis and malignancy)
Homocysteine Optimal: 7-8 mmol/L	Low Under 6 mmol/L	CBS polymorphism, high doses of 5-MTHF.
	High Over 9 mmol/L	Undermethylation due to MTHFR and MTR impairment, Deficiencies of folate and Vitamin B12, Inflammation, High Stress

COMPLETE BLOOD COUNT (CBC)

White Blood Cells		
WBC	Normal: 4,3- 10,8 x 10 ^{9}/L	
	Low	Viral infections, Diminished bone marrow function (congenital), Cancer (damages bone marrow), autoimmune disorders, severe infections, Medications such as antibiotics, Sarcoidosis, Chemo and Radiation therapy, HIV/Aids, Leukemia, Lupus, Malnutrition and vitamin deficiencies, Kostmann's syndrome
	High	Acute lymphocytic leukaemia, Acute myelogenous leukemia (AML), Allergy, especially severe allergic reactions, Chronic myelogenous leukaemia, Drugs, such as corticosteroids and epinephrine, Infections, Bacterial or viral, myelofibrosis, polycythemia vera, Rheumatoid arthritis, Smoking, Stress such as severe emotional or physical stress, Tuberculosis, whooping cough
Neutrophils	Normal: 2.5- 7.5 x 10 9/L	
	Low (Neutropenia)	Infection, Nutritional deficiencies (B12, folate, zinc) Bone marrow problem, Leukemia, Radiation and chemotherapy, Tuberculosis, dengue fever, Viral infections such as Epstein- Barr virus, cytomegalovirus, HIV, viral hepatitis, Crohn's disease, Rheumatoid arthritis, Lupus, Drugs (antibiotics, blood pressure drugs, psychiatric drugs, epilepsy drugs)
	High	High level of stress (exercise, seizures, nerves), sudden bacterial infections, sudden kidney failure, Ketoacidosis, Eclampsia, Cancer, Haemolytic anaemia, Polycythemia vera, Myeloid metaplasia, Dugs (corticosteroids)
Lymphocytes	Normal: 1.5 - 3.5 x 10 9/L	
	Low (Lymphocytopenia)	Infectious diseaes (AIDS, viral hepatitis, tuberculosis, typhoid fever), Autoimmune disorders (lupus), Steroid therapy, leukemia, Hodgkin's disease, Aplastic anemia, Radiation and chemotherapy

White Blood Cells		
	High (Lymphocytosis)	Acute lymphocytic Leukemia, Chronic lymphocytic leukemia, Cytomegalovirus (CMV) infection, HIV/ AIDS, Mononucleosis Other viral infections, Tuberculosis, Vasculitis, Whooping cough, Chronic inflammation in autoimmune disorder
Monocytes	Normal: 0.2 - 0.8 x 10 9/L	
	Low	Anything that decreases the overall white blood cell count (see Neutropenia and Lymphocytopenia), such as a bloodstream infection , chemotherapy, or a bone marrow disorder, Rheumatoid arthritis, Prednisone treatment
	High	Chronic infections, in autoimmune disorders, in blood disorders, and in certain cancers.
Basophils	Normal: 0.01 - 0.1 x 10 9/L	
	Low	Crohn's Disease, Polycythemia Vera, Chickenpox, Collagen Vascular Disease, Asthma, Myelofibrosis, Low Progesterone, Hypothyroidism
	High	Estrogen dominance, Chronic forms of dermatitis, Asthma, Chicken pox, Consequences of splenectomy, Crohn’s disease, Haemolytic anemia, Hodgkin’s lymphoma, Hypothyroidsm, Sinusitis, Ulcerative Colitis
Eosinophils	Normal: 0.04 - 0.4 x 10 9/L	
	Low (Eosinopenia)	Alcohol intoxication, Over production of steroids such as cortisol, Cushing syndrome, Sepsis,
	High	Allergic disease (hay fever, Asthma, food allergies…)Parasite infection, Fungus infections, Hodgkin lymphoma, Leukemia, and Myeloproliferative disorders, Vascular disease, Inflammation, Drug reactions

Red Blood Cells		
Red Blood Cell Count	Reference range: 4.52-5.90 x1012/L in adult male. 4.10-5.10 x1012/L in adult female.	
	Low	Blood loss, Haemorrhage, Bone marrow failure, Deficiencies in iron, folate, or vitamins B6 and B12, Hemolysis, Certain cancers, repeated infections with fever
	High	High altitude, Congential heart disease, Cor pulmonate, Polycythemia vera, Pulmonary fibrosis, Dehydration
Hemoglobin	Reference range: 120 to 170 g/L Ideal range: 130 to 170 g/L	
	Low	Anemia, Blood loss, Deficiencies in iron, folate or vitamins B6 and B12
	High	Sickle cell anaemia, Thalassemia, Transfusion reaction, Hemolysis, Dehydration, Polycythemia, High altitude
Hematocrit	Reference range: 36 to 48% Ideal range: 41 to 45%	
	Low	Anemia, Blood loss, Bone marrow failure, Hemolysis, Certain cancers, Deficiencies of iron, folate or vitamin B6 and B12, Cirrhosis
	High	Dehydration, Polycythemia vera, High altitude
Mean corpuscular volume (MCV)	Reference range: 81 to 97 fl	
	Low	Microcytic anemia, Iron deficiency, Thalassemia
	High	Macrocytic anemia, Folic acid or B12 deficiency, Alcohol abuse, Hereditary sperocytosis, excesses of iron, exposure to mercury or other toxic metals, possible pesticides exposure, chemotherapy, hypothyroidism, chronic renal disease

Platelet count	Reference range; 150-450 x 10^9/L	
	Low	Chemotherapy, Haemolytic anaemia, Hypersplenism, Vitamin B12 or folate deficiency, Leukemia, Prosthetic heart valves, Sequelae of massive blood transfusion, Disseminated intravascular coagulation
	High	Post-spenectomy, Primary thrombocytosis, Certain malignancies, Early chronic myelogenous leukemias, Polycythemia vera, Rheumatoid arthritis