Common Diagnostic Tests and Range of Values

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ABIM Laboratory Test Reference Ranges – July 2021

Laboratory Tests	Reference Ranges
1,25-Dihydroxyvitamin D (1,25-dihydroxycholecalciferol), serum	*See* Vitamin D metabolites
17-Hydroxyprogesterone, serum	
Female, follicular	<80 ng/dL
Female, luteal	<285 ng/dL
Female, postmenopausal	<51 ng/dL
Male (adult)	<220 ng/dL
25-Hydroxyvitamin D (25-Hydroxycholecalciferol), serum	*See* Vitamin D metabolites
5-Hydroxyindoleacetic acid, urine	2–9 mg/24 hr
6-Thioguanine, whole blood	230–400 pmol/8×10^8 RBCs
Absolute neutrophil count (ANC)	2000–8250/μL
Acid phosphatase, serum	
Total	0.5–2.0 (Bodansky) units/mL
Prostatic fraction	0.1–0.4 unit/mL
ACTH, plasma	10–60 pg/mL
Activated partial thromboplastin time	25–35 seconds
ADAMTS13 activity	>60%
Adrenocorticotropic hormone (ACTH), plasma	10–60 pg/mL
Albumin, serum	3.5–5.5 g/dL
Albumin, urine	<25 mg/24 hr
Albumin-to-creatinine ratio, urine	<30 mg/g
Aldolase, serum	0.8–3.0 IU/mL
Aldosterone, plasma	
Supine or seated	≤10 ng/dL
Standing	<21 ng/dL
Low-sodium diet (supine)	≤30 ng/dL
Aldosterone, urine	5–19 μg/24 hr
Alkaline phosphatase, serum	30–120 U/L
Alkaline phosphatase, bone specific	5.6–18.0 μg/L for premenopausal women
Alpha$_1$-antitrypsin (AAT), serum	150–350 mg/dL
Alpha$_2$-antiplasmin activity, plasma	75%–115%
Alpha-amino nitrogen, urine	100–290 mg/24 hr
Alpha-fetoprotein, serum	<10 ng/mL
Amino acids, urine	200–400 mg/24 hr
Aminotransferase, serum alanine (ALT, SGPT)	10–40 U/L
Aminotransferase, serum aspartate (AST, SGOT)	10–40 U/L
Ammonia, blood	40–70 μg/dL
Amylase, serum	25–125 U/L (80–180 [Somogyi] units/dL)
Amylase, urine	1–17 U/hr
Androstenedione, serum	Female: 30–200 ng/dL; male: 40–150 ng/dL
Angiotensin-converting enzyme, serum	8–53 U/L
Anion gap, serum	7–13 mEq/L
Antibodies to double-stranded DNA	0–7 IU/mL

Anticardiolipin antibodies	
IgG	<20 GPL
IgM	<20 MPL
Anti-cyclic citrullinated peptide, antibodies to	<20 units
Antideoxyribonuclease B	<280 units
Anti-F-actin antibodies, serum	≤1:80
Antihistone antibodies	<1:16
Anti-liver-kidney microsomal antibodies (anti-LKM)	<1:20
Antimitochondrial antibodies	≤1:5
Anti–myelin associated glycoprotein antibody	<1:1600
Antimyeloperoxidase antibodies	<1.0 U
Antinuclear antibodies	≤1:40
Anti–smooth muscle antibodies	≤1:80
Antistreptolysin O titer	<200 Todd units
Antithrombin activity	80%–120%
Antithyroglobulin antibodies	<20 U/mL
Antithyroid peroxidase antibodies	<2.0 U/mL
Anti-tissue transglutaminase antibodies	*See* Tissue transglutaminase antibody
Arterial blood gas studies (patient breathing room air):	
pH	7.38–7.44
$PaCO_2$	38–42 mm Hg
PaO_2	75–100 mm Hg
Bicarbonate	23–26 mEq/L
Oxygen saturation	≥95%
Methemoglobin	0.5%–3.0%
Ascorbic acid (vitamin C), blood	0.4–1.5 mg/dL
Ascorbic acid, leukocyte	16.5 ± 5.1 mg/dL of leukocytes
(1,3)-Beta-D-glucan, serum	<60 pg/mL
Beta-human chorionic gonadotropin (beta-hCG), serum	Female, premenopausal nonpregnant: <1.0 U/L ; female, postmenopausal: <7.0 U/L; male: <1.4 U/L
Beta-human chorionic gonadotropin (beta-hCG), urine	<2 mIU/24 hr
$Beta_2$-glycoprotein I antibodies:	
IgG	<21 SGU
IgM	<21 SMU
Beta-hydroxybutyrate, serum	<0.4 mmol/L
$Beta_2$-microglobulin, serum	0.54–2.75 mg/L
Bicarbonate, serum	23–28 mEq/L
Bilirubin, serum	
Total	0.3–1.0 mg/dL
Direct	0.1–0.3 mg/dL
Indirect	0.2–0.7 mg/dL
Bleeding time (template)	<8 minutes
Blood urea nitrogen (BUN), serum or plasma	8–20 mg/dL
B-type natriuretic peptide, plasma	<100 pg/mL
C peptide, serum	0.8–3.1 ng/mL
Calcitonin, serum	Female: ≤5 pg/mL; male: ≤10 pg/mL
Calcium, ionized, serum	1.12–1.23 mmol/L
Calcium, serum	8.6–10.2 mg/dL

Calcium, urine	Female: <250 mg/24 hr; male: <300 mg/24 hr
Carbohydrate antigens, serum	
CA 19-9	0–37 U/mL
CA 27-29	<38.0 U/mL
CA 125	<35 U/mL
Carbon dioxide content, serum	23–30 mEq/L
Carboxyhemoglobin, blood	<5%
Carcinoembryonic antigen, plasma	<2.5 ng/mL
Carotene, serum	75–300 µg/dL
Catecholamines, plasma	
Dopamine	<30 pg/mL
Epinephrine	
Supine	<50 pg/mL
Standing	<95 pg/mL
Norepinephrine	
Supine	112–658 pg/mL
Standing	217–1109 pg/mL
Catecholamines, urine	
Dopamine	65–400 µg/24 hr
Epinephrine	2–24 µg/24 hr
Norepinephrine	15–100 µg/24 hr
Total	26–121 µg/24 hr
CD4 T-lymphocyte count	530–1570/µL
Cell count, CSF:	
Leukocytes (WBCs)	0–5 cells/µL
Erythrocytes (RBCs)	0/µL
Ceruloplasmin, serum (plasma)	25–43 mg/dL
Chloride, CSF	120–130 mEq/L
Chloride, serum	98–106 mEq/L
Chloride, urine	
Random ("spot")	mEq/L; varies
24-hour measurement	mEq/24 hr; varies with intake
Cholesterol, serum	
Total	
Desirable	<200 mg/dL
Borderline-high	200–239 mg/dL
High	>239 mg/dL
High-density lipoprotein	
Low	Female: <50 mg/dL; male: <40 mg/dL
Low-density lipoprotein	
Optimal	<100 mg/dL
Near-optimal	100–129 mg/dL
Borderline-high	130–159 mg/dL
High	160–189 mg/dL
Very high	>189 mg/dL
Cholinesterase, serum (pseudocholinesterase)	≥0.5 pH units/hr
Packed cells	≥0.7 pH units/hr
Chorionic gonadotropin, beta-human (beta-hCG), serum	*See* Beta-human chorionic gonadotropin (beta-hCG), serum

Chorionic gonadotropin, beta-human (beta-hCG), urine	*See* Beta-human chorionic gonadotropin (beta-hCG), urine
Chromogranin A, serum	<93 ng/mL
Citrate, urine	250–1000 mg/24 hr
Clotting time (Lee-White)	5–15 minutes
Coagulation factors, plasma	
Factor I (fibrinogen)	200–400 mg/dL
Factor II (prothrombin)	60%–130%
Factor V (accelerator globulin)	60%–130%
Factor VII (proconvertin)	60%–130%
Factor VIII (antihemophilic globulin)	50%–150%
Factor IX (plasma thromboplastin component)	60%–130%
Factor X (Stuart factor)	60%–130%
Factor XI (plasma thromboplastin antecedent)	60%–130%
Factor XII (Hageman factor)	60%–130%
Factor XIII	57%–192%
Cold agglutinin titer	>1:64 positive
Complement components, serum	
C3	100–233 mg/dL
C4	14–48 mg/dL
CH50	110–190 units/mL
Copper, serum	100–200 µg/dL
Copper, urine	0–100 µg/24 hr
Coproporphyrin, urine	50–250 µg/24 hr
Cortisol, free, urine	4–50 µg/24 hr
Cortisol, plasma	
8 AM	5–25 µg/dL
4 PM	<10 µg/dL
1 hour after cosyntropin	≥18 µg/dL
Overnight suppression test (1-mg)	<1.8 µg/dL
Overnight suppression test (8-mg)	>50% reduction in cortisol
Cortisol, saliva, 11 PM – midnight	<0.09 µg/dL
C-reactive protein, serum	≤0.8 mg/dL
C-reactive protein (high sensitivity), serum	Low risk = <1.0 mg/L; Average risk = 1.0–3.0 mg/L; High risk = >3.0 mg/L
Creatine kinase, serum	
Total	Female: 30–135 U/L; male: 55–170 U/L
MB isoenzymes	<5% of total
Creatine, urine	Female: 0–100 mg/24 hr; male: 0–40 mg/24 hr
Creatinine clearance, urine	90–140 mL/min/1.73 m^2
Creatinine, serum	Female: 0.50–1.10 mg/dL; male: 0.70–1.30 mg/dL
Creatinine, urine	
Random ("spot")	mg/dL; varies
24-hour measurement	15–25 mg/kg body weight/24 hr
Cyclosporine, whole blood (trough)	
Therapeutic	100–200 ng/mL
0–3 months post transplantation	150–250 ng/mL
More than 3 months post transplantation	75–125 ng/mL
D-dimer, plasma	<0.5 µg/mL
Dehydroepiandrosterone sulfate (DHEA-S), serum	Female: 44–332 µg/dL; male: 89–457 µg/dL

Delta-aminolevulinic acid, serum	<20 µg/dL
Digoxin, serum	Therapeutic: 1.0–2.0 ng/mL (<1.2 ng/mL for patients with heart failure)
Dihydrotestosterone, serum	Adult male: 25–80 ng/dL
Dopamine, plasma	<30 pg/mL
Dopamine, urine	65–400 µg/24 hr

D-Xylose absorption
  (after ingestion of 25 g of D-xylose)
    Serum
    Urinary excretion
	
	25–40 mg/dL
	4.5–7.5 g during a 5-hr period

Electrolytes, serum
  Sodium
  Potassium
  Chloride
  Bicarbonate
	
	136–145 mEq/L
	3.5–5.0 mEq/L
	98–106 mEq/L
	23–28 mEq/L

Epinephrine, plasma
  Supine
  Standing
	
	<110 pg/mL
	<140 pg/mL

Epinephrine, urine	<20 µg/24 hr
Erythrocyte count	4.2–5.9 million/µL
Erythrocyte sedimentation rate (Westergren)	Female: 0–20 mm/hr; male: 0–15 mm/hr
Erythrocyte survival rate (^{51}Cr)	T½ = 28 days
Erythropoietin, serum	4–26 mU/mL

Estradiol, serum
  Female, follicular
    Mid-cycle peak
    Luteal
    Postmenopausal
  Male
	
	10–180 pg/mL
	100–300 pg/mL
	40–200 pg/mL
	<10 pg/mL
	20–50 pg/mL

Estriol, urine	>12 mg/24 hr
Estrogen receptor protein	Negative: <10 fmol/mg protein
Estrone, serum	10–60 pg/mL

Ethanol, blood
  Coma level
  Intoxication
	<0.005% (<5 mg/dL)
	>0.5% (>500 mg/dL)
	≥0.08%–0.1% (≥80–100 mg/dL)

Euglobulin clot lysis time	2–4 hours at 37.0 C
Everolimus, whole blood (trough)	Therapeutic: 3.0–8.0 ng/mL
Factor XIII, B subunit, plasma	60–130 U/dL
Fecal fat	<7 g/24 hr
Fecal nitrogen	<2 g/24 hr
Fecal pH	7.0–7.5
Fecal potassium	<10 mEq/L
Fecal sodium	<10 mEq/L
Fecal urobilinogen	40–280 mg/24 hr
Fecal weight	<250 g/24 hr
Ferritin, serum	Female: 24–307 ng/mL; male: 24–336 ng/mL
Fibrin(ogen) degradation products	<10 µg/mL
Fibrinogen, plasma	200–400 mg/dL
Fibroblast growth factor-23, serum	30–80 RU/mL
Flecainide, serum	Therapeutic: 0.2–1.0 µg/mL

Folate, red cell	150–450 ng/mL of packed cells
Folate, serum	1.8–9.0 ng/mL
Follicle-stimulating hormone, serum	
Female, follicular/luteal	2–9 mIU/mL (2–9 U/L)
Female, mid-cycle peak	4–22 mIU/mL (4–22 U/L)
Female, postmenopausal	>30 mIU/mL (>30 U/L)
Male (adult)	1–7 mIU/mL (1–7 U/L)
Children, Tanner stages 1, 2	0.5–8.0 mIU/mL (0.5–8.0 U/L)
Children, Tanner stages 3, 4, 5	1–12 mIU/mL (1–12 U/L)
Free kappa light chain, serum	3.3–19.4 mg/L
Free kappa-to-free lambda light chain ratio, serum	0.26–1.65
Free lambda light chain, serum	5.7–26.3 mg/L
Gamma globulin, CSF	6.1–8.3 mg/dL
Gamma-glutamyltransferase	
(gamma-glutamyl transpeptidase), serum	Female: 8–40 U/L; male: 9–50 U/L
Gastric secretion	
Basal acid analysis	10–30 units of free acid
Basal acid output	Female: 2.0 ± 1.8 mEq of HCl/hr; male: 3.0 ± 2.0 mEq of HCl/hr
Maximal output after pentagastrin stimulation	23 ± 5 mEq of HCl/hr
Gastrin, serum	<100 pg/mL
Gentamicin, serum	Therapeutic: peak 5.0–10.0 µg/mL; trough: <2.0 µg/mL
Glucose, CSF	50–75 mg/dL
Glucose, plasma (fasting)	70–99 mg/dL
Glucose-6-phosphate dehydrogenase, blood	5–15 units/g of hemoglobin
Glycoprotein α-subunit, serum	<1 ng/mL
Growth hormone, serum	
At rest	<5 ng/mL
Response to provocative stimuli	>7 ng/mL
Haptoglobin, serum	83–267 mg/dL
Hematocrit, blood	Female: 37%–47%; male: 42%–50%
Hemoglobin A_{1C}	4.0%–5.6%
Hemoglobin, blood	Female: 12–16 g/dL; male: 14–18 g/dL
Hemoglobin fractionation	
Hb A	96%–98%
Hb A_2	1.5%–3.5%
Hb F	<1%
Hemoglobin, plasma	<5.0 mg/dL
Heparin–anti-factor Xa assay, plasma	0.3–0.7 IU/mL [therapeutic range for standard (unfractionated) heparin therapy]
Heparin–platelet factor 4 antibody, serum	Positive: >0.4 optical density units
Hepatic copper	25–40 µg/g dry weight
Hepatic iron index	<1.0
Histamine excretion, urine	20–50 µg/24 hr
Homocysteine, plasma	5–15 µmol/L
β-Human chorionic gonadotropin (β-hCG), serum	Female, premenopausal nonpregnant: <1.0 U/L; female, postmenopausal: <7.0 U/L; male: <1.4 U/L
β-Human chorionic gonadotropin (β-hCG), urine	<2 mIU/24 hr
Hydroxyproline, urine	10–30 mg/sq meter of body surface/24 hr
Immature platelet fraction	1%–5% of platelet count

Immune complexes, serum	0–50 µg/dL
Immunoglobulins, serum	
IgA	90–325 mg/dL
IgE	<380 IU/mL
IgG	800–1500 mg/dL
IgM	45–150 mg/dL
Immunoglobulin free light chains, serum	
Kappa	3.3–19.4 mg/L
Lambda	5.7–26.3 mg/L
Kappa-to-lambda ratio	0.26–1.65
Insulin, serum (fasting)	<20 µU/mL
Insulin-like growth factor 1 (IGF-1) (somatomedin-C), serum	
Ages 16–24	182–780 ng/mL
Ages 25–39	114–492 ng/mL
Ages 40–54	90–360 ng/mL
Ages 55 and older	71–290 ng/mL
Iodine, urine	
Random ("spot")	µg/L; varies
Iron, serum	50–150 µg/dL
Iron-binding capacity, serum (total)	250–310 µg/dL
Lactate dehydrogenase, serum	80–225 U/L
Lactate, arterial blood	<1.3 mmol/L (<1.3 mEq/L)
Lactate, serum or plasma	0.7–2.1 mmol/L
Lactate, venous blood	0.7–1.8 mEq/L; 6–16 mg/dL
Lactic acid, serum	6–19 mg/dL (0.7–2.1 mmol/L)
Lactose tolerance test, GI	Increase in plasma glucose: >15 mg/dL
Lead, blood	<5.0 µg/dL
Leukocyte count	4000–11,000/µL
Segmented neutrophils	50%–70%
Band forms	0%–5%
Lymphocytes	30%–45%
Monocytes	0%–6%
Basophils	0%–1%
Eosinophils	0%–3%
Lipase, serum	10–140 U/L
Lipoprotein(a), serum	Desirable: <30 mg/dL
Lithium, plasma	
Therapeutic	0.6–1.2 mEq/L
Toxic level	>2 mEq/L
Luteinizing hormone (LH), serum	
Female, follicular/luteal	1–12 mIU/mL (1–12 U/L)
Female, mid-cycle peak	9–80 mIU/mL (9–80 U/L)
Female, postmenopausal	>30 mIU/mL (>30 U/L)
Male (adult)	2–9 mIU/mL (2–9 U/L)
Children, Tanner stages 1, 2, 3	<9.0 mIU/mL (<9.0 U/L)
Children, Tanner stages 4, 5	1–15 mIU/mL (1–15 U/L)

Lymphocyte subsets	
CD3	900–3245/µL
CD4	530–1570/µL
CD8	430–1060/µL
CD19	208–590/µL
CD56	40–500/µL
Magnesium, serum	1.6–2.6 mEq/L
Magnesium, urine	14–290 mg/24 hr
Mean corpuscular hemoglobin	28–32 pg
Mean corpuscular hemoglobin concentration	33–36 g/dL
Mean corpuscular volume	80–98 fL
Mean platelet volume	7–9 fL
Metanephrines, fractionated, plasma	
Metanephrine	<0.5 nmol/L
Normetanephrine	<0.9 nmol/L
Metanephrines, fractionated, 24-hour urine	
Metanephrine	<400 µg/24 hr
Normetanephrine	<900 µg/24 hr
Myoglobin, serum	<100 µg/L
Norepinephrine, plasma	
Supine	70–750 pg/mL
Standing	200–1700 pg/mL
Norepinephrine, urine	0–100 µg/24 hr
Normetanephrine, fractionated, plasma	<0.9 nmol/L
Normetanephrine, fractionated, 24-hour urine	<900 µg/24 hr
N-telopeptide, urine	Female: 11–48 nmol BCE/mmol creatinine; male: 7–68 nmol BCE/mmol creatinine

N-terminal-pro-B-type natriuretic peptide (NT-pro-BNP), serum or plasma	<u>If eGFR >60 mL/min/1.73 m^2</u>
	18–49 years of age
	   Heart failure unlikely: ≤300 pg/mL
	   High probability of heart failure: ≥450 pg/mL
	50–75 years of age
	   Heart failure unlikely: ≤300 pg/mL
	   High probability of heart failure: ≥900 pg/mL
	Older than 75 years of age
	   Heart failure unlikely: ≤300 pg/mL
	   High probability of heart failure: ≥1800 pg/mL
	<u>If eGFR <60 mL/min/1.73 m^2</u>
	18 years of age or older
	   High probability of heart failure: ≥1200 pg/mL

Osmolality, serum	275–295 mOsm/kg H_2O
Osmolality, urine	38–1400 mOsm/kg H_2O
Osmotic fragility of erythrocytes	Increased if hemolysis occurs in over 0.5% NaCl; decreased if hemolysis is incomplete in 0.3% NaCl
Osteocalcin, serum	Female: 7.2–27.9 ng/mL; male: 11.3–35.4 ng/mL
Oxalate, urine	<40 mg/24 hr
Oxygen consumption	225–275 mL/min
Oxygen saturation, arterial blood	≥95%
Parathyroid hormone, serum	
C-terminal	150–350 pg/mL
Intact	10–65 pg/mL
Intact (dialysis patients only)	Target: 130–585 pg/mL

Parathyroid hormone-related protein, serum	<1.5 pmol/L
Partial thromboplastin time (activated)	25–35 seconds
pH, urine	4.5–8.0
Phenolsulfonphthalein, urine	At least 25% excreted by 15 minutes; 40% by 30 minutes; 60% by 120 minutes
Phenytoin, serum	Therapeutic: 10–20 µg/mL
Phosphatase (acid), serum	
Total	0.5–2.0 (Bodansky) units/mL
Prostatic fraction	0.1–0.4 unit/mL
Phosphatase (alkaline), serum	30–120 U/L
Phospholipids, serum (total)	200–300 mg/dL
Phosphorus, serum	3.0–4.5 mg/dL
Phosphorus, urine	500–1200 mg/24 hr
Platelet count	150,000–450,000/µL
Platelet function analysis (PFA-100):	
Collagen–epinephrine closure time	60–143 seconds
Collagen–ADP closure time	58–123 seconds
Platelet survival rate (^{51}Cr)	10 days
Potassium, serum	3.5–5.0 mEq/L
Potassium, urine	
Random ("spot")	mEq/L; varies
24-hour measurement	mEq/24 hr; varies with intake
Prealbumin, serum	16–30 mg/dL
Pregnanetriol, urine	0.2–3.5 mg/24 hr
Pressure (opening) [initial], CSF	70–180 mm CSF (70–180 mm H$_2$O)
Procalcitonin, serum	≤0.10 ng/mL
Progesterone, serum	
Female, follicular	0.02–0.9 ng/mL
Female, luteal	2–30 ng/mL
Male (adult)	0.12–0.3 ng/mL
Proinsulin, serum	3–20 pmol/L
Prolactin, serum	<20 ng/mL
Prostate-specific antigen, serum	ng/mL; no specific normal or abnormal level
Protein C activity, plasma	65%–150%
Protein C antigen, plasma	70%–140%
Protein catabolic rate, urine	goal: 1.0–1.2 g/kg/24 hr
Protein S activity, plasma	57%–131%
Protein S antigen, plasma	
Total	60%–140%
Free	60%–130%
Protein, urine	
Random ("spot")	mg/dL; varies
24-hour measurement	<100 mg/24 hr
Proteins, CSF total	15–45 mg/dL
Proteins, serum	
Total	5.5–9.0 g/dL
Albumin	3.5–5.5 g/dL

Proteins, serum (continued)	
Globulin	2.0–3.5 g/dL
Alpha1	0.2–0.4 g/dL
Alpha2	0.5–0.9 g/dL
Beta	0.6–1.1 g/dL
Gamma	0.7–1.7 g/dL
Protein-to-creatinine ratio, urine	<0.2 mg/mg
Prothrombin time, plasma	11–13 seconds
Pyruvic acid, blood	0.08–0.16 mmol/L
Quinidine, serum	Therapeutic: 2–5 µg/mL
Red cell distribution width (RDW)	9.0–14.5
Red cell mass	Female: 22.7–27.9 mL/kg; male: 24.9–32.5 mL/kg
Renin activity (angiotensin-I radioimmunoassay)	
Peripheral plasma	
Normal diet	
Supine	0.3–2.5 ng/mL/hr
Upright	0.2–3.6 ng/mL/hr
Low sodium diet	
Supine	0.9–4.5 ng/mL/hr
Upright	4.1–9.1 ng/mL/hr
Diuretics + low sodium diet	6.3–13.7 ng/mL/hr
Renal vein concentration	Normal ratio (high:low): <1.5
Reptilase time	10–12 seconds
Reticulocyte count	0.5%–1.5% of red cells
Reticulocyte count, absolute	25,000–100,000/µL
Rheumatoid factor (nephelometry)	<24 IU/mL
Rheumatoid factor, latex test for	≤1:80
Ristocetin cofactor activity of plasma	*See* von Willebrand factor activity (ristocetin cofactor activity), plasma
Russell viper venom time, dilute	33–44 seconds
Salicylate, plasma	Therapeutic: 20–30 mg/dL
Sex hormone-binding globulin	Female, nonpregnant: 18–144 nmol/L; male: 10–57 nmol/L
Sodium, serum	136–145 mEq/L
Sodium, urine	
Random ("spot")	mEq/L; varies
24-hour measurement	mEq/24 hr; varies with intake
Specific gravity, urine	1.002–1.030
Sperm density	10–150 million/mL
Sweat test for sodium and chloride	<60 mEq/L
T3 resin uptake	25%–35%
T-lymphocyte count, CD4	530–1570/µL
Tacrolimus, whole blood (trough)	Therapeutic: 5–15 ng/mL {For transplant patients: 10.0–15.0 ng/mL (0–3 months post transplantation); 5.0–10.0 ng/mL (more than 3 months post transplantation)}
Testosterone, serum	Female: 18–54 ng/dL; male: 291–1100 ng/dL
Testosterone, bioavailable, serum	Female, age 18–69 yrs: 0.5–8.5 ng/dL
Testosterone, free, serum	Male: 70–300 pg/mL
Theophylline, serum	Therapeutic: 8–20 µg/mL
Thrombin time	17–23 seconds

Thyroid function studies	
T3 resin uptake	25%–35%
Thyroglobulin, serum	<20 ng/mL
Thyroidal iodine (^{123}I) uptake	5%–30% of administered dose at 24 hours
Thyroid-stimulating hormone (TSH), serum	0.5–4.0 µU/mL (0.5–4.0 mU/L)
Thyroid-stimulating immunoglobulin (TSI)	<130%
Thyroxine-binding globulin, serum	12–27 µg/mL
Thyroxine index, free (estimate)	5–12
Thyroxine (T_4), serum	
Total	5–12 µg/dL
Free	0.8–1.8 ng/dL
Triiodothyronine (T_3), serum	
Total	80–180 ng/dL
Reverse	20–40 ng/dL
Free	2.3–4.2 pg/mL
Tissue transglutaminase antibody, IgA [by chemiluminescence method]	<20 AU
Tissue transglutaminase antibody, IgG [by chemiluminescence method]	<20 AU
Tissue transglutaminase antibody, IgA [by ELISA]	<4.0 U/mL
Tissue transglutaminase antibody, IgG [by ELISA]	<6.0 U/mL
Total proteins, CSF	15–45 mg/dL
Transaminase, serum glutamic oxaloacetic (SGOT)	*See* Aminotransferase, serum aspartate (AST)
Transaminase, serum glutamic pyruvic (SGPT)	*See* Aminotransferase, serum alanine (ALT)
Transferrin saturation	20%–50%
Transferrin, serum	200–400 mg/dL
Triglycerides, serum (fasting)	
Optimal	<100 mg/dL
Normal	<150 mg/dL
Borderline-high	150–199 mg/dL
High	200–499 mg/dL
Very high	>499 mg/dL
Troponin I, cardiac, serum	≤0.04 ng/mL
Troponin T, cardiac, serum	≤0.01 ng/mL
Tryptase, serum	<11.5 ng/mL
Urea clearance, urine	
Standard	40–60 mL/min
Maximal	60–100 mL/min
Urea nitrogen, blood	8–20 mg/dL
Urea nitrogen, urine	12–20 g/24 hr
Uric acid, serum	3.0–7.0 mg/dL
Uric acid, urine	250–750 mg/24 hr
Uroporphyrin, urine	10–30 µg/24 hr
Vanillylmandelic acid, urine	<9 mg/24 hr
Venous oxygen content, mixed	14–16 mL/dL

Venous studies, mixed, blood	
pH	7.32–7.41
PCO_2	42–53 mm Hg
PO_2	35–42 mm Hg
Bicarbonate	24–28 mEq/L
Oxygen saturation (SvO2)	65%–75%
Viscosity, serum	1.4–1.8 cp
Vitamin A, serum:	
Adult	32.5–78.0 µg/dL
Pediatric, age 1–2 yr (retinol)	20–43 µg/dL
Vitamin B_{12}, serum	200–800 pg/mL
Vitamin D metabolites, serum	
1,25-Dihydroxyvitamin D (1,25-dihydroxycholecalciferol)	15–60 pg/mL
25-Hydroxyvitamin D (25-hydroxycholecalciferol)	30–60 ng/mL
Vitamin E, serum:	
Adult	5.5–17.0 mg/L
Pediatric, age 1–2 yr (alpha-tocopherol)	2.9–16.6 mg/L
Volume, blood	
Plasma	Female: 43 mL/kg body weight; male: 44 mL/kg body weight
Red cell	Female: 20–30 mL/kg body weight; male: 25–35 mL/kg body weight
von Willebrand factor activity (ristocetin cofactor activity), plasma	50%–150%
von Willebrand factor antigen, plasma	50%–150%
Zinc, serum	75–140 µg/dL

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Diagnostic Tests and Laboratory Values

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Common Lab Tests

The following table lists common lab tests in three categories.[41]

Chemistry	Hematology	Urine
Albumin (AL) Ammonia (AMM, NH3) Amylase (AMY) Aspartate transaminase (AST) Blood urea nitrogen (BUN) Chloride (Cl) Creatine kinase (CK) Creatinine (Cr) D-dimer (DDIMER) Glucose (GLU) Ischemia-modified albumin (IMA) Lactate dehydrogenase (LDH) Potassium (K) Sodium (Na) Troponins (cTnT & cTnI)	**Complete blood count and differential**: CBC, Hgb, PCV, Mb, BNP, thrombocytes, WBC, WBC differential **Coagulation studies**: prothrombin time (PT) partial thromboplastin time (PTT) international normalized ratio (INR) **Diabetes testing**: FBS, OGTT, HbA1c	Urinalysis (UA) Culture and sensitivity Urine toxicology

Note: The above-mentioned labs represent those frequently requested for the scope and practice of the LPN. There are lab studies that may be required in your work environment not listed in this module.

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CHEMISTRY TESTS

Body chemistry is complex. There are many chemical elements in a human body that are finely balanced to produce particular functions and processes, and maintain homeostasis. In the following tables, key information of relevance to nurses is provided for each chemical element.

Albumin (AL)		
Normal Range	35–50 g/L *	
Indications	Used to diagnose and monitor diseases of the liver, impaired nutrition, chronic edema, and cancer.	
Test Explanation	Component of total serum protein (pre-albumin, albumin, and globulins). Albumin is a protein that is made in the liver. Albumin maintains colloidal osmotic pressure.	
Purpose	Used to check liver and kidney function. Find out if diet contains enough protein. Helps determine cause of edema to extremities, abdomen.	
Interfering Factors	Drugs that interrupt normal serum electrophoretic patterns (e.g., Aspirin, bicarbonates, corticosteroids, salicylates).	
Results and Significance	**Lower** Indicative of malnutrition Liver disease Ascites Inflammatory disease Autoimmune disorder GI malabsorption syndromes	**Higher** Severe dehydration

* All lab values are shown in SI format. If you need a refresher on SI units, you should take the SI Units of Measurement quiz in the Supplementary Practice Quizzes section of this online course. To ensure accuracy and to maintain optimal level of care for individuals receiving any lab tests or specimen collection, please refer to your workplace policies and procedures manual or contact the laboratory.

Ammonia (AMM, NH3)

Normal Range	6–47 mcmol/L
Indications	Used to diagnose severe liver diseases.
Test Explanation	Measures the amount of ammonia in the blood. Ammonia in the body is created by the breakdown of protein. The liver converts ammonia to urea, which is excreted as urine in the kidneys.
Purpose	Check liver function. Check success of treatment for severe liver disease (e.g., cirrhosis). Check levels in a person receiving total parenteral nutrition.
Interfering Factors	Smoking. Eating high-protein or low-protein diet. Medications that increase blood ammonia (e.g., Loop diuretics and thiazides). Strenuous exercise before test.

Results and Significance	**Lower** Essential or malignant hypertension	**Higher** Liver disease (cirrhosis or hepatitis) Reye syndrome Heart failure Kidney failure Severe bleeding from stomach or intestines

Amylase (AMY)		
Normal Range	**Serum Amylase** <160 U/L	**Urine Amylase** 2–34 U/hr
Indications	Used to diagnose or treat diseases in the pancreas. Can be conducted by obtaining a blood or urine sample.	
Test Explanation	Amylase is produced by the pancreas, salivary glands, and liver and is excreted by the kidneys. When there is an inflammation of the pancreas or salivary gland, more amylase goes into the blood and more amylase is excreted in the urine.	
Purpose	Diagnose pancreatic disease. See if treatment for pancreatic disease is working. Diagnose client with acute abdominal pain.	
Interfering Factors	Opiates, diuretics, and blood thinners will affect results. For urine amylase specimen: presence of fecal material or toilet paper can contaminate results. Prolonged urine collection time. For serum blood: Narcotic drugs. IV fluids containing glucose. Wait two hours after eating to draw blood (sugar can decrease serum amylase).	
Results and Significance	**Lower** Acute alcoholism Cirrhosis of liver Extensive destruction of pancreas	**Higher** Acute pancreatitis Cancer of pancreas Inflammation of salivary glands (mumps) Severe damage to intestines Stomach ulcer Diabetic ketoacidosis Kidney failure

Aspartate Transaminase (AST)

Normal Range	**Adult**: 0–35 U/L
Indications	This test is used in the evaluation of clients with suspected hepatocellular diseases.
Test Explanation	This enzyme is found in very high concentrations with highly metabolic tissue, such as the heart muscle, liver cells, skeletal muscle cells, and, to a lesser degree, in the kidneys, pancreas, and red blood cells. When disease or injury affects the cells of these tissues, the cells lyse. AST is released and picked up by the blood, and the serum level rises. The amount of AST elevation is related directly to the number of cells affected by the disease or injury. The degree of elevation depends on the length of time between the injury and when the blood is collected.
Purpose	Used to detect diseases such as acute hepatitis, gallstones, cirrhosis, liver congestion, metastatic tumour of the liver, infectious mononucleosis, acute pancreatitis, acute renal disease, musculoskeletal diseases or trauma.
Interfering Factors	Pregnancy can cause decreased AST levels. Exercise may increase AST levels. Levels decreased by liver disease, uremia, or diabetic ketoacidosis. Some drugs may cause increases in AST (e.g., antihypertensives, cholinergic agents, anticoagulants, contraceptives, opiates, and statins).

Results and Significance	**Lower**	**Higher**
	Acute renal disease	Liver diseases such as hepatitis, hepatic cirrhosis, drug-induced liver injury, hepatic metastasis, mononucleosis
	Beriberi	Skeletal muscle diseases such as muscle trauma, surgery, burns, muscular dystrophy, heat stroke
	Diabetic ketoacidosis	
	Pregnancy	Other diseases such as acute hemolytic anemia and acute pancreatitis
	Chronic renal dialysis	

Adapted from Pagana, K. D., and T. J. Pagana. *Mosby's Canadian Manual of Diagnostic and Laboratory Tests*. 1st ed. Toronto, ON: Elsevier Canada, 2013.

Blood Urea Nitrogen (BUN)

Normal Range	3.6–7.1 mmol/L	
Indications	Check for kidney function.	
Test Explanation	A test that measures the amount of nitrogen in your blood, which comes from the waste product urea. Urea is made when protein is broken down in the body. Urea is made in the liver and excreted by the kidneys.	
Purpose	The BUN test is used to see how well your kidneys are working, to see if kidney treatment is working, and to check for severe dehydration.	
Interfering Factors	**Decreases** Low-protein and high-carbohydrate diet Low muscle mass Early pregnancy Medications Over hydration	**Increases** Late pregnancy Old age Medications (The nurse should check the specific medications that the client is taking at the time of the test.)
Results and Significance	**Lower** Liver disease or damage to liver	**Higher** Heart failure Dehydration Diet high in protein Shock Kidney injury or disease

Chloride (Cl)	
Normal Range	96–106 mmol/L
Indications	This test is usually included as one element in the test for electrolytes. In conjunction with the other elements, chloride can provide an indication of acid-base balance and hydration status.
Test Explanation	Chloride's purpose is to maintain water balance in the body and acid-base balance.
Purpose	To check the chloride level in relation to potassium, sodium, and bicarbonate balance. This helps form a differential with regard to acid-base balance.
Interfering Factors	Infusions of saline solutions can increase chloride levels. Drugs that may cause increased serum chloride levels (e.g., cortisone, estrogens, hydrochlorothiazide, and NSAIDS).

Results and Significance	**Lower**	**Higher**
	Heart failure	Dehydration (diarrhea or vomiting)
	Ongoing vomiting	Increased sodium intake
	Over hydration	Renal disease

Creatine Kinase (CK)

Normal Range	**Male**: 55–170 U/L	**Female**: 30–135 U/L
Indications	Cardiac enzyme study: This test is used to support diagnosis of myocardial infarction. Performed when client exhibits chest pain.	
Test Explanation	CK is found in the cardiac muscle, skeletal muscle, and brain. Serum CK levels are elevated when these muscle or nerve cells are injured.	
Purpose	Used to diagnose myocardial infarction or skeletal muscle disease.	
Interfering Factors	Drugs can cause increased levels of CK (e.g., ampicillin, anesthetics [some], anticoagulants, aspirin, Decadron, Lasix, and morphine).	
Results and Significance		**Higher** Acute myocardial infarction Skeletal muscle disease Cerebrovascular accident (CVA) Severe angina

Creatinine (Cr)	23	
Normal Range	**Male:** 53–106 mcmol/L	**Female:** 44–97 mcmol/L
Indications	Test is usually performed along with BUN to investigate liver and kidney function.	
Test Explanation	Creatinine is a by-product formed by the breakdown of muscle creatine phosphate in the body. Creatinine is filtered by the glomerulus and excreted in the urine.	
Purpose	Best measure of renal function.	
Interfering Factors	Eating red meat in large amounts may affect results.	
Results and Significance	**Lower** Severe liver disease Diet low in protein	**Higher** Acute and chronic renal failure Shock Systematic lupus erythematosus Cancers Leukemias Muscle injury (rhabdomyolysis, muscular dystrophy)

D-dimer (DDIMER)

Normal Range	<250 mcg/L
Indications	To check for blood-clotting problems.
Test Explanation	Blood tests used to measure a substance that is released when a blood clot breaks up. Can be ordered in combination with imaging scans to help with blood-clotting problems. D-dimer assesses both thrombin and plasmin activities that help with the clotting process.
Purpose	To diagnose dangerous blood-clotting problems, such as deep vein thrombosis and pulmonary embolism.
Interfering Factors	False-positive tests are obtained with high titres of rheumatoid factor. Inflammation. Liver disease. Advancing ovarian cancer. Post-op or post-trauma. Pregnancy.

Results and Significance		**Higher**
		Disseminated intravascular coagulation (DIC)
		Serious bleeding disorder from abnormally accelerated clotting
		DVT
		PE
		Surgical complication

Glucose (GLU)
(Fasting Blood Sugar, Random Blood Sugar)

Normal Range	Fasting Blood 4.0–7.0 mmol/L	Random Glucose <7.0 mmol/L
Indications	To control blood glucose levels. Used for persons with diabetes taking oral hypoglycemic medication or insulin.	
Test Explanation	Test that measures the amount of glucose in the blood. Glucose comes from carbohydrates, which are the main source of energy used by the body.	
Purpose	Used to check for diabetes, monitor treatment of diabetes.	
Interfering Factors	Vigorous exercise, stress, trauma, infection. Use of cortisone drugs. Intravenous fluids that contain dextrose.	
Results and Significance	**Lower** Excessive doses of insulin Inadequate food intake Hypoglycemia Liver disease Malnutrition Eating disorder Hypothyroidism Addison disease Starvation	**Higher** Diabetes Prolonged corticosteroid therapy Severe stress

Ischemia-Modified Albumin (IMA)

Normal Range	<85 IU/mL
Indications	This test is performed on individuals with chest pain to determine whether the pain is caused by cardiac ischemia.
Test Explanation	When albumin is exposed to an ischemic environment, this causes an alteration of the albumin, called ischemia-modified albumin (IMA). The presence of IMA has become particularly helpful in identifying cardiac ischemia. Blood levels of IMA appear and begin rising with ten minutes of the initiation of the ischemic event and stay elevated for six hours after ischemia has resolved.
Purpose	When combined with other diagnostic tests, the diagnosis of an ischemic cardiac event can be corroborated or ruled out.
Interfering Factors	False positives can occur in other clinical situations such as advanced cancers, acute infections, and end-stage renal or liver disease.
Results and Significance	**Higher** Myocardial ischemia Brain ischemia Pulmonary ischemia

Adapted from Pagana, K. D., and T. J. Pagana. *Mosby's Canadian Manual of Diagnostic and Laboratory Tests*. 1st ed. Toronto, ON: Elsevier Canada, 2013.

Lactate Dehydrogenase (LDH)

Normal Range	Total lactate dehydrogenase levels: **Newborn**: 160–450 U/L **Infant**: 100–250 U/L **Child**: 60–170 U/L **Adult**: 100–190 U/L **Isoenzymes (electrophoresis) for adults**: LDH-1: 0.17–0.27 LDH-2: 0.27–0.37 LDH-3: 0.18–0.25 LDH-4: 0.03–0.08 LDH-5: 0–0.05
Indications	LDH is an intracellular enzyme used to diagnose injury or disease of the heart, liver, red blood cells, kidneys, skeletal muscle, brain, and lungs.
Test Explanation	Because LDH is widely distributed through the body, the total level is not a specific indicator of any one disease or injury. When disease or injury affects the cells containing LDH, the cells lyse, and LDH is spilled into the bloodstream, in which it is identified in higher-than-normal levels. Five separate fractions (isoenzymes) make up the total LDH. Each tissue contains a predominance of one or more LDH enzymes.
Purpose	A higher level of LDH-1 indicates myocardial injury. Isolated elevation of LDH-5 indicates hepatocellular injury or disease. Elevation of LDH- 2 and LDH-3 indicates pulmonary injury or disease. Elevation of all LDH isoenzyme levels indicates multi-organ injury.
Interfering Factors	Hemolysis of blood elevates LDH level. Strenuous exercise may elevate LDH. Some drugs (alcohol, anaesthetics, aspirin, clofibrate, fluorides) may increase LDH levels. Ascorbic acid may decrease LDH levels.

Results and Significance		Higher
		Myocardial infarction (LDH-1, LDH-2)
		Pulmonary disease (LDH-2, LDH-3)
		Hepatic disease (LDH-5)
		RBC disease (LDH-1)
		Skeletal muscle disease/injury (LDH-5)
		Renal parenchymal disease (LDH-1)
		Intestinal ischemia and infarction (LDH-5)
		Testicular tumours (LDH-1)
		Lymphoma (LDH-3, LDH-2)
		Pancreatitis (LDH-4)

Adapted from Pagana, K. D., and T. J. Pagana. *Mosby's Canadian Manual of Diagnostic and Laboratory Tests*. 1st ed. Toronto, ON: Elsevier Canada, 2013.

Potassium (K)

Normal Range	3.50–5.0 mmol/L
Indications	Routine blood test that checks for cardiac and muscle function. Can be used to diagnose disease in conjunction with sodium.
Test Explanation	Potassium is essential in keeping the water and electrolyte balance of the body. Potassium is vital to how nerves and muscles work. Potassium levels can change with sodium levels.
Purpose	Used to check potassium level, detect the presence of hypo- or hyperkalemia. Monitor potassium levels during renal insufficiency, with cancers, and with certain drugs (diuretics).
Interfering Factors	Taking potassium supplements. Certain medications (e.g., antibiotics that contain potassium, NSAIDS, heparin, inulin, corticosteroids, non-potassium-sparing diuretics). Overuse of laxatives. Severe vomiting.

Results and Significance	**Lower**	**Higher**
	Overuse of diuretics	Damage or injury to the kidneys
	Hyperaldosteronism	Severe burns
	Severe burns	Crushing injuries
	Cystic fibrosis	Heart attack
	Alcoholism	Overconsuming potassium supplements
	Dehydration	Medications (e.g., ACE inhibitors)

Sodium (Na)		
Normal Range	135–145 mmol/L	
Indications	A blood test performed in conjunction with potassium and chloride (serum electrolytes) to monitor fluid and electrolyte activity.	
Test Explanation	Sodium plays a major role in how nerves and muscles work. Sodium is controlled by the hormone aldosterone in the body. When aldosterone levels rise, the kidneys hold on to sodium and excrete water.	
Purpose	Blood test used to check sodium levels related to water and electrolyte balance.	
Interfering Factors	Taking medications (birth control pills, corticosteroids, antibiotics, NSAIDS, diuretics, and heparin). Elevated levels of glucose or protein. Receiving Intravenous fluids.	
Results and Significance	**Lower** (Hyponatremia) Excessive sweating Severe vomiting and diarrhea Drinking too much water Poor nutrition Kidney disease Cirrhosis Underactive adrenal or thyroid glands	**Higher** Increased salt or sodium intake Dehydration Severe vomiting and diarrhea Diabetic ketoacidosis

Troponins (cTnT and cTnI) 31		
Normal Range	**Troponin T (cTnT)** <0.2 mcg/L	**Troponin I (cTnI)** <0.03 mcg/L
Indications	Cardiac enzyme study: Performed with presenting chest pain or possible heart attack. Can be performed in conjunction with CK.	
Test Explanation	Troponins are specific markers for cardiac injury. Levels of troponin will increase in the presence of myocardial infarction.	
Purpose	To diagnose myocardial infarction or injury to the heart from other causes, such as myocarditis or unstable angina pectoris. May also be used when presenting with chest pain, shortness of breath, nausea, sweating, and abnormal ECG results.	
Interfering Factors	False-positive results. Elevation in acute and chronic renal failure or chronic muscle disease. Other heart conditions (cardiomyopathy and myocarditis). Kidney injury. Excessive substance abuse. Other diseases (e.g., hypothyroidism, muscular dystrophy).	
Results and Significance		**Higher** Myocardial injury Myocardial infarction

Summary

Chemical tests provide critical information to the LPN, which can inform the client assessment. They also provide indicators for the development of nursing care plans specific to the client's health concerns. It behooves the LPN to remain current in this knowledge domain.

HEMATOLOGY TESTS

Blood tests are used to detect various diseases and help diagnose certain conditions. As part of the LPN's role and responsibilities, you may be required to provide patients with education regarding these tests. In addition, the LPN monitors specific blood tests for individuals throughout their health journeys and should understand how these results may affect aspects of nursing care and medications.

Complete Blood Count (CBC, Diff)

Components of Complete Blood Count (CBC)		
Normal Range	Erythrocyte count	**Male**: 4.7–6.1 x 10^{12}/L **Female**: 4.2–5.4 x 10^{12}/L
	Mean corpuscular volume (MCV)	80–95 mm^3
	Mean corpuscular hemoglobin (MCH)	27–31 pg
	Mean corpuscular hemoglobin concentration (MCHC)	320–360 g/L
Test Explanation	This test provides information about the kinds and numbers of cells in the blood. It is used to both determine general health status and detect a wide range of disorders (e.g., infection, anemia, inflammation, and bleeding disorders).	
Interfering Factors	Exercise. Hydration status. Medications.	High altitudes for prolonged periods. Leukemias. Pregnancy.

Results and Significance	LOWER	HIGHER
	Erythrocyte count	
	Anemia Leukemia Post hemorrhage	Dehydration High altitudes Polycythemia vera Severe diarrhea
	Mean corpuscular volume (MCV)	
	Microcytic anemia	Folic acid and vitamin B_{12} deficiency Liver disease Macrocytic anemia
	Mean corpuscular hemoglobin (MCH)	
	Microcytic anemia	Macrocytic anemia
	Mean corpuscular hemoglobin concentration (MCHC)	
	Hypochromic anemia	Intravascular hemolysis Spherocytosis

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Hemoglobin (Hgb)

Normal Range	**Male**: 135–180 g/L	**Female**: 120–160 g/L
Test Explanation	Hgb is the protein in RBC that carries oxygen. There are millions of hemoglobin molecules in each red cell.	
Results and Significance	**Lower** Chronic blood loss Decreased dietary intake	**Higher** Chronic obstructive pulmonary disease High altitudes Polycythemia

Hematocrit or Packed Cell Volume (PCV)

Normal Range	**Male**: 0.42–0.52 volume fraction	**Female**: 0.37–0.47 volume fraction
Test Explanation	The test for hematocrit measures the volume of cells as a percentage of the total volume of cells and plasma in whole blood. This percentage is usually three times greater than the hemoglobin.	
Results and Significance	**Lower** Hemorrhage Excessive intravenous fluid infusion	**Higher** Dehydration

Myoglobin (Mb)		
Normal Range	1.0–5.3 nmol/L	
Test Explanation	This test is used in the early evaluation of a client with suspected acute myocardial infarction. It is also used to assist in the diagnosis of disease or injury in skeletal muscles.	
Interfering Factors	Recent administration of radioactive substances. Myoglobin levels can increase after intramuscular injections.	
Results and Significance	**Lower** Polymyositis	**Higher** Myocardial infarction Skeletal muscle inflammation (myositis) Malignant hyperthermia Muscular dystrophy Skeletal muscle ischemia/trauma Rhabdomyolysis

Adapted from Pagana, K. D., and T. J. Pagana. *Mosby's Canadian Manual of Diagnostic and Laboratory Tests*. 1st ed. Toronto, ON: Elsevier Canada, 2013.

Natriuretic Peptides: BNP/or NP-proBNT42

Normal Range	Atrial natriuretic peptide (ANP): 22–77 mcg/L
	Brain natriuretic peptide (BNP): <100 mcg/L
	Critical values: >100 mcg/L
Test Explanation	Natriuretic peptides are used to diagnose and categorize clients with congestive heart failure (CHF).
Interfering Factors	BNP levels are higher in women than in men.
	Levels are higher in older clients.
	Levels are higher after cardiac surgery.
	May vary due to methods of measurement of BNP.

Results and Significance		**Higher**
		Congestive heart failure
		Myocardial infraction
		Systemic hypertension
		Heart transplant rejection
		Cor pulmonale

Platelet Count (Thrombocytes)

Normal Range	130–400 x 10^9/L	
Test Explanation	This test measures the number of platelets in the blood and is often included in the CBC when there are signs and symptoms of a bleeding disorder or excessive clotting.	
Results and Significance	**Lower** Acute leukemia Chemotherapy Hemorrhage Toxic effect of medications Systemic lupus erythematosus Viral infections	**Higher** Acute infections Chronic pancreatitis Cirrhosis Collagen disorders Iron deficiency Polycythemia vera Post splenectomy

White Blood Cell Count (WBC)

Normal Range	Critical Value: <2.5 x 10^9/L		
	Newborn (0–6 weeks) 9–30 x 10^9/L	**Child </= 2 years** 6.2–17 x 10^9/L	**Adult/Child >2 years** 5–10 x 10^9/L
Test Explanation	To detect the presence of infection. Supports diagnosis of inflammation. WBC are cells that fight foreign bodies and infection. WBC, also known as leukocytes, are larger in size and less numerous than red cells. They develop from stem cells in the bone marrow. WBC function involves the response to an inflammatory process or injury.		
Results and Significance	**Lower** Bone marrow disorders or damage Autoimmune disorders Enlarged spleen Malnutrition and vitamin deficiencies Infectious diseases (e.g. TB, HIV, AIDS) Liver damage Lymphoma or other cancer that has spread to bone marrow Severe infections Chemotherapy	**Higher** Viral or bacterial infection Reaction to certain drugs (e.g. corticosteroids) Leukemia Inflammation Allergic responses Smoking Thyroid gland problems Severe physical or emotional stress (e.g. fever, injury, surgery) Burns	

White Blood Cell Types (WBC Differential)		
Normal Range	**Segmented neutrophils**	2.5–7.5 x 10^9/L
	Band neutrophils	0–1 x 10^9/L
	Lymphocytes	0.1–0.4 x 10^9/L
	Monocytes	0.02–0.07 x 10^9/L
	Eosinophils	0.01–0.04 x 10^9/L
	Basophils	0.0–0.01 x 10^9/L
Test Explanation	The measurement of the total and differential WBC counts is a routine laboratory test to aid in the evaluation of clients with infection, neoplasm, allergy, and immunosuppression. The WBC differential consists of major types of WBC. Each type of WBC plays a different role in the body, and the numbers give information about the immune system.	
Results and Significance	**Lower**	**Higher**
	Neutrophils	
	Neutropenia Aplastic anemia Dietary deficiency Bacterial infection Viral infection	Neutrophilia Trauma Inflammatory disorders Metabolic disorders
	Lymphocytes	
	Leukemia Sepsis Immunodeficiency diseases Lupus erythematosus Chemotherapies	Chronic bacterial infection Viral infection Multiple myeloma

	Monocytes	
	Aplastic anemia Medications (e.g., prednisone)	Monocytosis Chronic inflammatory disorders Viral infections Tuberculosis
	Eosinophils	
	Increased adrenosteroid production	Parasitic infections Allergic reactions Eczema Leukemia
	Basophils	
	Acute allergic reactions Hyperthyroidism Stress reactions	Myeloproliferative disease Leukemia

Summary

Hematology tests are helpful to diagnose, treat, and manage blood disorders. The LPN can aid in providing education for individuals receiving the above-mentioned tests and collaborate with interdisciplinary health teams to provide safe care.

Coagulation Studies

The following lab tests refer to blood-clotting studies and are used to diagnose bleeding and clotting disorders. This includes prothrombin time (PT), partial thromboplastin time (PTT), and international normalized ratio (INR).

Prothrombin Time (PT)		
Normal Range	11.0–12.5 seconds Full anticoagulant therapy: >1.5–2.0 times control value in seconds Normal international normalized ratio (INR): 0.8–1.2 **Critical values**: >20 seconds (for clients not taking anticoagulants)	
Test Explanation	A measurement used to test clotting times. Both PT and PTT are used to check for bleeding problems or the chances of excessive bleeding during surgery. PT is a blood test that measures how long it takes blood to clot. PT is also used to check whether medicine to prevent blood clots is working.	
Interfering Factors	Prolonged PT can be caused by treatment with blood-thinning medications (warfarin and Coumadin, vitamin K).	
Results and Significance		**Higher** Lack of or low level of one or more blood-clotting factors Lack of vitamin K (due to liver disease, cirrhosis, or liver injury) Indication of DIC (disseminated intravascular coagulation), which is life threatening

Partial Thromboplastin Time (PTT)

Normal Range	Activated partial thromboplastin time (aPTT): 30–40 seconds Partial thromboplastin time (PTT): 60–70 seconds Clients receiving anticoagulant therapy: 1.5–2.5 times control value in seconds **Critical values** aPTT: 70 seconds PTT: > 100 seconds
Test Explanation	PTT might be used if you take a blood-thinning medicine called Heparin. This test measures other clotting factors or checks if Heparin dose is therapeutic. Also checks the effects of anticoagulants (e.g., Heparin, warfarin).
Interfering Factors	Increased consumption of alcohol.
Results and Significance		**Higher** Deficiency of factors I, II, V, VIII, IX and X, XI, XII Hemophilia Heparin therapy Liver disease

International Normalized Ratio (INR)

Normal Range	0.8–1.2	
Test Explanation	INR is a way of standardizing the results of prothrombin time tests, no matter the testing method. It lets the physician understand results regardless of different test methods.	
Results and Significance		**Higher** Lack of or low level of one or more blood-clotting factors Lack of vitamin K (due to liver disease, cirrhosis, or liver injury) Indication of DIC (disseminated intravascular coagulation), which is life threatening

Diabetes Studies

Fasting Plasma Glucose Test (FBS)			
Normal Range	4.0–6.0 mmol/L		
Test Explanation	Screens for diabetes. A fasting plasma glucose test is used when the person has not had any caloric intake for at least eight hours.		
Interfering Factors	Stress may elevate blood glucose levels temporarily. Certain medications (cortisone, thiazide, and loop diuretics). Trauma increases blood sugar.		
Results and Significance	**Lower** Observe for signs and symptoms of hypoglycemia	**Prediabetes** Blood glucose level between 6.0–7.0 mmol/L	**Higher** Blood glucose level of higher than 7.0 mmol/L indicates diabetes

Oral Glucose Tolerance Test (OGTT)		
Normal Range	<11.1 mmol/L	
Test Explanation	Screens for diabetes. For the oral glucose tolerance test, the person drinks a solution containing 75 grams of glucose. Two hours later, a blood glucose level is taken.	
Interfering Factors	Stress may elevate blood glucose levels temporarily. Certain medications (cortisone, thiazide, and loop diuretics). Trauma increases blood sugar.	
Results and Significance	**Lower** Hyperinsulinism	**Higher** >11.1 mmol/L indicates diabetes

Hemoglobin A1C (HbA1c)

Normal Range	<6.5%	
Test Explanation	HbA1c is used to diagnose diabetes. HbA1c results give an estimate of the average blood glucose level over the past two to three months. Thus, it is useful in checking how well a person is controlling his or her diabetes. HbA1C test is used to evaluate long-term blood glucose control in people with known diabetes or diagnose prediabetes.	
Interfering Factors	Stress may elevate blood glucose levels temporarily. Certain medications (cortisone, thiazide, and loop diuretics). Trauma increases blood sugar.	
Results and Significance	**Lower** Nondiabetic hyperglycemia Poorly controlled diabetes mellitus	**Higher** >6.9% = diabetic

URINE TESTS

The LPN is involved in obtaining urine samples such as urinalysis, urine for culture and sensitivity, and urine toxicology to determine presence of infection or help diagnose disease. Following your workplace policies and procedures manual will ensure accurate specimen retrieval.

Urinalysis (UA)			
Normal Range	**Appearance**: Clear **Colour**: Amber yellow **Odour**: Aromatic **pH**: 4.6–8.0	**Protein** **At rest**: <50–80 mg/24 hr **During exercise**: <250 mg/24 hr	**Specific Gravity** **Newborn**: 1.001–1.020 **Adult:** 1.005–1.030 **Older adult**: Values decrease with age
Test Explanation	Tests the urine for colour, clarity, odour, concentration, and pH (acidity or alkalinity). It also checks for abnormal levels of protein, sugar, and blood cells or other substances that may contribute to an illness or disease in the body.		
Purpose	To screen for a disease or infection of the urinary tract. To monitor the treatment of certain medical conditions (e.g., diabetes, kidney stones, UTI, or kidney disease).		
Interfering Factors	Foods that can colour the urine (blackberries, beets, and rhubarb). Menstruating or starting menstrual period. Certain medications that can colour the urine (vitamin B, Pyridium).		
Results and Significance	**Appearance and Colour**	**Odour**	**pH**	**Protein**
	Changes in colour may be due to drug therapy. Infection: note a foul smell of the urine. Gross hematuria: RBCs in the urine cause red colour. Tumours, trauma, stones, and infection anywhere in the urinary tract can cause urine to be red.	Ketonuria (smell will be fruity) UTI (foul smell) Phenylketonuria (urine will smell musty)	**Lower** Acidemia (excess hydrogen ion excreted) Diabetes Starvation **Higher** UTI Vomiting	**Higher** Glomerulonephritis Malignant hypertension Trauma

Urine C & S (Culture and Sensitivity)

Normal Range	No bacteria or other organisms (such as fungi) grow in the culture. The culture result is positive.
Test Explanation	The urine C & S identifies the specific bacteria and tests its susceptibility to different antibiotic agents. This ensures that the proper antibiotic can be prescribed to clear up the infection.
Purpose	To detect UTI.
Interfering Factors	A urine specimen that has been sitting for an hour or longer at room temperature (should be kept in refrigerator until assessed by lab). Feces or toilet paper in the urine specimen. Drugs and food. Use of antibiotics.

Results and Significance	**Lower** < infection is unlikely	**Higher** >100,000 or more bacteria per milliliter (mL) of urine may indicate an infection

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Urine Toxicology		
Normal Range	No unexpected drugs are found in the sample.	
Test Explanation	This test can detect hundreds of drugs and drug metabolites.	
Purpose	Urine screening to check for one certain drug or for multiple drugs at once.	
Interfering Factors	Poppy seeds and dextromethorphan have been reported to lead to a false-positive result for amphetamines. Decongestants (ephedrine) also have been found to cause false-positive results for amphetamines.	
Results and Significance	**Normal Values** Levels of prescription or non-prescription medicines found in the sample are within the effective (therapeutic) range.	**Abnormal Values** Unexpected drugs are found in the sample. Levels of prescription or non-prescription drugs are below therapeutic range or above the therapeutic range or toxic.

Summary

The information provided in this module assists the LPN in understanding the most commonly ordered lab tests and their implications for the client's health and well-being. Due care must be taken to obtain accurate lab results. The LPN is knowledgeable and can relay information regarding the test and initiate appropriate nursing interventions before, during, and after the testing period.

Knowledge related to lab tests and values includes an understanding of how laboratory data is used in the nursing process, preparing the client for bloodwork and supporting the client after tests. Factors that affect tests results negatively should be identified and avoided whenever possible. Finally, an awareness of complications that may occur and identifying critical lab values is essential for safe client care.
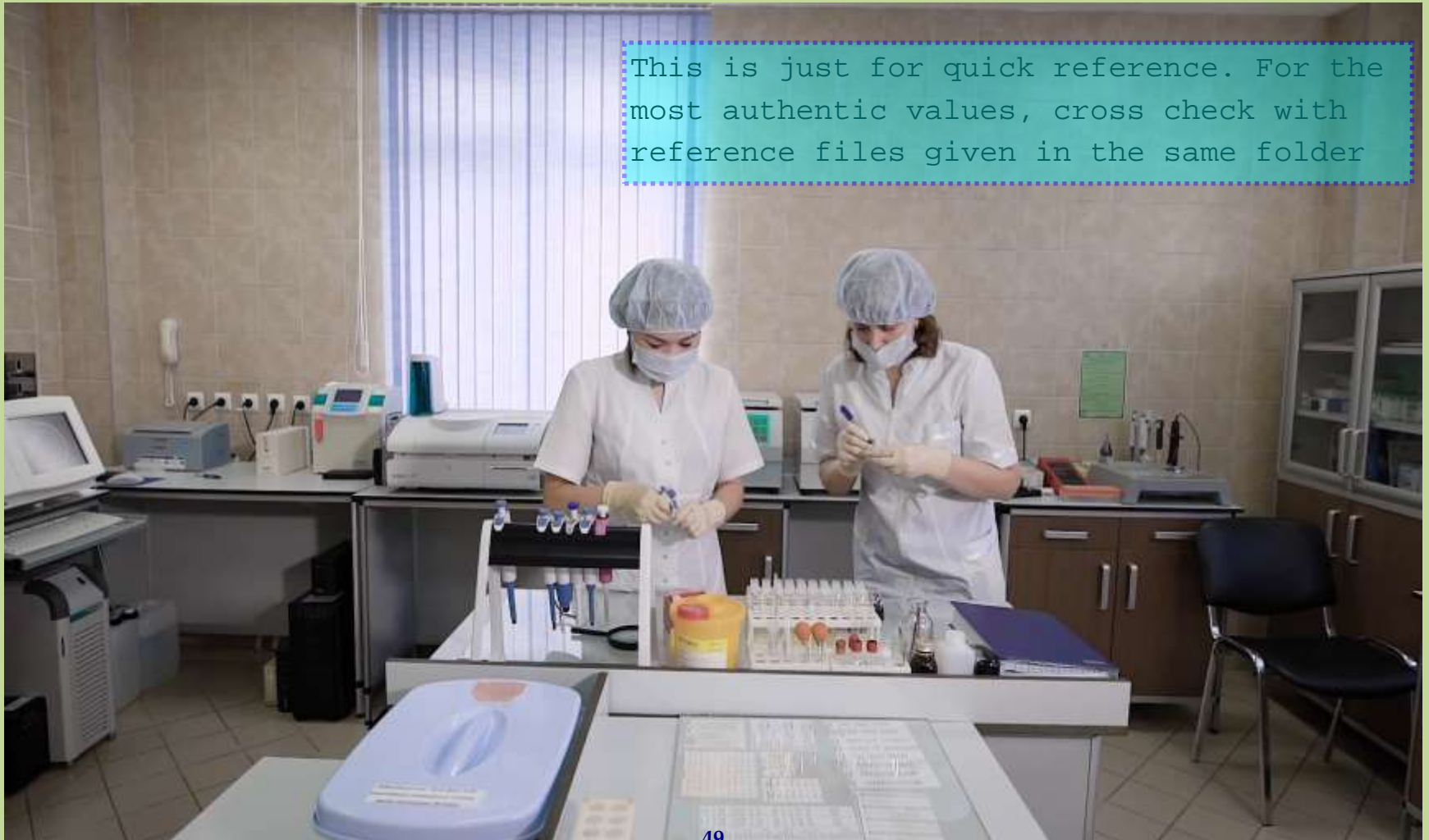
BLOOD TESTS

https://instapdf.in/list-medical-diagnostic-tests-with-diseases/

(Normal value and its importance)

This is just for quick reference. For the most authentic values, cross check with reference files given in the same folder

COMPLETE BLOOD COUNT

NAME	DEFINATION	NORMAL RANGE
Hb or Hbg (hemoglobin)	This is the protein in your blood that holds the oxygen.	men -14 to 17 gm/dl women - 12 to 15 gm/dL
White blood cells (WBCs)	also called leukocytes or leucocytes, are the cells of the immune system	4,500 to 10,000 cells per microliter (cells/mcL).
RBC (red blood cell count)	they carry oxygen through your body. They also help filter carbon dioxide	Men- 14 to 17 gm/dL women - 12 to 15 gm/dL.
Hct (hematocrit).	is the volume % percentage of red blood cell.	It is normally 40% for men and 31% for women.
MCV (mean corpuscular volume).	This is the average size of your red blood cells.	MCV score - 80 to 95.
Platelets.	also called **thrombocytes** are a component of blood whose function is to stop bleeding by clumping and clotting blood vessel	140,000 to 450,000 cells/mcL

50

NAME	DEFINATION	NORMAL RANGE
ESR (Westegren) 1hr	An ESR test can help determine if you have a condition that causes inflammation. If your ESR is high, it may be related to an inflammatory condition	Male - 1-10mm Female - 5-15mm

Please cross check with MSD and ABIM Reference manuals included in the folder for authentic range of normal values. This file is included for quick reference. paramanuseniorshealth.org

Liver Function Tests (LFT)

Bilirubin Total	Bilirubin is a reddish yellow pigment made during the normal breakdown of red blood cells.	0-1 mg/dl
Conjugated (D.Bilirubin)	**Direct bilirubin** is the more soluble, less toxic and conjugated with glucuronic acid.	0-0.35 mg/dl
Unconjugated (I.D.Bilirubin)	Bilirubin that is bound to a certain protein (albumin) in the blood	0.2-0.65 mg/dl
SGOT (AST)	Serum glutamic oxaloacetic transaminase, an enzyme that is normally present in liver and heart cells.	10-40 iu/l
SGPT (ALT)	Serum glutamic pyruvic transaminase, an enzyme that is normally present in liver and heart cells	10-40 iu/l
Alkaline Phosphatase	**Alkaline phosphatase** is an enzyme found throughout the body. However, it tends to be most concentrated in the liver, the bile ducts, bones and placenta.	40-112 u/l
Total Protein	is a biochemical test for measuring the total amount of protein in serum. Protein in the serum is made up of albumin and globulin.	6-8.5 gm/l
Albumin	is produced in the liver and forms a large proportion of all plasma protein.	3.5-5 gm/l
Globulin	group of proteins in blood, play an important role in liver function, blood clotting, and fighting infection.	2-3.5 gm/l

KIDNEY FUNCTION TEST

Test Name	Defination	Normal value
Blood urea	▪Urea is the terminal product of protein metabolism, and 1g of protein can produce about 0.3g of urea	10-50 mg/dl
Serum Creatinine	▪Creatinine is a chemical waste product in the blood that passes through the kidneys to be filtered and eliminated in urine.	0.6–1.1 mg/dl In Women & 0.7–1.3 mg/dl In Men.
Serum Uric Acid	▪Uric acid is a product of the metabolic breakdown of purinenucleotide, and it is a normal component of urine.	2.4-6.0 mg/dl (female) and 3.4-7.0 mg/dl (male).
Serum Sodium	Sodium is key to controlling the amount of fluid in your body. body needs it for brain and muscles to work the right way.	135-145 mmol /L.
Serum Potassium	A potassium test is used to measure the amount of potassium in your blood. Potassium is an electrolyte that's essential for proper muscle and nerve function..	Adults: 3.5-5.1 mEq/L or mmol/L Children: 3.4-4.7 mEq/L or mmol/L (age dependent)
Chloride	Chloride is an electrolyte that helps keep a proper fluid and acid-base balance in body.	98-106 mmol/L
Total Protein	Albumin and globulin are two types of protein in your body. The total protein test measures the total amount albumin and globulin in your body.	6 -8.3 grams per deciliter (g/dL).

Lipid profile: Lipid profile (Cholesterol and triglycerides)

Test Name	Defination	Normal Range
Total Cholesterol	Total cholesterol: This is the total amount of cholesterol in your blood.	<200 mg/dL
Triglycerides	Triglycerides, another type of fat that causes hardening of the arteries	10 to 150 mg/dL
HDL Cholesterol High-density lipoprotein	This is referred to as "good" cholesterol because it helps remove LDL cholesterol from your blood.	> 40 to 60 mg/dL
LDL Cholesterol Low-density lipoprotein	This is referred to as "bad" cholesterol. Too much of it raises your risk of heart attack, stroke, and atherosclerosis.	70 to 130 mg/dL
VLDL-Very Low-Density Lipoprotein	VLDL cholesterol is a type of blood fat. It's considered one of the "bad" forms of cholesterol, along with LDL cholesterol and triglycerides.	less than or equal to 2 to 30 mg/dL (0.1 to 1.7 mmol/l).

BLOOD SUGER TEST

Plasma glucose test	Definition	Normal		Prediabetes
Random	A **random blood sugar** test checks your blood glucose at a random time of day.	79–160 mg/dl		N/A
Fasting	Fasting, as the name suggests, means refraining from eating of drinking any liquids other than water for eight hours. It is used as a test for diabetes.	90 to 110mg/dL		110 to 125 mg/dl
2 hour post-prandial	**postprandiaL** blood glucose test measures blood glucose exactly 2 hours after eating a meal,timed from the start of the meal.	Below 140 mg/dl		140 to 199 mg/dl
Glucose tolerance test	A glucose tolerance test measures how well your body's cells are able to absorb glucose(75 gm), or sugar, after you ingest a given amount of sugar.	Fasting	60 to 100 mg/dL	
		1 hour	<200 mg/dL	
		2 hour	<140 mg/dL	

55

HbA1c Blood Test

HbA1c	HbA1c is a marker that can determine your average blood sugar (glucose) levels over the previous 3-months

HbA1c (%)	What it means
4.5 – 6.4	Excellent
6.5 – 7.0	Good
7.1 – 8.0	Acceptable
>8.0	Poor

HbA1c test

5.6%   6.5%

Pre-diabetes

Normal   Diabetes

URINE TEST

Measurement	Reference range	
Color	yellow	cloudy, dark, or blood-colored.
A**ppearance**	Clear	Cloudy **urine** may be caused by crystals, deposits, white cells, red cells, epithelial cells or fat globules.
Specific gravity (g/ml)	1.005-1.030	Increases in **specific gravity** - dehydration, diarrhea, emesis, excessive sweating, urinary tract/bladder infection, glucosuria , renal artery s tenosis ...
PH	5.0-8.0	A **high** (alkaline) **pH** can be caused by severe vomiting, a kidney **disease**, some **urinary** tract infections, and asthma.
Protein (mg/dl)	Negative	**Protein** may be present in the **urine** because of acute inflammation or kidney stone disease, or as a sign of kidney damage.
Glucose (mg/dl)	Negative	when blood **sugar** levels rise well above a target range-which can occur in type 1 and type 2 diabetes-the kidneys often release some of the excess **sugar** from the blood into the **urine**.
Ketones (mg/dl)	Negative	High **ketone** levels in **urine** may indicate diabetic ketoacidosis (DKA), a complication of diabetes that can

Bilirubin	**Negative**	In certain liver diseases, such as biliary obstruction or hepatitis, excess **bilirubin** can build up in the blood and is eliminated in **urine**.
Blood	Negative	**Painful** blood in the urine can be caused by a number of disorders, including infections and stones in the urinary tract. **Painless** blood in the urine can also be due to many causes, including **cancer**.
Nitrite	Negative	This test is commonly used in diagnosing **urinary** tract infections (UTI). A positive **nitrite** test indicates that the cause of the UTI is a gram negative organism, most commonly Escherichia coli.
Urobilinogen	0.2-1.0	Too much **urobilinogen in urine** can indicate a liver disease such as hepatitis or cirrhosis.
Leukocyte esterase	Negative	**Leukocyte esterase** is a screening test used to detect a substance that suggests there are white blood cells in the **urine**. This may mean you have a **urinary** tract infection.
WBC/HPF (WBCs per high power field, HPF).	0-4	This test is usually ordered to determine is someone has a **urinary** tract infection. ... If both **WBC** and leukoesterase are elevated, it more strongly suggests a UTI.
Squamous epithelium	0-4	The presence of **squamous epithelial cells** may indicate contamination of the **urine** specimen.

CARDIAC BLOOD TESTS

Test	Definition	Normal Range	
Creatine phosphokinase -MB (CPK-MB)	**CPK-MB test** is a cardiac marker used to assist diagnoses of an acute myocardial infarction.	5 to 25 IU/L.	
Troponin	A **troponin test** measures the levels troponin T or troponin I proteins in the blood. These proteins are released when the heart muscle has been damaged, such as occurs with a heart attack.	less than 0.01 ng/mL	
C-Reactive Protein and Heart Disease Risk	CRP seems to predict the chance of having cardiovascular problems at least as well as cholesterol levels.	**Test Result**	**Risk**
		Less than 1.0 mg	**Low**
		1.0-2.9 mg	**Intermediate**
		Greater than	**High**

THYROID FUNCTION TEST

HORMONES	DEFINATION	NORMAL RANGE
TRIIODOTHYRONINE (T3)	Abnormally high levels most commonly indicate a condition called Grave's disease.This is an autoimmune disorder associated with hyperthyroidism.	75 -200 ng/dL
THYROXINE (T4)	A high level of T4 indicates an overactive thyroid (hyperthyroidism). Symptoms include anxiety, unplanned weight loss, tremors, and diarrhea.	4.5 -11.5 ug/dL
THYROID-STIMULATING HORMONE (TSH)	is a pituitary hormone that stimulates the thyroid gland to produce (T4), and then (T3) which stimulates the metabolism of almost every tissue in the body.	0.3 - 5.0 U/mL

Blood Tests for Infertility

FSH **Follicle-stimulating hormone**	It helps control a woman's menstrual cycle and the production of eggs.	5-20 IU/L (THIRD DAY OF MENSTRUAL PERIOD)	
LH **Luteinizing Hormone Level**	In women, luteinizing hormone (LH) is linked to ovarian hormone production and egg maturation.	5 – 20 mIU/ ml 25 – 40 mIU/ml (24 – 36 hours before ovulation)	
Prolactin	In women, a prolactin test is done to find out why they are not menstruating, or why they are having infertility problems or abnormal nipple discharge	Non pregnant females: **2 to 29 ng /mL**. Pregnant females: **10 to 209 ng/mL**.	
Ovarian Reserve (AMH) Test **Anti-Mullerian Hormone**	The level of AMH in a woman's blood is generally a good indicator of her ovarian reserve.	High (often PCOS) Normal Low normal range Low	Over 4.0 ng/ml 1.5-4.0 ng/ml 1.0-1.5 ng/ml 0.5-1.0 ng/ml

Blood Tests for Infertility

Vitamin B12	**Vitamin B12**, also called cobalamin, is a water-soluble vitamin that has a key role in the normal functioning of the brain and nervous system via the synthesis of myelin (myelinogenesis), and the formation of red blood cells.	300-900 pg/ml
Vitamin D	**Vitamin D** is a nutrient essential for proper growth and formation of teeth and bones. A **vitamin D** test measures the level of **25-hydroxyvitamin** D and/or 1,25-dihydroxyvitamin D in the blood to detect a deficiency or excess.	20 nanograms/milliliter to 50 ng/mL
Serum Calcium	All cells need **calcium** in order to work. **Calcium** helps build strong bones and teeth. It is important for heart function, and helps with muscle contraction, nerve signaling, and blood clotting	8.5-10.2 mg/dL
Bone density test	A **bone density test** is the only test that can diagnose osteoporosis before a broken bone occurs. This test helps to estimate the density of your bones and your chance of breaking a bone.	A T-score -1.0 or above is normal bone density. A T-score of -2.5 or below is a diagnosis of osteoporosis.

SEMAN ANALYSIS

Volume	The average volume of semen produced at Ejaculation.	1.5 – 5 mL
Concentration (sperm count)	sperm per milliliter	50 to 150 million
Motility	How many moving sperm are present. Low motility can also indicate hormonal problems or a varicocele.	50 – 60%
Morphology	What percentage of sperm are normally shaped?	more than 50 percent
Liquefaction	While semen is initially thick, its ability to liquefy, or turn to a watery consistency, helps sperm to move. If semen does not liquefy in 15 to 30 minutes, fertility could be affected	It should take 15 to 30 minutes before semen liquefies.
pH level	A pH level higher than 8.0 could indicate the donor has an infection	between 7.2 - 7.8

Tumor marker

Tumor marker	Associated tumor types
Alpha fetoprotein(AFP)	Hepatocellular Carcinoma, germ cell tumor
CA15-3	Breast Cancer
CA27-29	Breast Cancer
CA19-9	Mainly pancreatic cancer, but also colorectal cancer and other types of gastrointestinal cancer
CA-125	Mainly ovarian cancer, but may also be elevated in endometrial cancer, fallopian tube cancer, lung cancer, breast cancer and gastrointestinal cancer, in endometriosis
Calcitonin	medullary thyroid carcinoma
Human chorionic gonadotropin(hCG)	gestational trophoblastic disease, germ cell tumor, choriocarcinoma

Tumor marker	Associated tumor types
Neuron-specific enolase (NSE)	It is a substance that has been detected in patients with certain tumors, namely: **neuroblastoma**, small cell **lung cancer**, medullary **thyroid cancer**, carcinoid tumors, endocrine tumors of the **pancreas**, and melanoma.
CEA: Carcinoembryonic antigen	is a protein found in many types of cells but associated with **tumors** and the developing fetus. **CEA** is tested in blood. CEA level is the **tumor marker** most often used in **colorectal cancer**.

Prostate-specific antigen (PSA) test

A prostate-specific antigen (PSA) test measures the amount of prostate-specific antigen in the blood. PSA is released into a man's blood by his prostate gland .

Age Range (Years)	Asian Americans
40 to 49	0 to 2.0 ng/mL
50 to 59	0 to 3.0 ng/mL
60 to 69	0 to 4.0 ng/mL
70 to 79	0 to 5.0 ng/mL

BLOOD TEST FOR ARTHRITIS

Rheumatoid factor (RF)	**RF** are proteins produced by your immune system that can attack healthy tissue in your body.	Less than 15 IU/mL
Antinuclear antibody (ANA)	It detects antinuclear antibodies (**ANA**) in your blood. Your immune system normally makes antibodies to help you fight infection.	Positive or negetive
Anti-cyclic citrullinated peptide (anti-CCP)	**Anti**-cyclic citrullinated peptide (**anti**-**CCP**) is an antibody present in most rheumatoid arthritis patients.	Less than **20 u/ml**
HLA-B27	Human leukocyte antigen **B27** is a major histocompatibility complex class 1 molecule that is strongly associated with the disease ankylosing spondylitis.	Positive or negetive
C-reactive protein	– This test measures body-wide inflammation. It measures a substance produced by the liver that increases in the presence of inflammation.	Below 3.0 mg/dL

66

Antistreptolysin O titer (ASO)

Positive titre: >200 IU/mL

- Detects antibody to the antigen streptolysin O produced by group A streptococci. Titer rises to a peak at 4-6 weeks and may remain elevated for 1 year.

Positive in:

- Streptococcal infection (eg, upper airway infections, scarlet fever)

- post-streptococcal infection complication (eg, glomerulonephritis and rheumatic fever)

False positive in

- Some bacterial infections.

WIDAL TEST

Stage	Examination	Result (% positive)
1st week	Blood culture	95
	Blood picture	Leucopenia with relative lymphocytosis
2nd week	Blood culture	40-50
	Widal test	Low titre antibody
3rd week	Widal test	100
	Blood culture	15-20
	Stool and urine culture	80
4th week	Widal test	100
	Stool and urine culture	90
	Blood culture	5-10

Table 7.11 : Show materials for examination at different phases of enteric fever

Table of differences between the various types of parasites that cause malaria

Plasmodium type	Type that causes malaria	Endemic area	Febrile seizures period	Involvement and severity
Falciparum	tropical malaria	In all endemic areas	Irregular Crisis	Very serious. It can cause death if not treated quickly and effectively.
Vivax	tertian malaria	South America and Asia	Every 2 days	Grave, but with a delayed onset.
malariae	quartan malaria	South America and Asia	Every 3 days	Moderate, less frequently.
Ovale	tertian malaria	Africa	Every 2 days	Moderate, less frequently.

Dengue Serology

- NS1 is a glycoprotein that is common to all dengue serotypes and can be used to detect either primary or secondary infections in the earliest stages.

- Serology testing for dengue virus-specific antibodies, types IgG and IgM, can be useful in confirming primary or secondary diagnosis.

Chikungunya

- The type of testing performed is typically dictated by the timing and volume of samples available. Blood test is the only reliable way to identify chikungunya since the symptoms are similar to much more deadly dengue fever.

- Common laboratory tests for chikungunya include for instance **RT-PCR** and **serological tests.**

Name	Defination
Hepatitis A	It is a liver disease caused by the hepatitis A virus. The virus is primarily spread when an uninfected (and unvaccinated) person ingests food or water that is contaminated with the faeces of an infected person. The disease is closely associated with unsafe water or food, inadequate sanitation and poor personal hygiene.
Hepatitis B	HBsAg (also known as the Australia antigen) is the surface antigen of the hepatitis B virus (HBV). It indicates current hepatitis B infection.
Hepatitis C	Hepatitis C is an infectious disease caused by the hepatitis C virus (HCV) that primarily affects the liver.During the initial infection people often have mild or no symptoms. Occasionally a fever, dark urine, abdominal pain, and yellow tinged skin occurs.

HIV -1 & HIV-2

- **HIV tests** are used to detect the presence of the human immunodeficiency virus (HIV), the virus that causes acquired immunodeficiency syndrome(AIDS), in serum, saliva, or urine. Such tests may detect antibodies, antigens, or RNA.

- The **CD4 T-cell count** is not an HIV test, but rather a procedure where the number of CD4 T-cells in the blood is determined.

- A CD4 count does not check for the presence of HIV.

- It is used to monitor immune system function in HIV-positive people.

- **A normal CD4 count can range from 500 cells/mm3 to 1000 cells/mm3.**

- **In HIV-positive people- CD4 count below 200 cells/µL**

Thank you

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https://www.msdmanuals.com/en-in/professional/resources/normal-laboratory-values/blood-tests-normal-values#v8508814

Normal Laboratory Values: Blood, Plasma, and Serum

Test	Specimen	Conventional Units	SI Units
Acetoacetate	Plasma	< 1 mg/dL	< 0.1 mmol/L
Acetylcholinesterase (ACE), RBC	Blood	26.7–49.2 U/g Hb	—
Acid phosphatase	Serum	0.5–5.5 U/L	0–0.9 mckat/L
Activated partial thromboplastin time (aPTT)	Plasma	25–36 sec	—
Adrenocorticotropic hormone (ACTH)	Serum	9–52 pg/mL (morning draw)	2–11 pmol/L (morning draw)
Albumin	Serum	3.5–5.4 g/dL	35–54 g/L
Aldosterone			
• Standing	Serum	7–20 ng/dL	194–554 pmol/L
• Supine	Serum	2–5 ng/dL	55–138 pmol/L
Alkaline phosphatase (ALP)	Serum	36–150 U/L	0.5–2.5 mckat/L
Alpha-1 antitrypsin (AAT)	Serum	83–199 mg/dL	15.3–36.6 mcmol/L
Alpha fetoprotein (AFP)	Serum	0–20 ng/dL	0–20 pg/L
δ-Aminolevulinic acid (ALA)	Serum	15–23 mcg/L	1.14–1.75 mcmol/L
Aminotransferase, alanine (ALT)	Serum	0–35 U/L	0–0.58 pkat/L
Aminotransferase, aspartate (AST)	Serum	0–35 U/L	0–0.58 pkat/L
Ammonia	Plasma	40–80 mcg/dL	23–47 mcmol/L
Amylase	Serum	0–130 U/L	0–2.17 mckat/L
Antibodies to extractable nuclear antigen (AENA)	Serum	< 20.0 units	—
Anti–cyclic citrullinated peptide (anti-CCP) antibodies	Serum	≤ 5.0 units	—
Antidiuretic hormone (ADH; arginine vasopressin)	Plasma	< 1.7 pg/mL	< 1.57 pmol/L
Anti–double-stranded DNA (dsDNA) antibodies, IgG	Serum	< 25 IU	—
Antimitochondrial M2 antibodies	Serum	< 0.1 units	—
Antineutrophil cytoplasmic antibodies	Serum	Negative	—

(cANCA)			
Antinuclear antibodies (ANA)	Serum	≤ 1.0 units	—
Anti–smooth muscle antibodies (ASMA) titer	Serum	≤ 1:80	—
Antistreptolysin O titer	Serum	< 150 units	—
Antithyroid microsomal antibody titer	Serum	< 1:100	—
α_1-Antitrypsin (AAT)	Serum	83–199 mg/dL	15.3–36.6 mcmol/L
Apolipoproteins:			
• A-I, females	Serum	98–210 mg/dL	0.98–2.1 g/L
• A-I, males	Serum	88–180 mg/dL	0.88–1.8 g/L
• B-100, females	Serum	44–148 mg/dL	0.44–1.48 g/L
• B-100, males	Serum	55–151 mg/dL	0.55–1.51 g/L
Bicarbonate	Serum	23–28 mEq/L	23–28 mmol/L
Bilirubin:			
• Direct	Serum	0–0.3 mg/dL	0–5.1 mcmol/L
• Total	Serum	0.3–1.2 mg/dL	5.1–20.5 mcmol/L
Blood volumes (radioisotope labeling):			
• Plasma, females*	Blood	28–43 mL/kg body wt	0.028–0.043 L/kg body wt
• Plasma, males*	Blood	25–44 mL/kg body wt	0.025–0.044 L/kg body wt
• RBCs, females*	Blood	20–30 mL/kg body wt	0.02–0.03 L/kg body wt
• RBCs, males*	Blood	25–35 mL/kg body wt	0.025–0.035 L/kg body wt
Brain (B-type) natriuretic peptide (BNP)	Plasma	< 100 pg/mL	—
Calcitonin, age ≥ 16 yr:			
• Females	Serum	< 8 pg/mL	—
• Males	Serum	< 16 pg/mL	—
Calcium	Serum	9–10.5 mg/dL	2.2–2.6 mmol/L
Cancer antigen (CA):			
• CA 125	Serum	< 35 U/mL	—
• CA 15-3	Serum	< 30 U/mL	—
Carbon dioxide (CO_2) content	Serum	23–28 mEq/L	23–28 mmol/L
Carbon dioxide partial pressure (PCO_2)	Blood	35–45 mm Hg	—

Carboxyhemoglobin	Plasma	0.5–5%	—
Carcinoembryonic antigen (CEA)	Serum	< 2 ng/mL	< 2 mcg/L
Carotene	Serum	75–300 mcg/L	1.4–5.6 mcmol/L
CD4:CD8 ratio	Blood	1–4	—
CD4+ T-cell count	Blood	640–1175/mcL	$0.64–1.18 \times 10^9$/L
CD8+ T-cell count	Blood	335–875/mcL	$0.34–0.88 \times 10^9$/L
Ceruloplasmin	Serum	25–43 mg/dL	250–430 mg/L
Chloride	Serum	98–106 mEq/L	98–106 mmol/L
Cholesterol, desirable level:			
• High-density lipoprotein (HDL-C)	Plasma	≥ 40 mg/dL	≥ 1.04 mmol/L
• Low-density lipoprotein (LDL-C)	Plasma	≤ 130 mg/dL	≤ 3.36 mmol/L
Total (TC)	Plasma	150–199 mg/dL	3.88–5.15 mmol/L
Coagulation factors:			
• Factor I	Plasma	150–300 mg/dL	1.5–3.5 g/L
• Factor II	Plasma	60–150% of normal	—
• Factor IX	Plasma	60–150% of normal	—
• Factor V	Plasma	60–150% of normal	—
• Factor VII	Plasma	60–150% of normal	—
• Factor VIII	Plasma	60–150% of normal	—
• Factor X	Plasma	60–150% of normal	—
• Factor XI	Plasma	60–150% of normal	—
• Factor XII	Plasma	60–150% of normal	—
Complement:			
• C3	Serum	55–120 mg/dL	0.55–1.20 g/L
• C4	Serum	20–59 mg/dL	0.20–0.59 g/L
Total	Serum	37–55 U/mL	37–55 kU/L
Copper	Serum	70–155 mcg/L	11–24.3 mcmol/L
Cortisol:			
• 1 h after cosyntropin	Serum	> 18 mcg/dL and usually ≥ 8 mcg/dL above baseline	> 498 nmol/L and usually ≥ 221 nmol/L above baseline

• At 5 pm	Serum	3–13 mcg/dL	83–359 nmol/L
• At 8 am	Serum	8–20 mcg/dL	251–552 nmol/L
• After overnight suppression test	Serum	< 5 mcg/dL	< 138 nmol/L
C-peptide	Serum	0.9–4.3 ng/mL	297–1419 pmol/L
C-reactive protein (CRP)	Serum	< 0.5 mg/dL	< 0.005 g/L
C-reactive protein, highly sensitive (hsCRP)	Serum	< 1.1 mg/L	< 0.0011 g/L
Creatine kinase (CK)	Serum	30–170 U/L	0.5–2.83 mckat/L
Creatinine	Serum	0.7–1.3 mg/dL	61.9–115 mcmol/L
d-Dimer	Plasma	≤ 300 ng/mL	≤ 300 mcg/L
Dehydroepiandrosterone sulfate (DHEA-S):			
• Females	Plasma	0.6–3.3 mg/mL	1.6–8.9 mcmol/L
• Males	Plasma	1.3–5.5 mg/mL	3.5–14.9 mcmol/L
Delta-aminolevulinic acid (ALA)	Serum	15–23 mcg/L	1.14–1.75 mcmol/L
11-Deoxycortisol (DOC):			
• After metyrapone	Plasma	> 7 mcg/dL	> 203 nmol/L
• Basal	Plasma	< 5 mcg/dL	< 145 nmol/L
d-Xylose level 2 h after ingestion of 25 g of d-xylose	Serum	> 20 mg/dL	> 1.3 nmol/L
Epinephrine, supine	Plasma	< 75 ng/L	< 410 pmol/L
Erythrocyte sedimentation rate (ESR):			
• o Females	Blood	0–20 mm/h	0–20 mm/h
• o Males	Blood	0–15 mm/h	0–20 mm/h
Erythropoietin	Serum	4.0–18.5 mIU/mL	4.0–18.5 IU/L
Estradiol, females:			
• Day 1–10 of menstrual cycle	Serum	14–27 pg/mL	50–100 pmol/L
• Day 11–20 of menstrual cycle	Serum	14–54 pg/mL	50–200 pmol/L
• Day 21–30 of menstrual cycle	Serum	19–40 pg/mL	70–150 pmol/L
Estradiol, males	Serum	10–30 pg/mL	37–110 pmol/L
Ferritin:			

• Females	Serum	30–200 ng/mL	30–200 mcg/L
• Males	Serum	30–300 ng/mL	30–300 mcg/L
α-Fetoprotein (AFP)	Serum	0–20 ng/dL	0–20 pg/L
Fibrinogen	Plasma	150–350 mg/dL	1.5–3.5 g/L
Folate (folic acid):			
• RBC	Blood	160–855 ng/mL	362–1937 nmol/L
• Serum	Serum	2.5–20 ng/mL	5.7–45.3 nmol/L
Follicle-stimulating hormone (FSH), females:			
• Follicular or luteal phase	Serum	5–20 mU/mL	5–20 U/L
• Midcycle peak	Serum	30–50 mU/mL	30–50 U/L
• Postmenopausal	Serum	> 35 mU/mL	> 35 U/L
Follicle-stimulating hormone (FSH), adult males	Serum	5–15 mU/mL	5–15 U/L
Fructosamine	Plasma	200–285 mol/L	—
Gamma-glutamyl transpeptidase (GGT)	Serum	8–78 U/L	—
Gastrin	Serum	0–180 pg/mL	0–180 ng/L
Globulins:	Serum	2.5–3.5 g/dL	25–35 g/L
• Alpha-1 globulins	Serum	0.2–0.4 g/dL	2–4 g/L
• Alpha-2 globulins	Serum	0.5–0.9 g/dL	5–9 g/L
• Beta globulins	Serum	0.6–1.1 g/dL	6–11 g/L
• Beta-2 microglobulin	Serum	0.7–1.8 mcg/mL	—
• Gamma globulins	Serum	0.7–1.7 g/dL	7–17 g/L
Glucose:			
• 2-h postprandial	Plasma	< 140 mg/dL	< 7.8 mmol/L
• Fasting	Plasma	70–105 mg/dL	3.9–5.8 mmol/L
Glucose-6-phosphate dehydrogenase (G6PD)	Blood	5–15 U/g Hb	0.32–0.97 mU/ mol Hb
γ-Glutamyl transpeptidase (GGT)	Serum	8–78 U/L	—
Growth hormone:			
• After oral glucose	Plasma	< 2 ng/mL	< 2 mcg/L

• In response to provocative stimuli	Plasma	> 7 ng/mL	> 7 mcg/L
Haptoglobin	Serum	30–200 mg/dL	300–2000 mg/L
Hematocrit:			
• Females	Blood	36–47%	—
• Males	Blood	41–51%	—
Hemoglobin:			
• Females	Blood	12–16 g/dL	120–160 g/L
• Males	Blood	14–17 g/dL	140–170 g/L
Hemoglobin A_{1c}	Blood	4.7–8.5%	—
Hemoglobin electrophoresis, adults:			
• Hb A_1	Blood	95–98%	—
• Hb A_2	Blood	2–3%	—
• Hb C	Blood	0%	—
• Hb F	Blood	0.8–2.0%	—
• Hb S	Blood	0%	—
Hemoglobin electrophoresis, Hb F in children:			
• Neonate	Blood	50–80%	—
• 1–6 mo	Blood	8%	—
• > 6 mo	Blood	1–2%	—
Homocysteine:			
• Females	Plasma	0.40–1.89 mg/L	3–14 mcmol/L
• Males	Plasma	0.54–2.16 mg/L	4–16 mcmol/L
Human chorionic gonadotropin (hCG), quantitative	Serum	< 5 mIU/mL	—
Immunoglobulins:			
• IgA	Serum	70–300 mg/dL	0.7–3.0 g/L
• IgD	Serum	< 8 mg/dL	< 80 mg/L

• IgE	Serum	0.01–0.04 mg/dL	0.1–0.4 mg/L
• IgG	Serum	640–1430 mg/dL	6.4–14.3 g/L
• IgG_1	Serum	280–1020 mg/dL	2.8–10.2 g/L
• IgG_2	Serum	60–790 mg/dL	0.6–7.9 g/L
• IgG_3	Serum	14–240 mg/dL	0.14–2.4 g/L
• IgG_4	Serum	11–330 mg/dL	0.11–3.3 g/L
• IgM	Serum	20–140 mg/dL	0.2–1.4 g/L
Insulin, fasting	Serum	1.4–14 mcIU/mL	10–104 pmol/L
International normalized ratio (INR):			
• Therapeutic range (standard intensity therapy)	Plasma	2.0–3.0	—
• Therapeutic range in patients at higher risk (eg, patients with prosthetic heart valves)	Plasma	2.5–3.5	—
• Therapeutic range in patients with lupus anticoagulant	Plasma	3.0–3.5	—
Iron	Serum	60–160 mcg/dL	11–29 mcmol/L
Iron-binding capacity, total (TIBC)	Serum	250–460 mcg/dL	45–82 mcmol/L
Lactate dehydrogenase (LDH)	Serum	60–160 U/L	1–1.67 mckat/L
Lactic acid, venous	Blood	6–16 mg/dL	0.67–1.8 mmol/L
Lactose tolerance test	Plasma	> 15 mg/dL increase in plasma glucose level	> 0.83 mmol/L increase in plasma glucose level
Lead	Blood	< 40 mcg/dL	< 1.9 mcmol/L
Leukocyte alkaline phosphatase (LAP) score	Peripheral blood smear	13–130/100/ polymorphonuclear (PMN) leukocyte neutrophils and bands	—
Lipase	Serum	< 95 U/L	< 1.58 mckat/L
Lipoprotein (a) [Lp(a)]	Serum	≤ 30 mg/dL	< 1.1 mcmol/L
Luteinizing hormone (LH), females:			
• Follicular or luteal phase	Serum	5–22 mU/mL	5–22 U/L
• Midcycle peak	Serum	30–250 mU/mL	30–250 U/L

• Postmenopausal	Serum	> 30 mU/mL	> 30 U/L
Luteinizing hormone, males	Serum	3–15 mU/mL	3–15 U/L
Magnesium	Serum	1.5–2.4 mg/dL	0.62–0.99 mmol/L
Manganese	Serum	0.3–0.9 ng/mL	5.5–16.4 nmol/L
Mean corpuscular hemoglobin (MCH)	Blood	28–32 pg	—
Mean corpuscular hemoglobin concentration (MCHC)	Blood	32–36 g/dL	320–360 g/L
Mean corpuscular volume (MCV)	Blood	80–100 fL	—
Metanephrines, fractionated:			
• Metanephrines, free	Plasma	< 0.50 nmol/L	—
• Normetanephrines, free	Plasma	< 0.90 nmol/L	—
Methemoglobin	Blood	< 1.0%	—
Methylmalonic acid (MMA)	Serum	150–370 nmol/L	—
Myeloperoxidase (MPO) antibodies	Serum	< 6.0 U/mL	—
Myoglobin:			
• Females	Serum	25–58 mcg/L	1.4–3.5 nmol/L
• Males	Serum	28–72 mcg/L	1.6–4.1 nmol/L
Norepinephrine, supine	Plasma	50–440 pg/mL	0.3–2.6 nmol/L
N-Terminal propeptide of BNP (NT-proBNP)	Plasma	< 125 pg/mL	—
5'-Nucleotidase (5'NT)	Serum	4–11.5 U/L	—
Osmolality	Plasma	275–295 mOsm/kg H_2O	275–295 mmol/ kg H_2O
Osmotic fragility test	Blood	Increased fragility if hemolysis occurs in > 0.5% sodium chloride Decreased fragility if hemolysis is incomplete in 0.3% sodium chloride	—
Oxygen partial pressure (PO_2)	Blood	80–100 mm Hg	—
Parathyroid hormone (PTH)	Serum	10–65 pg/mL	10–65 ng/L
Parathyroid hormone–related peptide (PTHrP)	Plasma	< 2.0 pmol/L	—
Partial thromboplastin time, activated (aPTT)	Plasma	25–35 sec	—
pH	Blood	7.38–7.44	—
Phosphorus, inorganic	Serum	3.0–4.5 mg/dL	0.97–1.45 mmol/L
Platelet count	Blood	150–350 x 10^3/mcL	150–350 x 10^9/L
Platelet life span, using chromium-51 (^{51}Cr)	—	8–12 days	—
Porphyrins	Plasma	≤ 1.0 mcg/dL	—
Potassium	Serum	3.5–5 mEq/L	3.5–5 mmol/L

Prealbumin (transthyretin)	Serum	18–45 mg/dL	—
Progesterone:			
• Follicular phase	Serum	< 1 ng/mL	< 0.03 nmol/L
• Luteal phase	Serum	3–30 ng/mL	0.1–0.95 nmol/L
Prolactin:			
• Females (nonpregnant)	Serum	< 20 mcg/L	< 870 pmol/L
• Males	Serum	< 15 mcg/L	< 652 pmol/L
Prostate-specific antigen, total (PSA-T)	Serum	0–4 ng/mL	—
Prostate-specific antigen, ratio of free to total (PSA-F:PSA-T)	Serum	> 0.25	—
Protein C activity	Plasma	67–131%	—
Protein C resistance, activated ratio (APC-R)	Plasma	2.2–2.6	—
Protein S activity	Plasma	82–144%	—
Protein, total	Serum	6–7.8 g/dL	60–78 g/L
Prothrombin time (PT)	Plasma	11–13 sec	—
Pyruvic acid	Blood	0.08–0.16 mmol/L	—
RBC count	Blood	$4.2–5.9 \times 10^6$ cells/mcL	$4.2–5.9 \times 10^{12}$ cells/L
RBC survival rate, using ^{51}Cr	Blood	$T_{1/2}$ = 28 days	—
Renin activity, plasma (PRA), upright, in males and females aged 18–39 yr:			
• Sodium-depleted	Plasma	2.9–24 ng/mL/h	—
• Sodium-repleted	Plasma	0.6 (or lower)–4.3 ng/mL/h	—
Reticulocyte count:			
• Percentage	Blood	0.5–1.5%	—
• Absolute	Blood	$23–90 \times 10^3$/mcL	$23–90 \times 10^9$/L
Rheumatoid factor (RF), by nephelometry	Serum	< 40 U/mL	< 40 kU/L
Sodium	Serum	136–145 mEq/L	136–145 mmol/L
Testosterone (total), adults:			
• Females	Serum	20–75 ng/dL	0.7–2.6 nmol/L
• Males	Serum	300–1200 ng/dL	10–42 nmol/L
Thrombin time	Plasma	18.5–24 sec	—
Thyroid iodine-123 (^{123}I) uptake	—	5–30% of administered dose at 24 h	—
Thyroid-stimulating hormone (TSH)	Serum	0.5–5.0 mcIU/mL	0.5–5.0 mIU/L

Thyroxine (T$_4$):			
• Free	Serum	0.9–2.4 ng/dL	12–31 pmol/L
• Free index	—	4–11	—
• Total	Serum	5–12 mcg/dL	64–155 nmol/L
Transferrin	Serum	212–360 mg/dL	2.1–3.6 g/L
Transferrin saturation	Serum	20–50%	—
Triglycerides (fasting)	Serum	< 250 mg/dL	< 2.82 mmol/L
Triiodothyronine (T$_3$):			
• Uptake	Serum	25–35%	—
• Total	Serum	70–195 ng/dL	1.1–3.0 nmol/L
Troponin I	Plasma	< 0.1 ng/mL	< 0.1 mcg/L
Troponin T	Serum	≤ 0.03 ng/mL	≤ 0.03 mcg/L
Urea nitrogen (BUN)	Serum	8–20 mg/dL	2.9–7.1 mmol/L
Uric acid	Serum	2.5–8 mg/dL	0.15–0.47 mmol/L
Vitamin B$_{12}$	Serum	200–800 pg/mL	148–590 pmol/L
Vitamin C (ascorbic acid):			
• Leukocyte	Blood	< 20 mg/dL	< 1136 mcmol/L
• Total	Blood	0.4–1.5 mg/dL	23–85 mcmol/L
Vitamin D:			
• 1,25-Dihydroxycholecalciferol (calcitriol)	Serum	25–65 pg/mL	65–169 pmol/L
• 25-Hydroxycholecalciferol	Serum	15–80 ng/mL	37–200 nmol/L
WBC count	Blood	4.5–11 x 10^3 cells/mcL	4.5–11 x 10^9 cells/L
Segmented neutrophils		2.6–8.5 x 10^3 cells/mcL	2.6–8.5 x 10^9 cells/L
Band neutrophils		0–1.2 x 10^3 cells/mcL	0–1.2 x 10^9 cells/L
Lymphocytes		0.77–4.5 x 10^3 cells/mcL	0.77–4.5 x 10^9 cells/L
Monocytes		0.14–1.3 x 10^3 cells/mcL	0.14–1.3 x 10^9 cells/L
Eosinophils		0–0.55 x 10^3 cells/mcL	0–0.55 x 10^9 cells/L
Basophils		0–0.22 x 10^3 cells/mcL	0–0.22 x 10^9 cells/L
Zinc	Serum	66–110 mcg/dL	10.1–16.8 mcmol/L
*American Board of Internal Medicine: ABIM Laboratory Test Reference Ranges−January 2018. Accessed 8/25/18.			
mckat = microkatal; pkat = picokatal			

Normal Laboratory Values: Urine			
Test	**Specimen**	**Conventional Units**	**SI Units**
Aldosterone	Urine, 24 h	5–19 mcg/24 h	13.9–52.6 nmol/24 h
Amino acids, total	Urine, 24 h	200–400 mg/24 h	14–29 nmol/24 h
Amylase	Urine, timed	6.5–48.1 U/h	—
Calcium (unrestricted diet)	Urine, timed	100–300 mg/day	2.5–7.5 mmol/day
Catecholamines, total	Urine, 24 h	< 100 mcg/m^2/24 h	< 591 nmol/m^2/24 h
Chloride	Urine, timed	80–250 mEq/day	80–250 mmol/day
Copper	Urine, 24 h	0–100 mcg/24 h	0–1.6 mcmol/24 h
Coproporphyrin	Urine, 24 h	50–250 mcg/24 h	76–382 nmol/24 h
Cortisol, free	Urine, 24 h	< 90 mcg/24 h	< 248 nmol/24 h
Creatine:			
• Females	Urine, 24 h	0–100 mg/24 h	0–763 mmol/24 h
• Males	Urine, 24 h	4–40 mg/24 h	30–305 mmol/24 h
Creatinine, weight-based	Urine, 24 h	15–25 mg/kg/24 h	133–221 mmol/kg/ 24 h
d-Xylose excretion 5 h after ingestion of 25 g of d-xylose	Urine, 5 h collection	5–8 g	33–53 mmol
Estriol, females	Urine, 24 h	> 12 mg/24 h	> 42 mcmol/24 h
17-Hydroxycorticosteroids, fractionated, adults ≥ 18 yr:			
• Cortisol	Urine, 24 h	3.5–4.5 mcg/24 h	9.7–12.4 nmol/24 h
• Cortisone	Urine, 24 h	17–129 mcg/24 h	47–359 nmol/24 h
5-Hydroxyindoleacetic acid (5-HIAA)	Urine, 24 h	2–9 mg/24 h	10.4–46.8 mcmol/24 h
17-Ketosteroid, fractionated, females > 12 yr:			
• Androsterone	Urine, 24 h	55–1589 mcg/24 h	—

• Pregnanetriol	Urine, 24 h	59–1391 mcg/24 h	—
17-Ketosteroid, fractionated, males > 12 yr:			
• Androsterone	Urine, 24 h	234–2703 mcg/24 h	—
• Etiocholanolone	Urine, 24 h	151–3198 mcg/24 h	—
• 11-Hydroxyandrosterone	Urine, 24 h	66–1032 mcg/24 h	—
• 11-Hydroxyetiocholanolone	Urine, 24 h	17–1006 mcg/24 h	—
• 11-Ketoandrosterone	Urine, 24 h	4–55 mcg/24 h	—
• 11-Ketoetiocholanolone	Urine, 24 h	51–1016 mcg/24 h	—
• Pregnanetriol	Urine, 24 h	245–1701 mcg/24 h	—
Metanephrines, fractionated, normotensive patients ≥ 18 yr:			
• Females, metanephrine	Urine, 24 h	30–180 mcg/24 h	—
• Females, total metanephrines	Urine, 24 h	142–510 mcg/24 h	—
• Males, metanephrine	Urine, 24 h	44–261 mcg/24 h	—
• Males, total metanephrines	Urine, 24 h	190–583 mcg/24 h	—
Metanephrines, fractionated, normotensive males and females aged 18–29 yr:			
• Normetanephrine	Urine, 24 h	103–390 mcg/24 h	—
Metanephrines, fractionated, hypertensive males and females:			
• Metanephrine	Urine, 24 h	< 400 mcg/24 h	—
• Normetanephrine	Urine, 24 h	< 900 mcg/24 h	—
• Total metanephrines	Urine, 24 h	< 1300 mcg/24 h	—
Microalbumin	Urine, 24 h	< 30 mg/24 h	—
Microalbumin, albumin/ creatinine ratio	Urine, random	< 20 mcg/mg	—
Osmolality	Urine, random	38–1400 mOsm/kg H_2O	—

Oxalate	Urine, 24 h	0.11–0.46 mmol/specimen*	—
Phosphate, tubular reabsorption	Urine, random	79–94% of filtered load	—
Porphobilinogens	Urine, random	0–0.5 mg/g creatinine	—
Potassium	Urine, 24 h	25–100 mEq/24 h	25–100 mmol/24 h
Protein, total	Urine, 24 h	< 100 mg/24 h	—
Sodium	Urine, 24 h	100–260 mEq/24 h	100–260 mmol/24 h
Uric acid	Urine, 24 h	250–750 mg/24 h	1.48–4.43 mmol/24 h
Urinalysis, routine[†]			
• pH	Urine, random	5–7	—
Urinalysis, routine, dipstick testing[†]:			
• Bilirubin	Urine, random	Negative	—
• Blood	Urine, random	Negative	—
• Glucose	Urine, random	Negative	—
• Ketones	Urine, random	Negative	—
• Leukocyte esterase	Urine, random	Negative	—
• Nitrites	Urine, random	Negative	—
• Protein	Urine, random	Negative	—
• Urobilinogen	Urine, random	0.2–1.0 EU	—
Urobilinogen	Urine, 24 h	0.05–2.5 mg/24 h	0.08–4.22 mcmol/24 h
Vanillylmandelic acid (VMA)	Urine, 24 h	< 8 mg/24 h	< 40.4 mol/24 h
*Value is based on 24-h collection.			
[†]Normal findings detected by microscopic examination can include a few RBCs (especially in menstruating women), WBCs, epithelial cells, bacteria, yeast cells, crystals (eg, calcium oxalate, triple phosphate, amorphous phosphates and urates), sperm, and unidentifiable materials. Large amounts of these substances or the presence of certain other materials may be abnormal.			
EU = Ehrlich units.			

Normal Laboratory Values: CSF*		
Test	Conventional Units	SI Units
Cell count	0–5 lymphocytes/mcL	0–5 x 10^6 lymphocytes/L
Glucose	40–80 mg/dL (< 40% of simultaneously measured plasma level if that plasma level is abnormal)	2.2–4.4 mmol/L (< 40% of simultaneously measured plasma level is abnormal)
Myelin basic protein	< 1.5 ng/mL	—
Protein, total	15–60 mg/dL	150–600 mg/L
*See also table Cerebrospinal Fluid Abnormalities in Various Disorders		

Normal Laboratory Values: Stool		
Test	Conventional Units	SI Units
Test	Conventional Units	SI Units
Fat	< 5 g/day in patients on a 100-g fat diet	—
Nitrogen	< 2 g/day	—
Urobilinogen	40–280 mg/24 h	68–473 mcmol/24 h
Weight	< 200 g/day	—

Normal Laboratory Values: Other			
Test	Specimen	Conventional Units	SI Units
Gastric acid secretion:			
• Basal, females	Gastric fluid	0.2–3.8 mEq /h	0.2–3.8 mmol/h
• Basal males	Gastric fluid	1–5 mEq /h	1–5 mmol/h
• Peak, females	Gastric fluid	11–21 mEq /h	11–21 mmol/h
• Peak, males	Gastric fluid	18–28 mEq /h	18–28 mmol/h
Lipase	Ascitic fluid	< 200 U/L	< 3.33 mckat/L
Sperm concentration	Semen	20–150 x 10^6/mL	20–150 x 10^9/mL
mckat = microkatal.			Compilation by paramanuseniorshealth.org