

APPENDIX II

Normal Laboratory Values

Following are 5 tables with reference values (intervals) for blood, urine, CSF, stool, and other fluids (eg, gastric acid). Table 6 lists commonly used panels. (NOTE: The reference values provided in these tables should be used as guidelines only.) Reference values vary

based on several factors, including the demographics of the healthy population from which specimens were obtained and the specific methods and/or instruments used to assay these specimens. Laboratories that are accredited by the College of American Pathologists (CAP) are required to establish and/or validate their own reference values at least annually. Thus, any given result should be interpreted based on the reference value of the laboratory in which the test was done; the laboratory typically provides these values with the test result.

**Table 1. 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 μ kat/L
Activated partial thromboplastin time (aPTT)	Plasma	25–35 sec	—
Adrenocorticotrophic hormone (ACTH)	Serum	9–52 pg/mL	2–11 pmol/L
Albumin	Serum	3.5–5.5 g/dL	35–55 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	36–92 U/L	0.5–1.5 μ kat/L
Alpha ₁ -antitrypsin (AAT)	Serum	83–199 mg/dL	—
Alpha fetoprotein (AFP)	Serum	0–20 ng/dL	0–20 pg/L
δ -Aminolevulinic acid (ALA)	Serum	15–23 μ g/L	1.141.75 μ mol/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 μ g/dL	23–47 μ mol/L
Amylase	Serum	0–130 U/L	0–2.17 μ kat/L
Antibodies to extractable nuclear antigen (AENA)	Serum	< 20.0 units	—
Anti-cyclic citrullinated peptide (anti-CCP) antibodies	Serum	\leq 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	—
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Antimitochondrial M2 antibodies	Serum	< 0.1 units	—

Table continues on the following page.

**Table 1. NORMAL LABORATORY VALUES:
BLOOD, PLASMA, AND SERUM (Continued)**

TEST	SPECIMEN	CONVENTIONAL UNITS	SI UNITS
Antineutrophil cytoplasmic antibodies (cANCA)	Serum	Negative	—
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 μmol/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 μmol/L
Total	Serum	0.3–1.2 mg/dL	5.1–20.5 μmol/L
Blood volume:			
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
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 μg/L
Carotene	Serum	75–300 μg/L	1.4–5.6 μmol/L

**Table 1. NORMAL LABORATORY VALUES:
BLOOD, PLASMA, AND SERUM (Continued)**

TEST	SPECIMEN	CONVENTIONAL UNITS	SI UNITS
CD4:CD8 ratio	Blood	1–4	—
CD4+ T-cell count	Blood	640–1175/ μ L	0.64–1.18 $\times 10^9$ /L
CD8+ T-cell count	Blood	335–875/ μ L	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 μ g/L	11–24.3 μ mol/L
Cortisol:			
1 h after cosyntropin	Serum	> 18 μ g/dL and usually ≥ 8 μ g/dL above baseline	> 498 nmol/L and usually ≥ 221 nmol/L above baseline
At 5 PM	Serum	3–13 μ g/dL	83–359 nmol/L
At 8 AM	Serum	8–20 μ g/dL	251–552 nmol/L
After overnight suppression test	Serum	< 5 μ g/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

**Table 1. NORMAL LABORATORY VALUES:
BLOOD, PLASMA, AND SERUM (Continued)**

TEST	SPECIMEN	CONVENTIONAL UNITS	SI UNITS
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 μ kat/L
Creatinine	Serum	0.7–1.3 mg/dL	61.9–115 μ mol/L
D-Dimer	Plasma	\leq 300 ng/mL	\leq 300 μ g/L
Dehydroepiandrosterone sulfate (DHEA-S):			
Females	Plasma	0.6–3.3 mg/mL	1.6–8.9 μ mol/L
Males	Plasma	1.3–5.5 mg/mL	3.5–14.9 μ mol/L
δ -aminolevulinic acid (ALA)	Serum	15–23 μ g/L	1.14–1.75 μ mol/L
11-Deoxycortisol (DOC):			
After metyrapone	Plasma	> 7 μ g/dL	> 203 nmol/L
Basal	Plasma	< 5 μ g/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):			
Females	Blood	0–20 mm/h	0–20 mm/h
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	50–100 pmol/L
Day 11–20 of menstrual cycle	Serum	14–54	50–200 pmol/L
Day 21–30 of menstrual cycle	Serum	19–40	70–150 pmol/L
Estradiol, males	Serum	10–30 pg/mL	37–110 pmol/L
Ferritin	Serum	15–200 ng/mL	15–200 μ g/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	—

**Table 1. NORMAL LABORATORY VALUES:
BLOOD, PLASMA, AND SERUM (Continued)**

TEST	SPECIMEN	CONVENTIONAL UNITS	SI UNITS
Gastrin	Serum	0–180 pg/mL	0–180 ng/L
Globulins:	Serum	2.5–3.5 g/dL	25–35 g/L
α_1 -Globulins	Serum	0.2–0.4 g/dL	2–4 g/L
α_2 -Globulins	Serum	0.5–0.9 g/dL	5–9 g/L
β -Globulins	Serum	0.6–1.1 g/dL	6–11 g/L
γ -Globulins	Serum	0.7–1.7 g/dL	7–17 g/L
β_2 -Microglobulin	Serum	0.7–1.8 μ g/mL	—
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 μ g/L
In response to provocative stimuli	Plasma	> 7 ng/mL	> 7 μ g/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	—	95–98%	—
Hb A ₂	—	2–3%	—
Hb C	—	0%	—
Hb F	—	0.8–2.0%	—
Hb S	—	0%	—
Hemoglobin electrophoresis, Hb F in children:			
Neonate	50–80%	—	—
1–6 mo	8%	—	—
> 6 mo	1–2%	—	—
Homocysteine:			
Females	Plasma	0.40–1.89 mg/L	3–14 μ mol/L
Males	Plasma	0.54–2.16 mg/L	4–16 μ mol/L
Human chorionic gonadotropin (hCG), quantitative	Serum	< 5 mIU/mL	—

**Table 1. NORMAL LABORATORY VALUES:
BLOOD, PLASMA, AND SERUM (Continued)**

TEST	SPECIMEN	CONVENTIONAL UNITS	SI UNITS
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 µIU/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 µg/dL	11–29 µmol/L
Iron-binding capacity, total (TIBC)	Serum	250–460 µg/dL	45–82 µmol/L
Lactate dehydrogenase (LDH)	Serum	60–160 U/L	1–1.67 µkat/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 plas- ma glucose level
Lead	Blood	< 40 µg/dL	< 1.9 µmol/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 µkat/L
Lipoprotein (a) (Lp[a])	Serum	≤ 30 mg/dL	< 1.1 µmol/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	—

**Table 1. NORMAL LABORATORY VALUES:
BLOOD, PLASMA, AND SERUM (Continued)**

TEST	SPECIMEN	CONVENTIONAL UNITS	SI UNITS
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 µg/L	1.4–3.5 nmol/L
Males	Serum	28–72 µg/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 ₂ O	275–295 mmol/kg H ₂ O
Osmotic fragility test	Blood	Increased fragility if hemolysis occurs in > 0.5% NaCl Decreased fragility if hemolysis is incomplete in 0.3% NaCl	—
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 × 10 ³ /µL	150–350 × 10 ⁹ /L
Platelet life span, using chromium-51 (⁵¹ Cr)	—	8–12 days	—
Porphyrins	Plasma	≤ 1.0 µg/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

**Table 1. NORMAL LABORATORY VALUES:
BLOOD, PLASMA, AND SERUM (Continued)**

TEST	SPECIMEN	CONVENTIONAL UNITS	SI UNITS
Prolactin:			
Females	Serum	< 20 µg/L	< 870 pmol/L
Males	Serum	< 15 µg/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	—
Pyruvate	Blood	0.08–0.16 mmol/L	—
	Blood	4.2–5.9 × 10 ⁶ cells/µL	4.2–5.9 × 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 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 × 10 ³ /µL	23–90 × 10 ⁹ /L
Rheumatoid factor (RF)	Serum	< 40 U/mL	< 40 kU/L
Sodium	Serum	136–145 mEq/L	136–145 mmol/L
Testosterone, 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 µIU/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 µg/dL	—
Total	Serum	5–12 µg/dL	64–155 nmol/L
Transferrin	Serum	212–360 mg/dL	2.1–3.6 g/L
Transferrin saturation	Serum	20–50%	—
Triglycerides (desirable level)	Serum	< 250 mg/dL	< 2.82 mmol/L

**Table 1. NORMAL LABORATORY VALUES:
BLOOD, PLASMA, AND SERUM (Continued)**

TEST	SPECIMEN	CONVENTIONAL UNITS	SI UNITS
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 µg/L
Troponin T	Serum	≤ 0.03 ng/mL	≤ 0.03 µg/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 µmol/L
Total	Blood	0.4–1.5 mg/dL	23–85 µmol/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 (see pp. 948 and 952)	Blood	3.9–10.7 × 10 ³ cells/µL	3.9–10.7 × 10 ⁹ cells/L
Zinc	Serum	66–110 µg/dL	10.1–16.8 µmol/L

µkat = microkatal; pkat = picokatal.