

CASE RECORDS of the MASSACHUSETTS GENERAL HOSPITAL

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## Laboratory Reference Values

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The following is a table of reference values for adults for laboratory tests commonly ordered at the Massachusetts General Hospital (MGH) and recorded in the Case Records. The table revises the most recently published data (Normal Reference Laboratory Values. N Engl J Med 1998;339:1063-72). Laboratory values are expressed in the units used at the MGH and the units of the Système International d'Unités (SI units). The table is not intended to provide a comprehensive review of reference values, since this information is widely available in standard textbooks. To avoid suggesting an endorsement of commercial products by the hospital or the *Journal*, information on specific methods and instruments is not provided. Reference values are affected by many variables, including the patient population and the laboratory methods used. The ranges used at the MGH may therefore not be appropriate for other institutions and may not be optimal in some situations.

<b>Hematology and Coagulation.</b>			
<b>Analyte</b>	<b>Specimen*</b>	<b>Units Used at MGH</b>	<b>SI Units</b>
Activated clotting time	WB	70–180 sec	70–180 sec
Activated protein C resistance (factor V Leiden)	P	Ratio >2.1	Not applicable
Alpha <sub>2</sub> -antiplasmin	P	80–130%	0.80–1.30
Antiphospholipid-antibody panel			
Partial-thromboplastin time–lupus anticoagulant screen	P	Negative	Negative
Platelet-neutralization procedure	P	Negative	Negative
Dilute viper-venom screen	P	Negative	Negative
Anticardiolipin antibody	S		
IgG		0–15 GPL units	0–15 arbitrary units
IgM		0–15 MPL units	0–15 arbitrary units
Antithrombin III	P		
Antigenic		22–39 mg/dl	220–390 mg/liter
Functional		80–130%	0.8–1.30 U/liter
Anti-Xa assay (heparin assay)	P		
Unfractionated heparin		0.3–0.7 IU/ml	0.3–0.7 kIU/liter
Low-molecular-weight heparin		0.5–1.0 IU/ml	0.5–1.0 kIU/liter
Danaparoid		0.5–0.8 IU/ml	0.5–0.8 kIU/liter
Bleeding time		2.0–9.5 min	2.0–9.5 min
Carboxyhemoglobin	WB		
Nonsmoker		0–2.3%	0–0.023
Smoker		2.1–4.2%	0.021–0.042
Clot retraction	WB	50–100%/2 hr	0.50–1.00/2 hr
Cryofibrinogen	P	Negative	Negative
D-Dimer	P	<0.5 µg/ml	<0.5 mg/liter
Differential blood count	WB		
Neutrophils		40–70%	0.40–0.70
Band forms		0–10%	0–0.10
Lymphocytes		22–44%	0.22–0.44
Monocytes		4–11%	0.04–0.11
Eosinophils		0–8%	0–0.08
Basophils		0–3%	0–0.03
Erythrocyte count	WB		
Male		4.50–5.90×10 <sup>6</sup> /mm <sup>3</sup>	4.50–5.90×10 <sup>12</sup> /liter
Female		4.00–5.20×10 <sup>6</sup> /mm <sup>3</sup>	4.00–5.20×10 <sup>12</sup> /liter
Erythrocyte lifespan	WB		
Normal survival		120 days	120 days
Chromium labeled, half-life		25–35 days	25–35 days
Erythrocyte sedimentation rate	WB		
Female		1–25 mm/hr	1–25 mm/hr
Male		0–17 mm/hr	0–17 mm/hr
Factor II, prothrombin	P	60–140%	0.60–1.40
Factor V	P	60–140%	0.60–1.40
Factor VII	P	60–140%	0.60–1.40
Factor VIII	P	50–200%	0.50–2.00
Factor IX	P	60–140%	0.60–1.40

<b>Hematology and Coagulation. (Continued.)</b>			
<b>Analyte</b>	<b>Specimen*</b>	<b>Units Used at MGH</b>	<b>SI Units</b>
Factor X	P	60–140%	0.60–1.40
Factor XI	P	60–140%	0.60–1.40
Factor XII	P	60–140%	0.60–1.40
Factor XIII screen	P	No deficiency detected	Not applicable
Factor-inhibitor assay	P	<0.5 Bethesda unit	<0.5 Bethesda unit
Ferritin	S		
Male		30–300 ng/ml	30–300 µg/liter
Female		10–200 ng/ml	10–200 µg/liter
Fibrin and fibrinogen-degradation products	P	<2.5 µg/ml	<2.5 mg/liter
Fibrinogen	P	150–400 mg/dl	1.50–4.00 g/liter
Folate (folic acid)	S, P		
Normal		3.1–17.5 ng/ml	7.0–39.7 nmol/liter
Borderline deficient		2.2–3.0 ng/ml	5.0–6.8 nmol/liter
Deficient		<2.2 ng/ml	<5.0 nmol/liter
Excess		>17.5 ng/ml	>39.7 nmol/liter
Glucose-6-phosphate dehydrogenase, erythrocyte	WB	No gross deficiency	Not applicable
Ham's test (acidified serum test)	WB	Negative	Negative
Haptoglobin	S	16–199 mg/dl	0.16–1.99 g/liter
Hematocrit	WB		
Male		41.0–53.0%	0.41–0.53
Female		36.0–46.0%	0.36–0.46
Hemoglobin			
Plasma	P	1–5 mg/dl	0.01–0.05 g/liter
Whole blood			
Male	WB	13.5–17.5 g/dl	8.4–10.9 mmol/liter
Female	WB	12.0–16.0 g/dl	7.4–9.9 mmol/liter
Hemoglobin electrophoresis	WB		
Hemoglobin A		95–98%	0.95–0.98
Hemoglobin A <sub>2</sub>		1.5–3.5%	0.015–0.035
Hemoglobin F		0–2.0%	0–0.02
Hemoglobins other than A, A <sub>2</sub> , or F		Absent	Absent
Heparin-induced thrombocytopenia antibody	P	Negative	Negative
Homocysteine	P	0–12 µmol/liter	0–12 µmol/liter
Iron	S	30–160 µg/dl	5.4–28.7 µmol/liter
Iron-binding capacity	S	228–428 µg/dl	40.8–76.7 µmol/liter
Leukocyte count (WBC)	WB	4.5–11.0×10 <sup>3</sup> /mm <sup>3</sup>	4.5–11×10 <sup>9</sup> /liter
Mean corpuscular hemoglobin (MCH)	WB	26.0–34.0 pg/cell	26.0–34.0 pg/cell
Mean corpuscular hemoglobin concentration (MCHC)	WB	31.0–37.0 g/dl	310–370 g/liter
Mean corpuscular volume (MCV)	WB	80–100 µm <sup>3</sup>	80–100 fl
Methemoglobin	WB	≤1% of total hemoglobin	
Osmotic fragility of erythrocytes	WB	No increased hemolysis as compared with normal control	Not applicable
Partial-thromboplastin time, activated	P	22.1–35.1 sec	22.1–35.1 sec
Plasminogen	P		
Antigenic		8.4–14.0 mg/dl	84–140 mg/liter
Functional		80–130%	0.80–1.30

<b>Hematology and Coagulation. (Continued.)</b>			
<b>Analyte</b>	<b>Specimen*</b>	<b>Units Used at MGH</b>	<b>SI Units</b>
Plasminogen activator inhibitor 1	P	4–43 ng/ml	4–43 µg/liter
Platelet aggregation	PRP	>65% aggregation in response to adenosine diphosphate, epinephrine, collagen, ristocetin, and arachidonic acid	Not applicable
Platelet count	WB	150–350×10 <sup>3</sup> /mm <sup>3</sup>	150–350×10 <sup>9</sup> /liter
Prekallikrein assay	P	60–140%	0.60–1.40
Prekallikrein screen	P	Deficiency not detected	Not applicable
Protein C	P		
Total antigen		70–140%	0.70–1.40
Functional		70–140%	0.70–1.40
Protein S	P		
Total antigen		70–140%	0.70–1.40
Functional		70–140%	0.70–1.40
Free antigen		70–140%	0.70–1.40
Prothrombin-gene mutation G20210A	WB	Not present	Not applicable
Prothrombin time	P	11.1–13.1 sec	11.1–13.1 sec
Protoporphyrin, free erythrocyte	WB	16–36 µg/dl red cells	0.28–0.64 µmol/liter red cells
Red-cell distribution width	WB	11.5–14.5%	0.115–0.145
Reptilase time	P	16–24 sec	16–24 sec
Reticulocyte count	WB	0.5–2.5% red cells	0.005–0.025 red cells
Reticulocyte hemoglobin content	WB	>26 pg/cell	>26 pg/cell
Ristocetin cofactor (functional von Willebrand factor)	P		
Blood group O		75% mean of normal	0.75 mean of normal
Blood group A		105% mean of normal	1.05 mean of normal
Blood group B		115% mean of normal	1.15 mean of normal
Blood group AB		125% mean of normal	1.25 mean of normal
Schilling test, orally administered vitamin B <sub>12</sub> excreted in urine	U	7–40%	Not applicable
Sickle-cell test	WB	Negative	Negative
Sucrose hemolysis	WB	<10%	<0.1
Thrombin time	P	16–24 sec	16–24 sec
Transferrin receptor	S, P	9.6–29.6 nmol/liter	9.6–29.6 nmol/liter
Viscosity	P	1.7–2.1	1.7–2.1
	S	1.4–1.8	1.4–1.8
Vitamin B <sub>12</sub>	S, P		
Normal		>250 pg/ml	>185 pmol/liter
Borderline		125–250 pg/ml	92–185 pmol/liter
Deficient		<125 pg/ml	<92 pmol/liter
von Willebrand factor (vWF) antigen (factor VIII:R antigen)	P		
Blood group O		75% mean of normal	0.75 mean of normal
Blood group A		105% mean of normal	1.05 mean of normal
Blood group B		115% mean of normal	1.15 mean of normal
Blood group AB		125% mean of normal	1.25 mean of normal
von Willebrand factor multimers	P	Normal distribution	Normal distribution
White cells: see Leukocytes			

<b>Immunology.</b>			
<b>Analyte</b>	<b>Specimen*</b>	<b>Units Used at MGH</b>	<b>SI Units</b>
<b>Autoantibodies</b>			
Antiadrenal antibody	S	Negative at 1:10 dilution	Not applicable
Anti-double-stranded (native) DNA	S	Negative at 1:10 dilution	Not applicable
Anti-glomerular basement membrane antibody	S		
Qualitative		Negative	Negative
Quantitative		<5 U/ml	<5 kU/liter
Antigranulocyte antibody	S	Negative	Not applicable
Anti-Jo-1 antibody	S	Negative	Not applicable
Anti-La antibody	S	Negative	Not applicable
Antimitochondrial antibody	S	Negative	Not applicable
Antineutrophil cytoplasmic autoantibody, cytoplasmic (c-ANCA)	S		
Qualitative		Negative	Negative
Quantitative (antibody to proteinase 3)		<2.8 U/ml	<2.8 kU/liter
Antineutrophil cytoplasmic autoantibody, perinuclear (p-ANCA)	S		
Qualitative		Negative	Negative
Quantitative (antibody to myeloperoxidase)		<1.4 U/ml	<1.4 kU/liter
Antinuclear antibody	S	Negative at 1:40 dilution	Not applicable
Anti-parietal-cell antibody	S	Negative at 1:20 dilution	Not applicable
Anti-Ro antibody	S	Negative	Not applicable
Antiplatelet antibody	S	Negative	Not applicable
Anti-RNP antibody	S	Negative	Not applicable
Anti-Scl-70 antibody	S	Negative	Not applicable
Anti-Smith antibody	S	Negative	Not applicable
Anti-smooth-muscle antibody	S	Negative at 1:20 dilution	Not applicable
Antithyroglobulin	S	Negative	Not applicable
Antithyroid antibody	S	<0.3 IU/ml	<0.3 kIU/liter
Bence Jones protein	S	None detected	Not applicable
Qualitative	U	None detected in 50-fold concentrated specimen	Not applicable
Quantitative	U		
Kappa		<2.5 mg/dl	<0.03 g/liter
Lambda		<5.0 mg/dl	<0.05 g/liter
Beta <sub>2</sub> -microglobulin	S	<0.27 mg/dl	<2.7 mg/liter
	U	<120 µg/day	<120 µg/day
C1-esterase-inhibitor protein	S		
Antigenic		12.4–24.5 mg/dl	0.12–0.25 g/liter
Functional		Present	Present
C-reactive protein	S		
Routine		0.08–3.10 mg/liter	0.08–3.10 mg/liter
High-sensitivity		0.02–8.00 mg/liter	0.02–8.00 mg/liter
<b>Complement</b>			
C3	S	86–184 mg/dl	0.86–1.84 g/liter
C4	S	20–58 mg/dl	0.20–0.58 g/liter
Total complement, enzyme immunoassay	S	63–145 U/ml	63–145 kU/liter
Factor B	S	17–42 mg/dl	0.17–0.42 g/liter

<b>Immunology. (Continued.)</b>			
Analyte	Specimen*	Units Used at MGH	SI Units
Cryoproteins	S	Negative	Not applicable
Immunofixation	S	Negative	Not applicable
Immunoglobulin			
IgA	S	60–309 mg/dl	0.60–3.09 g/liter
IgD	S	0–14 mg/dl	0–140 mg/liter
IgE	S	10–179 IU/ml	24–430 μg/liter
IgG	S	614–1295 mg/dl	6.14–12.95 g/liter
IgG1	S	270–1740 mg/dl	2.7–17.4 g/liter
IgG2	S	30–630 mg/dl	0.3–6.3 g/liter
IgG3	S	13–320 mg/dl	0.13–3.20 g/liter
IgG4	S	11–620 mg/dl	0.11–6.20 g/liter
IgM	S	53–334 mg/dl	0.53–3.34 g/liter
Joint-fluid crystal	JF	Negative	Not applicable
Joint-fluid mucin	JF	Only type I mucin present	Not applicable
LE-cell test	WB	Negative	Negative
Rheumatoid factor	S, JF	<30.0 IU/ml	<30 kIU/liter
Serum protein electrophoresis	S	Normal pattern	Not applicable

<b>Clinical Chemistry.</b>			
Analyte	Specimen*	Units Used at MGH	SI Units
Acetoacetate	P	<1 mg/dl	<100 μmol/liter
Albumin	S	3.5–5.5 g/dl	35–55 g/liter
Aldolase	S	0–6 U/liter	0–100 nkat/liter
Alpha <sub>1</sub> -antitrypsin	S	85–213 mg/dl	0.8–2.1 g/liter
Alpha-fetoprotein	S	<15 ng/ml	<15 μg/liter
Aminotransferases			
Aspartate (AST, SGOT)		0–35 U/liter	0–0.58 μkat/liter
Alanine (ALT, SGPT)		0–35 U/liter	0–0.58 μkat/liter
Ammonia, as NH <sub>3</sub>	P	10–80 μg/dl	6–47 μmol/liter
Amylase	S	60–180 U/liter	0.8–3.2 μkat/liter
Angiotensin-converting enzyme (ACE)	S	<40 U/liter	<670 nkat/liter
Anion gap	S	7–16 mmol/liter	7–16 mmol/liter
Apolipoprotein			
Apolipoprotein A-1		119–240 mg/dl	1.2–2.4 g/liter
Apolipoprotein B		52–163 mg/dl	0.52–1.63 g/liter
Apolipoprotein B:apolipoprotein A-1		0.35–0.98	0.35–0.98
Arterial blood gases, sea level			
Bicarbonate (HCO <sub>3</sub> <sup>-</sup> )	WB, arterial	21–30 mEq/liter	21–28 mmol/liter
Partial pressure of carbon dioxide (PCO <sub>2</sub> )		35–45 mm Hg	4.7–5.9 kPa
pH		7.38–7.44	7.38–7.44
Partial pressure of oxygen (PO <sub>2</sub> )		80–100 mm Hg	11–13 kPa
β-Hydroxybutyrate	P	<3 mg/dl	<300 μmol/liter

Clinical Chemistry. (Continued.)				
Analyte	Specimen*	Units Used at MGH	SI Units	
Beta <sub>2</sub> -microglobulin	S	1.2–2.8 mg/liter	1.2–2.8 mg/liter	
	U	≤200 μg/liter	≤200 μg/liter	
Bilirubin	S	Total	0.3–1.0 mg/dl	
		Direct	0.1–0.3 mg/dl	
		Indirect	0.2–0.7 mg/dl	
			5.1–17.0 μmol/liter	
Brain-type natriuretic peptide (BNP)	P	<167 pg/ml (age- and sex-dependent)	<167 ng/liter (age- and sex-dependent)	
Calcium	S	9.0–10.5 mg/dl	2.2–2.6 mmol/liter	
Calcium, ionized	WB	4.5–5.6 mg/dl	1.1–1.4 mmol/liter	
CA 15-3	S	0–30 U/ml	0–30 kU/liter	
CA 19-9	S	0–37 U/ml	0–37 kU/liter	
CA 27-29	S	0–32 U/ml	0–32 kU/liter	
CA 125	S	0–35 U/ml	0–35 kU/liter	
Calcitonin	S	Male	3–26 pg/ml	
		Female	2–17 pg/ml	
			3–26 ng/liter	
Carbon dioxide	P	Content, sea level	21–30 mEq/liter	
		Partial pressure (PCO <sub>2</sub> ), sea level	35–45 mm Hg	
			21–30 mmol/liter	
Carbon monoxide content	WB		Symptoms with 20% saturation of hemoglobin	
Carcinoembryonic antigen (CEA)	S	0–3.4 ng/ml	0–3.4 μg/liter	
Ceruloplasmin	S	27–37 mg/dl	270–370 mg/liter	
Cholinesterase	S	5–12 U/ml	5–12 kU/liter	
Chloride	S	98–106 mEq/liter	98–106 mmol/liter	
Cholesterol	P	Low-density lipoprotein (LDL) cholesterol		
		Optimal	<100 mg/dl	<2.59 mmol/liter
		Near or above normal	100–129 mg/dl	2.59–3.34 mmol/liter
		Borderline high	130–159 mg/dl	3.36–4.11 mmol/liter
		High	160–189 mg/dl	4.13–4.88 mmol/liter
		Very high	≥190 mg/dl	≥4.91 mmol/liter
		High-density lipoprotein (HDL) cholesterol		
		Low	<40 mg/dl	<1.03 mmol/liter
		High	≥60 mg/dl	≥1.55 mmol/liter
		Total cholesterol		
Desirable	<200 mg/dl	<5.17 mmol/liter		
Borderline high	200–239 mg/dl	5.17–6.18 mmol/liter		
High	≥240 mg/dl	≥6.18 mmol/liter		
Copper	S	70–140 μg/dl	11–22 μmol/liter	
	U	3–35 μg/24 hr	0.047–0.55 μmol/24 hr	
Coproporphyrins, types I and III	U	100–300 μg/24 hr	150–460 μmol/24 hr	
C-peptide	S	0.5–2.0 ng/ml	0.17–0.66 nmol/liter	

Clinical Chemistry. (Continued.)			
Analyte	Specimen*	Units Used at MGH	SI Units
Creatine kinase	S		
Total			
Female		40–150 U/liter	0.67–2.50 $\mu$ kat/liter
Male		60–400 U/liter	1.00–6.67 $\mu$ kat/liter
MB isoenzyme	S	0–7 ng/ml	0–7 $\mu$ g/liter
Relative index†	S	Method-dependent	Method-dependent
Creatinine	S	<1.5 mg/dl	<133 $\mu$ mol/liter
Erythropoietin	S	5–36 IU/liter	5–36 IU/liter
Fatty acids, free (nonesterified)	P	<8–25 mg/dl	0.28–0.89 mmol/liter
Fibrinogen and fibrinogen-degradation products: see under Hematology and Coagulation			
Folic acid	RC	150–450 ng/ml/cells	340–1020 nmol/liter/cells
$\gamma$ -Glutamyltransferase	S	1–94 U/liter	1–94 U/liter
Glucose	P		
Fasting			
Normal		75–115 mg/dl	4.2–6.4 mmol/liter
Diabetes mellitus		>125 mg/dl	>7.0 mmol/liter
2 Hr postprandial	P	120 mg/dl	<6.7 mmol/liter
Hemoglobin A <sub>1c</sub>	WB	3.8–6.4%	0.038–0.064 hemoglobin fraction
Homocysteine	P	4–12 $\mu$ mol/liter	4–12 $\mu$ mol/liter
Hydroxyproline	U	0–1.3 mg/24 hr	0–10 $\mu$ mol/24 hr
Iron	S	50–150 $\mu$ g/dl	9–27 $\mu$ mol/liter
Iron-binding capacity	S	250–370 $\mu$ g/dl	45–66 $\mu$ mol/liter
Iron-binding capacity, saturation	S	20–45%	0.2–0.45
Ketone (acetone)	S, U	Negative	Negative
Lactate	P, venous	5–15 mg/dl	0.6–1.7 mmol/liter
Lactate dehydrogenase	S	100–190 U/liter	1.7–3.2 $\mu$ kat/liter
Lactate dehydrogenase isoenzymes	S		
Fraction 1 (of total)		14–26%	0.14–0.25
Fraction 2		29–39%	0.29–0.39
Fraction 3		20–26%	0.20–0.25
Fraction 4		8–16%	0.08–0.16
Fraction 5		6–16%	0.06–0.16
Lead (adult)	S	<10–20 $\mu$ g/dl	<0.5–1 $\mu$ mol/liter
Lipase	S	0–160 U/liter	0–2.66 $\mu$ kat/liter
Lipids, triglyceride: see Triglycerides			
Lipoprotein (a)	S	0–30 mg/dl	0–300 mg/liter
Magnesium	S	1.8–3.0 mg/dl	0.8–1.2 mmol/liter
Mercury	WB U, 24 hr	0.6–59 $\mu$ g/liter <20 $\mu$ g/liter	3.0–294 nmol/liter <99.8 nmol/liter
Microalbumin	U		
24-hr		<20 mg/liter or <31 mg/24 hr	<0.02 g/liter or <0.031 g/24 hr
Spot, morning		<0.03 mg albumin/mg creatinine	<0.03 g albumin/g creatinine



Clinical Chemistry. (Continued.)			
Analyte	Specimen*	Units Used at MGH	SI Units
Myoglobin	S		
Male			19–92 µg/liter
Female			12–76 µg/liter
5'-Nucleotidase	S	0–11 U/liter	0.02–0.18 µkat/liter
Osmolality	P	285–295 mOsm/kg serum water	285–295 mmol/kg serum water
	U	300–900 mOsm/kg	300–900 mmol/kg
Oxygen			
Content, sea level	WB, arterial WB, venous (arm)	17–21 vol% 10–16 vol%	
Saturation, sea level	WB, arterial WB, venous (arm)	97% 60–85%	0.97 mol/mol 0.60–0.85 mol/mol
Partial pressure (PO <sub>2</sub> )	WB	80–100 mm Hg	11–13 kPa
pH	WB	7.38–7.44	
Parathyroid hormone–related peptide	S	<1.3 pmol/liter	<1.3 pmol/liter
Phosphatase			
Acid	S	0–5.5 U/liter	0.90 nkat/liter
Alkaline	S	30–120 U/liter	0.5–2.0 nkat/liter
Phosphorus, inorganic	S	3–4.5 mg/dl	1.0–1.4 mmol/liter
Porphobilinogen	U	None	None
Potassium	S	3.5–5.0 mEq/liter	3.5–5.0 mmol/liter
Prealbumin	S	19.5–35.8 mg/dl	195–358 mg/liter
Prostate-specific antigen (PSA)	S		
Female		<0.5 ng/ml	<0.5 µg/liter
Male			
≤40 yr		0–2.0 ng/ml	0–2.0 µg/liter
>40 yr		0–4.0 ng/ml	0–4.0 µg/liter
Prostate-specific antigen (PSA), free (men 45–75 yr with PSA values between 4 and 20 ng/ml)		>25% associated with benign prostatic hyperplasia	>0.25 associated with benign prostatic hyperplasia
Protein			
Total	S	5.5–8.0 g/dl	55–80 g/liter
Fractions	S		
Albumin		3.5–5.5 g/dl (50–60%)	35–55 g/liter
Alpha <sub>1</sub>		0.2–0.4 g/dl (4.2–7.2%)	2–4 g/liter
Alpha <sub>2</sub>		0.5–0.9 g/dl (6.8–12%)	5–9 g/liter
Beta		0.6–1.1 g/dl (9.3–15%)	6–11 g/liter
Gamma		0.7–1.7 g/dl (13–23%)	7–17 g/liter
Globulin		2.0–3.5 g/dl (40–50%)	20–35 g/liter
Pyruvate	P, venous	0.5–1.5 mg/dl	60–170 µmol/liter
Sodium	S	136–145 mEq/liter	136–145 mmol/liter
Transferrin	S	230–390 mg/dl	2.3–3.9 g/liter
Triglycerides	S	<160 mg/dl	<1.8 mmol/liter
Troponin			
I	S	0–0.4 ng/ml	0–0.4 µg/liter
T	S	0–0.1 ng/ml	0–0.1 µg/liter

<b>Clinical Chemistry. (Continued.)</b>			
Analyte	Specimen*	Units Used at MGH	SI Units
Urea nitrogen	S	10–20 mg/dl	3.6–7.1 mmol/liter
Uric acid	S		
Male		2.5–8.0 mg/dl	150–480 μmol/liter
Female		1.5–6.0 mg/dl	90–360 μmol/liter
Urobilinogen	U	1–3.5 mg/24 hr	1.7–5.9 μmol/24 hr
Vitamin A	S	20–100 μg/dl	0.7–3.5 μmol/liter
Vitamin B <sub>1</sub> (thiamine)	S	0–2 μg/dl	0–75 nmol/liter
Vitamin B <sub>2</sub> (riboflavin)	S	4–24 μg/dl	106–638 nmol/liter
Vitamin B <sub>6</sub>	P	5–30 ng/ml	20–121 nmol/liter
Vitamin C (ascorbic acid)	S	0.4–1.0 mg/dl	23–57 μmol/liter
Vitamin D <sub>3</sub> (1,25-dihydroxyvitamin D)	S	25–45 pg/ml	60–108 pmol/liter
Vitamin D <sub>3</sub> (25-hydroxyvitamin D)	P	10–68 ng/ml	24.9–169.5 nmol/liter
Vitamin E	S	5–18 μg/ml	12–42 μmol/liter
Vitamin K	S	0.13–1.19 ng/ml	0.29–2.64 nmol/liter

<b>Metabolic and Endocrine Tests.</b>			
Analyte	Specimen*	Units Used at MGH	SI Units
Adrenocorticotropin (ACTH)	P	6.0–76.0 pg/ml	1.3–16.7 pmol/liter
Aldosterone			
Supine, normal-sodium diet	S, P	2–9 ng/dl	55–250 pmol/liter
Upright, normal-sodium diet	S, P	2–5 times supine value with normal-sodium diet	
Supine, low-sodium diet	S, P	2–5 times supine value with normal-sodium diet	
Random, low-sodium diet	U	2.3–21.0 μg/24 hr	6.38–58.25 nmol/24 hr
Androstenedione	S	50–250 ng/dl	1.75–8.73 nmol/liter
Cortisol			
Fasting, 8 a.m.–noon	S	5–25 μg/dl	138–690 nmol/liter
Noon–8 p.m.		5–15 μg/dl	138–414 nmol/liter
8 p.m.–8 a.m.		0–10 μg/dl	0–276 nmol/liter
Cortisol, free	U	20–70 μg/24 hr	55–193 nmol/24 hr
Dehydroepiandrosterone (DHEA)			
Male	S	180–1250 ng/dl	6.24–41.6 nmol/liter
Female		130–980 ng/dl	4.5–34.0 nmol/liter
Dehydroepiandrosterone (DHEA) sulfate	S		
Male		10–619 μg/dl	100–6190 μg/liter
Female (premenopausal)		12–535 μg/dl	120–5350 μg/liter
Female (postmenopausal)		30–260 μg/dl	300–2600 μg/liter
Deoxycorticosterone (DOC)	S	2–19 ng/dl	61–576 nmol/liter
11-Deoxycortisol (8 a.m.)	S	12–158 ng/dl	0.34–4.56 nmol/liter
Dopamine	P	<87 pg/ml	<475 pmol/liter
	U	65–400 μg/day	425–2610 nmol/day

<b>Metabolic and Endocrine Tests. (Continued.)</b>			
<b>Analyte</b>	<b>Specimen*</b>	<b>Units Used at MGH</b>	<b>SI Units</b>
<b>Epinephrine</b>			
Supine (30 min)	P	<50 pg/ml	<273 pmol/liter
Sitting	P	<60 pg/ml	<328 pmol/liter
Standing (30 min)	P	<900 pg/ml	<4914 pmol/liter
	U	0–20 µg/day	0–109 nmol/day
<b>Estradiol</b>			
	S, P		
<b>Female</b>			
<b>Menstruating</b>			
Follicular phase		<20–145 pg/ml	184–532 pmol/liter
Mid-cycle peak		112–443 pg/ml	411–1626 pmol/liter
Luteal phase		<20–241 pg/ml	184–885 pmol/liter
Postmenopausal		<59 pg/ml	217 pmol/liter
<b>Male</b>			
		<20 pg/ml	184 pmol/liter
<b>Estrone</b>			
	S, P		
<b>Female</b>			
<b>Menstruating</b>			
Follicular phase		1.5–15.0 pg/ml	55–555 pmol/liter
Luteal phase		1.5–20.0 pg/ml	55–740 pmol/liter
Postmenopausal		1.5–5.5 pg/ml	55–204 pmol/liter
<b>Male</b>			
		1.5–6.5 pg/ml	55–240 pmol/liter
<b>Follicle-stimulating hormone (FSH)</b>			
	S, P		
<b>Female</b>			
<b>Menstruating</b>			
Follicular phase		3.0–20.0 mIU/ml	3.0–20.0 IU/liter
Ovulatory phase		9.0–26.0 mIU/ml	9.0–26.0 IU/liter
Luteal phase		1.0–12.0 mIU/ml	1.0–12.0 IU/liter
Postmenopausal		18.0–153.0 mIU/ml	18.0–153.0 IU/liter
<b>Male</b>			
		1.0–12.0 mIU/ml	1.0–12.0 IU/liter
Fructosamine	S	1.61–2.68 mmol/liter	1.61–2.68 mmol/liter
Gastrin	S	<100 pg/ml	<100 ng/liter
Glucagon	P	20–100 pg/ml	20–100 ng/liter
Growth hormone (resting)	S	0.5–17.0 ng/ml	0.5–17.0 µg/liter
Human chorionic gonadotropin (hCG) (nonpregnant women)	S	<5 mIU/ml	<5 IU/liter
<b>17-Hydroxyprogesterone</b>			
<b>Male</b>			
		5–250 ng/dl	0.15 nmol/liter
<b>Female</b>			
<b>Menstruating</b>			
Follicular phase		20–100 ng/dl	0.6–3.0 nmol/liter
Mid-cycle peak		100–250 ng/dl	3.0–7.5 nmol/liter
Luteal phase		100–500 ng/dl	3.0–15 nmol/liter
Postmenopausal		≤70 ng/dl	≤2.1 nmol/liter
5-Hydroxyindoleacetic acid (5-HIAA)	U	<6 mg/24 hr	<31 µmol/24 hr
Insulin	S, P	2–20 µU/ml	14.35–143.50 pmol/liter
17-Ketosteroids	U	3–12 mg/24 hr	10–42 µmol/24 hr

Metabolic and Endocrine Tests. (Continued.)			
Analyte	Specimen*	Units Used at MGH	SI Units
Luteinizing hormone (LH)	S, P		
Female			
Menstruating			
Follicular phase		2.0–15.0 mIU/ml	2.0–15.0 IU/liter
Ovulatory phase		22.0–105.0 mIU/ml	22.0–105.0 IU/liter
Luteal phase		0.6–19.0 mIU/ml	0.6–19.0 IU/liter
Postmenopausal		16.0–64.0 mIU/ml	16.0–64.0 IU/liter
Male			
		2.0–12.0 mIU/ml	2.0–12.0 IU/liter
Metanephrine	P	<0.5 nmol/liter	<0.5 nmol/liter
	U	0.05–1.20 µg/mg creatinine	0.03–0.69 mmol/mol creatinine
Norepinephrine	U	15–80 µg/24 hr	89–473 nmol/24 hr
Norepinephrine	P		
Supine (30 min)		<110–410 pg/ml	650–2423 pmol/liter
Sitting		120–680 pg/ml	709–4019 pmol/liter
Standing (30 min)		125–700 pg/ml	739–4137 pmol/liter
Parathyroid hormone	S	10–60 pg/ml	10–60 ng/liter
Pregnanetriol	U	Age- and sex-dependent	Age- and sex-dependent
Progesterone	S, P		
Menstruating female			
Follicular		<0.2 ng/ml	<0.6 nmol/liter
Midluteal		3–20 ng/ml	9.54–63.6 nmol/liter
Male			
		<0.2–1.4 ng/ml	<0.60–4.45 nmol/liter
Prolactin	S		
Female		0–20 ng/ml	0–20 µg/liter
Male		0–15 ng/ml	0–15 µg/liter
Serotonin	WB Platelets	50–200 ng/ml 125–500 ng/10 <sup>9</sup> platelets	0.28–1.14 µmol/liter 0.7–2.8 amol/platelet
Sex hormone-binding globulin	S		
Male		13–71 nmol/liter	13–71 nmol/liter
Female		18–114 nmol/liter	18–114 nmol/liter
Somatostatin	P	<25 pg/ml	<25 ng/liter
Somatomedin C (insulin-like growth factor I [IGF-I])	S		
16–24 yr		182–780 ng/ml	182–780 µg/liter
25–39 yr		114–492 ng/ml	114–492 µg/liter
40–54 yr		90–360 ng/ml	90–360 µg/liter
>54 yr		71–290 ng/ml	71–290 µg/liter
Testosterone	S		
Total, morning			
Female		6–86 ng/dl	0.21–2.98 nmol/liter
Male		270–1070 ng/dl	9.36–37.10 nmol/liter
Unbound, morning			
Female		0.2–3.1 pg/ml	6.9–107.5 pmol/liter
Male		12.0–40.0 pg/ml	416–1387 pmol/liter

Metabolic and Endocrine Tests. (Continued.)			
Analyte	Specimen*	Units Used at MGH	SI Units
Thyroglobulin	S	0–60 ng/ml	0–60 µg/liter
Thyroid-binding globulin	S	16–24 µg/ml	206–309 nmol/liter
Thyroid-stimulating hormone	S	0.5–4.7 µU/ml	0.5–4.7 µU/liter
Thyroxine	S		
Total (T <sub>4</sub> )		4.5–10.9 µg/dl	58–140 nmol/liter
Free (fT <sub>4</sub> )		0.8–2.7 ng/dl	10.3–35.0 pmol/liter
Triiodothyronine	S		
Total (T <sub>3</sub> )		60–181 ng/dl	0.92–2.78 nmol/liter
Free (fT <sub>3</sub> )		1.4–4.4 pg/ml	0.22–6.78 pmol/liter
Vanillylmandelic acid (VMA)	U	0.15–1.20 mg/24 hr	7.6–37.9 µmol/24 hr
Vasoactive intestinal polypeptide (VIP)	P	<75 pg/ml	<75 ng/liter

Therapeutic-Drug Monitoring and Toxicology.				
Drug	Therapeutic Level		Toxic Level	
	Units Used at MGH	SI Units	Units Used at MGH	SI Units
Acetaminophen	10–30 µg/ml	66–199 µmol/liter	>200 µg/ml	>1324 µmol/liter
Amikacin				
Peak	25–35 µg/ml	43–60 µmol/liter	>35 µg/ml	>60 µmol/liter
Trough	4–8 µg/ml	6.8–13.7 µmol/liter	>10 µg/ml	>17 µmol/liter
Amitriptyline	120–250 ng/ml	433–903 nmol/liter	>500 ng/ml	>1805 nmol/liter
Amphetamine	20–30 ng/ml	148–222 nmol/liter	>200 ng/ml	>1480 nmol/liter
Barbiturates, most short-acting			>20 mg/liter	>88 µmol/liter
Bromide			>1250 µg/ml	>15.6 mmol/liter
Carbamazepine	6–12 µg/ml	26–51 µmol/liter	>15 µg/ml	>63 µmol/liter
Chlordiazepoxide	700–1000 ng/ml	2.34–3.34 µmol/liter	>5000 ng/ml	>16.7 µmol/liter
Clonazepam	15–60 ng/ml	48–190 nmol/liter	>80 ng/ml	>254 nmol/liter
Clozapine	200–350 ng/ml	0.6–1.0 µmol/liter		
Cocaine			>1000 ng/ml	>3300 nmol/liter
Cyclosporine	Varies with time after dose and type of transplantation, with ranges of 100–400 ng/ml	Varies with time after dose and type of transplantation, with ranges of 83–333 nmol/liter	Varies with time after dose and type of transplantation	Varies with time after dose and type of transplantation
Desipramine	75–300 ng/ml	281–1125 nmol/liter	>400 ng/ml	>1500 nmol/liter
Diazepam	100–1000 ng/ml	0.35–3.51 µmol/liter	>5000 ng/ml	>17.55 µmol/liter
Digoxin	0.8–2.0 ng/ml	1.0–2.6 nmol/liter	>2.5 ng/ml	>3.2 nmol/liter
Doxepin	30–150 ng/ml	107–537 nmol/liter	>500 ng/ml	>1790 nmol/liter
Ethanol			>300 mg/dl	>65 mmol/liter
Behavioral changes			>20 mg/dl	>4.3 mmol/liter
Clinical intoxication			>100 mg/dl	>1 g/liter

Therapeutic-Drug Monitoring and Toxicology. (Continued.)				
Drug	Therapeutic Level		Toxic Level	
	Units Used at MGH	SI Units	Units Used at MGH	SI Units
Ethosuximide	40–100 µg/ml	283–708 µmol/liter	>150 µg/ml	>1062 µmol/liter
Flecainide	0.2–1.0 µg/ml	0.5–2.4 µmol/liter	>1.0 µg/ml	>2.4 µmol/liter
Gentamicin				
Peak	8–10 µg/ml	16.7–20.9 µmol/liter	>10 µg/ml	>21.0 µmol/liter
Trough	<2–4 µg/ml	<4.2–8.4 µmol/liter	>4 µg/ml	>8.4 µmol/liter
Ibuprofen	10–50 µg/ml	49–243 µmol/liter	100–700 µg/ml	485–3395 µmol/liter
Imipramine	125–250 ng/ml	446–893 nmol/liter	>500 ng/ml	>1784 nmol/liter
Lidocaine	1.5–6.0 µg/ml	6.4–26 µmol/liter		
Central nervous system or cardiovascular depression			6–8 µg/ml	26–34.2 µmol/liter
Seizures, obtundation, decreased cardiac output			>8 µg/ml	>34.2 µmol/liter
Lithium	0.6–1.2 mEq/liter	0.6–1.2 nmol/liter	>2 mEq/liter	>2 mmol/liter
Methadone	100–400 ng/ml	0.32–1.29 µmol/liter	>2000 ng/ml	>6.46 µmol/liter
Methotrexate	Variable	Variable		
1–2 wk after low dose			>9.1 ng/ml	>20 nmol/liter
48 hr after high dose			>227 ng/ml	>0.5 µmol/liter
Morphine	10–80 ng/ml	35–280 nmol/liter	>200 ng/ml	>700 nmol/liter
Nortriptyline	50–170 ng/ml	190–646 nmol/liter	>500 ng/ml	>1.9 µmol/liter
Phenobarbital	10–40 µg/ml	43–170 µmol/liter		
Slowness, ataxia, nystagmus			35–80 µg/ml	151–345 µmol/liter
Coma with reflexes			65–117 µg/ml	280–504 µmol/liter
Coma without reflexes			>100 µg/ml	>430 µmol/liter
Phenytoin	10–20 µg/ml	40–79 µmol/liter	>20 µg/ml	>79 µmol/liter
Procainamide	4–10 µg/ml	17–42 µmol/liter	>10–12 µg/ml	>42–51 µmol/liter
Quinidine	2–5 µg/ml	6–15 µmol/liter	>6 µg/ml	>18 µmol/liter
Salicylates	150–300 µg/ml	1086–2172 µmol/liter	>300 µg/ml	>2172 µmol/liter
Theophylline	8–20 µg/ml	44–111 µmol/liter	>20 µg/ml	>110 µmol/liter
Thiocyanate				
After nitroprusside infusion	6–29 µg/ml	103–499 µmol/liter	>120 µg/ml	>2064 µmol/liter
Nonsmoker	1–4 µg/ml	17–69 µmol/liter		
Smoker	3–12 µg/ml	52–206 µmol/liter		
Tobramycin				
Peak	8–10 µg/ml	17–21 µmol/liter	>10 µg/ml	>21 µmol/liter
Trough	<4 µg/ml	<9 µmol/liter	>4 µg/ml	>9 µmol/liter
Valproic acid	50–150 µg/ml	347–1040 µmol/liter	>150 µg/ml	>1040 µmol/liter
Vancomycin				
Peak	18–26 µg/ml	12–18 µmol/liter	>80–100 µg/ml	>55–69 µmol/liter
Trough	5–10 µg/ml	3–7 µmol/liter		

<b>Urine Analysis.</b>		
<b>Analyte</b>	<b>Units Used at MGH</b>	<b>SI Units</b>
Acidity, titratable	20–40 mEq/24 hr	20–40 mmol/24 hr
Ammonia	30–50 mEq/24 hr	30–50 mmol/24 hr
Amylase	4–400 U/liter	0.07–7.67 nkat/liter
Amylase:creatinine clearance ratio‡	1–5	1–5
Calcium (with dietary calcium 10 mEq/24 hr or 200 mg/24 hr)	<300 mg/24 hr	<7.5 mmol/24 hr
Creatine, as creatinine		
Female	<100 mg/24 hr	<760 μmol/24 hr
Male	<50 mg/24 hr	<380 μmol/24 hr
Creatinine	1.0–1.6 g/24 hr	8.8–14 mmol/24 hr
Eosinophils	<100 eosinophils/ml	<100 eosinophils/ml
Glucose, true (oxidase method)	50–300 mg/24 hr	0.3–1.7 mmol/24 hr
Microalbumin	0–2.0 mg/dl	0–0.02 g/liter
Oxalate	2–60 mg/24 hr	228–684 μmol/24 hr
pH	5.0–9.0	5.0–9.0
Phosphate (phosphorus)	400–1300 mg/24 hr (varies with intake)	12.9–42.0 mmol/24 hr (varies with intake)
Potassium	25–100 mEq/24 hr (varies with intake)	25–100 mmol/24 hr (varies with intake)
Protein	<150 mg/24 hr	<0.15 g/24 hr
Sediment		
Bacteria	Negative	Negative
Bladder cells	Negative	Negative
Broad casts	Negative	Negative
Crystals	Negative	Negative
Epithelial-cell casts	Negative	Negative
Granular casts	Negative	Negative
Hyaline casts	0–5/low-power field	0–5/low-power field
Red-cell casts	Negative	Negative
Red cells	0–2/high-power field	0–2/high-power field
Squamous cells	Negative	Negative
Tubular cells	Negative	Negative
Waxy casts	Negative	Negative
White cells	0–2/high-power field	0–2/high-power field
White-cell casts	Negative	Negative
Sodium	100–260 mEq/24 hr (varies with intake)	100–260 mmol/24 hr (varies with intake)
Specific gravity	1.001–1.035	1.001–1.035
Urea nitrogen	6–17 g/24 hr	214–607 mmol/24 hr
Uric acid (with normal diet)	250–800 mg/24 hr	1.49–4.76 mmol/24 hr

Microbiology.			
Specimen	Routinely Cultured For	Also Reported	Normal Flora
Throat	Group A beta-hemolytic streptococci, pyogenic groups C and G beta-hemolytic streptococci, <i>Arcanobacterium haemolyticum</i>	If complete throat culture is requested: <i>Haemophilus influenzae</i> , <i>Staphylococcus aureus</i> , <i>Streptococcus pneumoniae</i> , <i>Neisseria meningitidis</i> , and yeast	Alpha-hemolytic streptococci, non-hemolytic streptococci, diphtheroids, coagulase-negative staphylococci, saprophytic neisseria
Sputum	Pneumococci, <i>H. influenzae</i> , beta-hemolytic streptococci, <i>Staph. aureus</i> , <i>Moraxella (Branhamella) catarrhalis</i> , gram-negative bacilli	Presence or absence of normal throat flora	Little or no normal throat flora, if specimen carefully collected
Urine	Aerobic bacteria and yeast: "abundant" if $>10^5$ colony-forming units/ml, "moderate" if $10^4$ – $10^5$ colony-forming units/ml	"Few" if $10^3$ – $10^4$ colony-forming units/ml, "rare" if $10^2$ – $10^3$ colony-forming units/ml (either may indicate clinically significant bacteriuria if accompanied by pyuria, clinical symptoms, or both)	No mixed bacterial species (i.e., not more than one of the following: lactobacilli, non-beta-hemolytic streptococci, diphtheroids, coagulase-negative staphylococci, or <i>Gardnerella vaginalis</i> ) if specimen carefully collected
Blood	Aerobic bacteria, anaerobic bacteria, yeasts		None; common contaminants: aerobic diphtheroids, anaerobic diphtheroids, coagulase-negative staphylococci
Cerebrospinal fluid and other fluids	Aerobic bacteria, anaerobic bacteria, yeasts (including cryptococcus)	Any organism isolated	None
Stool	Enteric pathogens: salmonella, shigella, campylobacter, plesiomonas, and aeromonas when predominant	Moderate or abundant yeast or <i>Staph. aureus</i> ; presence or absence of normal gram-negative enteric flora; if special cultures requested, yersinia, <i>Vibrio cholerae</i> , <i>V. parahaemolyticus</i> , or hemorrhagic strains of <i>Escherichia coli</i> (O157)	Enterobacteriaceae, streptococci, pseudomonas, small numbers of staphylococci and yeast (and anaerobes that are not routinely cultured)
Wounds	Aerobic bacteria, anaerobic bacteria, yeasts		
Cervical or vaginal	Gonococci, group A beta-hemolytic streptococci, pyogenic groups C and G beta-hemolytic streptococci, <i>Staph. aureus</i> (Gram's stain for diagnosis of bacterial vaginosis according to Nugent score)	Yeasts and enteric gram-negative rods if present in large numbers	

\* WB denotes whole blood, P plasma, S serum, PRP platelet-rich plasma, U urine, and JF joint fluid, and RC red cells.

† The creatine kinase relative index is calculated as [MB isoenzyme (in nanograms per milliliter) ÷ total creatine kinase (in units per liter)] × 100.

‡ The amylase:creatinine clearance ratio is calculated as [amylase clearance ÷ creatinine clearance] × 100.

For further information, see Kratz A, Sluss PM, Januzzi JL, Lewandrowski KB. Laboratory values of clinical importance. In: Kasper DL, Braunwald E, Fauci AS, Hauser SL, Longo DL, Jameson JL, eds. Harrison's principles of internal medicine. 16th ed. New York: McGraw-Hill, 2004:A1-A15.

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