

Laboratory Medicine: The Diagnosis of Disease in the Clinical Laboratory >

Clinical Laboratory Reference Values

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Acetaminophen (therapeutic)	Serum, plasma	10-30	µg/mL	6.62	70-200	µmol/L
Acetoacetic acid	Serum, plasma	<1	mg/dL	0.098	<0.1	mmol/L
Acetone	Serum, plasma	<2.0	mg/dL	0.172	<0.34	mmol/L
Acetylcholinesterase	Red blood cells	5-10	U/mL	1	5-10	U/L
Activated partial thromboplastin time (APTT)	Whole blood	25-40	s	1	25-40	s
Adenosine deaminase ^a	Serum	11.5-25.0	U/L	0.017	0.20-0.43	µKat/L
Adrenocorticotropic hormone (ACTH) (see corticotropin)						
Alanine ^b (adult)	Plasma	1.87-5.88	mg/dL	112.2	210-661	µmol/day
Alanine aminotransferase (ALT, SGPT) ^b	Serum	10-40	U/L	1	10-40	U/L

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Albumin ^b	Serum	3.5-5.0	g/dL	10	35-50	g/L
Alcohol (see ethanol, isopropanol, methanol)						
Alcohol dehydrogenase ^a	Serum	<2.8	U/L	0.017	<0.05	µKat/L
Aldolase ^{a,b}	Serum	1.0-7.5	U/L	0.017	0.02-0.13	µKat/L
Aldosterone ^b (upright)	Plasma	7-30	ng/dL	0.0277	0.19-0.83	nmol/L
Aldosterone	Urine, 24 h	3-20	µg/24 h	2.77	8-55	nmol/day
Alkaline phosphatase ^b	Serum	50-120	U/L	1	50-120	U/L
α ₁ -Acid glycoprotein	Serum	50-120	mg/dL	0.01	0.5-1.2	g/L
α ₂ -Macroglobulin	Serum	130-300	mg/dL	0.01	1.3-3.0	g/L
Alprazolam (therapeutic)	Serum, plasma	10-50	ng/mL	3.24	32-162	nmol/L
Aluminum	Serum, plasma	<6	ng/mL	37.06	0.0-222.4	nmol/L
Amikacin (therapeutic, peak)	Serum, plasma	20-30	µg/mL	1.71	34-52	µmol/L
Amino acid fractionation						
Alanine ^b	Plasma	1.87-5.89	mg/dL	112.2	210-661	µmol/L
α-Aminobutyric acid ^b	Plasma	0.08-0.36	mg/dL	97	8-35	µmol/L

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Arginine ^b	Plasma	0.37-2.40	mg/dL	57.4	21-138	μmol/L
Asparagine ^b	Plasma	0.40-0.91	mg/dL	75.7	30-69	μmol/L
Aspartic acid ^b	Plasma	<0.3	mg/dL	75.1	<25	μmol/L
Citrulline ^b	Plasma	0.2-1.0	mg/dL	57.1	12-55	μmol/L
Cystine ^b	Plasma	0.40-1.40	mg/dL	83.3	33-117	μmol/L
Glutamic acid ^b	Plasma	0.2-2.8	mg/dL	67.97	15-190	μmol/L
Glutamine ^b	Plasma	6.1-10.2	mg/dL	68.42	420-700	μmol/L
Glycine ^b	Plasma	0.9-4.2	mg/dL	133.3	120-560	μmol/L
Histidine ^b	Plasma	0.5-1.7	mg/dL	64.5	32-110	μmol/L
Hydroxyproline ^b	Plasma	<0.55	mg/dL	76.3	<42	μmol/L
Isoleucine ^b	Plasma	0.5-1.3	mg/dL	76.24	40-100	μmol/L
Leucine ^b	Plasma	1.0-2.3	mg/dL	76.3	75-175	μmol/L
Lysine ^b	Plasma	1.2-3.5	mg/dL	68.5	80-240	μmol/L
Methionine ^b	Plasma	0.1-0.6	mg/dL	67.1	6-40	μmol/L
Ornithine ^b	Plasma	0.4-1.4	mg/dL	75.8	30-106	μmol/L
Phenylalanine ^b	Plasma	0.6-1.5	mg/dL	60.5	35-90	μmol/L
Proline ^b	Plasma	1.2-3.9	mg/dL	86.9	104-340	μmol/L

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Serine ^b	Plasma	0.7-2.0	mg/dL	95.2	65-193	μmol/L
Taurine ^b	Plasma	0.3-2.1	mg/dL	80	24-168	μmol/L
Threonine ^b	Plasma	0.9-2.5	mg/dL	84	75-210	μmol/L
Tryptophan ^b	Plasma	0.5-1.5	mg/dL	48.97	25-73	μmol/L
Tyrosine ^b	Plasma	0.4-1.6	mg/dL	55.19	20-90	μmol/L
Valine ^b	Plasma	1.7-3.7	mg/dL	85.5	145-315	μmol/L
α-Aminobutyric acid ^b	Plasma	0.08-0.36	mg/dL	97	8-35	μmol/L
Amiodarone (therapeutic)	Serum, plasma	0.5-2.5	μg/mL	1.55	0.8-3.9	μmol/L
δ-Aminolevulinic acid	Urine	1.0-7.0	mg/24 h	7.626	8-53	μmol/day
Amitriptyline (therapeutic)	Serum, plasma	80-250	ng/mL	3.61	289-903	nmol/L
Ammonia (as NH ₃) ^b	Plasma	15-50	μg/dL	0.714	11-35	μmol/L
Amobarbital (therapeutic)	Serum	1-5	μg/mL	4.42	4-22	μmol/L
Amoxapine (therapeutic)	Plasma	200-600	ng/mL	1	200-600	μg/L
Amylase ^{a,b}	Serum	27-130	U/L	0.017	0.46-2.21	μKat/L
Androstenedione, ^b male	Serum	75-205	ng/dL	0.0349	2.6-7.2	nmol/L

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Androstenedione, ^b female	Serum	85-275	ng/dL	0.0349	3.0-9.6	nmol/L
Angiotensin I	Plasma	<25	pg/mL	1	<25	ng/L
Angiotensin II	Plasma	10-60	pg/mL	1	10-60	ng/L
Angiotensin-converting enzyme (ACE) ^{a,b}	Serum	8-52	U/L	0.017	0.14-0.88	µKat/L
Anion gap (Na^+)-($\text{Cl}^- + \text{HCO}_3^-$)	Serum, plasma	8-16	mEq/L	1	8-16	nmol/L
Antidiuretic hormone (ADH, vasopressin) (varies with osmolality: 285-290 mOsm/kg)	Plasma	1-5	pg/mL	0.926	0.9-4.6	pmol/L
α_2 -Antiplasmin	Plasma	80-130	%	0.01	0.8-1.3	Fraction of 1.0
Antithrombin III	Plasma	21-30	mg/dL	10	210-300	mg/L
Antithrombin III activity	Plasma	80-130	%	0.01	0.8-1.3	Fraction of 1.0
α_1 -Antitrypsin	Serum	80-200	mg/dL	0.01	0.8-2.0	g/L
Apolipoprotein A ^b						
Male	Serum	80-151	mg/dL	0.01	0.8-1.5	g/L
Female	Serum	80-170	mg/dL	0.01	0.8-1.7	g/L

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Apolipoprotein B ^b						
Male	Serum, plasma	50-123	mg/dL	0.01	0.5-1.2	g/L
Female	Serum, plasma	25-120	mg/dL	0.01	0.25-1.20	g/L
Arginine ^b	Plasma	0.37-2.40	mg/dL	57.4	21-138	μmol/L
Arsenic (As)	Whole blood	<23	μg/L	0.0133	<0.31	μmol/L
Arsenic (As), chronic poisoning	Whole blood	100-500	μg/L	0.0133	1.33-6.65	μmol/L
Arsenic (As), acute poisoning	Whole blood	600-9300	μg/L	0.0133	7.9-123.7	μmol/L
Ascorbate, ascorbic acid (see vitamin C)						
Asparagine ^b	Plasma	0.40-0.91	mg/dL	75.7	30-69	μmol/L
Aspartate aminotransferase (AST, SGOT) ^{a,b}	Serum	20-48	U/L	0.017	0.34-0.82	μKat/L
Aspartic acid ^b	Plasma	<0.3	mg/dL	75.1	<25	μmol/L
Atrial natriuretic hormone	Plasma	20-77	pg/mL	1	20-77	ng/L
Barbiturates (see individual drugs; pentobarbital, phenobarbital, thiopental)						

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Basophils (see complete blood count, white blood cell count)						
Benzodiazepines (see individual drugs; alprazolam, chlordiazepoxide, diazepam, lorazepam)						
Beryllium, toxic	Urine	>20	µg/L	0.111	>2.22	µmol/L
Bicarbonate	Plasma	21-28	mEq/L	1	21-28	mmol/L
Bile acids (total)	Serum	0.3-2.3	µg/mL	2.448	0.73-5.63	µmol/L
Bilirubin						
Total ^b	Serum	0.3-1.2	mg/dL	17.1	2-18	µmol/L
Direct (conjugated)	Serum	<0.2	mg/dL	17.1	<3.4	µmol/L
Biotin	Whole blood, serum	200-500	pg/mL	0.0041	0.82-2.05	nmol/L
Bismuth	Whole blood	1-12	µg/L	4.785	4.8-57.4	nmol/L
Blood gases						
PCO ₂	Arterial blood	35-45	mm Hg	1	35-45	mm Hg
pH	Arterial blood	7.35-7.45	—	1	7.35-7.45	—
PO ₂	Arterial blood	80-100	mm Hg	1	80-100	mm Hg
Blood urea nitrogen (BUN, see urea nitrogen)						

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BNP	Plasma	<100	pg/mL	1	<100	pg/mL
Bupropion (Wellbutrin, Zyban)	Serum, plasma	25-100	ng/mL	3.62	91-362	nmol/L
C1 esterase inhibitor	Serum	12-30	mg/dL	0.01	0.12-0.30	g/L
C3 complement ^b	Serum	1200-1500	µg/mL	0.001	1.2-1.5	g/L
C4 complement ^b	Serum	350-600	µg/mL	0.001	0.35-0.60	g/L
CA125	Serum	<35	U/mL	1.0	<35	kU/L
CA19-9	Serum	<37	U/mL	1.0	<37	kU/L
CA15-3	Serum	<30	U/mL	1.0	<30	kU/L
CA27.29	Serum	<37.7	U/mL	1.0	<37.7	kU/L
Cadmium (nonsmoker)	Whole blood	0.3-1.2	µg/L	8.897	2.7-10.7	nmol/L
Caffeine (therapeutic, infants)	Serum, plasma	8-20	µg/mL	5.15	41-103	µmol/L
Calciferol (see vitamin D)						
Calcitonin	Serum, plasma	<19	pg/mL	1	<19	ng/L
Calcium, ionized	Serum	4.60-5.08	mg/dL	0.25	1.15-1.27	mmol/L
Calcium, total	Serum	8.2-10.2	mg/dL	0.25	2.05-2.55	mmol/L
Calcium, normal diet	Urine	<250	mg/24 h	0.025	<6.2	mmol/day

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Carbamazepine (therapeutic)	Serum, plasma	8-12	µg/mL	4.23	34-51	µmol/L
Carbon dioxide	Serum, plasma, venous blood	22-28	mEq/L	1	22-28	mmol/L
Carboxyhemoglobin (carbon monoxide), as fraction of hemoglobin saturation						
Nonsmoker	Whole blood	<2.0	%	0.01	<0.02	Fraction of 1.0
Toxic	Whole blood	>20	%	0.01	>0.2	Fraction of 1.0
β-Carotene	Serum	10-85	µg/dL	0.0186	0.2-1.6	µmol/L
Catecholamines, total (see norepinephrine)						
CEA, nonsmoker	Serum	<3	ng/mL	1.0	<3	µg/L
CEA, smoker	Serum	<5	ng/mL	1.0	<5	µg/L
Ceruloplasmin ^b	Serum	20-40	mg/dL	10	200-400	mg/L
Chloramphenicol (therapeutic)	Serum	10-25	µg/mL	3.1	31-77	µmol/L
Chlordiazepoxide (therapeutic)	Serum, plasma	0.7-1.0	µg/mL	3.34	2.3-3.3	µmol/L
Chloride	Serum, plasma	96-106	mEq/L	1	96-106	mmol/L

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Chloride	CSF	118-132	mEq/L	1	118-132	mmol/L
Chlorpromazine (therapeutic, adult)	Plasma	50-300	ng/mL	3.14	157-942	nmol/L
Chlorpromazine (therapeutic, child)	Plasma	40-80	ng/mL	3.14	126-251	nmol/L
Chlorpropamide (therapeutic)	Plasma	75-250	mg/L	3.61	270-900	μmol/L
Cholesterol, high-density lipoproteins (HDL)	Plasma	40-60	mg/dL	0.02586	1.03-1.55	mmol/L
Cholesterol, low-density lipoproteins (LDL) ^b						
Optimal	Plasma	<100	mg/dL	0.02586	<2.59	mmol/L
Near optimal	Plasma	100-129	mg/dL	0.02586	2.59-3.34	mmol/L
Borderline high	Plasma	130-159	mg/dL	0.02586	3.37-4.12	mmol/L
High	Plasma	160-189	mg/dL	0.02586	4.15-4.90	mmol/L
Very high	Plasma	>190	mg/dL	0.02586	>4.90	mmol/L
Cholesterol (total), adult						
Desirable	Serum	<200	mg/dL	0.02586	<5.17	mmol/L
Borderline high	Serum	200-239	mg/dL	0.02586	5.17-6.18	mmol/L
High	Serum	>240	mg/dL	0.02586	>6.21	mmol/L

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Cholesterol (total), children						
Desirable	Serum	<170	mg/dL	0.02586	4.40	mmol/L
Borderline high	Serum	170-199	mg/dL	0.02586	4.40-5.15	mmol/L
High	Serum	>200	mg/dL	0.02586	>5.18	mmol/L
Chromium	Whole blood	0.7-28.0	µg/L	19.2	13.4-538.6	nmol/L
Citrate	Serum	1.2-3.0	mg/dL	52.05	60-160	µmol/L
Citrulline ^b	Plasma	0.4-2.4	mg/dL	57.1	20-135	µmol/L
Clonazepam (therapeutic)	Serum	15-60	ng/mL	3.17	48-190	nmol/L
Coagulation factor I (fibrinogen)	Plasma	150-400	mg/dL	0.01	1.5-4.0	g/L
Coagulation factor II (prothrombin)	Plasma	60-140	%	0.01	0.60-1.40	Fraction of 1.0
Coagulation factor V	Plasma	60-140	%	0.01	0.60-1.40	Fraction of 1.0
Coagulation factor VII	Plasma	60-140	%	0.01	0.60-1.40	Fraction of 1.0
Coagulation factor VIII	Plasma	50-200	%	0.01	0.50-2.00	Fraction of 1.0

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Coagulation factor IX	Plasma	60-140	%	0.01	0.60-1.40	Fraction of 1.0
Coagulation factor X	Plasma	60-140	%	0.01	0.60-1.40	Fraction of 1.0
Coagulation factor XI	Plasma	60-140	%	0.01	0.60-1.40	Fraction of 1.0
Coagulation factor XII	Plasma	60-140	%	0.01	0.60-1.40	Fraction of 1.0
Cobalt	Serum	<1.0	µg/L	16.97	<17	nmol/L
Codeine (therapeutic)	Serum	10-100	ng/mL	3.34	33-334	nmol/L
Complete blood count (CBC)						
Hematocrit^b						
Male	Whole blood	41-50	%	0.01	0.41-0.50	Fraction of 1.0
Female	Whole blood	35-45	%	0.01	0.35-0.45	Fraction of 1.0
Hemoglobin (mass concentration) ^b						
Male	Whole blood	13.5-17.5	g/dL	10	135-175	g/L
Female	Whole blood	12.0-15.5	g/dL	10	120-155	g/L

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Hemoglobin (substance concentration, Hb [Fe])						
Male	Whole blood	13.6-17.2	g/dL	0.6206	8.44-10.65	mmol/L
Female	Whole blood	12.0-15.0	g/dL	0.6206	7.45-9.30	mmol/L
Mean corpuscular hemoglobin (MCH), mass concentration ^b	Whole blood	27-33	pg/cell	1	27-33	pg/cell
MCH, substance concentration, Hb [Fe]	Whole blood	27-33	pg/cell	0.06206	1.70-2.05	fmol
Mean corpuscular hemoglobin concentration (MCHC), mass concentration	Whole blood	33-37	g Hb/dL	10	330-370	g Hb/L
MCHC, substance concentration, Hb [Fe]	Whole blood	33-37	g Hb/dL	0.6206	20-23	mmol/L
Mean cell volume (MCV) ^b	Whole blood	80-100	μm ³	1	80-100	fL
Platelet count	Whole blood	150-450	10 ³ μL ⁻¹	1	150-450	10 ⁹ L ⁻¹
Red blood cell count						
Female	Whole blood	3.9-5.5	10 ⁶ μL ⁻¹	1	3.9-5.5	10 ¹² L ⁻¹

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Male	Whole blood	4.6-6.0	$10^6 \mu\text{L}^{-1}$	1	4.6-6.0	10^{12} L^{-1}
Reticulocyte count ^b	Whole blood	25-75	$10^3 \mu\text{L}^{-1}$	1	25-75	10^9 L^{-1}
Reticulocyte count ^b (fraction)	Whole blood	0.5-1.5	% of RBCs	0.01	0.005-0.015	Fraction of RBCs
White blood cell count ^b	Whole blood	4.5-11.0	$10^3 \mu\text{L}^{-1}$	1	4.5-11.0	10^9 L^{-1}
Differential count ^b (absolute)						
Neutrophils	Whole blood	1800-7800	μL^{-1}	1	1.8-7.8	10^9 L^{-1}
Bands	Whole blood	0-700	μL^{-1}	1	0.00-0.70	10^9 L^{-1}
Lymphocytes	Whole blood	1000-4800	μL^{-1}	1	1.0-4.8	10^9 L^{-1}
Monocytes	Whole blood	0-800	μL^{-1}	1	0.00-0.80	10^9 L^{-1}
Eosinophils	Whole blood	0-450	μL^{-1}	1	0.00-0.45	10^9 L^{-1}
Basophils	Whole blood	0-200	μL^{-1}	1	0.00-0.20	10^9 L^{-1}
Differential count ^b (number fraction)						

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Neutrophils	Whole blood	56	%	0.01	0.56	Fraction of 1.0
Bands	Whole blood	3	%	0.01	0.03	Fraction of 1.0
Lymphocytes	Whole blood	34	%	0.01	0.34	Fraction of 1.0
Monocytes	Whole blood	4	%	0.01	0.04	Fraction of 1.0
Eosinophils	Whole blood	2.7	%	0.01	0.027	Fraction of 1.0
Basophils	Whole blood	0.3	%	0.01	0.003	Fraction of 1.0
Copper ^b	Serum	70-140	µg/dL	0.1574	11.0-22.0	µmol/L
Coproporphyrin	Urine	<200	µg/24 h	1.527	<300	nmol/day
Corticotropin ^b (08:00)	Plasma	<120	pg/mL	0.22	<26	pmol/L
Cortisol, total ^b						
08:00	Plasma	5-25	µg/dL	27.6	138-690	nmol/L
16:00	Plasma	3-16	µg/dL	27.6	83-442	nmol/L
20:00	Plasma	<50% of 08:00	µg/dL	1	<50% of 08:00	nmol/L
Cortisol, free ^b	Urine	30-100	µg/24 h	2.76	80-280	nmol/day

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Cotinine (smoker)	Plasma	16-145	ng/mL	5.68	91-823	nmol/L
C-peptide	Serum	0.5-3.5	ng/mL	0.333	0.17-1.17	nmol/L
Creatine, male	Serum	0.2-0.7	mg/dL	76.3	15.3-53.3	μmol/L
Creatine, female	Serum	0.3-0.9	mg/dL	76.3	22.9-68.6	μmol/L
Creatine kinase (CK) ^a	Serum	50-200	U/L	0.017	0.85-3.40	μKat/L
CK-MB fraction	Serum	<6	%	0.01	<0.06	Fraction of 1.0
Creatinine ^b	Serum, plasma	0.6-1.2	mg/dL	88.4	53-106	μmol/L
Creatinine	Urine	1-2	g/24 h	8.84	8.8-17.7	mmol/day
Creatinine clearance, glomerular filtration rate	Serum, urine	75-125	mL/min/1.73 m ²	0.00963	0.72-1.2	mL/s/m ²
C-telopeptide						
Men	Serum, plasma	60-700	pg/mL	1	60-700	pg/mL
Premenopausal women	Serum, plasma	40-465	pg/mL	1	40-465	pg/mL
Cyanide (toxic)	Whole blood	>1.0	μg/mL	38.4	>38.4	μmol/L
Cyanocobalamin (see vitamin B ₁₂)						

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Cyclic adenosine monophosphate (cAMP)	Plasma	4.6-8.6	ng/mL	3.04	14-26	nmol/L
Cyclosporine (toxic)	Whole blood	>400	ng/mL	0.832	>333	nmol/L
Cystine ^b	Plasma	0.40-1.40	mg/dL	83.3	33-117	μmol/L
D-dimer	Plasma	Negative (<500)	ng/mL	1	Negative (<500)	ng/mL
Dehydroepiandrosterone (DHEA) (unconjugated, male) ^b	Plasma, serum	180-1250	ng/dL	0.0347	6.2-43.3	nmol/L
Dehydroepiandrosterone sulfate (DHEA-S) (male) ^b	Plasma, serum	10-619	μg/dL	0.027	0.3-16.7	μmol/L
Desipramine (therapeutic)	Plasma, serum	50-200	ng/mL	3.75	170-700	nmol/L
Diazepam (therapeutic)	Plasma, serum	100-1000	ng/mL	0.00351	0.35-3.51	μmol/L
Digoxin (therapeutic)	Plasma	0.5-2.0	ng/mL	1.281	0.6-2.6	nmol/L
Disopyramide (therapeutic)	Plasma, serum	2.8-7.0	mg/L	2.95	8-21	μmol/L
Doxepin (therapeutic)	Plasma, serum	150-250	ng/mL	3.58	540-890	nmol/L
Electrolytes						

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Chloride	Serum, plasma	96-106	mEq/L	1	96-106	mmol/L
Carbon dioxide (CO ₂)	Serum, plasma, venous blood	22-28	mEq/L	1	22-28	mmol/L
Potassium	Plasma	3.5-5.0	mEq/L	1	3.5-5.0	mmol/L
Sodium ^b	Plasma	136-142	mEq/L	1	136-142	mmol/L
Eosinophils (see complete blood count, white blood cell count)						
Epinephrine (supine)	Plasma	<50	pg/mL	5.46	<273	pmol/L
Epinephrine ^b	Urine	<20	µg/24 h	5.46	<109	nmol/day
Erythrocyte count (see complete blood count, red blood cell count)						
Erythrocyte sedimentation rate (ESR) ^b	Whole blood	0-20	mm/h	1	0-20	mm/h
Erythropoietin	Serum	5-36	mU/mL	1	5-36	IU/L
Estradiol (E2, unconjugated), ^b female						
Follicular phase	Serum	20-350	pg/mL	3.69	73-1285	pmol/L
Midcycle peak	Serum	150-750	pg/mL	3.69	551-2753	pmol/L
Luteal phase	Serum	30-450	pg/mL	3.69	110-1652	pmol/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Postmenopausal	Serum	<59	pg/mL	3.69	<218	pmol/L
Estradiol (unconjugated), ^b male	Serum	<20	pg/mL	3.67	<184	pmol/L
Estriol (E3, unconjugated), males and nonpregnant females, varies with length of gestation	Serum	<2	ng/mL	3.47	<6.9	nmol/L
Estrogens (total), ^b female						
Follicular phase	Serum	60-200	pg/mL	1	60-200	ng/L
Luteal phase	Serum	160-400	pg/mL	1	160-400	ng/L
Postmenopausal	Serum	<130	pg/mL	1	<130	ng/L
Estrogens (total), ^b male	Serum	20-80	pg/mL	1	20-80	ng/L
Estrone (E1), ^b female						
Follicular phase	Plasma, serum	100-250	pg/mL	3.69	370-925	pmol/L
Luteal phase	Plasma, serum	15-200	pg/mL	3.69	55-740	pmol/L
Postmenopausal	Plasma, serum	15-55	pg/mL	3.69	55-204	pmol/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Estrone (E1), ^b male	Plasma, serum	15-65	pg/mL	3.69	55-240	pmol/L
Ethanol (ethyl alcohol), toxic	Serum, whole blood	>100	mg/dL	0.2171	>21.7	mmol/L
Ethosuximide	Plasma, serum	40-100	µg/mL	7.08	283-708	µmol/L
Ethylene glycol (toxic)	Plasma, serum	>30	mg/dL	0.1611	>5	mmol/L
Everolimus	Whole blood	3-15	ng/mL	1.04	3-16	nmol/L
Fatty acids (nonesterified)	Plasma	8-25	mg/dL	0.0354	0.28-0.89	mmol/L
Fecal fat (as stearic acid)	Stool	2.0-6.0	g/day	1	2-6	g/day
Felbamate	Serum, plasma	30-60	µg/mL	4.20	126-252	µmol/L
Ferritin ^b	Plasma	15-200	ng/mL	1	15-200	µg/L
α-Fetoprotein ^b	Serum	<10	ng/mL	1	<10	µg/L
Fibrinogen	Plasma	150-400	mg/dL	0.01	1.5-4.0	g/L
Fibrin breakdown products (fibrin split products)	Serum	<10	µg/mL	1	<10	mg/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Folate (folic acid)	Red blood cells	166-640	ng/mL	2.266	376-1450	nmol/L
Folate (folic acid)	Serum	5-25	ng/mL	2.266	11-57	nmol/L
Follicle-stimulating hormone (FSH, follitropin), ^b female						
Follicular phase	Serum	1.37-9.9	mIU/mL	1	1.3-9.9	IU/L
Ovulatory phase	Serum	6.17-17.2	mIU/mL	1	6.1-17.2	IU/L
Luteal phase	Serum	1.09-9.2	mIU/mL	1	1.0-9.2	IU/L
Postmenopausal	Serum	19.3-100.6	mIU/mL	1	19.3-100.6	IU/L
FSH (follitropin), ^b male	Serum	1.42-15.4	mIU/mL	1	1.4-15.4	IU/L
FSH (follitropin), ^b female	Urine	2-15	IU/24 h	1	2-15	IU/day
FSH (follitropin), ^b male	Urine	3-12	IU/24 h	1	3-11	IU/day
Fructosamine ^b	Serum	1.5-2.7	mmol/L	1	1.5-2.7	mmol/L
Gabapentin	Serum, plasma	2-20	µg/mL	5.84	12-117	µmol/L
Gastrin (fasting)	Serum	<100	pg/mL	1	<100	ng/L
Gentamicin (therapeutic, peak)	Serum	6-10	µg/mL	2.1	12-21	µmol/L
Glucagon ^b	Plasma	20-100	pg/mL	1	20-100	ng/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Glucose ^b	Serum, plasma	70-110	mg/dL	0.05551	3.9-6.1	mmol/L
Glucose	CSF	50-80	mg/dL	0.05551	2.8-4.4	mmol/L
Glucose-6-phosphate dehydrogenase	Red blood cells	10-14	U/g of Hb	0.0645	0.65-0.90	U/mol of Hb
Glutamic acid ^b	Plasma	0.2-2.8	mg/dL	67.97	15-190	μmol/L
Glutamine	Plasma	6.1-10.2	mg/dL	68.42	420-700	μmol/L
γ-Glutamyltransferase (GGT; γ-glutamyl transpeptidase)^b						
Female	Serum	<30	U/L	0.017	0.51	μKat/L
Male	Serum	<50	U/L	0.017	<0.85	μKat/L
Glycerol (free) ^b	Serum	<1.5	mg/dL	0.1086	<0.16	mmol/L
Glycine ^b	Plasma	0.9-4.2	mg/dL	133.3	120-560	μmol/L
Glycated hemoglobin (hemoglobin A1, A1c)						
Whole blood	Whole blood	4-5.6	% of total Hb	1	4-5.6	Fraction of total Hb
Diagnosis	Whole blood	>6.5	% of total Hb	1	>6.5	Fraction of total Hb
Gold (therapeutic)	Serum	100-200	μg/dL	0.05077	5.1-10.2	μmol/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Growth hormone, adult (GH, somatotropin) ^b	Plasma, serum	<10	ng/mL	1	<10	µg/L
Haloperidol (therapeutic)	Serum, plasma	5-20	ng/mL	2.6	13-52	nmol/L
Haptoglobin ^b	Serum	40-180	mg/dL	0.01	0.4-1.8	g/L
Hematocrit (see complete blood count)						
Hemoglobin (see complete blood count)						
Hemoglobin A1c (see glycated hemoglobin)						
Hemoglobin A2 ^b	Whole blood	2.0-3.5	% total Hb		2.0-3.5	Fraction of 1.0
Hemoglobin F ^b (fetal hemoglobin in adult)	Whole blood	<2	%	0.01	<2	Fraction of 1.0
Histidine ^b	Plasma	0.5-1.7	mg/dL	64.5	32-110	µmol/L
Homocysteine (total)	Plasma, serum	4-12	µmol/L	1	4-12	µmol/L
Homovanillic acid ^b	Urine	<8	mg/24 h	5.489	<45	µmol/day
Human chorionic gonadotropin (hCG) (nonpregnant adult female)	Serum	<3	mIU/mL	1	<3	IU/L
β-Hydroxybutyric acid	Serum	0.21-2.81	mg/dL	96.05	20-270	µmol/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
5-Hydroxyindoleacetic acid (5-HIAA)	Urine	<25	mg/24 h	5.23	<131	µmol/day
17α-Hydroxyprogesterone, ^b female						
Follicular phase	Serum	15-70	ng/dL	0.03	0.4-2.1	nmol/L
Luteal phase	Serum	35-290	ng/dL	0.03	1.0-8.7	nmol/L
Postmenopausal	Serum	<70	ng/dL	0.03	<2.1	nmol/L
17α-Hydroxyprogesterone, ^b male	Serum	27-199	ng/dL	0.03	0.8-6.0	nmol/L
Hydroxyproline	Plasma	<0.55	mg/dL	76.3	<42	µmol/L
5-Hydroxytryptamine (see serotonin)						
Ibuprofen (therapeutic)	Serum, plasma	10-50	µg/mL	4.85	49-243	µmol/L
Imipramine (therapeutic)	Serum, plasma	150-250	ng/mL	3.57	536-893	nmol/L
Immunoglobulin A (IgA) ^b	Serum	50-350	mg/dL	0.01	0.5-3.5	g/L
Immunoglobulin D (IgD)	Serum	0.5-3.0	mg/dL	10	5-30	mg/L
Immunoglobulin E (IgE)	Serum	10-179	IU/mL	2.4	24-430	µg/L
Immunoglobulin G (IgG) ^b	Serum	600-1560	mg/dL	0.01	6.0-15.6	g/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Immunoglobulin M (IgM) ^b	Serum	54-222	mg/dL	0.01	0.5-2.2	g/L
Insulin	Plasma	5-20	μU/mL	6.945	34.7-138.9	pmol/L
Inhibin A						
Males	Serum	1.0-3.6	pg/mL	1	1.0-3.6	ng/L
Female, early follicular	Serum	5.5-28.2	pg/mL	1	5.5-28.2	ng/L
Female, late follicular	Serum	19.5-102.3	pg/mL	1	19.5-102.3	ng/L
Female, midcycle	Serum	49.9-155.5	pg/mL	1	49.9-155.5	ng/L
Female, midluteal	Serum	13.2-159.6	pg/mL	1	13.2-159.6	ng/L
Female, postmenopausal	Serum	1.0-3.9	pg/mL	1	1.0-3.9	ng/L
Insulin C-peptide (see C-peptide)						
Insulin-like growth factor ^b	Serum	130-450	ng/mL	1	130-450	μg/L
Ionized calcium (see calcium)						
Iron (total) ^b	Serum	60-150	μg/dL	0.179	10.7-26.9	μmol/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Iron-binding capacity	Serum	250-400	µg/dL	0.179	44.8-71.6	µmol/L
Isoleucine ^b	Plasma	0.5-1.3	mg/dL	76.24	40-100	µmol/L
Isoniazid (therapeutic)	Plasma or serum	1-7	µg/mL	7.29	7-51	µmol/L
Isopropanol (toxic)	Plasma, serum	>400	mg/L	0.0166	>6.64	mmol/L
Lactate (lactic acid)	Arterial blood	3-11.3	mg/dL	0.111	0.3-1.3	mmol/L
Lactate (lactic acid)	Venous blood	4.5-19.8	mg/dL	0.111	0.5-2.2	mmol/L
Lactate dehydrogenase (LDH)	Serum	50-200	U/L	1	50-200	U/L
Lamotrigine	Serum, plasma	2.5-15	µg/dL	3.91	10-59	µmol/L
Lead	Whole blood	<25	µg/dL	0.0483	<1.21	µmol/L
Leucine ^b	Plasma	1.0-2.3	mg/dL	76.3	75-175	µmol/L
Leukocyte count (see complete blood count, white blood cell count)						
Levetiracetam	Serum, plasma	12-46	µg/mL	5.88	71-270	µmol/L
Lidocaine (therapeutic)	Serum, plasma	1.5-6.0	µmL g/mL	4.27	6.4-25.6	µmol/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Lipase ^a	Serum	0-160	U/L	0.017	0-2.72	µKat/L
Lipoprotein(a) (Lp(a))	Serum, plasma	10-30	mg/dL	0.01	0.1-0.3	g/L
Lithium (therapeutic)	Serum, plasma	0.6-1.2	mEq/L	1	0.6-1.2	mmol/L
Lorazepam (therapeutic)	Serum, plasma	50-240	ng/mL	3.11	156-746	nmol/L
LDL cholesterol ^b	Serum, plasma	60-130	mg/dL	0.02586	1.55-3.37	mmol/L
Luteinizing hormone (LH), ^b female						
Follicular phase	Serum	2.0-15.0	mIU/L	1	2.0-15.0	IU/L
Ovulatory peak	Serum	22.0-105.0	mIU/L	1	22.0-105.0	IU/L
Luteal phase	Serum	0.6-19.0	mIU/L	1	0.6-19.0	IU/L
Postmenopausal	Serum	16.0-64.0	mIU/L	1	16.0-64.0	IU/L
LH, ^b male	Serum	2.0-12.0	mIU/L	1	2.0-12.0	IU/L
Lymphocytes (see complete blood count, white blood cell count)						
Lysine ^b	Plasma	1.2-3.5	mg/dL	68.5	80-240	µmol/L
Lysozyme (muramidase)	Serum	4-13	mg/L	1	4-13	mg/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Magnesium ^b	Serum	1.5-2.5	mg/dL	0.4114	0.62-1.03	mmol/L
Magnesium ^b	Serum	1.3-2.1	mEq/L	0.5	0.65-1.05	mmol/L
Manganese	Whole blood	10-12	µg/L	18.2	182-218	nmol/L
Maprotiline (therapeutic)	Plasma, serum	200-600	ng/mL	1	200-600	µg/L
MCH (see complete blood count)						
MCHC (see complete blood count)						
Meperidine (therapeutic)	Serum, plasma	0.4-0.7	µg/mL	4.04	1.6-2.8	µmol/L
Mercury	Whole blood	0.6-59.0	µg/L	4.99	3.0-294.4	nmol/L
Metanephhrines (total) ^b	Urine	<1.0	mg/24 h	5.07	<5	µmol/day
Methadone (therapeutic)	Serum, plasma	100-400	ng/mL	0.00323	0.32-1.29	µmol/L
Methanol	Whole blood, serum	<1.5	mg/L	0.0312	<0.05	mmol/L
Methemoglobin	Whole blood	<0.24	g/dL	155	<37.2	µmol/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Methemoglobin	Whole blood	<1.0	% of total Hb	0.01	<0.01	Fraction of total Hb
Methionine ^b	Plasma	0.1-0.6	mg/dL	67.1	6-40	μmol/L
Methsuximide (therapeutic)	Serum, plasma	10-40	μg/mL	5.29	53-212	μmol/L
Methyldopa (therapeutic)	Serum, plasma	1-5	μg/mL	4.73	5-24	μmol/L
Metoprolol (therapeutic)	Serum, plasma	75-200	ng/mL	3.74	281-748	nmol/L
Methotrexate						
Toxic 24 h after dose	Serum, plasma	≥10	μmol/L	1	≥10	μmol/L
Toxic 48 h after dose	Serum, plasma	≥1	μmol/L	1	≥1	μmol/L
Toxic 72 h after dose	Serum, plasma	≥0.1	μmol/L	1	≥0.1	μmol/L
β ₂ -Microglobulin	Serum	<2	μg/mL	85	<170	nmol/L
Monocytes (see complete blood count, white blood cell count)						
Morphine (therapeutic)	Serum, plasma	10-80	ng/mL	3.5	35-280	nmol/L
Muramidase (see lysozyme)						

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Mycophenolic acid	Serum, plasma	1.3-3.5	µg/mL	3.12	4-11	µmol/L
Naproxen (therapeutic trough)	Plasma, serum	>50	µg/mL	4.34	>217	µmol/L
Neutrophils (see complete blood count, white blood cell count)						
Niacin (nicotinic acid)	Urine	2.4-6.4	mg/24 h	7.3	17.5-46.7	µmol/day
Nickel	Whole blood	1.0-28.0	µg/L	17	17-476	nmol/L
Nicotine (smoker)	Plasma	0.01-0.05	mg/L	6.16	0.062-0.308	µmol/L
Norepinephrine ^b	Plasma	110-410	pg/mL	5.91	650-2423	nmol/L
Norepinephrine ^b	Urine	15-80	µg/24 h	5.91	89-473	nmol/day
Nortriptyline (therapeutic)	Serum, plasma	50-150	ng/mL	3.8	190-570	nmol/L
N-telopeptide (BCE, bone collagen equivalents)						
Men	Serum	5.4-24.2	nmol BCE/L	1	5.4-24.2	nmol BCE/L
Premenopausal women	Serum	6.2-19.0	nmol BCE/L	1	6.2-19.0	nmol BCE/L
Ornithine ^b	Plasma	0.4-1.4	mg/dL	75.8	30-106	µmol/L
Osmolality ^b	Serum	275-295	mOsm/kg H ₂ O	1	275-295	mmol/kg H ₂ O

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Osmolality	Urine	250-900	mOsm/kg H ₂ O	1	250-900	mmol/kg H ₂ O
Osteocalcin ^b	Serum	3.0-13.0	ng/mL	1	3.0-13.0	µg/L
Oxalate	Serum	1.0-2.4	mg/L	11.4	11-27	µmol/L
Oxazepam (therapeutic)	Serum, plasma	0.2-1.4	µg/mL	3.49	0.7-54.9	µmol/L
Oxycodone (therapeutic)	Plasma, serum	10-100	ng/mL	3.17	32-317	nmol/L
Oxygen, partial pressure (Po ₂)	Arterial blood	80-100	mm Hg	1	80-100	mm Hg
Pantothenic acid (see vitamin B ₅)						
Parathyroid hormone						
Intact ^b	Serum	10-50	pg/mL	1	10-50	ng/L
N-terminal specific ^b	Serum	8-24	pg/mL	1	8-24	ng/L
C-terminal (mid-molecule)	Serum	0-340	pg/mL	1	0-340	ng/L
Pentobarbital (therapeutic)	Serum, plasma	1-5	µg/mL	4.42	4.0-22	µmol/L
Pepsinogen I ^b	Serum	28-100	ng/mL	1	28-100	µg/L
pH (see blood gases)						

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Phenobarbital (therapeutic)	Serum, plasma	15-40	µg/mL	4.31	65-172	µmol/L
Phenylalanine ^b	Plasma	0.6-1.5	mg/dL	60.5	35-90	µmol/L
Phenytoin (therapeutic)	Serum, plasma	10-20	µg/mL	3.96	40-79	µmol/L
Phosphatase, tartrate-resistant acid	Serum	1.5-4.5	U/L	0.017	0.03-0.08	µKat/L
Phosphorus (inorganic) ^b	Serum	2.3-4.7	mg/dL	0.3229	0.74-1.52	mmol/L
Phosphorus (inorganic) ^b	Urine	0.4-1.3	g/24 h	32.29	12.9-42.0	mmol/day
Plasminogen	Plasma	8.4-14.0	mg/dL	10	84-140	mg/L
Plasminogen	Plasma	80-120	%	0.01	0.80-1.20	Fraction of 1.0
Plasminogen activator inhibitor	Plasma	<15	IU/mL	1	<15	kIU/L
Platelet count (see complete blood count, platelet count)						
Porphobilinogen deaminase	Red blood cells	>7.0	nmol/s/L	1	>7.0	nmol/(s L)
Potassium	Plasma	3.5-5.0	mEq/L	1	3.5-5.0	mmol/L
Prealbumin—transthyretin	Serum, plasma	18-45	mg/dL	0.01	0.18-0.45	g/L
Pregnandiol, ^b female						

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Follicular phase	Urine	<2.6	mg/24 h	3.12	<8	μmol/day
Luteal phase	Urine	2.3-10.6	mg/24 h	3.12	8-33	μmol/day
Pregnane diol, ^b male	Urine	0-1.9	mg/24 h	3.12	0-5.9	μmol/day
Pregnane triol ^b	Urine	<2.5	mg/24 h	2.97	<7.5	μmol/day
Primidone (therapeutic)	Serum, plasma	5-12	μg/mL	4.58	23-55	μmol/L
Procainamide (therapeutic)	Serum, plasma	4-10	μg/mL	4.23	17-42	μmol/L
Progesterone, ^b female						
Follicular phase	Serum	0.1-0.7	ng/mL	3.18	0.5-2.2	nmol/L
Luteal phase	Serum	2.0-25.0	ng/mL	3.18	6.4-79.5	nmol/L
Progesterone, ^b male	Serum	0.13-0.97	ng/mL	3.18	0.4-3.1	nmol/L
Prolactin (nonlactating subject)	Serum	1-25	ng/mL	1	1-25	μg/L
Proline ^b	Plasma	1.2-3.9	mg/dL	86.9	104-340	μmol/L
Propoxyphene (therapeutic)	Serum	0.1-0.4	μg/mL	2.946	0.3-1.2	μmol/L
Propanolol (therapeutic)	Serum, plasma	50-100	ng/mL	3.86	190-386	nmol/L
Protein (total) ^b	Serum	6.0-8.0	g/dL	10	60-80	g/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Protein C	Plasma	70-140	%	0.01	0.70-1.40	Fraction of 1.0
Protein electrophoresis (serum protein electrophoresis [SPEP]), fraction of total protein						
Albumin	Serum	52-65	%	0.01	0.52-0.65	Fraction of 1.0
α ₁ -Globulin	Serum	2.5-5.0	%	0.01	0.025-0.05	Fraction of 1.0
α ₂ -Globulin	Serum	7.0-13.0	%	0.01	0.07-0.13	Fraction of 1.0
β-Globulin	Serum	8.0-14.0	%	0.01	0.08-0.14	Fraction of 1.0
γ-Globulin	Serum	12.0-22.0	%	0.01	0.12-0.22	Fraction of 1.0
Protein electrophoresis (SPEP), concentration						
Albumin	Serum	3.2-5.6	g/dL	10	32-56	g/L
α ₁ -Globulin	Serum	0.1-0.4	g/dL	10	1-10	g/L
α ₂ -Globulin	Serum	0.4-1.2	g/dL	10	4-12	g/L
β-Globulin	Serum	0.5-1.1	g/dL	10	5-11	g/L
γ-Globulin	Serum	0.5-1.6	g/dL	10	5-16	g/L
Protein S (activity)	Plasma	70-140	%	0.01	0.70-1.40	Fraction of 1.0

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Prothrombin time (PT)	Plasma	10-13	s	1	10-13	s
Protoporphyrin	Red blood cells	15-50	µg/dL	0.0177	0.27-0.89	µmol/L
PSA	Serum	0-4.0	ng/mL	1	0-4.0	µg/L
Pyridinium cross-links (deoxypyridinoline)						
Male	Urine	10.3-20	nmol/mmol creatinine	1	10.3-20	nmol/mmol creatinine
Premenopausal female	Urine	15.3-33.6	nmol/mmol creatinine	1	15.3-33.6	nmol/mmol creatinine
Pyridoxine (see vitamin B ₆)						
Pyruvate (as pyruvic acid)	Whole blood	0.3-0.9	mg/dL	113.6	34-102	µmol/L
Quinidine (therapeutic)	Serum, plasma	2.0-5.0	µg/mL	3.08	6.2-15.4	µmol/L
Red blood cell count (see complete blood count)						
Red cell folate (see folate)						
Renin (normal-sodium diet) ^b	Plasma	1.1-4.1	ng/mL/h	1	1.1-4.1	ng/(mL h)
Reticulocyte count ^b	Whole blood	25-75	10 ³ µL ⁻¹	1	25-75	10 ⁹ L ⁻¹

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Reticulocyte count ^b (fraction)	Whole blood	0.5-1.5	% of RBCs	0.01	0.005-0.015	Fraction of RBCs
Retinol (see vitamin A)						
Rheumatoid factor	Serum	<30	IU/mL	1	<30	kIU/L
Riboflavin (see vitamin B ₂)						
Salicylates (therapeutic)	Serum, plasma	15-30	mg/dL	0.0724	1.08-2.17	mmol/L
Sedimentation rate (see erythrocyte sedimentation rate)						
Selenium	Whole blood	58-234	µg/L	0.0127	0.74-2.97	µmol/L
Serine ^b	Plasma	0.7-2.0	mg/dL	95.2	65-193	µmol/L
Serotonin (5-hydroxytryptamine)	Whole blood	50-200	ng/mL	0.00568	0.28-1.14	µmol/L
Sertraline (Zoloft)	Serum or plasma	10-50	ng/mL	3.27	33-164	nmol/L
SPEP (see protein electrophoresis)						
Sex hormone-binding globulin ^b	Serum	0.5-1.5	µg/dL	34.7	17.4-52.1	nmol/L
Sirolimus	Whole blood	4-20	ng/mL	1.1	4-22	nmol/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Sodium ^b	Plasma	136-142	mEq/L	1	136-142	mmol/L
Somatostatin	Plasma	<25	pg/mL	1	<25	ng/L
Somatomedin C (see insulin-like growth factor)						
Strychnine (toxic)	Whole blood	>0.5	mg/L	2.99	>1.5	μmol/L
Substance P	Plasma	<240	pg/mL	1	<240	ng/L
Sulfhemoglobin	Whole blood	<1.0	% of total Hb	0.01	<0.010	Fraction of total Hb
Tacrolimus	Whole blood	3-20	ng/mL	1.24	4-25	nmol/L
Taurine ^b	Plasma	0.3-2.1	mg/dL	80	24-168	μmol/L
Testosterone, ^b male	Plasma, serum	300-1200	ng/dL	0.0347	10.4-41.6	nmol/L
Testosterone, ^b female	Plasma, serum	<85	ng/dL	0.0347	2.95	nmol/L
Theophylline (therapeutic)	Plasma, serum	10-20	μg/mL	5.55	56-111	μmol/L
Thiamine (see vitamin B ₁)						
Thiocyanate (nonsmoker)	Plasma, serum	1-4	mg/L	17.2	17-69	μmol/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Thiopental (therapeutic)	Plasma, serum	1-5	µg/mL	4.13	4-21	µmol/L
Thioridazine (therapeutic)	Plasma, serum	1.0-1.5	µg/mL	2.7	2.7-4.1	µmol/L
Thrombin time	Plasma	16-24	s	1.0	16-24	s
Threonine ^b	Plasma	0.9-2.5	mg/dL	84	75-210	µmol/L
Thyroglobulin ^b	Serum	3-42	ng/mL	1	3-42	µg/L
Thyrotropin (thyroid-stimulating hormone, TSH) ^b	Serum	0.5-5.0	µIU/mL	1	0.5-5.0	mU/L
Thyroxine, free (FT ₄) ^b	Serum	0.9-2.3	ng/dL	12.87	12-30	pmol/L
Thyroxine, total (T ₄) ^b	Serum	5.5-12.5	µg/dL	12.87	71-160	nmol/L
Thyroxine-binding globulin (TBG), ^b as T ₄ binding capacity	Serum	10-26	µg/dL	12.9	129-335	nmol/L
Tissue plasminogen activator	Plasma	<0.04	IU/mL	1000	<40	IU/L
Tobramycin (therapeutic, peak)	Plasma, serum	5-10	µg/mL	2.14	10-21	µmol/L
Tocainide (therapeutic)	Plasma, serum	4-10	µg/mL	5.2	21-52	µmol/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
α-Tocopherol (see vitamin E)						
Topiramate	Serum, plasma	5-20	µg/mL	2.95	15-59	µmol/L
Transferrin (siderophilin) ^b	Serum	200-380	mg/dL	0.01	2.0-3.8	g/L
Triglycerides ^b	Plasma, serum	10-190	mg/dL	0.01129	0.11-2.15	mmol/L
Triiodothyronine, free (FT ₃) ^b	Serum	260-480	pg/dL	0.0154	4.0-7.4	pmol/L
Triiodothyronine, resin uptake ^b	Serum	25-35	%	0.01	0.25-0.35	Fraction of 1.0
Triiodothyronine, total (T ₃) ^b	Serum	70-200	ng/dL	0.0154	1.08-3.14	nmol/L
Troponin I (cardiac)	Serum	0-0.4	ng/mL	1	0-0.4	µg/L
Troponin T (cardiac)	Serum	0-0.1	ng/mL	1	0-0.1	µg/L
Tryptophan ^b	Plasma	0.5-1.5	mg/dL	48.97	25-73	µmol/L
Tyrosine ^b	Plasma	0.4-1.6	mg/dL	55.19	20-90	µmol/L
Urea nitrogen (BUN) ^b	Serum	8-23	mg/dL	0.0357	2.9-8.2	mmol/L
Uric acid ^b	Serum	4.0-8.5	mg/dL	0.0595	0.24-0.51	mmol/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Urobilinogen ^b	Urine	0.05-2.5	mg/24 h	1.693	0.1-4.2	μmol/day
Valine ^b	Plasma	1.7-3.7	mg/dL	85.5	145-315	μmol/L
Valproic acid (therapeutic)	Plasma, serum	50-150	μg/mL	6.93	346-1040	μmol/L
Vancomycin (therapeutic, peak)	Plasma, serum	10-20	μg/mL	0.69	6.9-13.8	μmol/L
Vanillylmandelic acid (VMA) ^b	Urine	2.1-7.6	mg/24 h	5.046	11-38	μmol/day
Vasoactive intestinal polypeptide	Plasma	<50	pg/mL	1	<50	ng/L
Verapamil (therapeutic)	Plasma, serum	100-500	ng/mL	2.2	220-1100	nmol/L
Vitamin A (retinol) ^b	Serum	30-80	μg/dL	0.0349	1.05-2.80	μmol/L
Vitamin B ₁ (thiamine)	Whole blood	2.5-7.5	μg/dL	29.6	74-222	nmol/L
Vitamin B ₂ (riboflavin)	Plasma, serum	4-24	μg/dL	26.6	106-638	nmol/L
Vitamin B ₅ (pantothenic acid)	Whole blood	0.2-1.8	μg/mL	4.56	0.9-8.2	μmol/L
Vitamin B ₆ (pyridoxine)	Plasma	5-30	ng/mL	4.046	20-121	nmol/L
Vitamin B ₁₂ (cyanocobalamin) ^b	Serum	160-950	pg/mL	0.7378	118-701	pmol/L

	Specimen	Traditional Reference Interval	Traditional Units	Conversion Factor, Multiply →, ← Divide	SI Reference Interval	SI Units
Vitamin C (ascorbic acid)	Plasma, serum	0.4-1.5	mg/dL	56.78	23-85	μmol/L
Vitamin D, 1,25-dihydroxyvitamin D	Plasma, serum	16-65	pg/mL	2.6	42-169	pmol/L
Vitamin D, 25-hydroxyvitamin D	Plasma, serum	14-60	ng/mL	2.496	35-150	nmol/L
Vitamin E (α -tocopherol) ^b	Plasma, serum	0.5-1.8	mg/dL	23.22	12-42	μmol/L
Vitamin K	Plasma, serum	0.13-1.19	ng/mL	2.22	0.29-2.64	nmol/L
von Willebrand factor (ranges vary according to blood type)	Plasma	70-140	%	0.01	0.70-1.40	Fraction of 1.0
Warfarin (therapeutic)	Plasma, serum	1.0-10	μg/mL	3.24	3.2-32.4	μmol/L
White blood cell count ^b	Whole blood	4.5-11.0	$10^3 \mu\text{L}^{-1}$	1	4.5-11.0	10^9 L^{-1}
White blood cell, differential count (see complete blood count)						
Xylose absorption test (25-g dose) ^b	Whole blood	>25 mg/dL	mg/dL	0.06661	>1.7	mmol/L
Zidovudine (therapeutic)	Plasma, serum	0.15-0.27	μg/mL	3.74	0.56-1.01	μmol/L
Zinc	Serum	50-150	μg/dL	0.153	7.7-23.0	μmol/L

The sample type listed under Specimen in this table shows the reference interval for that specimen type. Thus, if the specimen for a test is listed as serum, the reference interval shown is for serum specimens. For many tests listed with serum as the specimen type, plasma is also acceptable, often with a similar reference interval.

The normal ranges listed here are included as a helpful guide and are by no means comprehensive. The listed reference, unless noted, pertains to adults. Laboratory results are method dependent and can have intralaboratory variation. Conversion factors are not affected by age-related differences. This table is compiled from data in the following sources: 1) Tietz NW, ed. *Clinical Guide to Laboratory Tests*. 3rd ed. Philadelphia: WB Saunders Co; 1995; 2) Laposata M. *SI Unit Conversion Guide*. Boston: NEJM Books; 1992; 3) *American Medical Association Manual of Style: A Guide for Authors and Editors*. 9th ed. Chicago: AMA; 1998:486–503. Copyright 1998, American Medical Association; 4) Jacobs DS, DeMott WR, Oxley DK, eds. *Jacobs & DeMott Laboratory Test Handbook With Key Word Index*. 5th ed. Hudson, OH: Lexi-Comp Inc; 2001; 5) Henry JB, ed. *Clinical Diagnosis and Management by Laboratory Methods*. 20th ed. Philadelphia: WB Saunders Co; 2001; 6) Kratz A, et al. Laboratory reference values. *N Engl J Med*. 2006;351:1548–1563; 7) Burtis CA, ed. *Tietz Textbook of Clinical Chemistry and Molecular Diagnostics*. 5th ed. St. Louis: Elsevier; 2012. This version of the table of reference ranges was reviewed and updated by Jessica Franco-Colon, PhD, and Kay Brooks.

^aThe SI unit katal is the amount of enzyme generating 1 mol of product per second. Although provisionally recommended as the SI unit for enzymatic activity, it has not been universally accepted. It is suitable to maintain use of U/L in these circumstances (conversion factor 1.0).

^bFor this analyte, there is age dependence for the reference range. There may be several different normal ranges for different pediatric age ranges. Consult your clinical laboratory for the local institution age-specific reference range. Pediatric reference values may also be found in Soldin SJ, Brugnara C, Wong EC, eds; Hicks JM, editor emeritus. *Pediatric References Intervals*. 5th ed. (formerly *Pediatric Reference Ranges*). Washington, DC: AACC Press; 2005.

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