

TABLE 27.1: REFERENCE VALUES

TABLE 27.1

REFERENCE VALUES

	Conventional Units	SI Units
ALANINE AMINOTRANSFERASE (ALT) ^{1,2*}		
(Major sources: Liver, skeletal muscle, and myocardium)		
Infant aged <12 mo	13–45 U/L	13–45 U/L
1–3 yr	5–45 U/L	5–45 U/L
4–6 yr	10–25 U/L	10–25 U/L
7–9 yr	10–35 U/L	10–35 U/L
10–11 yr		
Female	10–30 U/L	10–30 U/L
Male	10–35 U/L	10–35 U/L
12–13 yr		
Female	10–30 U/L	10–30 U/L
Male	10–55 U/L	10–55 U/L
14–15 yr		
Female	5–30 U/L	5–30 U/L
Male	10–45 U/L	10–45 U/L
>16 yr		
Female	5–35 U/L	5–35 U/L
Male	10–40 U/L	10–40 U/L
ALBUMIN		
(See Proteins)		
ALDOLASE ³ ..		
(Major sources: Skeletal muscle and myocardium)		
10–24 mo	3.4–11.8 U/L	3.4–11.8 U/L
2–16 yr	1.2–8.8 U/L	1.2–8.8 U/L
Adult	1.7–4.9 U/L	1.7–4.9 U/L
ALKALINE PHOSPHATASE ⁴ ..		
(Major sources: Liver, bone, intestinal mucosa, placenta, and kidney)		
Infant	150–420 U/L	150–420 U/L
2–10 yr	100–320 U/L	100–320 U/L
Adolescent male	100–390 U/L	100–390 U/L
Adolescent female	100–320 U/L	100–320 U/L
Adult	30–120 U/L	30–120 U/L

AMMONIA ² ..		
(Heparinized venous specimens on ice, analyzed within 30 min)		
Newborn	90–150 mcg/dL	64–107 µmo l/L
0–2 wk	79–129 mcg/dL	56–92 µmol/L
Infant/child	29–70 mcg/dL	21–50 µmol/L
Adult	15–45 mcg/dL	11–32 µmol/L
AMYLASE ⁵ ..		
(Major sources: Pancreas, salivary glands, and ovaries)		
0–14 days	3–10 U/L	3–10 U/L
15 days–13 wk	2–22 U/L	2–22 U/L
13 wk–1 yr	3–50 U/L	3–50 U/L
>1 yr	25–101 U/L	25–101 U/L
ANTINUCLEAR ANTIBODY (ANA) ² IMMUNOFLUORESCENCE ASSAY (IFA)		
Negative	<1:40	
Patterns with clinical correlation:		
Centromere: CREST [†]		
Nucleolar: Scleroderma		
Homogeneous: Systemic lupus erythematosus		
ANTISTREPTOLYSIN O TITER ⁶ ..		
(Fourfold rise in paired serial specimens is significant.)		
Newborn	Similar to mother's value	
6–24 mo	≤50 Todd units/mL	
2–4 yr	≤160 Todd units/mL	
≥5 yr	≤330 Todd units/mL	
ASPARTATE AMINOTRANSFERASE (AST) ² ..		
(Major sources: Liver, skeletal muscle, kidney, myocardium, and erythrocytes)		
0–10 days	47–150 U/L	47–150 U/L
10 days–24 mo	9–80 U/L	9–80 U/L
>24 mo		
Female	13–35 U/L	13–35 U/L
Male	15–40 U/L	15–40 U/L
BICARBONATE ^{2,4}		
Newborn	17–24 mEq/L	

		17–24 mmol/L
Infant	19–24 mEq/L	19–24 mmol/L
2 mo–2 yr	16–24 mEq/L	16–24 mmol/L
>2 yr	22–26 mEq/L	22–26 mmol/L

BILIRUBIN (TOTAL) ^{4,7}

Please see [Chapter 18](#) for more complete information about neonatal hyperbilirubinemia and acceptable bilirubin values.

Cord:		
Term and preterm	<2 mg/dL	<34 µmol/L
0–1 days:		
Term and preterm	<8 mg/dL	<137 µmol/L
1–2 days:		
Preterm	<12 mg/dL	<205 µmol/L
Term	<11.5 mg/dL	<197 µmol/L
3–5 days:		
Preterm	<16 mg/dL	<274 µmol/L
Term	<12 mg/dL	<205 µmol/L
Older infant:		
Preterm	<2 mg/dL	<34 µmol/L
Term	<1.2 mg/dL	<21 µmol/L
Adult	<1.5 mg/dL	<20.5 µmol/L

BILIRUBIN (CONJUGATED) ²⁻⁴

Neonate	<0.6 mg/dL	<10 µmol/L
Infants/children	<0.2 mg/dL	<3.4 µmol/L

BLOOD GAS, ARTERIAL (BREATHING ROOM AIR) ² ..

	pH	PaO ₂ (mmHg)	Paco ₂ (mmHg)	HCO ₃ ⁻ (mEq/L)
Cord blood	7.28 ± 0.05	18.0 ± 6.2	49.2 ± 8.4	14–22
Newborn (birth)	7.11–7.36	8–24	27–40	13–22
5–10 min	7.09–7.30	33–75	27–40	13–22
30 min	7.21–7.38	31–85	27–40	13–22
60 min	7.26–7.49	55–80	27–40	13–22
1 day	7.29–7.45	54–95	27–40	13–22
Child/adult	7.35–7.45	83–108	32–48	20–28

NOTE: Venous blood gases can be used to assess acid-base status, not oxygenation. Pco₂ averages 6–8 mm Hg higher than Paco₂, and pH is slightly lower. Peripheral venous samples are strongly affected by the local circulatory and metabolic environment. Capillary blood gases correlate best with arterial pH and moderately well with Paco₂.

	Conventional Units	SI Units
C-REACTIVE PROTEIN ⁴	0–0.5 mg/dL	
CALCIUM (TOTAL) ²		
Premature neonate	6.2–11 mg/dL	1.55–2.75 mmol/L
0–10 days	7.6–10.4 mg/dL	1.9–2.6 mmol/L
10 days–24 mo	9–11 mg/dL	2.25–2.75 mmol/L
24 mo–12 yr	8.8–10.8 mg/dL	2.2–2.7 mmol/L
12–18 yr	8.4–10.2 mg/dL	2.1–2.55 mmol/L
CALCIUM (IONIZED) ³		
0–1 mo	3.9–6.0 mg/dL	1.0–1.5 mmol/L
1–6 mo	3.7–5.9 mg/dL	0.95–1.5 mmol/L
1–18 yr	4.9–5.5 mg/dL	1.22–1.37 mmol/L
Adult	4.75–5.3 mg/dL	1.18–1.32 mmol/L
CARBON DIOXIDE (CO₂ CONTENT) ²		
(See Blood Gas, Arterial)		
CARBON MONOXIDE (CARBOXYHEMOGLOBIN)		
Nonsmoker	0.5%–1.5% of total hemoglobin	
Smoker	4%–9% of total hemoglobin	
Toxic	20%–50% of total hemoglobin	
Lethal	>50% of total hemoglobin	
	Conventional Units	SI Units
CHLORIDE (SERUM) ³		
0–6 mo	97–108 mEq/L	97–108 mmol/L
6–12 mo	97–106 mEq/L	97–106 mmol/L
Child/adult	97–107 mEq/L	97–107 mmol/L
CHOLESTEROL		
(See Lipids)		
CREATINE KINASE (CREATINE PHOSPHOKINASE) ²		
(Major sources: Myocardium, skeletal muscle, smooth muscle, and brain)		
Newborn	145–1578 U/L	

		145–1578 U/L
>6 wk–adult male	20–200 U/L	20–200 U/L
>6 wk–adult female	20–180 U/L	20–180 U/L
CREATININE (SERUM) ² (Enzymatic)		
Cord	0.6–1.2 mg/dL	53–106 µmol/L
Newborn	0.3–1.0 mg/dL	27–88 µmol/L
Infant	0.2–0.4 mg/dL	18–35 µmol/L
Child	0.3–0.7 mg/dL	27–62 µmol/L
Adolescent	0.5–1.0 mg/dL	44–88 µmol/L
Adult male	0.9–1.3 mg/dL	80–115 µmol/L
Adult female	0.6–1.1 mg/dL	53–97 µmol/L
ERYTHROCYTE SEDIMENTATION RATE (ESR) ²		
Child	0–10 mm/hr	
Adult male	0–15 mm/hr	
Adult female	0–20 mm/hr	
FERRITIN ²		
Newborn	25–200 ng/mL	56–450 pmo I/L
1 mo	200–600 ng/mL	450–1350 p mol/L
2–5 mo	50–200 ng/mL	112–450 pm ol/L
6 mo–15 yr	7–140 ng/mL	16–315 pmo I/L
Adult male	20–250 ng/mL	45–562 pmo I/L
Adult female	10–120 ng/mL	22–270 pmo I/L
FIBRINOGEN		
See Chapter 14 .		
FOLATE (SERUM) ³		
Newborn	16–72 ng/mL	16–72 nmol/L
Child	4–20 ng/mL	4–20 nmol/L
Adult	10–63 ng/mL	10–63 nmol/L
FOLATE (RBC) ²		

Newborn	150–200 ng/mL	340–453 nmol/L
Infant	74–995 ng/mL	168–2254 nmol/L
2–16 yr	>160 ng/mL	>362 nmol/L
>16 yr	140–628 ng/mL	317–1422 nmol/L
GALACTOSE ²		
Newborn	0–20 mg/dL	0–1.11 mmol/L
Older child	<5 mg/dL	<0.28 mmol/L
GAMMA-GLUTAMYL TRANSFERASE (GGT) ^{2,6}		
[Major sources: Liver (biliary tree) and kidney]		
Cord	37–193 U/L	37–193 U/L
0–1 mo	13–147 U/L	13–147 U/L
1–2 mo	12–123 U/L	12–123 U/L
2–4 mo	8–90 U/L	8–90 U/L
4 mo–10 yr	5–32 U/L	5–32 U/L
10–15 yr	5–24 U/L	5–24 U/L
Adult male	11–49 U/L	11–49 U/L
Adult female	7–32 U/L	7–32 U/L
GLUCOSE (SERUM) ^{2,6}		
Preterm	20–60 mg/dL	1.1–3.3 mmol/L
Newborn, <1 day	40–60 mg/dL	2.2–3.3 mmol/L
Newborn, >1 day	50–90 mg/dL	2.8–5.0 mmol/L
Child	60–100 mg/dL	3.3–5.5 mmol/L
>16 yr	70–105 mg/dL	3.9–5.8 mmol/L
HAPTOGLOBIN ²		
Newborn	5–48 mg/dL	50–480 mg/L
>30 days	26–185 mg/dL	260–1850 mg/L
HEMOGLOBIN A_{1c} ⁸		
Normal	4.5%–5.6%	
At risk for diabetes	5.7%–6.4%	
Diabetes mellitus	≥6.5%	
HEMOGLOBIN F, % TOTAL HEMOGLOBIN [MEAN (SD)] ²		
1 day	77.0 (7.3)	

5 days	76.8 (5.8)	
3 wk	70.0 (7.3)	
6–9 wk	52.9 (11)	
3–4 mo	23.2 (16)	
6 mo	4.7 (2.2)	
8–11 mo	1.6 (1.0)	
Adult	<2.0	
	Conventional Units	SI Units
IRON ²		
Newborn	100–250 mcg/dL	17.9–44.8 µmol/L
Infant	40–100 mcg/dL	7.2–17.9 µmol/L
Child	50–120 mcg/dL	9.0–21.5 µmol/L
Adult male	65–175 mcg/dL	11.6–31.3 µmol/L
Adult female	50–170 mcg/dL	9.0–30.4 µmol/L
LACTATE ^{2,3}		
Capillary blood:		
0–90 days	9–32 mg/dL	1.1–3.5 mmol/L
3–24 mo	9–30 mg/dL	1.0–3.3 mmol/L
2–18 yr	9–22 mg/dL	1.0–2.4 mmol/L
Venous	4.5–19.8 mg/dL	0.5–2.2 mmol/L
Arterial	4.5–14.4 mg/dL	0.5–1.6 mmol/L
LACTATE DEHYDROGENASE (AT 37°C) ²		
(Major sources: Myocardium, liver, skeletal muscle, erythrocytes, platelets, and lymph nodes)		
0–4 days	290–775 U/L	290–775 U/L
4–10 days	545–2000 U/L	545–2000 U/L
10 days–24 mo	180–430 U/L	180–430 U/L
24 mo–12 yr	110–295 U/L	110–295 U/L
>12 yr	100–190 U/L	100–190 U/L
LEAD ⁹		
Child	<5 mcg/dL	<0.24 µmol/L
LIPASE ³		
0–30 days	6–55 U/L	6–55 U/L

1–6 mo	4–29 U/L	4–29 U/L						
6–12 mo	4–23 U/L	4–23 U/L						
>1 yr	3–32 U/L	3–32 U/L						
	Cholesterol (mg/dL)		LDL (mg/dL)			HDL (mg/dL)		
	Desirable	Borderline	High	Optimal	Near/Above Optimal	Borderline	High	Desirable
LIPIDS ^{10,11}								
Child/adolescent	<170	170–199	>200	<110	-	110–129	≥ 130	>35
Adult	<200	200–239	≥240	<100	100–129	130–159	≥ 160	40–60
	Conventional Units		SI Units					
MAGNESIUM ²	1.6–2.4 mg/dL		0.63–1.05 mmol/L					
METHEMOGLOBIN ²	0.78% (±0.37%) of total hemoglobin							
OSMOLALITY ²	275–295 mOsm/kg (none onates as low as 266)		275–295 mmol/kg					
PHENYLALANINE ²								
Preterm	2.0–7.5 mg/dL		121–454 µmol/L					
Newborn	1.2–3.4 mg/dL		73–206 µmol/L					
Adult	0.8–1.8 mg/dL		48–109 µmol/L					
PHOSPHORUS ²								
0–9 days	4.5–9.0 mg/dL		1.45–2.91 mmol/L					
10 days–24 mo	4–6.5 mg/dL		1.29–2.10 mmol/L					
3–9 yr	3.2–5.8 mg/dL		1.03–1.87 mmol/L					
10–15 yr	3.3–5.4 mg/dL		1.07–1.74 mmol/L					
>15 yr	2.4–4.4 mg/dL		0.78–1.42 mmol/L					
PORCELAIN ¹²	0.930–6.0 mg/dL		1.2–10.15 mmol/L					
POTASSIUM ²								
Preterm	3.0–6.0 mEq/L							

		3.0–6.0 mmo l/L				
Newborn	3.7–5.9 mEq/L	3.7–5.9 mmo l/L				
Infant	4.1–5.3 mEq/L	4.1–5.3 mmo l/L				
Child	3.4–4.7 mEq/L	3.4–4.7 mmo l/L				
Adult	3.5–5.1 mEq/L	3.5–5.1 mmo l/L				
PREALBUMIN ³						
Newborn	7–39 mg/dL					
1–6 mo	8–34 mg/dL					
6 mo–4 yr	12–36 mg/dL					
4–6 yr	12–30 mg/dL					
6–19 yr	12–42 mg/dL					
PROTEIN ELECTROPHORESIS (g/dL) ²						
Age	Total Protein	Albumin	α -1	α -2	β	γ
Cord	4.8–8.0					
Premature	3.6–6.0					
Newborn	4.6–7.0					
0–15 day	4.4–7.6	3.0–3.9	0.1–0.3	0.3–0.6	0.4–0.6	0.7–1.4
15 day–1 yr	5.1–7.3	2.2–4.8	0.1–0.3	0.5–0.9	0.5–0.9	0.5–1.3
1–2 yr	5.6–7.5	3.6–5.2	0.1–0.4	0.5–1.2	0.5–1.1	0.5–1.7
3–16 yr	6.0–8.0	3.6–5.2	0.1–0.4	0.5–1.2	0.5–1.1	0.5–1.7
≥16 yr	6.0–8.3	3.9–5.1	0.2–0.4	0.4–0.8	0.5–1.0	0.6–1.2
	Conventional Units	SI Units				
PYRUVATE ³	0.7–1.32 mg/dL	0.08–0.15 m mol/L				
RHEUMATOID FACTOR ²	<30 U/mL					
SODIUM ¹						
<1 yr	130–145 mEq/L	130–145 mm ol/L				
>1 yr	135–147 mEq/L	135–147 mm ol/L				
TOTAL IRON-BINDING CAPACITY (TIBC) ²						
Infant	100–400 mcg/dL	17.9–71.6 μ mol/L				
Adult	250–425 mcg/dL					

		44.8–76.1 μ mol/L
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TOTAL PROTEIN

(See Proteins)

TRANSAMINASE (SGOT)

[See Aspartate aminotransferase (AST)]

TRANSAMINASE (SGPT)

[See Alanine aminotransferase (ALT)]

TRANSFERRIN²

Newborn	130–275 mg/dL	1.30–2.75 g/ L
3 mo–16 yr	203–360 mg/dL	2.03–3.6 g/L
Adult	215–380 mg/dL	2.15–3.8 g/L

TOTAL TRIGLYCERIDE³

	Conventional Units (mg/dL)		SI Units (mmol/L)	
	Male	Female	Male	Female
0–7 days	21–182	28–166	0.24–2.0 6	0.32–1.8 8
8–30 days	30–184	30–165	0.34–2.0 8	0.34–1.8 6
31–90 days	40–175	35–282	0.45–1.9 8	0.4–3.19 8
91–180 days	45–291	50–355	0.51–3.2 9	0.57–4.0 1
181–365 days	45–501	36–431	0.51–5.6 6	0.41–4.8 7
1–3 yr	27–125	27–125	0.31–1.4 1	0.31–1.4 1
4–6 yr	32–116	32–116	0.36–1.3 1	0.36–1.3 1
7–9 yr	28–129	28–129	0.32–1.4 6	0.32–1.4 6
10–19 yr	24–145	37–140	0.27–1.6 4	0.42–1.5 8
	Conventional Units	SI Units		
UREA NITROGEN ^{1,2}				
Premature (<1 wk)	3–25 mg/dL	1.1–8.9 mmo l/L		
Newborn	2–19 mg/dL	0.7–6.7 mmo l/L		
Infant/child	5–18 mg/dL	1.8–6.4 mmo l/L		
Adult	6–20 mg/dL	2.1–7.1 mmo l/L		
URIC ACID ^{3,6}				

0–30 days	1.0–4.6 mg/dL	0.059–0.27 1 mmol/L
1–12 mo	1.1–5.6 mg/dL	0.065–0.3 3 mmol/L
1–5 yr	1.7–5.8 mg/dL	0.1–0.35 mm ol/L
6–11 yr	2.2–6.6 mg/dL	0.13–0.39 m mol/L
Male 12–19 yr	3.0–7.7 mg/dL	0.18–0.46 m mol/L
Female 12–19 yr	2.7–5.7 mg/dL	0.16–0.34 m mol/L
VITAMIN A (RETINOL) ^{2,3}		
Preterm	13–46 mcg/dL	0.46–1.61 μ mol/L
Full term	18–50 mcg/dL	0.63–1.75 μ mol/L
1–6 yr	20–43 mcg/dL	0.7–1.5 μmo l/L
7–12 yr	20–49 mcg/dL	0.9–1.7 μmo l/L
13–19 yr	26–72 mcg/dL	0.9–2.5 μmo l/L
VITAMIN B₁ (THIAMIN E) ² ..	4.5–10.3 mcg/dL	106–242 μm ol/L
VITAMIN B₂ (RIBOFLA VIN)	4–24 mcg/dL	106–638 nm ol/L
VITAMIN B₁₂ (COBALAMIN) ² ..		
Newborn	160–1300 pg/mL	118–959 pm ol/L
Child/adult	200–835 pg/mL	148–616 pm ol/L
VITAMIN C (ASCORBIC ACID) ² ..	0.4–2.0 mg/dL	23–114 μmo l/L
VITAMIN D (1,25-DIHYD ROXY-VITAMIN D) ² ..	16–65 pg/mL	42–169 pmo l/L
VITAMIN D (25-HYDROXY-VITAMIN D) ^{13,14}		
Deficiency [‡]	<12 ng/mL	<30 mmol/L
Insufficiency [‡]	12–20 ng/mL	30–50 mmol/ L
Sufficient [‡]	≥20 ng/mL	≥50 mmol/L
VITAMIN E ¹⁻³		
Preterm	0.5–3.5 mg/L	1–8 μmol/L
Full term	1.0–3.5 mg/L	2–8 μmol/L
1–12 yr	3.0–9.0 mg/L	7–21 μmol/L

13–19 yr	6.0–10.0 mg/L	14–23 µmol/L
ZINC ²	70–120 mcg/dL	10.7–18.4 mol/L

* There is evidence to suggest that these cutoffs may not be sensitive enough to detect pediatric chronic liver diseases.¹⁵

† CREST: **C** alcinosis, **R** aynaud syndrome, **E** sophageal dysmotility, **S** clerodactyly, **T** elangiectasia.

‡ Controversy exists regarding optimal 25-hydroxyvitamin D level. Some experts recommend a level ≥30 ng/mL as sufficient.¹⁶

TABLE 27.1: REFERENCE VALUES is a sample topic from the **Harriet Lane Handbook**.

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