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Clinical Utility of Blood Gas

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	Parameter	Normal	Elevated	Decreased	Clinical Significance	Underlying Causes
Acid-Base Balance – Arterial Blood Values	**pH**	7.35 – 7.45		< 7.35 = Acidosis/Acidemia	Generalized CNS Depression • Drowsiness/Lethargy • Decreased Force Cardiac Contractions • Decreased Response Catecholamines • Coma/Death	• Respiratory Acidosis • Increased PCO_2 • Metabolic Acidosis • Decreased $cHCO_3^-$
	pH	7.35 – 7.45	> 7.45 = Alkalosis/Alkalemia		Generalized CNS Stimulation • Irritability • Tetany • Arrhythmias • Convulsions – Death	• Respiratory Alkalosis • Decreased PCO_2 • Metabolic Alkalosis • Increased $cHCO_3^-$
	PCO_2	35 – 45 mmHg 4.7 – 6.0 kPa	Respiratory Acidosis PCO_2 > 45 mmHg (6.0 kPa) (pH < 7.35)		• Variable Neurologic Symptoms • Pulmonary Dyspnea/Distress • Increased Cerebral Perfusion • Increased Adrenergic Response • Flushed/Warm/Diaphoretic • Hypotension/Arrhythmia when severe	• COPD +/– Oxygen Excess • Depressant Overdose • Extreme V/Q Imbalance • Neurologic Disease • Neuromuscular Disease • Extreme Work of Breathing • Insufficient Mech Ventilation • Excessive CO_2 Production
	PCO_2	35 – 45 mmHg 4.7 – 6.0 kPa		Respiratory Alkalosis PCO_2 < 35 mmHg (4.7 kPa) (pH > 7.45)	• Pulmonary Discomfort/Dyspnea • Paresthesia/Tingling/Numbness • Dizziness • Increased Adrenergic Response • Palpitations/Arrhythmias • GI Nausea/Vomiting	• Hypoxemia • Excessive Mech Ventilation • Restrictive Lung Disease • Neurologic Disorders • Shock
	HCO_3^-	22 – 26 mmol/L		Metabolic Acidosis $cHCO_3^-$ < 22 mmol/L (pH < 7.35)	• Decreased Myocardial Contractility • Decreased Cardiac Output • Decreased Blood Pressure • Hyperkalemia	• Toxins/Poisons • Renal Failure • Lactic Acidosis • Ketoacidosis • RTA/Renal Base Excretion • Intestinal Base Loss
	HCO_3^-	22 – 26 mmol/L	Metabolic Alkalosis $cHCO_3^-$ > 26 mmol/L (pH > 7.45)		• CNS Abnormalities • Neuromuscular Irritability/Tetany • Depressed Myocardial Contractility • Arrhythmias • Convulsions	• Hypokalemia • Loop/Thiazide Diuretics • Vomiting • NG Drainage • Bicarbonate Therapy • High-Dose Steroids • Extracellular Fluid Deficit
	BE(B)	–2 to +2 mmol/L	> +2 mmol/L	< –2 mmol/L	See increased/decreased $cHCO_3^-$	See increased/decreased $cHCO_3^-$
	BE(ECF)	–2 to +2 mmol/L	> +2 mmol/L	< –2 mmol/L	See increased/decreased $cHCO_3^-$	See increased/decreased $cHCO_3^-$
Electrolytes	**Na^+**	135 – 145 mmol/L	Hypernatremia Na^+ > 145 mmol/L		• Weakness/Fatigue • CNS Symptoms • Tetany/Convulsions • Febrile/Oliguria	Intracellular Fluid (ICF) Deficit • Insufficient Water Intake • Excessive Water Loss • Hyperosmolar Solutions
	Na^+	135 – 145 mmol/L		Hyponatremia Na^+ < 135 mmol/L	• CNS Symptoms • Twitching/Convulsions • Central Edema	Intracellular Fluid (ICF) Excess • Excessive Water Intake • Renal Disease/ADH • CHF
	Cl^-	95 – 105 mmol/L	Hyperchloremia Cl^- > 105 mmol/L		• See Metabolic Acidosis • See Hypernatremia	• Metabolic Acidosis • Parenteral Intake • Hypernatremia
	Cl^-	95 – 105 mmol/L		Hypochloremia Cl^- < 95 mmol/L	• See Metabolic Alkalosis • See Hyponatremia • Hypertonicity	• Metabolic Alkalosis • Hyponatremia
	K^+	3.5 – 5.0 mmol/L	Hyperkalemia K^+ > 5.0 mmol/L		• Muscle Weakness • Flaccid Paralysis/Paresthesia • ECG Abnormalities • Arrhythmia/Cardiac Arrest	• Renal/Adrenal Disease • Iatrogenic Administration • Cell Destruction/Hemolysis • Acidosis
	K^+	3.5 – 5.0 mmol/L		Hypokalemia K^+ < 3.5 mmol/L	• Muscle Weakness/Fatigue • Paralysis • ECG Abnormalities • Arrhythmia/Cardiac Arrest	• Diuretics/Steroids • Renal Loss • GI Loss • Alkalosis
	Ca^{++}	1.1 – 1.4 mmol/L	Hypercalcemia Ca^{++} > 3.0 mmol/L		• Hypotonicity • Polyuria/Kidney Stones • GI Symptoms • CNS Depression	• Hyperparathyroidism • Excessive Calcium Ingestion • Excessive Vitamin D
	Ca^{++}	1.1 – 1.4 mmol/L		Hypocalcemia Ca^{++} < 1.1 mmol/L	• Neuromuscular Irritability • Spasms/Tetany/Convulsions • Weak Cardiac Contraction • Bleeding/Coagulopathy	• Hypoparathyroidism • Decreased Calcium Ingestion • Inadequate Vitamin D • Alkalosis
Oxygenation – Arterial	**PO_2**	80 – 100 mmHg 10.7 – 13.3 kPa	Hyperoxemia PO_2 > 100 mmHg (13.3 kPa)		• Oxygen Toxicity • Coronary Vasoconstriction • Microatelectasis	• Excessive Oxygen Therapy • Hyperventilation
	PO_2	80 – 100 mmHg 10.7 – 13.3 kPa		Hypoxemia • Mild 60 – 79 mmHg (8.0 – 10.5 kPa) • Moderate 45 – 59 mmHg (6.0 – 7.9 kPa) • Severe < 45 mmHg (6.0 kPa)	• Sympathetic Stimulation • Increased Cardiac Output • CNS Abnormalities • Decreased Cardiac Output (severe)	• Hypoventilation • Absolute Shunting • V/Q Mismatch • Diffusion Defect
	SO_2	97 – 98%	Hyperoxemia SO_2 > 98%		See Hyperoxemia above	See Hyperoxemia above
	SO_2	97 – 98%		Hypoxemia SO_2 < 90%	See Hypoxemia above	See Hypoxemia above
	FO_2Hb	94 – 98%		Hypoxemia FO_2Hb < 90%	See Hypoxemia above	• Hypoxemia • Carboxyhemoglobinemia • Methemoglobinemia
	FCOHb	0 – 1.5%	Carboxyhemoglobinemia FCOHb > 1.5%		• Potential Tissue Hypoxia	• Smoke Inhalation • CO Exposure • Smoking
	FMetHb	0 – 1.5%	Methemoglobinemia FMetHb > 1.5%		• Potential Tissue Hypoxia	• Nitrate/Nitrite Exposure • Nitric Oxide • Topical Anesthetics
	FHHb	2 – 3%	Increased Desaturated Hb		• Potential Tissue Hypoxia	See Hypoxemia above
	tHb	12 – 15 g/dL*	Polycythemia ctHb > 15 g/dL		• Increased Blood Oxygen Capacity • Increased Blood Viscosity	• Primary Pathology • Secondary to Hypoxemia • COPD
	tHb	12 – 15 g/dL*		Anemia tHb < 12 g/dL	• Potential Tissue Hypoxia • Fatigue/Weakness	• Decreased RBC Production • Increased RBC Destruction • Blood Loss
General Analytes	**Lac**	1.0 – 1.8 mmol/L	Hyperlactatemia > 2.0 mmol/L		• Anaerobic Metabolism • Increased Morbidity • Increased Mortality	• Tissue Hypoxia • Sepsis • Trauma
	Glu	70 – 110 mg/dL 3.9 – 6.1 mmol/L	Hyperglycemia Glu > 110 mg/dL (6.1 mmol/L)		• Polyuria • Glycosuria • Dehydration	• Diabetes Mellitus • Stress
	Glu	70 – 110 mg/dL 3.9 – 6.1 mmol/L		Hypoglycemia Glu < 70 mg/dL (3.9 mmol/L)	• Weakness • Coma	• Starvation • Insulin Excess
	tBil	0.3 – 1.0 mg/dL (adult) 5.1 – 17.1 µmol/L (adult) 0.6 – 7.9 mg/dL (neonates**) 10.3 – 135.1 µmol/L (neonates**)	tBil > 2.0 mg/dL (34.2 µmol/L) (adults) tBil > 8.0 mg/dL (136.8 µmol/L) (neonates)		• Jaundice (neonates) • Seizures • Kernicterus	• Hepatitis/Cirrhosis • Drugs/Hemolysis • Pathological Syndromes

*Gender-specific normals exist. Refer to your Medical Director for normals. **Acceptable neonatal values are time and birth weight dependent.

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