Pomerene HOSPITAL

PROCEDURE PC101.00

TITLE: I-STAT Blood Gas Analyzer

Issuing Department:	Laboratory
Clinical Director Signature:	
Departments Involved:	
Effective Date:	05/05
Review Dates:	12/06, 05/13
Revision Dates:	01/08, 2/10, 08/10, 3/11, 3/12

I. PURPOSE

THE Abbott i-STAT instrument is a hand held device for making a rapid and safe point-of-care blood testing for Blood Gas analysis.

II. PRINCIPLE

A. I-STAT 1 Analyzer: When a sample-filled i-STAT cartridge is inserted into an analyzer for analysis, the analyzer automatically controls all functions of the testing cycle including fluid movement within the cartridge, calibration and continuous quality monitoring. Results are reported in approximately 120 seconds.

B. Cartridges: A single-use disposable cartridge contains micro fabricated sensors, a calibrant solution, fluidics system, and a waste chamber. A whole blood sample of approximately 1 to 3 drops is dispensed into the cartridge sample well and the sample well is sealed.

C. pH, and PCO_2 are measured by ion-selective electrode potentiometry. Concentrations are calculated from the measured potential through the Nernst equation.

D. PO_2 is measured amperometrically. The oxygen sensor is similar to a conventional Clark electrode. Oxygen permeates through a gas permeable membrane from the blood sample into an internal electrolyte solution where it is reduced at the cathode. The oxygen reduction current is porportinal to the dissolved oxygen concentration.

III. SPECIMEN REQUIREMENTS

A. Specimen Collection and Handling:

1. Arterial Specimens:

a) For cartridge testing of blood gases, fill a plain syringe or fill a blood gas syringe, labeled for the assays to be performed to the recommended capacity, or use the least amount of liquid heparin anticoagulant that will prevent clotting. Under filling

syringes containing liquid heparin may yield inaccurate results due to improper blood to anticoagulant ration. For ionized calcium, balanced or low volume heparin blood gas syringes should be used.

b) Mix blood and anticoagulant by rolling syringe between palms for at least 5 seconds and then inverting the syringe repeatedly for at least 5 seconds. For blood gas testing, avoid or remove immediately any air drawn into syringe to maintain anaerobic conditions.

c) Test within 10 minutes of collection. If not tested immediately, remix the sample and discard the first one or two drops of blood from a syringe before testing.

2. In-Dwelling Line: Back flush line with sufficient amount of blood to remove intravenous solution, heparin, or medications that may contaminate the sample. Recommendation: Three to six times the volume of the catheter, connectors, and needle.

3. Finger and Heel stick Specimens: For cartridge testing, wipe away the first drop of blood, which contains excess tissue fluid and can increase the potassium result and dilute other test results. Avoid drawing air into the capillary tube. Use balanced heparin or plain capillary tubes for ionized calcium. Test samples immediately to avoid clotting (especially in neonates).

B. Specimen Labeling

1. Unless the specimen is analyzed immediately after collection and then discarded, the specimen container must be labeled with the information.:

a) All specimens must be labeled with patient's full name, date of birth, date and time of collection, collector's initials.

b) Specimens collected at the bedside must be labeled while the collector is with the patient. Specimens must never be removed from a patient room without a properly completed label.

C. Criteria for Specimen Rejection

1. Improperly labeled specimens

2. Evidence of clotting

3. Specimens collected in vacuum tubes with anticoagulant other than lithium or sodium heparin

4. Syringe for pH, PCO_2, and PO_2 with air bubbles in sample

5. Incompletely filled vacuum tube for the measurement of PCO_2

6. Other sample types such as urine, CSF, and pleural fluid

D. Precautions: Avoid the Following Circumstances

1. Drawing a specimen from an arm with an IV.

2. Stasis (tourniquet left on longer than one minute before venipuncture)

3. Extra muscle activity (fist pumping)

4. Hemolysis (alcohol left over puncture site, or a traumatic draw)

5. Icing before filling cartridge

6. Time delays before filling cartridge

7. Exposing the sample to air when measuring pH, $PC0_2$, and $P0_2$

IV. SUPPLIES AND EQUIPMENT

A. Cartridges:

1. Sensors for analysis of pH, PCO_2, and PO_2, available in one cartridge configuration.

2. Cartridges are sealed in individual pouches. Store the main supply of cartridges at a temperature between 2 to 8^0C (35 to 46^0F). Cartridges may be stored at room temperature (18 to 30^0C or 64 to 84^0F) for 2 months. Cartridges should not be returned to the refrigerator once they have been at room temperature, and should not be exposed to temperatures above 30^0C (86^0F).

3. Date individual cartridges to indicate the two-week room temperature expiration date.

4. Cartridges should remain in pouches until the time of use. Do not use after the labeled expiration date.

B. Controls: i-STAT Controls for blood gases: Store at 2 to 8^0C (35 to 46^0F). Controls may be stored at room temperature (18 to 30^0C or 64 to 86^0F) for five days. Do not use after expiration date on the box and ampules.

C. Electronic Simulator: Store at room temperature and protect contact pads from contamination by replacing the plastic cap and placing the Electronic Simulator in its protective case after use.

D. I-Stat Data System: A dedicated desktop computer with the CE I-STAT Data System program provides the primary information management capabilities for the i-STAT System.

V. QUALITY CONTROL

A. Analyzer Verification: Verify the performance of each handheld analyzer or Blood Analysis Module in the i-STAT System using an Electronic Simulator every 8 hours of use.

1. If PASS is displayed on the analyzer screen (after using the external Electronic Simulator):

a) Remove the Electronic Simulator after the LCK or Simulator Locked message disappears from the display screen

b) Transmit the result to the Data Station.

c) Use the analyzer as required

NOTE: If the internal Electronic Simulator is used, the "PASS" message will not be displayed on the analyzer screen. The "PASS" record will appear in the analyzer's stored results for transmission to the CE I-STAT Data System. The I-STAT automatically performs an internal electronic simulator every 8 hours when testing specimens.

d) Remedial Action:

- If FAIL is displayed on the analyzer screen:

i. Repeat the procedure with the same Electronic Simulator or rerun the cartridge if the internal Electronic Simulator is being used. If PASS is displayed use the analyzer as required.

ii. If FAIL is displayed repeat the procedure with a different external Electronic Simulator.

B. Verification of Cartridge Storage Conditions

1. Refrigerated Cartridges

a) Verify that the cartridges stored in the refrigerator are all within the expiration date printed on the boxes. Deliver any expired cartridges to Laboratory Technical Supervisor or designee.

b) Verify that the refrigerator has not exceeded the limits of 2 to 8^0C (35 to 46^0F)

c) If the temperature of the cartridge storage refrigerator is within the range of 2 to 8^0C (35 to 46^0F) use cartridges as required.

d) If the temperature is outside the range of 2 to 8^0C (35 to 46^0F), quarantine the cartridges in the storage refrigerator. Notify the Laboratory Technical Supervisor or

designee immediately. DO NOT USE the cartridges from this refrigerator. Record the QC failure on an Internal Occurrence Report Form.

2. Room Temperature Cartridges

a) Verify that all boxes of cartridges at room temperature have been out of the refrigerator less than two weeks.

b) Do not use expired cartridges

c) Verify that room temperature has not exceeded 30^0C (night shift logs room temperature).

d) If the measured temperature of the room has been continuously below 30^0C (86^0F) use cartridges as required.

e) If the measured room temperature has exceeded 30^0C (86^0F) for any period of time:

- Quarantine the cartridges
- Notify Laboratory Technical Supervisor or designee immediately.
- DO NOT USE the cartridges.
- Record the out-of-control on an Internal Occurrence Report Form.

C. Monthly Procedures:

1. Integrity Testing: From each lot of blood gas cartridges received and every 30 days, run i-STAT Level 1, 2 and 3 Controls on one of the iSTAT analyzers. It is preferred that instruments are rotated. Transmit the results to the Data Station. Use the manufacturer's range to verify the integrity of the cartridges.

a) Prior to testing cartridges that measure PO2, ampules should stand at room temperature a minimum of 4 hours before use. When testing other cartridges, ampules may be used once the fluid has reached room temperature, approximately 30 minutes for individual ampules. For best results, ampules, cartridges, and analyzers should be at the same temperature. When using cartridges that contain sensors for measuring ionized calcium, pH, PCO2, or P02, a separate ampule must be used for each cartridge being tested; if these sensors are not present (i.e., the 6+ cartridge), the contents of one ampule may be used to fill more than one cartridge as long as the cartridges are filled and inserted into an analyzer within 10 minutes of opening the ampule.

b) Immediately before use, shake the ampule vigorously for 5 to 10 seconds to equilibrate the liquid and gas phases. To shake, hold the ampule at the tip and bottom with forefinger and thumb to minimize increasing the temperature of the solution. If necessary, tap the tip of the ampule to send solution back into the bottom section of

the ampule. Protect fingers with gauze, tissue, or glove, or use an ampule breaker to snap off the tip of the ampule at the neck.

c) Immediately transfer the solution from the ampule into the capillary tube or syringe, and then immediately transfer the solution into the cartridge. Immediately seal the cartridge and insert it into an analyzer. It is important not to expose the solution to room air since this will alter the results.

d) When using a capillary tube, fill from the bottom of the ampule. Avoid drawing solution from the surface by covering the far end of the tube as it is inserted into the ampule. Once the open end of the tube rests at the bottom of the ampule, uncover the other end to allow filling by capillary action.

e) When using a syringe (1cc or 3cc syringes with 16 to 20 gauge needles are recommended), slowly draw approximately 1mL of solution from the bottom of the ampule. If air is trapped between the leading edge of the solution and the plunger, do not invert the syringe to expel it; this will not affect solution near the tip of the syringe, discard the ampule and syringe and use a fresh ampule and syringe. Expel one or two drops from the syringe before filling the cartridge.

f) Do not use solution left in the syringe, ampule, or capillary tube for additional testing of the cartridges that contain sensors for pH, PCO2, or PO2. However, cartridges without these sensors may be tested with remaining tests if within 10 minutes of opening the ampule.

g) Compare results to the manufacturer's ranges. Check that the lot number on the control ampule matches the lot number on the sheet and that the software version listed on the sheet matches the software installed in the analyzer. If all results are within expected ranges, use the cartridges as needed. Transmit the results to the Data Station.

2. Print results for any control fluids analyzed from the CE I-STAT Data System. Include the report in the i-STAT liquid QC folder. Liquid QC must be run with each new shipment of test cartridges received, and also every 30 days. Refer to the CE I-STAT Data System operator's manual for detailed instructions.

3. Print a copy of the Electronic Simulator results from the Central Data Station. Include the report in the i-STAT Liquid QC folder. Refer to the Date Station (DE) operator's manual for detailed instructions.

D. Periodic Procedures for Cartridges: For acceptance of newly received cartridge lots, check the Temperature Monitor and perform integrity testing. Liquid QC must be run with each new shipment of test cartridges received, and every 30 days.

1. Fill out the record of receipt and forward materials to refrigerator.

2. Check temperature monitor: i-STAT cartridges are shipped refrigerated with a four-window indicator to monitor temperature during transit.

3. If all windows are white or if only the A windows is blue, then transit temperatures were satisfactory and the cartridges can be used.

4. If the B window is blue, contact the i-STAT System Coordinator before using cartridges. If the C, or D windows are blue:

   a) Quarantine the suspect cartons.

   b) Notify the i-STAT System Coordinator immediately.

   c) DO NOT USE cartridges from the suspect cartons.

   d) Record the out-of-control on an Internal Occurrence Report Form.

E. Calibration Verification Procedure (every six months)

1. I-STAT's Calibration Verification Set includes five levels of solutions for all tests. Reportable ranges can be verified using Levels 1, 3 and 5 since the concentrations in these solutions cover the low, mid and high areas of the ranges.

2. When performing the calibration verification procedure to meet a six-month calibration verification requirement, include each sensor and a representative selection of analyzers. When using the i-STAT Calibration Verification Set, triplicates should be tested since the insert ranges are based on the average of triplicate results.

VI. PROCEDURE FOR ANALYSIS

A. Preparation for Use

1. An individual cartridge may be used after standing five (5) minutes, in its pouch, at room temperature. An entire box should stand at room temperature for one hour before cartridges are used.

B. Procedure for the i-STAT 1 Analyzer with Information First Cartridge Testing

1. Turn the analyzer on and press 2 for i-STAT Cartridge.

2. Remove the cartridge from its pouch. Avoid touching the contact pads or exerting pressure over the calibrant pack in the center of the cartridge.

3. Direct the dispensing tip or capillary tube containing the blood into the sample well and dispense the sample until it reaches the fill mark on the cartridge and the well is about half full.

4. Close the cover over the sample well until it snaps into place (do not press over the sample well).

5. Insert the cartridge into the cartridge port until it clicks into place.

6. Scan or enter the operator and patient specimen order number.

7. Enter additional parameters on the Chart page if required.

    a. Choose the number corresponding to the type of sample used when prompted at the Sample Type field.

    b. Fields 1, 2 and 3 are user-defined fields, typically used for ventilator settings such as PIP or PEEP.

    c. Patient temperature can be entered as degrees Centigrade or Fahrenheit.

    d. FIO_2 can be entered as the number of liters or as a percentage of the oxygen a patient is receiving.

    e. Choose 1-YES or 2-NO for CPB.

    f. Press the → key to return to the results page.

8. View results shown on the analyzer's display screen.

VII. INTERPRETING AND REPORTING RESULTS

A. Displayed Results: Blood Gas Results are displayed numerically with their units. Ionized Calcium results are also depicted as bar graphs with reference ranges marked under the graphs.

B. Suppressed Results: There are three conditions under which the i-STAT System will not display results:

1. Results outside the System's reportable ranges are flagged with a < or >, indicating that the result is below the lower limit or above the upper limit of the reportable range respectively. (See the table of Reportable Ranges.) The <> flag indicates that the results for this test were dependant on the result of a test flagged as either > or <. Repeat analysis on same sample.

2. Cartridge results which are not reportable based on internal QC rejection criteria are flagged with ***. Analyze the specimen again using a fresh sample and another cartridge. The results that are not suppressed should be reported in the usual manner. If the result is suppressed again, send specimen(s) to the laboratory for analysis in accordance with the Laboratory Procedure Manual.

3. A Quality Check message will be reported instead of results if the analyzer detects problem with the sample, calibrant solution, sensors, or mechanical or electrical functions of the analyzer during the test cycle. Action: Take the action displayed with

the message that identifies the problem. Refer to the i-STAT or i-STAT 1 System Manual's troubleshooting section if necessary.

C. Printing and Transmitting Results

1. Printing Results from the i-STAT 1 Analyzer to the Portable Printer

a. Align the IR windows of the analyzer and the portable printer within 1 to 6 inches of each other or place analyzer in a Downloader or Downloader/Recharger if printer attached.

b. To print the displayed results, press the Print key.

c. Do not move analyzer or printer until the printout is complete.

d. Optional: Write the patient's name on the "Pt Name" line and the physician's name on the "Physician" line.
NOTE: Results printed on thermal paper will fade with time and are therefore not acceptable as a permanent chartable record.

2. Transmitting Results from the i-STAT 1 Analyzer to the Data Station

a. Place analyzer in front of Com-2 downloader (i-STAT analyzer should be off)

b. Red light should come on, on downloader

c. i-STAT 1 analyzer screen should turn on

d. The message "Communication in Progress" is displayed, and 2 arrows should circle. Do not move analyzer while this is displayed.

e. I-STAT 1 analyzer will shut itself off when download is complete.

VIII. CALCULATIONS

The i-STAT analyzer contains a microprocessor that performs all calculations required for reporting results.

IX. REFERENCE RANGES [1,2], REPORTABLE RANGES, AND TEST UNIT CONVERSIONS

A. Reference range means the range of test values expected from 95% of fasting individuals presumed to be healthy. Reportable range means the range of test values throughout which the measurement system's results have been shown to be valid. The following table contains the Reference Ranges (for adults) and Reportable Ranges applicable to the I-STAT System.

ANALYTE	UNIT	REFERENCE RANGE (arterial)	(venous)	REPORTABLE RANGE	UNIT CONVERSION
pH		7.35 – 7.45	7.31 – 7.41	6.50 – 8.00	N/A
Cord Blood pH		7.27-7.28			
PCO_2	mm/Hg	35 – 45	41-51	5-130	mmHg x 0.133 = kPa Example: 35 mmHg x 0.133 = 4.66 kPa
PO_2	mm/Hg	80 – 105		5 – 800	mmHg x 0.13 = kPa Example: 83 mmHg x 0.133 = 11.04 kPa
HCO_3*	mmol/L	22-26	23-28	1-85	mmol/L x 1 = mEq/L
TCO_2*	mmol/L	23-27	24-29	1-85	

ANALYTE	UNIT	REFERENCE RANGE (arterial)	(venous)	REPORTABLE RANGE	UNIT CONVERSION
BE*	mmol/L	(-2) – (+3)	(-2) – (+3)	(-30) – (+30)	
$S0_2$*	%	95-98		0-100	% x 0.01 = fraction saturated

*= calculated values

B. Critical Results [3]

1. Critical results are test results that fall outside high and low critical limits that define the boundaries of life-threatening values for a test. Critical results represent an emergency condition and must be reported immediately to the patient's attending physician or nurse.

ANALYTE (units)	**Low**	**High**
TCO_2 (mmol/L)	11	40
pH	7.20	7.60
PCO_2 (mmHg)	20	60
PO_2 (mmHg)	55	--

C. Interferences

1. As interferent is a substance which, if present at significant levels in the blood specimen being analyzed, will produce an error in the result of the analyte being measured. For example, in the table below, B-hydroxybutyrate at sample concentration level of 16mmol/L would decrease the measured sodium by 4mmol/L.

ANALYTE	INTERFERENT	INTERFERENT CONCENTRATION	EFFECT ON ANALYTE RESULT
PCO2 with JAMS Software	Propofol (Diprovan)	Sustained administration (>1 hour) at rates in excess of 50μg/kg/min (3 mg/kg/hr)	Decrease > 5 mmHg (0.67 kPa)
		50-100 μg/kg/min (3-6 mg/kg/hr)	Decrease up to 10mmHg (1.33kPa) below 40mmHg (5.33kPa) or up to 25% above 40mmHg (5.33kPa)
		Above 100μg/kg/min (6 mg/kg/hr) in excess of 5 hours	Decrease up to 40%
		Below 50μg/kg/min (3 mg/kg/hr)	Decrease of 3 to 5 mmHg (0.40 to 0.67 kPa)
		Single dose to induce anesthesia	No decrease
		Renal impairment	May decrease clearance of interferent. Consider an alternative method of measurement.
	Thiopental Sodium (thiomebumal sodium, penthiobarbital sodium, thiopentone sodium, thionembutal, Pentothal Sodium ®, Nesdonal Sodium ®, Intraval Sodium ®, Trapanal ®, Thiothal Sodium)	Sustained administration (over a few minutes)	Decrease >5mmHg (0.67kPa) up to 20mmHg (2.67kPa)
		Single dose, such as for the induction of anesthesia	Decrease <10% at 40mmHg (5.33kPa) or < 15% at 70mmHg (9.33kPa) approximately 15 minutes after administration. Interference diminished over time as drug is absorbed.

Diprivan is a registered trademark of the AstraZeneca group of companies.

Pentothol Sodium is a registered trademark of Abbott Labs, USA.

Nesodonal Sodium is a registered trademark of Specia, France.

Intraval Sodium is a registered trademark of May and Baker, Ltd. England.

Trapanal is a registered trademark of Chemische Fabrik Promonta, Germany.

X. MAINTENANCE

A. Routine Care of the Analyzer and Downloader

1. Drying a wet analyzer or downloader: If the analyzer is placed on a wet surface or if any liquid is spilled onto it, dry the analyzer immediately. If liquid enters the following compartments, the analyzer may be damaged:

   a. The electronics compartment

   b. The battery compartment

   c. The cartridge port

   d. The test strip port

2. The Downloader may also be damaged by liquid contamination. Unplug the power supply from the outlet and dry the Downloader completely.

3. Cleaning the Analyzer and Downloader: Clean the display screen and the case using a gauze pad moistened with any of the following:

   a. A mild non-abrasive cleaner

   b. Detergent

   c. Soap and water

   d. Alcohol

   e. 10% bleach solution

   f. PDI Super Sani-Cloth (solution of IPA, n-Alkyl dimethyl ethylbenzyl- and benzyl – ammonium chloride)

4. Rinse the case using another gauze pad moistened with water and dry. Avoid getting excess fluids in the seam between the display screen and the case.

5. CAUTION:

    a. Exercise universal safety precautions at all times when handling the analyzer, cartridges, and peripherals to prevent exposure to blood borne pathogens.

    b. The analyzer is NOT designed to be sterilized or autoclaved by any method, including those using gas (e.g. steam, ethylene oxide, etc..) high heat, bead, radiation, or other chemical processes. The analyzer is splash resistant, but should not be immersed in any liquids.

    c. Dispose of analyzer, peripheral electronics, and batteries according to local, state, and/or national guidelines.

    d. If the analyzer is not to be used for an extended period of time, the batteries should be removed to prevent leakage.

    e. Decontaminate the analyzer or Downloader whenever a specimen is spilled onto it or if the item is to be returned to i-STAT for repair. Wear gloves while performing the following procedure.

6. Procedure:

    a. Prepare a 1:10 solution of household bleach by mixing one part of bleach with nine parts of tap water. This solution will maintain its germicidal action for a week.

    b. Soak a few gauze pads in the bleach solution. Before use, squeeze the pads to remove excess solution.

    c. Soften, then remove any dried blood with one or two of the gauze pads soaked in the bleach solution. Avoid scraping dried blood as contaminated particles may become airborne.

    d. Clean the entire surface of the device twice with gauze pads soaked in the bleach solution.

    e. Rinse the surface of the device with gauze pads moistened with tap water and dry.

    f. If the device is to be shipped, place it in a plastic bag.

B. Removing and Replacing Disposable Batteries

1. Wait until any test in progress is completed, and turn off the analyzer before replacing the batteries or the most recent set of results may be lost. Stored results will not be lost when replacing the batteries. Use Lithium 9-volt batteries (obtained from Materials Management).

    a. Slide the battery compartment door off.

b. Tilt the analyzer slightly to slide out the battery carrier which contains the two 9-volt batteries.

c. Remove the old batteries from the carrier. Pull each battery out to the side and then lift back and out.

d. Note the battery orientation symbol molded into the carrier on each side of the center wall. Starting with one side, orient the new battery so it matches the symbol. Slide the battery into the carrier, pushing the terminal end in first, under the plastic bar, and slide it up as far as it will go. Then push the bottom of the battery inward. The terminals of the battery should be underneath the protective bar on the carrier. Repeat for the second battery on the other side of the carrier.

e. Note the orientation of the battery carrier illustrated on the label on the carrier. The label faces up, and the electrical contact end of the carrier goes into the instrument first. Insert the carrier into the instrument as shown on the label. If the carrier is inserted incorrectly, the battery door will not close.

f. Slide the battery compartment door back into place.

2. CAUTION: A falling instrument may cause injury. Place the instrument on a flat and stable surface at all times to ensure the instrument does not fall.

C. I-STAT Analyzer thermal Probe Check: Perform twice a year.

1. Procedure for handheld analyzers: Check the thermal probes on the analyzer as follows.

a. If the analyzer and simulator have been stored separately in areas where the ambient temperature differs by more than 3^0C (5^0F), allow the simulator and analyzer to stand in the same place, out of drafts, for 30 minutes before inserting the simulator into the analyzer. Handle the simulator as little as possible to maintain its thermal uniformity and stability.

b. Insert the simulator into the analyzer.

c. When results are displayed, the difference between the thermal probes can be viewed on the analyzer's screen:

i. I-STAT 1 Analyzer: press the period key.

d. Interpretation of the thermal probe check value:

i. Acceptable: a value equal to or less than 0.1 (≤ 0.1)

ii. Not acceptable: a FAIL message with a "t" Quality Check Code or a value greater than 0.1. Repeat the procedure to confirm results. Contact

your Technical Support representative if the repeat thermal check value is greater than 0.1

iii. Repeat the procedure: if" __.__" is displayed, repeat the procedure taking care to handle the simulator a little as possible. It may help to partially insert the simulator into the analyzer and let it stand for 15 minutes before inserting all the way.

CLINICAL SIGNIFICANCE		
Analyte	**Some Causes of Increased Values**	**Some Causes of Decreased Values**
pH	Respiratory alkalosis Metabolic alkalosis	Respiratory acidosis Metabolic acidosis
PCO_2	Acute Respiratory Acidosis: • Depression of respiratory center • Suppressed neuromuscular system • Pulmonary disorders • Inadequate mechanical ventilation Chronic respiratory acidosis • Decreased alveolar ventilation • Hypoventilation Compensation in metabolic alkalosis	Respiratory alkalosis: • Increased stimulation of respiratory center • Hypermetabolic states • Mechanical hyperventilation Compensation in metabolic acidosis
PO_2	Breathing oxygen-enriched air	Carbon-monoxide exposure Pulmonary disorders Myocardial infarction Congestive heart failure
HCO_3	Primary metabolic alkalosis Primary respiratory acidosis	Primary metabolic acidosis Primary respiratory alkalosis

XI. REFERENCES

A. I-STAT System Manual

B. Fundamentals of Clinical Chemistry, N. Tietz, Third Edition, Pages: 426-435, 614-616, and 676-678.

C. Clinical Chemistry Theory, Analysis and Correlation, Kaplan/Pesce, 2nd Edition, pages 850-856, 872-875, 884-888, and 1021-1024.

XII. FOOTNOTES

A. Statland, B.E., Clinical Decision Levels for Lab Tests. Medical Economics Books, 1987.

B. Tietz, N.W., Tietz Textbook of Clinical Chemistry, second edition, Ed. C.A. Burtis, E.R. Ashwood, W.B. Saunders Company, Philadelphia, 1994. Table 41-20, Appendix.

C. Kost, Gerald J., Using critical limits to improve patient outcome. Medical Laboratory Observer. March 1993; 25 (3):22-27.