i-STAT EG6+ Cartridge

Intended for use with the i-STAT 1 Analyzer (REF 04P75-01 & 03P75-06)

NAME

i-STAT EG6+ Cartridge – REF 03P77-25

INTENDED USE

The i-STAT EG6+ cartridge with the i-STAT 1 System is intended for use in the *in vitro* quantification of Sodium, Potassium, Hematocrit, pH, oxygen partial pressure, and carbon dioxide partial pressure in arterial, venous or capillary whole blood.

Analyte	Intended Use
Sodium (Na)	Sodium measurements are used for monitoring electrolyte imbalances.
Potassium (K)	Potassium measurements are used in the diagnosis and monitoring of diseases and clinical conditions that manifest high and low potassium levels.
Hematocrit (Hct)	Hematocrit measurements can aid in the determination and monitoring of normal or abnormal total red cell volume status including, but not limited to, conditions such as anemia, erythrocytosis, and blood loss related to trauma and surgery.
pH	pH, ***P***O_2, and ***P***CO_2 measurements are used in the diagnosis, monitoring, and treatment of respiratory disturbances and metabolic and respiratory-based acid-base disturbances. Bicarbonate is used in the diagnosis and treatment of numerous potentially serious disorders associated with changes in body acid-base balance.
Oxygen Partial Pressure (***P***O_2)	
Carbon Dioxide Partial Pressure (***P***CO_2)	

SUMMARY AND EXPLANATION/CLINICAL SIGNIFICANCE

Measured:

Sodium (Na)

Tests for sodium in the blood are important in the diagnosis and treatment of patients suffering from hypertension, renal failure or impairment, cardiac distress, disorientation, dehydration, nausea and diarrhea. Some causes of increased values for sodium include dehydration, diabetes insipidus, salt poisoning, skin losses, hyperaldosteronism and CNS disorders. Some causes for decreased values for sodium include dilutional hyponatremia (cirrhosis), depletional hyponatremia and syndrome of inappropriate ADH.

Potassium (K)

Tests for potassium in the blood are important in the diagnosis and treatment of patients suffering from hypertension, renal failure or impairment, cardiac distress, disorientation, dehydration, nausea and diarrhea. Some causes of increased values for potassium include renal glomerular disease, adrenocortical insufficiency, diabetic ketoacidosis (DKA), sepsis and *in vitro* hemolysis. Some causes of decreased values for potassium include renal tubular disease, hyperaldosteronism, treatment of DKA, hyperinsulinism, metabolic alkalosis and diuretic therapy.

Hematocrit (Hct)
Hematocrit is a measurement of the fractional volume of red blood cells. This is a key indicator of the body's state of hydration, anemia or severe blood loss, as well as the blood's ability to transport oxygen. A decreased hematocrit can be due to either overhydration, which increases the plasma volume, or a decrease in the number of red blood cells caused by anemias or blood loss. An increased hematocrit can be due to loss of fluids, such as in dehydration, diuretic therapy, and burns, or an increase in red blood cells, such as in cardiovascular and renal disorders, polycythemia vera, and impaired ventilation.

pH
pH is an index of the acidity or alkalinity of the blood with an arterial pH of <7.35 indicating an acidemia and >7.45 alkalemia. [1]

Oxygen Partial Pressure (PO_2)
PO_2 (partial pressure of oxygen) is a measurement of the tension or pressure of oxygen dissolved in blood. Some causes for decreased values of PO_2 include decreased pulmonary ventilation (e.g., airway obstruction or trauma to the brain), impaired gas exchange between alveolar air and pulmonary capillary blood (e.g., bronchitis, emphysema, or pulmonary edema), and alteration in the flow of blood within the heart or lungs (e.g., congenital defects in the heart or shunting of venous blood into the arterial system without oxygenation in the lungs).

Carbon Dioxide Partial Pressure (PCO_2)
PCO_2 along with pH is used to assess acid-base balance. PCO_2 (partial pressure of carbon dioxide), the respiratory component of acid-base balance, is a measure of the tension or pressure of carbon dioxide dissolved in the blood. PCO_2 represents the balance between cellular production of CO_2 and ventilatory removal of CO_2 and a change in PCO_2 indicates an alteration in this balance. Causes of primary respiratory acidosis (increase in PCO_2) are airway obstruction, sedatives and anesthetics, respiratory distress syndrome, and chronic obstructive pulmonary disease. Causes of primary respiratory alkalosis (decreased PCO_2) are hypoxia (resulting in hyperventilation) due to chronic heart failure, edema and neurologic disorders, and mechanical hyperventilation.

TEST PRINCIPLE

Measured:

The i-STAT System uses direct (undiluted) electrochemical methods. Values obtained by direct methods may differ from those obtained by indirect (diluted) methods. [2]

Sodium (Na), Potassium (K)
The respective analyte is measured by ion-selective electrode potentiometry. In the calculation of results, concentration is related to potential through the Nernst equation.

Hematocrit (Hct)
Hematocrit is determined conductometrically. The measured conductivity, after correction for electrolyte concentration, is inversely related to the hematocrit.

pH
pH is measured by direct potentiometry. In the calculation of results for pH, concentration is related to potential through the Nernst equation.

PO_2
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 proportional to the dissolved oxygen concentration.

***P*CO$_2$**

***P*CO$_2$ is measured by direct potentiometry. In the calculation of results for ***P*CO$_2$, concentration is related to potential through the Nernst equation.

Temperature "Correction" Algorithm

pH, ***P*O$_2$, and ***P*CO$_2$ are temperature-dependent quantities and are measured at 37°C. The pH, ***P*O$_2$, and ***P*CO$_2$ readings at a body temperature other than 37°C can be 'corrected' by entering the patient's temperature on the chart page of the analyzer. In this case, blood gas results will be displayed at both 37°C and the patient's temperature.

pH, ***P*O$_2$, and ***P*CO$_2$ at the patient's temperature (T_p) are calculated as follows [3]:

$$pH(T_p) = pH - 0.0147(T_p - 37) + 0.0065(7.4 - pH)(T_p - 37)$$

$$PO_2(T_p) = PO_2 \times 10^{\frac{5.49\times10^{-11} PO_2^{3.88} + 0.071}{9.72\times10^{-9} PO_2^{3.88} + 2.30}(T_p - 37)}$$

$$PCO_2(T_p) = PCO_2 \times 10^{0.019(T_p - 37)}$$

Calculated:

HCO$_3$, TCO$_2$, and BE

- HCO$_3$ (bicarbonate), the most abundant buffer in the blood plasma, is an indicator of the buffering capacity of blood. Regulated primarily by the kidneys, HCO$_3$ is the metabolic component of acid-base balance.
- TCO$_2$ is a measure of carbon dioxide which exists in several states: CO$_2$ in physical solution or loosely bound to proteins, bicarbonate (HCO$_3$) or carbonate (CO$_3$) anions, and carbonic acid (H$_2$CO$_3$). Measurement of TCO$_2$ as part of an electrolyte profile is useful chiefly to evaluate HCO$_3$ concentration. TCO$_2$ and HCO$_3$ are useful in the assessment of acid-base imbalance (along with pH and ***P*CO$_2$) and electrolyte imbalance.
- The calculated TCO$_2$ provided by the i-STAT System is determined from the measured and reported values of pH and ***P*CO$_2$ according to a simplified and standardized form of the Henderson-Hasselbalch equation. [3]
- This calculated TCO$_2$ measurement is metrologically traceable to the i-STAT pH and ***P*CO$_2$ measurements, which are in turn traceable to primary standard reference materials for pH and ***P*CO$_2$. Like all calculated parameters reported by the i-STAT System, the user can independently determine TCO$_2$ values from the reported pH and ***P*CO$_2$ measurements using a combination of the equation for HCO$_3$ given in the ***P*CO$_2$.
- Base excess of the extracellular fluid (ECF) or standard base excess is defined as the concentration of titratable base minus the concentration of titratable acid when titrating the average ECF (plasma plus interstitial fluid) to an arterial plasma pH of 7.40 at ***P*CO$_2$ of 40 mmHg at 37 °C. Excess concentration of base in the average ECF remains virtually constant during acute changes in the ***P*CO$_2$ and reflects only non-respiratory component of pH-disturbances.

When a cartridge includes sensors for both pH and PCO_2, bicarbonate (HCO_3), total carbon dioxide (TCO_2) and base excess (BE) are calculated. [3]

$$\log HCO_3 = pH + \log PCO_2 - 7.608$$
$$TCO_2 = HCO_3 + 0.03PCO_2$$
$$BE_{ecf} = HCO_3 - 24.8 + 16.2(pH-7.4)$$
$$BE_b = (1 - 0.014*Hb) * [\ HCO3 - 24.8 + (1.43 * Hb + 7.7) * (pH - 7.4)\ ]$$

sO_2

- sO_2 (oxygen saturation) is the amount of oxyhemoglobin expressed as a fraction of the total amount of hemoglobin able to bind oxygen (oxyhemoglobin plus deoxyhemoglobin).
- sO_2 is calculated from measured PO_2 and pH and from HCO_3 calculated from measured PCO_2 and pH. However, this calculation assumes normal affinity of oxygen for hemoglobin. It does not take into account erythrocyte diphosphoglycerate (2,3-DPG) concentrations which affect the oxygen dissociation curve. The calculation also does not take into account the effects of fetal hemoglobin or dysfunctional hemoglobins (carboxy-, met-, and sulfhemoglobin). Clinically significant errors can result from incorporation of such an estimated sO_2 value for oxygen saturation in further calculations, such as shunt fraction, or by assuming the value obtained is equivalent to fractional oxyhemoglobin.

$$sO_2 = 100 \frac{(X^3 + 150X)}{X^3 + 150X + 23400}$$

where $X = PO_2 \bullet 10^{(0.48(pH-7.4)-0.0013(HCO_3-25))}$

Hemoglobin

The i-STAT System provides a calculated hemoglobin result which is determined as follows [4]:
hemoglobin (g/dL) = hematocrit (% PCV) x 0.34
hemoglobin (g/dL) = hematocrit (decimal fraction) x 34
To convert a hemoglobin result from g/dL to mmol/L, multiply the displayed result by 0.621. The calculation of hemoglobin from hematocrit assumes a normal MCHC.

See below for information on factors affecting results. Certain substances, such as drugs, may affect analyte levels in vivo. [5] If results appear inconsistent with the clinical assessment, the patient sample should be retested using another cartridge.

REAGENTS

Contents
Each i-STAT cartridge contains one reference electrode, sensors for the measurement of specific analytes ad a buffered aqueous calibrant solution that contains known concentrations of analytes and preservatives. A list of reactive ingredients relevant for the i-STAT EG6+ cartridge is indicated below:

Sensor	Reactive Ingredient	Biological Source	Minimum Quantity
Na	Sodium (Na^+)	N/A	121 mmol/L
K	Potassium (K^+)	N/A	3.6 mmol/L
pH	Hydrogen Ion (H^+)	N/A	6.66 pH
PCO_2	Carbon Dioxide (CO_2)	N/A	25.2 mmHg

Warnings and Precautions

- For *in vitro* diagnostic use.
- Cartridges are intended for single-use only. Do not reuse.
- Refer to the i-STAT 1 System Manual for all warnings and precautions.

Storage Conditions

- Refrigerated at 2-8°C (35-46°F) until expiration date.
- Room Temperature at 18-30°C (64-86°F). Refer to the cartridge box for shelf life.

INSTRUMENTS

The i-STAT EG6+ cartridge is intended for use with the i-STAT 1 analyzer REF 04P75-01 (Model 300-G) and REF 03P75-06 (Model 300W).

SPECIMEN COLLECTION AND PREPARATION FOR ANALYSIS

Specimen Types

Arterial, venous or capillary whole blood.
Sample Volume: 95 µL

Blood Collection Options and Test Timing (time from collection to cartridge fill)

Analyte	Syringes	Test Timing	Evacuated Tubes	Test Timing	Capillary Tubes	Test Timing
pH ***P***CO_2 ***P***O_2	Without anticoagulant	3 minutes	Without anticoagulant	3 minutes	With balanced heparin anticoagulant or lithium heparin if labeled for the measurement of electrolytes	3 minutes
	With balanced heparin anticoagulant or lithium heparin anticoagulant (syringe must be filled per manufacturer's recommendation) • Maintain anaerobic conditions. • Remix thoroughly before filling cartridge.	10 minutes	With lithium heparin anticoagulant (tubes must be filled per manufacturer's recommendation) • Maintain anaerobic conditions. • Remix thoroughly before filling cartridge.	10 minutes		
Sodium Potassium Hematocrit	Without anticoagulant	3 minutes	Without anticoagulant	3 minutes	With balanced heparin anticoagulant or lithium heparin if labeled for the measurement of electrolytes	3 minutes
	With balanced heparin anticoagulant or lithium heparin anticoagulant (syringe must be filled per manufacturer's recommendation) • Remix	30 minutes	With lithium heparin anticoagulant (tubes must be filled per manufacturer's recommendation) • Remix thoroughly	30 minutes		

Analyte	Syringes	Test Timing	Evacuated Tubes	Test Timing	Capillary Tubes	Test Timing
	thoroughly before filling cartridge.		before filling cartridge.			

PROCEDURE FOR CARTRIDGE TESTING

Each cartridge is sealed in a foil pouch for protection during storage--do not use if pouch has been punctured.

- A cartridge should not be removed from its protective pouch until it is at room temperature (18-30 °C or 64-86 °F). For best results, the cartridge and analyzer should be at room temperature.
- Since condensation on a cold cartridge may prevent proper contact with the analyzer, allow refrigerated cartridges to equilibrate at room temperature for 5 minutes for a single cartridge and 1 hour for an entire box before use.
- Use a cartridge immediately after removing it from its protective pouch. Prolonged exposure may cause a cartridge to fail a Quality Check.
- Do not return unopened, previously refrigerated cartridges to the refrigerator.
- Cartridges may be stored at room temperature for the time frame indicated on the cartridge box.

Filling and Sealing the Cartridge (after cartridge has been equilibrated and blood sample has been collected)

1. Place the cartridge on a flat surface.
2. Mix the sample thoroughly. Invert a lithium heparin blood collection tube at least 10 times. If sample was collected into a syringe, invert syringe for 5 seconds then roll the syringe between the palms (hands parallel to the ground) for 5 seconds, flip and roll for an additional 5 seconds. The blood in the hub of the syringe will not mix, therefore expelling 2 drops before filling a cartridge is desired. Note that it may be difficult to properly mix a sample in a 1.0 mL syringe.
3. Fill the cartridge immediately after mixing. Direct the hub of syringe or tip of the transfer device (capillary tube, pipette, or dispensing tip) into the sample well of the cartridge.
4. Slowly dispense sample into the sample well until the sample reaches the fill mark indicated on the cartridge. Cartridge is properly filled when the sample reaches the 'fill to' mark and a small amount of sample is in the sample well. The sample should be continuous, no bubbles or breaks (see System Manual for details).
5. Fold the snap closure of the cartridge over the sample well.

Performing Patient Analysis

1. Press the power button to turn on the handheld.
2. Press 2 for *i-STAT Cartridge*.
3. Follow the handheld prompts.
4. Scan the lot number on the cartridge pouch.
5. Continue normal procedures for preparing the sample, and filling and sealing the cartridge.
6. Push the sealed cartridge into the handheld port until it clicks into place. Wait for the test to complete.
7. Review the results.

For additional information for cartridge testing, refer to the i-STAT 1 System Manual located at www.pointofcare.abbott.

Analysis Time
Approximately 130–200 seconds

Quality Control

The i-STAT quality control regimen comprises four aspects, with a system design that reduces the opportunity for error, including:

1. A series of automated, on-line quality measurements that monitors the sensors, fluidics, and instrumentation each time a test is performed.
2. A series of automated, on-line procedural checks that monitors the user each time a test is performed.
3. Liquid materials are available to be used to verify the performance of a batch of cartridges when they are first received or when storage conditions are in question. The performance of this procedure is not a manufacturer's system instruction.
4. Traditional quality control measurements that verify the instrumentation using an independent device, which simulates the characteristics of the electrochemical sensors in a way that stresses the performance characteristics of the instrumentation.

For additional information on Quality Control, refer to the i-STAT 1 System Manual located at www.pointofcare.abbott.

Calibration Verification

Calibration Verification is a procedure intended to verify the accuracy of results over the entire measurement range of a test. The performance of this procedure is not a manufacturer's system instruction. However, it may be required by regulatory or accreditation bodies. While the Calibration Verification Set contains five levels, verification of the measurement range could be accomplished using the lowest, highest and mid-levels.

EXPECTED VALUES

TEST	UNITS *	REPORTABLE RANGE	REFERENCE RANGE (arterial)	(venous)
MEASURED				
Sodium/Na	mmol/L(mEq/L)	100-180	138-146 [6]	
Potassium/K	mmol/L(mEq/L)	2.0–9.0	3.5–4.9 [6] **	
Hematocrit/Hct	% PCV ***	15–75	38–51 [6] ****	
	Fraction	0.15–0.75	0.38–0.51 [6]	
pH		6.50 - 8.20	7.35 - 7.45 [7]	7.31 -7.41******
PO_2	mmHg	5 - 800	80 - 105 [6] *****	
	kPa	0.7 – 106.6	10.7 - 14.0 [6] *****	
PCO_2	mmHg	5 - 130	35 - 45 [7]	41 - 51
	kPa	0.67 – 17.33	4.67 - 6.00	5.47 - 6.80

CALCULATED				
Hemoglobin/Hb	g/dL	5.1–25.5	12–17 [6]	
	g/L	51–255	120–170 [6]	
	mmol/L	3.2–15.8	7–11 [6]	
Bicarbonate/ HCO_3	mmol/L (mEq/L)	1.0 – 85.0	22 – 26******	23 – 28******
TCO_2	mmol/L (mEq/L)	5 - 50	23 - 27	24 - 29
Base Excess/ BE	mmol/L (mEq/L)	(-30) – (+30)	(-2) – (+3) [7]	(-2) – (+3) [7]
sO_2	%	0-100	95 - 98	

* The i-STAT System can be configured with the preferred units. Not applicable for pH test.

** The reference range for potassium has been reduced by 0.2 mmol/L from the range cited in Reference 6 to account for the difference in results between serum and plasma results.

*** PCV, packed cell volume.

**** The reference ranges for hematocrit and hemoglobin span both female and male populations

***** The reference ranges shown are for a healthy population. Interpretation of blood gas measurements depend on the underlying condition (e.g., patient temperature, ventilation, posture and circulatory status).

****** Calculated from Siggard-Andersen nomogram [1].

Unit Conversion

- **Hematocrit (Hct):** To convert a result from % PCV (packed cell volume) to fraction packed cell volume, divide the % PCV result by 100. For the measurement of hematocrit, the i-STAT System can be customized to agree with methods calibrated by the microhematocrit reference method using either K_3EDTA or K_2EDTA anticoagulant. Mean cell volumes of K_3EDTA anticoagulated blood are approximately 2–4% less than K_2EDTA anticoagulated blood. While the choice of anticoagulant affects the microhematocrit method to which all hematocrit methods are calibrated, results from routine samples on hematology analyzers are independent of the anticoagulant used. Since most clinical hematology analyzers are calibrated by the microhematocrit method using K_3EDTA anticoagulant, the i-STAT System default customization is K_3EDTA.
- ***P*O_2 and *P*CO_2:** To convert *P*O_2 and *P*CO_2 results from mmHg to kPa, multiple the mmHg value by 0.133.

The reference ranges programmed into the analyzer and shown above are intended to be used as guides for the interpretation of results. Since reference ranges may vary with demographic factors such as age, gender and heritage, it is recommended that reference ranges be determined for the population being tested.

METROLOGICAL TRACEABILITY

The measured analytes in the i-STAT EG6+ cartridge are traceable to the following reference materials or methods. The i-STAT System controls and calibration verification materials are validated for use only with the i-STAT System and assigned values may not be commutable with other methods.

Sodium (Na) and Potassium (K)

The respective analyte values assigned to i-STAT System controls and calibration verification materials are traceable to the U.S. National Institute of Standards and Technology (NIST) standard reference material SRM956.

Hematocrit (Hct)

The i-STAT System test for hematocrit measures packed red blood cell volume fraction in arterial, venous, or capillary whole blood (expressed as the % packed cell volume) for *in vitro* diagnostic use. Hematocrit values assigned to i-STAT System working calibrators are traceable to the Clinical and Laboratory

Standards Institute (CLSI) H7-A3 procedure for determining packed cell volume by the microhematocrit method. [8]

pH

The i-STAT System test for pH measures the hydrogen ion amount-of-substance concentration in the plasma fraction of arterial, venous, or capillary whole blood (expressed as the negative logarithm of the relative molal hydrogen ion activity) for *in vitro* diagnostic use. pH values assigned to i-STAT System controls and calibration verification materials are traceable to the U.S. National Institute of Standards and Technology (NIST) standard reference materials SRMs 186-I, 186-II, 185, and 187.

***P*O₂**

The i-STAT System test for oxygen partial pressure measures oxygen partial pressure in arterial, venous, or capillary whole blood (dimension kPa) for *in vitro* diagnostic use. PO_2 values assigned to i-STAT System controls and calibration verification materials are traceable to U.S. National Institute of Standards and Technology (NIST) standard reference materials via commercially available certified specialty medical gas standards.

***P*CO₂**

The i-STAT System test for carbon dioxide partial pressure measures carbon dioxide partial pressure in arterial, venous, or capillary whole blood (dimension kPa) for *in vitro* diagnostic use. PCO_2 values assigned to i-STAT System controls and calibration verification materials are traceable to U.S. National Institute of Standards and Technology (NIST) standard reference materials via commercially available certified specialty medical gas standards.

Additional information regarding metrological traceability is available from Abbott Point of Care Inc.

PERFORMANCE CHARACTERISTICS

The typical performance data summarized below was collected in healthcare facilities by healthcare professionals trained in the use of the i-STAT System and comparative methods.

Precision

Precision data were collected in multiple sites and tested as follows: Duplicates of each control fluid were tested in the morning and in the afternoon on five days for a total of 20 replicates. The averaged statistics are presented below.

Test	Units	Aqueous Control	Mean	SD (Standard Deviation)	CV (%) [Coefficient of Variation (%)]
Na	mmol/L or mEq/L	Level 1	120.0	0.46	0.4
		Level 3	160.0	0.53	0.3
K	mmol/L or mEq/L	Level 1	2.85	0.038	1.3
		Level 3	6.30	0.039	0.6
Hct	% PCV (packed cell volume)	Low	30.0	0.44	1.5
		High	49.0	0.50	1.0
pH		Level 1	7.165	0.005	0.08
		Level 3	7.656	0.003	0.04
PO_2	mmHg	Level 1	65.1	3.12	4.79
		Level 3	146.5	6.00	4.10
PCO_2	mmHg	Level 1	63.8	1.57	2.5
		Level 3	19.6	0.40	2.0

Method Comparison

Method comparison data was collected using CLSI guideline EP9-A. [9]

Deming regression analysis [10] was performed on the first replicate of each sample. In the method comparison table, n is the number of specimens in the data set, Sxx and Syy refer to estimates of imprecision based on the duplicates of the comparative and the i-STAT methods respectively, Sy.x is the standard error of the estimate, and r is the correlation coefficient.*

Method comparisons will vary from site to site due to differences in sample handling, comparative method calibration and other site-specific variables.

* The usual warning relating to the use of regression analysis is summarized here as a reminder. For any analyte, "if the data is collected over a narrow range, the estimate of the regression parameters are relatively imprecise and may be biased. Therefore, predictions made from these estimates may be invalid." [10] The correlation coefficient, r, can be used as a guide to assess the adequacy of the comparative method range in overcoming this problem. As a guide, the range of data can be considered adequate if r>0.975.

Sodium/Na (mmol/L or mEq/L)		Beckman Synchron CX®3	Kodak Ektachem™ 700	Nova STAT Profile® 5
Venous blood samples were collected in lithium heparin Vacutainer® tubes and analyzed in duplicate on the i-STAT System. A portion of the specimen was centrifuged and the separated plasma was analyzed in duplicate on comparative methods within 20 minutes of collection.	n	189	142	192
	Sxx	0.74	0.52	0.54
	Syy	0.53	0.58	0.53
	Slope	1.00	0.98	0.95
	Int't	-0.11	3.57	5.26
	Sy.x	1.17	1.04	1.53
	Xmin	126	120	124
	Xmax	148	148	148
	r	0.865	0.937	0.838

Potassium/K (mmol/L or mEq/L)		Beckman Synchron CX®3	Kodak Ektachem™ 700	Nova STAT Profile® 5
Venous blood samples were collected in lithium heparin Vacutainer® tubes and analyzed in duplicate on the i-STAT System. A portion of the specimen was centrifuged and the separated plasma was analyzed in duplicate on comparative methods within 20 minutes of collection.	n	189	142	192
	Sxx	0.060	0.031	0.065
	Syy	0.055	0.059	0.055
	Slope	0.97	1.06	0.99
	Int't	0.02	-0.15	-0.01
	Sy.x	0.076	0.060	0.112
	Xmin	2.8	3.0	2.8
	Xmax	5.7	9.2	5.8
	r	0.978	0.993	0.948

Hematocrit/Hct (% PCV) (% packed cell volume)		Coulter® S Plus	Nova STAT Profile® 5	Abbott Cell-Dyn 4000	Sysmex SE9500
Venous blood samples, collected in lithium heparin Vacutainer® tubes, were analyzed in duplicate on the i-STAT System and on the comparative methods for hematocrit within 20 minutes of collection.	n	142	192	29	29
	Sxx	0.50	0.46	0.41	0.53
	Syy	1.09	1.31	0.77	0.76
	Slope	0.98	1.06	1.06	1.11
	Int't	1.78	-3.98	-1.42	-4.19
	Sy.x	2.03	2.063	1.13	0.98
	Xmin	18	21	19	24

	Xmax	51	50	46	47
	r	0.952	0.932	0.993	0.980

pH		**IL BGE**	**Radiometer ICA 1**	**Nova STAT Profile 5**	**Radiometer ABL500**
Venous blood samples were collected in evacuated tubes and arterial samples were collected in blood gas syringes with lithium heparin anticoagulant. All sample were analyzed in duplicate on the i-STAT System and on the comparative methods within 10 minutes of each other. Arterial blood samples were collected from hospital patients in 3 mL blood gas syringes and were analyzed in duplicate on the i-STAT System and the comparative method within 5 minutes of each other.	n	62	47	57	45
	Sxx	0.005	0.011	0.006	0.004
	Syy	0.009	0.008	0.008	0.008
	Slope	0.974	1.065	1.058	1.0265
	Int't	0.196	-0.492	-0.436	-0.1857
	Sy.x	0.012	0.008	0.010	0.0136
	Xmin	7.210	7.050	7.050	----
	Xmax	7.530	7.570	7.570	----
	r	0.985	0.990	0.9920	0.986

Oxygen Partial Pressure/*P*O_2 (mmHg)		**Radiometer ABL500**	**Radiometer ABL700**	**Bayer 845**
Arterial blood samples were collected from hospital patients in 3 cc blood gas syringes and were analyzed in duplicate on the i-STAT System and the comparative method within 5 minutes of each other.	n	45	29	30
	Sxx	3.70	2.04	3.03
	Syy	2.78	2.64	3.28
	Slope	1.023	0.962	1.033
	Int't	-2.6	1.2	-2.9
	Sy.x	2.52	3.53	3.44
	Xmin	----	39	31
	Xmax	----	163	185
	r	0.996	0.990	0.996

Carbon Dioxide Partial Pressure/ *P*CO_2 (mmHg)		**IL BGE**	**Radiometer ABL500**
Venous blood samples were collected in blood gas syringes. All samples were analyzed in duplicate on the i-STAT System and on the comparative methods within 10 minutes of each other. Arterial blood samples were collected from hospital patients in 3 cc blood gas syringes and were analyzed in duplicate on the i-STAT System and the comparative method within 5 minutes of each other.	n	62	29
	Sxx	0.69	0.74
	Syy	1.24	0.53
	Slope	1.003	1.016
	Int't	-0.8	1.1
	Sy.x	1.65	0.32
	Xmin	30.4	28
	Xmax	99.0	91
	r	0.989	0.999

FACTORS AFFECTING RESULTS

The following substances were evaluated in plasma for relevant analytes at the test concentrations recommended in CLSI guideline EP7-A2 [11] unless otherwise noted. For those identified as an interferant the interference is described.

Substance	Test Concentration (mmol/L)	Analyte	Interference (Yes/No)	Comment
Acetaminophen	1.32	Na	No	
		K	No	
Acetylcysteine	10.2	Na	No	
		K	No	
Ascorbate	0.34	Na	No	
		K	No	
Bromide	37.5	Na	Yes	Increased results. Use another method.
		K	Yes	Increased results and rate of star (***) outs. Use another method.
		Hct	Yes	Increased rate of star (***) outs.
Bromide (therapeutic)	2.5 [12 13 14]	Na	No	
		K	No	
		Hct	No	
β-Hydroxybutyrate	6.0 [15]	Na	No	
		K	No	
Lactate	6.6	Na	No	
		K	No	
Magnesium Chloride	1.0	Na	No	
		K	No	
Nithiodote (Sodium thiosulfate)	16.7 [16]	Na	Yes	Increased results.
		K	Yes	Decreased results.
Salicylate	4.34	Na	No	
		K	No	

The degree of interference at concentrations other than those reported above might not be predictable. It is possible that interfering substances other than those tested may be encountered.

- Relevant comments regarding interference of Bromide and Nithiodote are noted below:
  - Bromide has been tested at two levels: the CLSI recommended level and a therapeutic plasma concentration level of 2.5 mmol/L. The latter is the peak plasma concentration associated with halothane anesthesia, in which bromide is released. APOC has not identified a therapeutic condition that would lead to levels consistent with the CLSI recommended level.
  - Nithiodote (sodium thiosulfate) has been shown to interfere with sodium and potassium results at 16.7 mmol/L. Nithiodote (sodium thiosulfate) is indicated for the treatment of acute cyanide poisoning. The journal article titled “Falsely increased chloride and missed anion gap elevation during treatment with sodium thiosulfate” indicated that sodium thiosulfate could be used in the treatment of calciphylaxis indicating that “the highest concentration likely to be seen in plasma [is] after infusion of a 12.5 g dose of sodium thiosulfate pentahydrate. Assuming that the 12.5 g dose of sodium thiosulfate pentahydrate is distributed in a typical blood volume of 5 L with a hematocrit of 40%, the peak sodium thiosulfate plasma concentration expected is 16.7 mmol/L.” [16]

OTHER FACTORS AFFECTING RESULTS

Factor	Analyte	Effect
Sodium heparin	Na	Sodium heparin may increase sodium results up to 1 mmol/L.[17]
Exposing the sample to air	***P***O_2	Exposure of the sample to air will cause an increase in ***P***O_2 when values are below 150 mmHg and a decrease in ***P***O_2 when values are above 150 mmHg (approximate ***P***O_2 of room air).
	pH ***P***CO_2 HCO_3 TCO_2	Exposing the sample to air allows CO_2 to escape which causes ***P***CO_2 to decrease and pH to increase and HCO_3 and TCO_2 to be under-estimated.
Venous stasis	pH	Venous stasis (prolonged tourniquet application) and forearm exercise may decrease pH due to localized production of lactic acid.
Line draw	Hct	Low hematocrit results can be caused by contamination of flush solutions in arterial or venous lines. Back flush a line with a sufficient amount of blood to remove intravenous solutions, heparin, or medications that may contaminate the sample. Five to six times the volume of the catheter, connectors, and needle is recommended.
Hemodilution	Na pH	Hemodilution of the plasma by more than 20% associated with priming cardiopulmonary bypass pumps, plasma volume expansion or other fluid administration therapies using certain solutions may cause clinically significant error on sodium, chloride, ionized calcium and pH results. These errors are associated with solutions that do not match the ionic characteristics of plasma. To minimize these errors when hemodiluting by more than 20%, use physiologically balanced multi-electrolyte solutions containing low-mobility anions (e.g. gluconate).
Cold temperature	***P***O_2	Do not ice samples before testing as ***P***O_2 results may be falsely elevated in cold samples. Do not use a cold cartridge as ***P***O_2 results may be falsely decreased if the cartridge is cold.
	K	Potassium values will increase in iced specimens.
Allowing blood to stand (without exposure to air)	K	If heparinized whole blood is allowed to stand before testing, potassium values will first decrease slightly, then increase over time.
	pH	pH decreases on standing anaerobically at room temperature at a rate of 0.03 pH units per hour.[1]
	PO_2	Standing anaerobically at room temperature will decrease ***P***O_2 at a rate of 2–6 mmHg per hour.[1]
	PCO_2	Standing anaerobically at room temperature will increase ***P***CO_2 by approximately 4 mmHg per hour.
	HCO_3 TCO_2	Allowing blood to stand (without exposure to air) before testing allows ***P***CO_2 to increase and pH to decrease, which will cause HCO_3 and TCO_2 to be over-estimated, due to metabolic processes.
Sample type	K	Serum Potassium results may be 0.1 to 0.7 mmol/L higher than Potassium results from anticoagulated samples due to the release of Potassium from platelets[1] and red blood cells during the clotting process.
Sample mixing	Hct	Samples from 1 mL syringes should not be used to determine hematocrit if testing is delayed.
Hemolysis	K	Potassium values obtained from skin puncture samples may vary due to

<table>
<tr><th>Factor</th><th>Analyte</th><th>Effect</th></tr>
<tr><td></td><td></td><td>hemolysis or an increase in tissue fluid from improper technique during the collection procedure.</td></tr>
<tr><td rowspan="3">Under fill or partial draw</td><td>PCO_2</td><td rowspan="3">The use of partial draw tubes (evacuated tubes that are adjusted to draw less than the tube volume, e.g., a 5 mL tube with enough vacuum to draw only 3 mL) is not recommended due to the potential for decreased PCO_2, HCO_3 and TCO_2 values. Underfilling blood collection tubes may also cause decreased PCO_2, HCO_3 and TCO_2 results. Care must be taken to eliminate “bubbling” of the sample with a pipette when filling a cartridge to avoid the loss of CO_2 in the blood.</td></tr>
<tr><td>HCO_3</td></tr>
<tr><td>TCO_2</td></tr>
<tr><td>Method of calculation</td><td>sO_2</td><td>Calculated sO_2 values from a measured PO_2 and an assumed oxyhemoglobin dissociation curve may differ significantly from the direct measurement. [3]</td></tr>
<tr><td>Clinical conditions</td><td>HCO_3</td><td>Causes of primary metabolic acidosis (decrease calculated HCO_3) are ketoacidosis, lactate acidosis (hypoxia), and diarrhea. Causes of primary metabolic alkalosis (increase calculated HCO_3) are vomiting and antacid treatment.</td></tr>
<tr><td>Erythrocyte sedimentation rate</td><td>Hct</td><td>The measurement of certain blood samples with high erythrocyte sedimentation rates (ESR) may be affected by analyzer angle. While testing blood samples, beginning 90 seconds after the cartridge is inserted, the analyzer should remain level until a result is obtained. A level surface includes running the handheld in the downloader/ recharger.
Hematocrit results can be affected by the settling of red blood cells in the collection device. The best way to avoid the effect of settling is to test the sample immediately. If there is a delay in testing of a minute or more, the sample must be remixed thoroughly.</td></tr>
<tr><td>White Blood Cell Count (WBC)</td><td>Hct</td><td>Grossly elevated white blood cell counts may increase results.</td></tr>
<tr><td>Lipids</td><td>Hct</td><td>Abnormally high lipids may increase results. Interference from lipids will be about two thirds the size of the interference from protein.</td></tr>
<tr><td>Total Protein</td><td>Hct</td><td>Hematocrit results are affected by the level of total protein as follows:
<table>
<tr><th>Displayed Result</th><th>Total Protein (TP) < 6.5 g/dL</th><th>Total Protein (TP) > 8.0 g/dL</th></tr>
<tr><td>HCT < 40% PCV</td><td>Hct decreased by ~1% PCV for each decrease of 1 g/dL TP</td><td>Hct increased by ~1% PCV for each increase of 1 g/dL TP</td></tr>
<tr><td>HCT > 40% PCV</td><td>Hct decreased by ~0.75 % PCV for each decrease of 1 g/dL TP</td><td>Hct increased by ~0.75 % PCV for each increase of 1 g/dL TP</td></tr>
</table>
Total protein levels may be low in neonatal and burn patient populations, as well as in additional clinical populations listed in Statland. [6] Total protein levels may also be decreased in patients undergoing cardiopulmonary bypass (CPB) or extracorporeal membrane oxygenation (ECMO) and with patients receiving large volumes of saline-based intravenous (IV) fluids. Care should be taken when using hematocrit results from patients with total protein levels below the adult reference range (6.5 to 8 g/dL).
The CPB sample type can be used to correct the hematocrit result for the dilutional effect of the pump prime in cardiovascular surgery. The CPB algorithm assumes that cells and plasma are diluted equally and that the pump priming solution has no added albumin or other colloid or packed red blood cells. Since perfusion practices vary, it is recommended that each practice verify the use of the CPB sample type and the length of time</td></tr>
</table>

Factor	Analyte	Effect
		in which the CPB sample type should be used during the recovery period. Note that for hematocrit values above 30% PCV, the CPB correction is ≤ 1.5% PCV; the size of the correction at this level should not impact transfusion decisions.
Sodium	Hct	The sample electrolyte concentration is used to correct the measured conductivity prior to reporting hematocrit results. Factors that affect sodium will therefore also affect hematocrit.
Propofol (Diprivan®) or thiopental sodium	$\boldsymbol{P}CO_2$	The use of EG6+ cartridge is recommended, which is free from clinically significant interference at all relevant therapeutic doses.
$\boldsymbol{P}O_2$ sensitivity	$\boldsymbol{P}CO_2$	In patient samples where the $\boldsymbol{P}O_2$ is > 100 mmHg above the normal range (80-105 mmHg), an increase in $\boldsymbol{P}CO_2$ of approximately 1.5 mmHg (with a range of 0.9 to 2.0 mmHg) may be observed for every 100 mmHg increase in $\boldsymbol{P}O_2$. For example, if an oxygenated patient has a measured $\boldsymbol{P}O_2$ of 200 mmHg, and a normal $\boldsymbol{P}O_2$ is 100 mmHg, the impact to the $\boldsymbol{P}CO_2$ result may be increased by approximately 1.5 mmHg.

KEY TO SYMBOLS

Symbol	Definition/Use
2	2 months room temperature storage at 18-30ºC.
	Use by or expiration date. An expiration date expressed as YYYY-MM-DD means the last day the product can be used.
LOT	Manufacturer's lot number or batch code. The lot number or batch will appear adjacent to this symbol.
Σ	Sufficient for <n> tests.
EC REP	Authorized representative for Regulatory Affairs in the European Community.
	Temperature limitations. The upper and lower limits for storage are adjacent to upper and lower arms.
REF	Catalog number, list number, or reference.
	Do not reuse.
	Manufacturer.
	Consult instructions for use or see System Manual for instructions.
IVD	*In vitro* diagnostic medical device
CE	Compliance to the European directive on *in vitro* diagnostic devices (98/79/EC).
Rx ONLY	For prescription use only.

Additional Information: To obtain additional product information and technical support, refer to the company website at www.pointofcare.abbott.

References

1. Pruden EL, Siggard-Andersen O, Tietz NW. Blood Gases and pH. In: C.A. Burtis and E.R. Ashwood, ed. *Tietz Textbook of Clinical Chemistry*. Second Edition ed. Philadelphia: W.B. Saunders Company; 1994.
2. Tietz NW, Pruden EL, Siggaard-Andersen O. Electrolytes. In: C.A. Burtis and E.R. Ashwood, ed. *Tietz Textbook of Clinical Chemistry*. Second Edition ed. Philadelphia: W.B. Saunders Company; 1994.
3. CLSI. *Blood Gas and pH Analysis and Related Measurements; Approved Guideline*. Wayne, Pennsylvania; 2001.
4. Evaluation of Formed Elements of Blood. In: Bower JD, Ackerman PG, Toto G, eds. *Clinical Laboratory Methods*. St. Louis: The C.V. Mosby Company; 1974.
5. Young DS. *Effects of Drugs on Clinical Laboratory Tests*. 3rd ed. ed. Washington, DC: American Association of Clinical Chemistry; 1990.
6. Statland BE. *Clinical Decision Levels for Lab Tests*. Oradell, NJ: Medical Economic Books; 1987.
7. Painter PC, Cope JY, Smith JL. Reference Ranges, Table 41–20. In: C.A. Burtis and E.R. Ashwood, ed. *Tietz Textbook of Clinical Chemistry*. Second Edition ed. Philadelphia: W.B. Saunders Company; 1994.
8. CLSI. *Procedure for Determining Packed Cell Volume by the Microhematocrit Method; Approved Standard-Third Edition*. Wayne, PA: Clinical and Laboratory Standards Institute; 2000.
9. CLSI. Method Comparison and Bias Estimation Using Patient Samples; Approved Guideline. *CLSI document EP9-A*. 1995.
10. Cornbleet PJ, Gochman N. Incorrect least-squares regression coefficients in method-comparison analysis. *Clinical Chemistry*. 1979;25(3).
11. Clinical and Laboratory Standards Institute. Interference Testing in Clinical Chemistry; Approved Guideline—Second Edition. *CLSI document EP7-A2*. 2005.
12. Kharasch ED, Hankins D, Mautz D, Thummel KE. Identification of the enzyme responsible for oxidative halothane metabolism: Implications for prevention of halothane hepatitis. *Lancet*. May 1996;347(9012):1367-1371.
13. Morrison JE, Friesen RH. Elevated serum bromide concentrations following repeated halothane anaesthesia in a child. *Canadian Journal of Anaesthesia*. October 1990;37(7):801-803.
14. Hankins DC, Kharasch ED. Determination of the halothane metabolites trifluoroacetic acid and bromide in plasma and urine by ion chromatography. *Journal of Chromatography B: Biomedical Applications*. May 1997;692(2):413-418.
15. Charles RA, Bee YM, Eng PHK, Goh SY. Point-of-care blood ketone testing: Screening for diabetic ketoacidosis at the emergency department. *Singapore Medical Journal*. November 2007;48(11):986-989.
16. Wendroth SM, Heady TN, Haverstick DM, et al. Falsely increased chloride and missed anion gap elevation during treatment with sodium thiosulfate. *Clinica Chimica Acta*. April 2014;431:77-79.

17. Tips on Specimen Collection. In: Mark Zacharia, ed. *Vol 1. Monograph of Medical Laboratory Observer's "Tips from the Clinical Experts"*. Montvale NJ: Medical Economics in collaboration with Becton, Dickinson and Company; 1997.

Abbott Point of Care Inc.
100 and 200 Abbott Park Road
Abbott Park, IL 60064 • USA

EC REP

EMERGO EUROPE
Prinsessegracht 20
2514 AP The Hague
The Netherlands

CE IVD

Rx ONLY