i-STAT CG8+ Cartridge

Intended for US only

NAME

i-STAT CG8+ Cartridge

INTENDED USE

The i-STAT CG8+ cartridge with the i-STAT 1 System is intended for use in the *in vitro* quantification of sodium, potassium, ionized calcium, glucose, hematocrit, pH, partial pressure of oxygen (***P***O_2), and partial pressure of carbon dioxide (***P***CO_2) in arterial or venous whole blood in point of care or clinical laboratory settings.

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Test	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.
Ionized Calcium (iCa)	Ionized calcium measurements are used in the diagnosis, monitoring, and treatment of conditions including, but not limited to, parathyroid disease, a variety of bone diseases, chronic renal disease, tetany, and disturbances related to surgical and intensive care.
Glucose (Glu)	Glucose measurements are used in the diagnosis, monitoring, and treatment of carbohydrate metabolism disorders including, but not limited to, diabetes mellitus, neonatal hypoglycemia, idiopathic hypoglycemia, and pancreatic islet cell carcinoma.
Hematocrit (Hct)	Hematocrit measurements can aid in the determination and monitoring of normal or abnormal total red cell volume status that can be associated with conditions including 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, metabolic and acid-base disturbances.
Partial Pressure of Oxygen (***P***O_2)	
Partial Pressure of Carbon Dioxide (***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 central nervous system (CNS) disorders. Some causes for decreased values of sodium include dilutional hyponatremia (cirrhosis), depletional hyponatremia and syndrome of inappropriate antidiuretic hormone (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.

Ionized Calcium (iCa)

Although most of the calcium in blood is bound to protein or complexed to smaller anionic species, the biologically active fraction of calcium is free ionized calcium. Through its role in a number of enzymatic reactions and in membrane transport mechanisms, ionized calcium is vitally important in blood coagulation, nerve conduction, neuromuscular transmission and in muscle contraction. Increased ionized calcium (hypercalcemia) may result in coma. Other symptoms reflect neuromuscular disturbances, such as hyperreflexia and/or neurologic abnormalities such as neurasthenia, depression or psychosis. Decreased ionized calcium (hypocalcemia) often results in cramps (tetany), reduced cardiac stroke work and depressed left ventricular function. Prolonged hypocalcemia may result in bone demineralization (osteoporosis) which can lead to spontaneous fractures. Measurements of ionized calcium have proven of value under the following clinical conditions: transfusion of citrated blood, liver transplantation, open heart surgery, neonatal hypocalcemia, renal disease, hyperparathyroidism, malignancy, hypertension and pancreatitis.

Glucose (Glu)

Glucose is a primary energy source for the body and the only source of nutrients for brain tissue. Measurements for determination of blood glucose levels are important in the diagnosis and treatment of patients suffering from diabetes and hypoglycemia. Some causes for increased values of glucose include diabetes mellitus, pancreatitis, endocrine disorders (e.g., Cushing's syndrome), drugs (e.g., steroids, thyrotoxicosis), chronic renal failure, stress, or I.V. glucose infusion. Some causes of decreased values of glucose include insulinoma, adrenocortical insufficiency, hypopituitarism, massive liver disease, ethanol ingestion, reactive hypoglycemia, and glycogen storage disease.

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 increased 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]

Partial Pressure of Oxygen (***P***O_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 ***P***O_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).

Partial Pressure of Carbon Dioxide (***P***CO_2)

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

TEST PRINCIPLE

The i-STAT 1 System uses direct (undiluted) electrochemical methods. Values obtained by direct methods may differ from those obtained by indirect (diluted) methods. [2]

Measured:

Sodium (Na), Potassium (K) and ionized Calcium (iCa)

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

Glucose (Glu)

Glucose is measured amperometrically. Oxidation of glucose, catalyzed by the enzyme glucose oxidase, produces hydrogen peroxide (H_2O_2). The liberated hydrogen peroxide is oxidized at the electrode to produce a current proportional to the sample glucose concentration.

$$\beta\text{-D-glucose} + H_2O + O_2 \xrightarrow{\text{glucose oxidase}} \text{D-gluconic acid} + H_2O_2$$

$$H_2O_2 \longrightarrow 2H^+ + O_2 + 2e^-$$

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.

***P*O₂**

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*CO₂**

PCO_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

- Bicarbonate (HCO_3), 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.
- Total carbon dioxide (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_2CO_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 1 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]
- Base excess (BE) 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 the non-respiratory component of pH‑disturbances.

  When a cartridge includes sensors for both pH and ***P***CO_2, HCO_3, TCO_2 and BE are calculated. [3]

  $\log HCO_3 = pH + \log$ ***P***$CO_2 - 7.608$
  $TCO_2 = HCO_3 + 0.03$***P***CO_2
  $BE_{ecf} = HCO_3 - 24.8 + 16.2(pH - 7.4)$
  $BE_b = (1 - 0.014*Hb) * [HCO_3 - 24.8 + (1.43 * Hb + 7.7) * (pH - 7.4)]$

sO_2

- Oxygen saturation (sO_2) 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 ***P***O_2 and pH and from HCO_3 calculated from measured ***P***CO_2 and pH.[4] 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.

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

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

Hemoglobin

The calculated hemoglobin is determined as follows [5]:

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.

Note: The calculation of hemoglobin from hematocrit assumes a normal MCHC (Mean Corpuscular Hemoglobin Concentration). Therefore, these calculated hemoglobin values may be artificially elevated in patients with lower MCHC levels and decreased in patients with a higher than normal MCHC.

Hypochromic microcytic anemia commonly results in low MCHC which would result in an overestimation of the calculated hemoglobin values.

MCHC levels are increased in patients with spherocytosis, as in hereditary spherocytosis or autoimmune hemolytic anemia, as well as those with homozygous sickle cell or hemoglobin C disease. The use of calculated hemoglobin may not be appropriate in these patients.[5]

See below for information on factors affecting results. Certain substances, such as drugs, may affect analyte levels in vivo. [6] If results appear inconsistent with the clinical assessment, the patient sample should be retested using another cartridge.

REAGENTS

Contents

Each i-STAT CG8+ cartridge contains a reference electrode, a ground electrode, potentiometric sensors, amperometric sensors and conductometric sensor for the measurement of specific analytes. It also contains a buffered aqueous calibrant solution with known concentrations of analytes and preservatives. A list of reactive ingredients relevant for the i-STAT CG8+ cartridge is shown 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
iCa	Calcium (Ca^{2+})	N/A	0.9 mmol/L
Glu	Glucose	N/A	7 mmol/L
	Glucose Oxidase	*Aspergillus niger*	0.002 IU
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.
- DO NOT REUSE – cartridges are intended for single-use only.
- Although the sample is contained within the cartridge, cartridges should be disposed of as biohazardous waste according to local, state, and national regulatory guidelines.
- The i-STAT 1 System automatically runs a comprehensive set of quality checks of instrument and cartridge performance each time a sample is tested. This internal quality system will suppress results by generating a Quality Check Code (QCC) if the instrument or cartridge does not meet certain specifications. To minimize the probability of delivering a result with medically significant error, the internal specifications are very stringent. It is typical for the system to suppress a very small percentage of results in normal operation given the stringency of these specifications. If, however, the instrument or cartridges have been compromised, results may be persistently suppressed, and one or the other must be replaced to restore normal operating conditions. Where unavailability of results while awaiting replacement of instruments or cartridges is unacceptable, Abbott Point of Care Inc. recommends maintaining both a backup analyzer and cartridges from an alternate lot number.
- Use a puncture device that provides free-flowing blood.
- Improperly filling and/or closing the cartridges may result in Quality Check Codes and/or inability to obtain results.

For additional warnings and precautions about the i-STAT 1 System refer to the i-STAT 1 System Manual located at www.globalpointofcare.abbott.

Storage Conditions

- Refrigerated at 2-8°C (35-46°F) until expiration date.
- Room Temperature at 18-30°C (64-86°F). Cartridges may be stored at room temperature for the time frame indicated on the cartridge box.

INSTRUMENTS

The i-STAT CG8+ cartridge is intended for use with the i-STAT 1 analyzer.

For a detailed description of the instrument and system procedures, refer to the i-STAT 1 System Manual located at www.globalpointofcare.abbott.

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)

Test	Syringes*	Test Timing	Evacuated Tubes	Test Timing	Capillary Tubes	Test Timing
pH ***P***CO_2 ***P***O_2 Ionized Calcium Sodium Potassium Glucose Hematocrit	Without anticoagulant	3 minutes	Without anticoagulant	3 minutes	Not applicable	Not applicable
pH ***P***CO_2 ***P***O_2 Ionized Calcium	With balanced heparin anticoagulant (or lithium heparin labeled for the measurement of electrolytes) (syringe must be filled to labeled capacity)** • Maintain anaerobic conditions. • Remix thoroughly before filling cartridge.	10 minutes	With lithium heparin anticoagulant (tubes must be filled to labeled capacity)** • Maintain anaerobic conditions. • Remix thoroughly before filling cartridge.	10 minutes	With balanced heparin anticoagulant or lithium heparin anticoagulant (tubes must be filled to labeled capacity)** **Not applicable for Ionized Calcium**	3 minutes **Not applicable for Ionized Calcium**
Sodium Glucose Hematocrit Potassium	With balanced heparin anticoagulant or lithium heparin anticoagulant (syringe must be filled to labeled capacity)** • Remix thoroughly before filling cartridge.	30 minutes **Note: Do not report pH, *P*CO_2, *P*O_2 and ionized calcium results for samples run beyond 10 minutes from collection**	With lithium heparin anticoagulant (tubes must be filled to labeled capacity)** • Remix thoroughly before filling cartridge.	30 minutes **Note: Do not report pH, *P*CO_2, *P*O_2 and ionized calcium results for samples run beyond 10 minutes from collection**	With balanced heparin anticoagulant or lithium heparin anticoagulant (tubes must be filled to labeled capacity)** † **Not applicable for Potassium**	3 minutes **Not applicable for Potassium**

* Do Not Use Heparin lock flush solution syringes.
** Fill blood collection devices to capacity. Underfilling will cause higher heparin to blood ratios which may affect results. Note: Do not use blood collection or transfer devices that would introduce air into the sample when pH, $\boldsymbol{P}CO_2$ or $\boldsymbol{P}O_2$ are being measured.
† Capillary whole blood specimens (e.g., obtained by fingerstick) should not be used in patients receiving intensive medical intervention/therapy because of the potential for pre-analytical collection error and specifically in patients with decreased peripheral blood flow, as it may not reflect the true physiological state. Examples include, but are not limited to, severe hypotension, shock, hyperosmolar-hyperglycemia (with or without ketosis) and severe dehydration.

PROCEDURE FOR CARTRIDGE TESTING

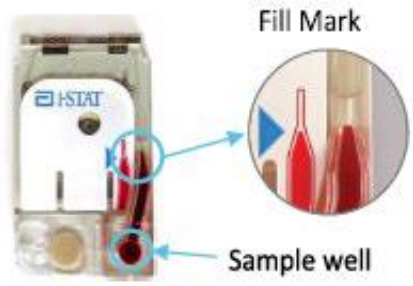
Each cartridge is sealed in a foil pouch for protection during storage--do not use if pouch has been punctured.

- 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. 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 recommended. Note that it may be difficult to properly mix a sample in a 1.0 mL syringe.
3. Fill the cartridge immediately. 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.

Note: Every effort should be made to fill cartridges properly before inserting into the analyzer. The illustrations below are provided to support proper cartridge filling using representative cartridges.

Properly filled cartridge	The sample fills the sample chamber to the fill mark indicator  Full sample well, and no bubble appears in the sample pathway. 
Underfilled cartridge	The sample well is sufficiently filled, but the sample does not reach the fill mark indicator  The sample well is insufficiently filled, and the sample does not reach the fill mark indicator. 

Overfilled cartridge	The sample well is overfilled, the sample exceeds the fill mark indicator  The sample well is overfilled, there is a bubble in the sample well. 

Performing Patient Analysis

1. Press the power button to turn on the analyzer.
2. Press 2 for *i-STAT Cartridge*.
3. Follow the analyzer 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 analyzer 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.globalpointofcare.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.
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.globalpointofcare.abbott.

Calibration Verification

Calibration Verification is a procedure intended to verify the accuracy of results over the entire measurement range of a test. While the Calibration Verification Set contains five levels, verification of the measurement range could be accomplished using the lowest, highest and mid-levels.

For additional information on Calibration Verification, refer to the i-STAT 1 System Manual located at www.globalpointofcare.abbott.

EXPECTED VALUES

The reference ranges for whole blood are similar to reference ranges derived from serum or plasma measurements with standard laboratory methods.

TEST	UNITS *	REPORTABLE RANGE	REFERENCE RANGE *arterial*	*venous*
MEASURED				
Na	mmol/L(mEq/L)	100 – 180	138 – 146 [7]	
K	mmol/L(mEq/L)	2.0 – 9.0	3.5 – 4.9 [7] **	
iCa	mmol/L	0.25 – 2.50	1.12 – 1.32 [8]	
	mg/dL	1.0 – 10.0	4.5 – 5.3 [8]	
Glu*******	mmol/L	1.1 – 38.9	3.9 – 5.8 [8]	
	mg/dL	20 – 700	70 –105 [8]	
	g/L	0.20 – 7.00	0.70 – 1.05 [8]	
Hct***	% PCV	15 – 75	38 – 51 [7] ****	
	Fraction	0.15 – 0.75	0.38 – 0.51 [7]	
pH	pH units	6.50 – 7.80	7.35 – 7.45 [8]	7.31 – 7.41******
PO_2	mmHg	5 – 700	80 – 105 [7] *****	–
	kPa	0.7 – 93.3	10.7 – 14.0 [7] *****	–
PCO_2	mmHg	5 – 130	35 – 45 [8]	41 – 51 [8]
	kPa	0.67 – 17.33	4.67 – 6.00	5.47 – 6.80
Hb	g/dL	5.1 – 25.5	12 – 17 [7] ****	
	g/L	51 – 255	120 – 170 [7]	
	mmol/L	3.2 – 15.8	7 – 11 [7]	
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******
BE	mmol/L (mEq/L)	(-30) – (+30)	(-2) – (+3) [8]	(-2) – (+3) [8]
sO_2	%	0 – 100	95 – 98 [7]	–

***** The i-STAT 1 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 7 to account for the difference in results between serum and plasma results.

******* PCV, packed cell volume. Hematocrit reference ranges by age and sex are provided in the table below.

******** The reference ranges for hematocrit span both female (38-46 %PCV) and male (43-51 %PCV) populations. The reference ranges for hemoglobin span both female (12-15.6 g/dL) and male (14-17 g/dL) populations. [7]

********* 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]

******* Glucose reference ranges by age are provided in the table below.

Unit Conversion:

- **Ionized Calcium (iCa):** To convert mmol/L to mg/dL, multiply the mmol/L value by 4. To convert mmol/L to mEq/L, multiply the mmol/L value by 2.
- **Glucose (Glu):** To convert mg/dL to mmol/L, multiply the mg/dL value by 0.055.

Glucose reference range by age (where applicable) [8]

Age	Reference Range* (mg/dL)
Premature	20-60
Neonate	30-60
Newborn	
1 day	40-60
>1 day	50-80
Child	60-100
Adult	70-105

* for serum specimens

- **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 1 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. [9] 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 1 System default customization is K_3EDTA.

Hematocrit reference range by age and sex (where applicable) [10]

Age	Reference Range (% PCV)
1 month	33−55
2 months	28−42
4 months	32−44
6 months	31−41
9 months	32−40
12 months	33−41
1−2 years	32−40
3−5 years	32−42
6−8 years	33−41
9−11 years	34−43
12−14 years	35−45 (Male) 34−44 (Female)
15−17 years	37−48 (Male) 34−44 (Female)

- ***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, sex, race and ethnicity, it is recommended that reference ranges be determined for the population being tested.

METROLOGICAL TRACEABILITY

The measured analytes in the i-STAT CG8+ cartridge are traceable to the following reference materials or methods. The i-STAT 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) and Ionized Calcium (iCa)
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.

Glucose (Glu)
Glucose 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 SRM965.

Hematocrit (Hct)
Hematocrit values assigned to i-STAT working calibrators are traceable to the Clinical and Laboratory Standards Institute (CLSI) H07-A3 procedure for determining packed cell volume by the microhematocrit method.[9]

pH

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*O$_2$**

***P*O$_2$** 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*CO$_2$**

***P*CO$_2$** 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.

To obtain additional information and technical support, refer to the company website at www.globalpointofcare.abbott.

PERFORMANCE CHARACTERISTICS

The typical performance of the i-STAT CG8+ cartridge with the i-STAT 1 System are shown below.

Precision

Precision data was collected in studies based on CLSI guideline EP05-A3 [11]. The precision studies were conducted using five (5) levels of aqueous materials for Na, K, iCa, Glu, pH, ***P*O$_2$** and ***P*CO$_2$**, and using four levels of aqueous materials for Hct. Duplicates of each level were tested twice a day for a minimum of 20 days.

The statistics for Mean, Standard Deviation (SD) and Coefficient of Variation (CV) are represented below. This is representative data, results in individual laboratories may vary.

Test	Units	Fluid Level	N	Mean	SD	CV (%)
Na	mmol/L	CV L1	80	99.3	0.19	0.20
		CV L2	80	121.4	0.22	0.18
		CV L3	80	134.8	0.23	0.17
		CV L4	80	161.3	0.30	0.19
		CV L5	80	181.1	0.35	0.19
K	mmol/L	CV L1	80	2.09	0.009	0.41
		CV L2	80	2.87	0.008	0.28
		CV L3	80	3.76	0.014	0.36
		CV L4	80	6.41	0.025	0.39
		CV L5	80	7.99	0.032	0.40
iCa	mmol/L	CV L1	80	2.280	0.0144	0.63
		CV L2	80	1.517	0.0080	0.52
		CV L3	80	1.282	0.0085	0.66
		CV L4	80	0.763	0.0039	0.51
		CV L5	80	0.260	0.0020	0.76
Glu	mg/dL	CV L1	80	28.4	0.47	1.66
		CV L2	80	42.0	0.52	1.25
		CV L3	80	124.7	1.00	0.80
		CV L4	80	279.4	2.63	0.94
		CV L5	80	576.8	6.01	1.04
Hct	%PCV	CV L2	81	22.0	0.42	1.89
		CV L3	80	35.0	0.45	1.27
		CV L4	80	56.4	0.27	0.48
		CV L5	82	66.3	0.24	0.37
pH	pH units	CV L1	80	6.5831	0.00482	0.07
		CV L2	80	7.0326	0.00229	0.03
		CV L3	80	7.4574	0.00217	0.03
		CV L4	80	7.6365	0.00251	0.03
		CV L5	80	7.9612	0.00321	0.04
PO_2	mmHg	CV L1	80	75.7	2.53	3.35
		CV L2	80	87.3	1.94	2.23
		CV L3	80	115.0	3.01	2.62
		CV L4	80	144.1	3.92	2.72
		CV L5	80	371.6	10.80	2.91
PCO_2	mmHg	CV L1	80	88.55	1.307	1.48
		CV L2	80	54.96	0.616	1.12
		CV L3	80	28.90	0.321	1.11
		CV L4	80	22.59	0.298	1.32
		CV L5	80	13.81	0.412	2.98

Whole blood precision was evaluated using whole blood specimens † collected with lithium heparin. The repeatability analysis was conducted using the data collected across multiple point of care sites. For each sample type, samples were grouped into subintervals based on their mean values.

† The capillary whole blood clinical precision study design involved the performance of two individual fingersticks,

Test	Units	Sample Type	Sample Range	N	Mean	SD	CV (%)
Na	mmol/L	Venous Whole Blood	100-130	17	122.6	0.30	0.24
			>130-140	99	137.5	0.45	0.33
			>140-180	67	146.2	0.43	0.30
		Arterial Whole Blood	100-130	2	128.0	0.00	0.00
			>130-140	89	137.4	0.42	0.31
			>140-180	62	142.9	0.37	0.26
		Capillary Whole Blood	100-130	3	120.8	0.41	0.34
			>130-140	56	138.1	0.61	0.44
			>140-180	95	142.4	0.62	0.44
K	mmol/L	Venous Whole Blood	2.0-3.5	27	3.22	0.036	1.12
			>3.5-5.0	135	4.12	0.038	0.92
			>5.0-9.0	19	6.49	0.032	0.50
		Arterial Whole Blood	2.0-3.5	23	3.21	0.021	0.65
			>3.5-5.0	124	4.11	0.032	0.79
			>5.0-9.0	6	5.67	0.041	0.72
iCa	mmol/L	Venous Whole Blood	0.25-0.75	5	0.468	0.0045	0.96
			>0.75-1.20	95	1.123	0.0094	0.84
			>1.20-1.50	77	1.281	0.0165	1.29
			>1.50-2.50	7	2.179	0.0214	0.98
		Arterial Whole Blood	0.25-0.75	0	N/A	N/A	N/A
			>0.75-1.20	92	1.144	0.0063	0.55
			>1.20-1.50	58	1.282	0.0114	0.89
			>1.50-2.50	3	1.797	0.0100	0.56
Glu	mg/dL	Venous Whole Blood	20-90	29	73.9	0.86	1.17
			>90-150	102	111.7	1.08	0.96
			>150-250	27	173.4	1.82	1.05
			>250-400	13	308.5	2.08	0.67
			>400-700	9	544.3	7.92	1.46
		Arterial Whole Blood	20-90	5	80.8	0.77	0.96
			>90-150	105	113.6	0.75	0.66
			>150-250	35	178.0	1.55	0.87
			>250-400	8	280.7	2.19	0.78
		Capillary Whole Blood	20-90	32	77.6	1.08	1.39
			>90-150	107	108.3	2.34	2.16
			>150-700	15	203.8	2.74	1.34
Hct	%PCV	Venous Whole Blood	15-35	88	27.3	0.45	1.63
			>35-50	75	39.4	2.20	5.59
			>50-75	7	60.1	0.46	0.77
		Arterial Whole Blood	15-35	104	26.3	0.55	2.08
			>35-50	45	38.9	0.48	1.24
			>50-75	2	50.0	0.00	0.00
		Capillary Whole Blood	15-35	28	29.5	1.23	4.18
			>35-50	109	41.1	1.10	2.68
			>50-75	17	53.5	0.95	1.78
pH	pH units	Venous Whole Blood	6.500-7.300	14	7.0076	0.00378	0.05
			>7.300-7.450	95	7.3790	0.00605	0.08
			>7.450-7.800	9	7.5257	0.00350	0.05
			6.500-7.300	7	7.2059	0.00292	0.04

collected independently by two operators into two separate capillary tubes and tested on two (2) i-STAT CG8+ cartridges.

Test	Units	Sample Type	Sample Range	N	Mean	SD	CV (%)
		Arterial Whole Blood	>7.300-7.450	100	7.3772	0.00574	0.08
			>7.450-7.800	41	7.4704	0.00585	0.08
		Capillary Whole Blood	6.500-7.300	0	N/A	N/A	N/A
			>7.300-7.450	108	7.4075	0.01847	0.25
			>7.450-7.800	45	7.4729	0.02508	0.34
PO_2	mmHg	Venous Whole Blood	10-40	72	30.5	0.98	3.21
			>40-50	15	44.7	0.68	1.53
			>50-100	20	58.9	1.17	1.99
			>100-250	5	141.1	4.72	3.35
			>250-700	6	550.1	5.35	0.97
		Arterial Whole Blood	10-40	2	37.3	1.12	3.00
			>40-50	3	48.2	1.22	2.54
			>50-100	61	76.7	1.26	1.64
			>100-250	66	161.2	3.87	2.40
			>250-700	15	323.3	7.45	2.30
		Capillary Whole Blood	10-40	5	36.3	1.52	4.18
			>40-50	13	45.5	2.49	5.47
			>50-100*	136	70.4	7.50	10.65
			>100-250	0	N/A	N/A	N/A
			>250-700	0	N/A	N/A	N/A
PCO_2	mmHg	Venous Whole Blood	5.0-35.0	27	33.30	0.555	1.67
			>35.0-50.0	70	45.32	0.777	1.71
			>50.0-62.5	14	55.79	1.592	2.85
			>62.5-130.0	9	97.07	1.312	1.35
		Arterial Whole Blood	5.0-35.0	51	33.76	0.714	2.12
			>35.0-50.0	85	43.56	0.958	2.20
			>50.0-62.5	10	60.78	0.489	0.81
			>62.5-130.0	2	87.85	0.570	0.65
		Capillary Whole Blood	5.0-35.0	51	31.23	2.048	6.56
			>35.0-50.0	97	40.16	1.749	4.36
			>50.0-62.5	5	54.82	2.835	5.17
			>62.5-130	0	N/A	N/A	N/A

* Precision for capillary whole blood for ***P***O_2 sample range 50-70 mmHg is as follows: Mean=61.3 mmHg, SD (95% CI)=4.72 mmHg (4.05, 5.64), %CV (95% CI)=7.69 (6.61, 9.21)

Whole blood precision may vary from site to site due to differences in sample handling and other site-specific variables.

Method Comparison

Method comparison was demonstrated in a study based on CLSI guideline EP09cED3. [12]

Lithium heparin venous and arterial whole blood specimens collected across multiple point of care sites were evaluated using *i-STAT CG8+* cartridges on the i-STAT 1 analyzer against whole blood specimens tested on a comparative method. For pH, *P*O_2, and *P*CO_2, the first replicate result from the i-STAT 1 analyzer was compared to the singlicate result from the comparative method. For sodium, potassium, ionized calcium, glucose, and hematocrit, the first replicate result from the i-STAT 1 analyzer was compared to the mean result from the comparative method.

Two (2) capillary specimens collected from skin puncture with balanced heparin capillary tubes from each study subject across multiple point of care sites were evaluated and analyzed in singlicate on the i-STAT 1 analyzer against the comparative method. For sodium, glucose, hematocrit, pH, *P*O_2, and *P*CO_2, the

singlicate result from the i-STAT 1 analyzer was compared to the singlicate result of the comparative method.

The arterial, venous, and capillary data were pooled, and a Passing-Bablok linear regression analysis was performed using the results from the *i-STAT CG8+* cartridges on the i-STAT 1 analyzer versus the comparative method results as shown in the table below.

In the method comparison table, N is the number of specimens in the data set, and r is the correlation coefficient.

Test (units)	Comparative Method		N	Slope	Intercept	r	Xmin	Xmax	Medical Decision Level	Bias at Medical Decision Level
	Arterial/ Venous	Capillary								
Na (mmol/L)	i-STAT CHEM8+	epoc Blood Analysis System	551	1.00	0.00	0.99	101	178	115	0.0
									135	0.0
									150	0.0
Glu (mg/dL)	i-STAT CHEM8+	epoc Blood Analysis System	547	0.98	1.62	1.00	24	695	45	0.6
									120	-1.1
									180	-2.5
Hct (%PCV)	i-STAT CHEM8+	epoc Blood Analysis System	535	1.000	-1.00	0.98	16	75	33	-1.0
									53	-1.0
									56	-1.0
									70	-1.0
pH (pH units)	RAPIDPoint 500/500e	RAPIDPoint 500/500e	468	1.00	0.00	0.99	6.608	7.772	7.300	-0.0040
									7.350	-0.0040
									7.400	-0.0040
PO_2 (mmHg)	RAPIDPoint 500/500e	RAPIDPoint 500/500e	461	1.03	-0.72	0.99	12	654	30	0.1
									45	0.5
									60	0.9
PCO_2 (mmHg)	RAPIDPoint 500/500e	RAPIDPoint 500/500e	465	1.08	-1.13	0.97	6.6	129.3	35.0	1.79
									45.0	2.63
									50.0	3.04
									70.0	4.71

The venous and arterial data were pooled, and a Passing-Bablok linear regression analysis was performed using the i-STAT Potassium and Ionized Calcium results from the *i-STAT CG8+* cartridges on the i-STAT 1 analyzer versus the comparative method results as shown in the table below.

Test (units)	Comparative Method	N	Slope	Intercept	r	Xmin	Xmax	Medical Decision Level	Bias at Medical Decision Level
	Arterial/ Venous								
K (mmol/ L)	i-STAT CHEM8+	340	1.00	0.00	1.00	2.4	8.8	3.0	0.00
								5.8	0.00
								7.5	0.00
iCa (mmol/ L)	i-STAT CHEM8+	343	1.02	-0.02	0.99	0.30	2.47	0.37	-0.009
								0.82	0.003

Method comparison results comparing the i-STAT Sodium, Glucose, Hematocrit, pH, ***P***O_2, and ***P***CO_2 performance on the i-STAT 1 analyzer to comparative methods for capillary whole blood are shown in the table below.

Test (units)	Comparative Method	N	Slope	Intercept	r	Xmin	Xmax
Na (mmol/L)	epoc Blood Analysis System	209	1.00	0.00	0.98	101	172
Glu (mg/dL)	epoc Blood Analysis System	208	1.02	1.21	0.99	26	657
Hct (%PCV)	epoc Blood Analysis System	208	1.000	0.00	0.97	18	73
pH (pH units)	RAPIDPoint 500e	195	1.02	-0.11	0.98	6.619	7.772
PO_2 (mmHg)	RAPIDPoint 500e	190	1.02	-1.75	0.99	12.8	652.6
PCO_2 (mmHg)	RAPIDPoint 500e	189	1.09	-1.90	0.97	9.1	124.9

The bias at the medical decision levels for native capillary whole blood specimens only are shown in the table below.

Test (units)	N	Min	Max	Medical Decision Level	Bias	
					Estimate	95% CI
Na (mmol/L)	194	125	149	115	0.0	(-1.0, 0.0)
				135	0.0	(-1.0, 0.0)
				150	0.0	(-1.0, 0.0)
Glu (mg/dL)	193	42	442	45	1.5	(-0.5, 3.8)
				120	4.0	(2.8, 5.3)
				180	6.0	(3.0, 9.1)
Hct (%PCV)	193	23	68	33	0.0	(-1.0, 0.0)
				53	0.0	(-1.0, 0.0)
				56	0.0	(-1.0, 0.0)
				70	0.0	(-1.0, 0.0)
pH (pH units)	179	7.289	7.531	7.300	-0.0160	(-0.0352, 0.0020)
				7.350	-0.0101	(-0.0211, 0.0010)
				7.400	-0.0041	(-0.0083, 0.0008)
PO_2 (mmHg)	175	32	108	30	-1.8	(-4.7, 0.9)
				45	-1.3	(-3.0, 0.2)
				60	-0.7	(-1.9, 0.1)
PCO_2 (mmHg)	179	26.9	59.3	35.0	1.17	(0.66, 1.75)
				45.0	1.79	(0.68, 3.05)
				50.0	2.11	(0.48, 3.86)
				70.0	3.36	(-0.26, 7.08)

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

Linearity
Linearity studies were performed based on guidance from CLSI EP06-Ed2.[13] The results using lithium heparin whole blood samples demonstrated linearity across the reportable range of the analytes described in the “Expected Values” section above.

LIMITATIONS OF THE PROCEDURE

The analyte results should be assessed in conjunction with the patient's medical history, clinical examination, and other findings. If results appear inconsistent with the clinical assessment, the patient sample should be retested using another cartridge.

Interference Testing

Interference studies were based on CLSI guideline EP07 3rd edition.[14] The substances listed were evaluated in lithium heparin whole blood for relevant analytes. For those identified as an interferant the interference is described.

Substance*	Substance Concentration mmol/L	mg/dL	Test	Interference (Yes/No)	Comments
Acetaldehyde [a]	0.045 [10]	0.2	Glu	No	
Acetaminophen	1.03 [10]	15.6	Na	No	
			K	No	
			iCa	No	
			Glu	No	
			pH	No	
			PO_2	No	
			PCO_2	No	
Acetoacetate (Lithium Acetoacetate)	2.0	20	Glu	No	
Acetyl Cysteine (N-Acetyl-L-Cysteine)	0.92 [15,16]	15.0	Na	No	
			K	No	
			iCa	No	
			Glu	No	
Acetylsalicylic Acid	0.167	3.0	Na	No	
Ammonium (Ammonium Chloride) [a]	2.0	10.7	Na	No	
			K	No	
			Glu	No	
Ascorbic Acid (L-Ascorbic Acid)	0.298	5.25	Na	No	
			K	No	
			iCa	No	
			Glu	No	
Atracurium [a] (Atracurium Besylate)	0.0287	3.57	pH	No	
			PO_2	No	
			PCO_2	No	
Benzalkonium (Benzalkonium Chloride) [a]	0.03	1.13	K	No	Refer to factors affecting results.
β-Hydroxybutyric Acid [a]	6.0 [17]	62.46	Na	No	
			K	No	
			iCa	No	
			Glu	No	
Bilirubin	0.684	40	Na	No	
			K	No	
			iCa	No	
			Glu	No	
			Hct	No	
			pH	No	
			PO_2	No	
			PCO_2	No	
Bromide [a] (Lithium Bromide)	2.5	21.7	Na	No	Refer to comment below.
			K	No	
			iCa	No	

Substance*	Substance Concentration		Test	Interference (Yes/No)	Comments
	mmol/L	mg/dL			
18, 19, 20			Glu	No	
			Hct	No	
	37.5	325.7	Na	No	Use another method. Refer to comment below.
			K	No	
			iCa	Yes	
			Glu	Yes	
			Hct	Yes	
Calcium (Calcium Chloride)	5.0	20	Na	No	
			K	No	
			pH	No	
			PO_2	No	
			PCO_2	No	
Chloride [a] (Lithium Chloride)	3.2	13.6	Na	No	
			K	No	
Cholesterol	11.0	425	Na	Yes	Decreased results > 400 mg/dL.
			K	No	
			iCa	No	
	10.3	400	Glu	No	
Creatinine	1.326	15	Glu	No	
Dopamine (Dopamine Hydrochloride)	4.06 µmol/L	0.0621	Glu	No	
Ethanol	130	600	Glu	No	
			pH	No	
			PO_2	No	
			PCO_2	No	
Fluoride (Lithium Fluoride)	0.0632	0.12	Glu	No	
Formaldehyde [a]	0.133 [10]	0.399	Glu	No	
Fructose	1	18	Glu	No	
Galactose	3.33	60	Glu	No	
Gentamicin (Gentamicin Sulfate)	0.0628	3	Glu	No	
Gentisic Acid	0.0973	1.5	Glu	No	
Glucosamine (Glucosamine Hydrochloride) [a]	0.030	0.647	Glu	No	
Glutathione, reduced	3	3 mEq/L	Glu	No	
Glycolic Acid [a]	10.0 [10]	76.05	Glu	No	
Guaifenesin	0.0227	0.45	Glu	No	
Hemoglobin	10 g/L	1000	Na	No	
			K	No	
			iCa	No	
			Glu	No	
			pH	No	
			PO_2	No	
			PCO_2	No	

Substance*	Substance Concentration		Test	Interference (Yes/No)	Comments
	mmol/L	mg/dL			
Heparin (Sodium Heparin)	3.30 U/mL	330 U/dL	Na	No	
			Glu	No	
Hydroxyurea	0.405	3.08	Glu	Yes	Increased results ≥ 0.08 mmol/L. Refer to comment below.
Ibuprofen	1.06	21.9	Na	No	
			Glu	No	
			pH	No	
			$\boldsymbol{P}O_2$	No	
			$\boldsymbol{P}CO_2$	No	
Intralipid 20%	N/A	2395	Na	No	
		3216	K	No	
		3447	iCa	No	
		2891	Glu	No	
		2325	Hct	No	
		2684	pH	No	
			$\boldsymbol{P}O_2$	No	
			$\boldsymbol{P}CO_2$	No	
Iodide (Sodium Iodide) [a]	2.99	44.82	iCa	No	
Isoniazid	0.438	6	Glu	Yes	The highest drug concentration under therapeutic treatment reported by CLSI EP37 is 0.146 mmol/L. Glucose measurements in patients treated with Isoniazid are expected to be elevated when Isoniazid is at ≥ 0.29 mmol/L.
Lactate (Lithium Lactate)	10	90	Na	No	
			K	No	
			iCa	Yes	Decreased results ≥ 6 mmol/L.
			Glu	No	
Leflunomide [a]	0.722 [21]	19.5	iCa	Yes	Decreased results ≥ 0.345 mmol/L. Refer to comment below.
Magnesium (Magnesium Chloride)	4.1	10	Na	No	
			K	No	
			iCa	Yes	Increased results ≥ 3.5 mmol/L.
Maltose	10.5	360	Glu	No	
Mannose [a]	1	18.02	Glu	No	
Morphine (Morphine Sodium Salt)	0.0273	0.78	pH	No	
			$\boldsymbol{P}O_2$	No	
			$\boldsymbol{P}CO_2$	No	
Nithiodote (sodium thiosulfate) [a]	16.7 [22]	264.04	Hct	No	
			Na	Yes	Increased results ≥ 2.1 mmol/L. Refer to comment below.
			K	No	
			iCa	Yes	Decreased results ≥ 5.3 mmol/L. Refer to comment below.
			Glu	No	
pH	8.0 pH units	N/A	Glu	No	
	8	59.6	iCa	No	

Substance*	Substance Concentration mmol/L	mg/dL	Test	Interference (Yes/No)	Comments
Potassium (Potassium Chloride)			pH	No	
			PO_2	No	
			PCO_2	No	
Pyruvate (Lithium Pyruvate)	0.570	5	Glu	No	
Salicylate (Lithium Salicylate)	0.207	2.86	Na	No	
			K	No	
			iCa	No	
			Glu	No	
Sodium (Sodium Chloride)	170	993.48	iCa	No	
			pH	No	
			PO_2	No	
			PCO_2	No	
Teriflunomide [a]	0.722 [21]	19.5	iCa	Yes	Decreased results ≥ 0.049 mmol/L.
Thiocyanate (Lithium Thiocyanate)	0.898 [10,23]	5.22	iCa	Yes	Decreased results ≥ 0.898 mmol/L. Refer to comment below.
			Glu	No	
Thiopental	1.66	40.2	pH	No	
			PO_2	No	
			PCO_2	No	
Total Protein (Human Serum Albumin)	15 g/dL	150 g/L	Hct	Yes	Increased results ≥ 9.5 g/dL. Refer to Factors Affecting Results.
Triglyceride	16.94	1500	Na	No	
			K	No	
			iCa	No	
			Glu	No	
			Hct	No	
			pH	No	
			PO_2	No	
			PCO_2	No	
Uric Acid	1.4	23.5	Na	No	
			Glu	No	
White Blood Cells [a]	50,000 WBC/µL	N/A	Hct	No	
Xylose [a]	3	45.04	Glu	No	

[a] The test concentration for this substance is not included in CLSI guideline EP37 1st edition. [24]

*The compound tested to evaluate the interfering substance is presented in parenthesis.

This is representative data and results may vary from study to study due to matrix effects. Viscosity, surface tension, turbidity, ionic strength and pH are common causes of matrix effects. It is possible that interfering substances other than those tested may be encountered. The degree of interference at concentrations other than those listed might not be predictable.

- Relevant comments regarding interference of Bromide, Hydroxyurea, Leflunomide, Nithiodote, and Thiocyanate are noted below:

    - Bromide at 2.5 mmol/L is the peak plasma concentration associated with halothane anesthesia, in

which bromide is released. Bromide may result in an increased rate of star outs (***).

- Hydroxyurea is a DNA synthesis inhibitor used in the treatment of sickle cell anemia, HIV infection, and various types of cancer. The malignancies that it is used to treat include melanoma, metastatic ovarian cancer, and chronic myelogenous leukemia. It is also used in the treatment of polycythemia vera, thrombocythemia, and psoriasis. At typical doses ranging from 500 mg to 2 g/day, concentrations of hydroxyurea in a patient's blood may be sustained at approximately 0.1 to 0.5 mmol/L (100 to 500 µmol/L). Higher concentrations may be observed soon after dosing or at higher therapeutic doses.
- Leflunomide is an isoxazole immunomodulatory agent that inhibits dihydroorotate dehydrogenase, an enzyme involved in *de novo* pyrimidine synthesis, and that has antiproliferative activity. It is used in the treatment of some immune diseases. Following oral administration, leflunomide is metabolized to an active metabolite, teriflunomide, which is responsible for essentially all its *in vivo* activity. The active metabolite teriflunomide reaches a plasma concentration of 8.5 µg/mL (0.031 mmol/L) after a 100 mg loading dose and the steady state concentration is maintained at 63 µg/mL [6.3 mg/dL] (0.23 mmol/L) after 24 weeks of maintenance dose at 25 mg/day [21] when treating inflammatory polyarthropathy.
- 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. [22]
- Thiocyanate is a major metabolite of cyanide produced in the liver. [10] The cyanide compound sodium nitroprusside may be used in emergency medical situations to produce a rapid decrease in blood pressure in humans and most of the cyanide produced during metabolism of sodium nitroprusside is eliminated in the form of thiocyanate. Additionally, cyanide elimination is accelerated by the co-infusion of thiosulfate, thiocyanate production is increased as in the case of thiosulphate treatment of cyanide poisoning. The highest drug concentration under therapeutic treatment reported by CLSI EP37 is 0.299 mmol/L. However, concentrations in patients receiving nitroprusside and co-infusion of thiosulfate may be much higher. Thiocyanate is mildly neurotoxic (tinnitus, miosis, hyperreflexia) at serum levels of 1 mmol/L. Thiocyanate toxicity is life-threatening when levels are 3 or 4 times higher.[25] Thiocyanate concentrations greater than 0.898 mmol/L will lead to falsely low ionized calcium results.

Factors Affecting Results

Note: The calculated values are affected when the factor affecting results impacts the analyte used in the calculations. See calculated value equations in EXPECTED RESULTS section.

Factor	Test	Effect
Sodium heparin	Na	Sodium heparin may increase sodium results up to 1 mmol/L. [26]
Exposing the sample to air	iCa	Exposing the sample to air will cause an increase in pH due to loss of CO_2, which will decrease ionized calcium.
	PO_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	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.
	PCO_2	
Partially filling a blood collection	iCa	Exposing the sample to air will cause an increase in pH due to loss of CO_2, which will decrease ionized calcium.

Factor	Test	Effect
device	iCa	Incomplete filling blood collection devices will cause higher heparin-to-blood ratios, which may affect results.
	Hct	
	K	
	Na	
	PO_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	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.
	PCO_2	
Venous stasis	iCa	Venous stasis (prolonged tourniquet application) and forearm exercise may increase ionized calcium due to a decrease in pH caused by localized production of lactic acid. [2]
	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.
Heparin	iCa	Heparin binds calcium. Each unit of heparin added per mL of blood will decrease ionized calcium by 0.01 mmol/L. [27] Therefore, the correct ratio of heparin anticoagulant to blood must be achieved during sample collection. Intravenous injection of 10,000 units of heparin has been shown in adults to cause a significant decrease of ionized calcium of about 0.03 mmol/L. [27] Use only non-heparinized sample transfer devices when using the i-STAT system aqueous control and calibration verification materials.
Hemodilution	Na	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).
	iCa	
	pH	
Benzalkonium Chloride (BAK)	Na, K, iCa	Samples contaminated with Benzalkonium Chloride may increase the i-STAT Na, K or iCa test results. Benzalkonium Chloride may be used to clean collection sites or arterial catheters.
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.
Sample collection	K	Use a puncture device that provides free-flowing blood. Inadequate blood flow may produce erroneous results.
	iCa	
	Hct	
	Na	
	PO_2	
	pH	
	PCO_2	

Factor	Test	Effect
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.
	Glu	Glucose values will decrease in whole blood samples over time. Venous blood glucose is as much as 7 mg/dL less than capillary blood glucose due to tissue utilization. [28]
	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	Allowing blood to stand (without exposure to air) before testing will increase ***P***CO_2 by approximately 4 mmHg per hour. Calculated HCO_3 and TCO_2 results are over-estimated, if blood is allowed to stand (without exposure to air), 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 [2] 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	iCa	Hemolysis may cause a decrease in ionized calcium results.
	K	Hemolysis will cause an increase in potassium.
Under fill or partial draw	***P***CO_2	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 ***P***CO_2, HCO_3 and TCO_2 values. Underfilling blood collection tubes may also cause decreased ***P***CO_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.
pH dependence	Glu	The dependence of the i-STAT glucose test with respect to pH is as follows: values below pH 7.4 at 37 °C decrease results by approximately 0.9 mg/dL (0.05 mmol/L) per 0.1 pH unit. Values above pH 7.4 at 37 °C increase results by approximately 0.8 mg/dL (0.04 mmol/L) per 0.1 pH unit.
	iCa	An increase of ~0.1 pH units decreases the iCa results by approximately 0.08 mmol/L.
PO_2 dependence	Glu	The dependence of the i-STAT Glucose test with respect to ***P***O_2 is as follows: oxygen levels of less than 20 mmHg (2.66 kPa) at 37 °C may decrease results.
Erythrocyte sedimentation rate	Hct	• 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.
White Blood Cell Count (WBC)	Hct	Grossly elevated white blood cell counts may increase results.
Lipids	Hct	Abnormally high lipids may increase results. The effect from lipids will be about two thirds the size of the effect from protein.

<table>
<tr><th>Factor</th><th>Test</th><th>Effect</th></tr>
<tr><td>Total Protein</td><td>Hct</td><td>Hematocrit results may be 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 ~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>
</table>

Total protein levels may be low in neonatal, infants < 1 year old, and burn patient populations, as well as in additional clinical populations listed in Statland (e.g., kidney disease, liver disease, severe malnutrition, and malabsorption conditions). [7] 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 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.
</td></tr>
<tr><td>Sodium</td><td>Hct</td><td>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.</td></tr>
<tr><td>Method of calculation</td><td>sO_2</td><td>Calculated sO_2 values from a measured $\boldsymbol{P}O_2$ 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>Hematocrit</td><td>Glu</td><td>The i-STAT Glucose test has not been evaluated at hematocrit levels <15 %PCV and >75 %PCV. No impact on performance was found at hematocrit levels within 15 - 75 %PCV.</td></tr>
<tr><td>Xylose</td><td>Glu</td><td>The i-STAT Glucose test has not been evaluated for interference at peak xylose concentrations expected to be found in patient blood following a Xylose Absorption test. No impact on i-STAT Glucose test performance was found up to 45 mg/dL of xylose. If patient undergoes a Xylose Absorption test, recommend waiting 24 hours after the procedure before collecting a specimen for testing glucose using the i-STAT Glucose test.</td></tr>
</table>

KEY TO SYMBOLS

Symbol	Definition/Use
	2 months room temperature storage at 18-30^{0}C
	Use by or expiration date. An expiration date expressed as YYYY-MM-DD means the last day the product can be used.
	Manufacturer's lot number or batch code. The lot number or batch will appear adjacent to this symbol.
	Sufficient for <n> tests
	Temperature limitations. The upper and lower limits for storage are adjacent to upper and lower arms.
	Catalog number, list number, or reference
	Do not reuse.
	Manufacturer
	Consult instructions for use or see System Manual for instructions.
	*In vitro* diagnostic medical device
	For prescription use only.

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

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