i-STAT EG7+ Cartridge

Intended for use with the i-STAT Alinity Instrument

NAME

i-STAT EG7+ Cartridge – REF 03P76-25

INTENDED USE

The i-STAT EG7+ cartridge with the i-STAT Alinity System is intended for use in the *in vitro* quantification of Sodium, Potassium, Ionized Calcium, Hematocrit, pH, partial pressure of oxygen, and partial pressure of carbon dioxide 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 for 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 and tetany and disturbances related to surgical and intensive care.
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.
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 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.

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.

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]

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 along with pH is used to assess acid-base balance. ***P***CO_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. ***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 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.

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*O$_2$**
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$_2$**
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.

The 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 $\boldsymbol{P}CO_2$ of 40 mmHg at 37 °C. Excess concentration of base in the average ECF remains virtually constant during acute changes in the $\boldsymbol{P}CO_2$ and reflects only the non-respiratory component of pH-disturbances.

When a cartridge includes sensors for both pH and $\boldsymbol{P}CO_2$, bicarbonate (HCO_3), total carbon dioxide (TCO_2) and base excess (BE) are calculated. [3]

$\log HCO_3 = pH + \log \boldsymbol{P}CO_2 - 7.608$
$TCO_2 = HCO_3 + 0.03\boldsymbol{P}CO_2$
$BE_{ecf} = HCO_3 - 24.8 + 16.2(pH-7.4)$
$BE_b = (1 - 0.014*Hb) * [HCO3 - 24.8 + (1.43 * Hb + 7.7) * (pH - 7.4)]$

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 $\boldsymbol{P}O_2$ and pH and from HCO_3 calculated from measured $\boldsymbol{P}CO_2$ 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 $X = \boldsymbol{P}O_2 \bullet 10^{(0.48(pH-7.4)-0.0013(HCO_3-25))}$

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 sensor, sensors for the measurement of specific analytes, and a buffered aqueous calibrant solution that contains known concentrations of analytes and preservatives. A list of reactive ingredients relevant for the i-STAT EG7+ 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
iCa	Calcium (Ca^{2+})	N/A	0.9 mmol/L

Sensor	Reactive Ingredient	Biological Source	Minimum Quantity
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 Alinity System Operations Manual for all warnings and precautions.

Storage Conditions

- Refrigeration at 2–8 ºC (35–46 ºF) until expiration date.
- Room Temperature at 18–30 ºC (64–86 ºF). Refer to the cartridge box for room temperature storage requirements.

INSTRUMENTS

The i-STAT EG7+ cartridge is intended for use with the i-STAT Alinity Instrument (Model No. AN-500).

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)
As higher heparin-to-blood ratios may affect results, fill blood collection tubes and syringes to capacity, following manufacturers' instructions.

	EG7+ Sample Collection
Syringe	**Without anticoagulant** • Maintain anaerobic conditions prior to filling this cartridge. • Mix sample immediately before filling cartridge. • Fill cartridge within 3 minutes of sample collection. **With balanced heparin anticoagulant** • Maintain anaerobic conditions prior to filling this cartridge. • Mix sample immediately before filling cartridge. • Fill cartridge within 10 minutes of sample collection.
Evacuated Tube	**Without anticoagulant** • Maintain anaerobic conditions prior to filling this cartridge. • Mix sample immediately before filling cartridge. • Fill cartridge within 3 minutes of sample collection. **With lithium heparin anticoagulant** • Maintain anaerobic conditions prior to filling this cartridge. • Mix sample immediately before filling cartridge. • Fill cartridge within 10 minutes of sample collection.
Capillary Tube	**With balanced heparin anticoagulant** • Mix sample immediately before filling cartridge. • Fill cartridge within 3 minutes of sample collection.
Fill cartridge directly from skin puncture	**Not Recommended**

PROCEDURE FOR CARTRIDGE TESTING

Preparation for Use:

1. Individual cartridges may be used after standing five minutes at room temperature. An entire box of cartridges should stand at room temperature for one hour.
2. All cartridges should be used immediately after opening pouch.
3. If the pouch has been punctured, the cartridge should not be used.
4. Do not return cartridges to the refrigerator after bringing them to room temperature.

How to Perform Patient Testing

1. From the Home screen, touch "**Perform Patient Test**". This initiates the patient testing pathway.
2. To begin, follow instructions on the screen to "**Scan or Enter OPERATOR ID**"
3. Follow instructions on the screen to "**Scan or Enter PATIENT ID**"
4. Continue to follow prompts on the screen to proceed with patient testing. "**Scan (CARTRIDGE POUCH) Barcode**", Scanning is required. Information cannot be entered manually.
5. The screen for selecting sample type will display if more than one sample type is applicable; select sample type if applicable.
6. Follow instructions on the screen to "**Close and Insert Filled Cartridge**". The action buttons at the bottom of the screen allow forward, backward and pause functionality.
7. Once the cartridge is inserted, **"Contacting Cartridge"** will display followed by the countdown bar. The following alerts are also displayed: **"Cartridge locked in instrument. Do not attempt to remove the Cartridge"** and **"Testing - Instrument Must Remain Level"**.
8. When the test is complete, the test results are displayed.

Analysis Time

Approximately 130–200 seconds.

Quality Control

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

1. The i-STAT Alinity System automatically runs a comprehensive set of quality checks of analyzer and cartridge performance each time a sample is tested. This internal quality system will suppress results if the analyzer or cartridge does not meet certain internal specifications.
2. Aqueous-based control solutions are available for verifying the integrity of newly received cartridges.
3. In addition, the instrument performs internal electronic checks and calibration during each test cycle, and the Electronic Simulator test provides an independent check on the ability of the instrument to take accurate and sensitive measurements of voltage, current and resistance from the cartridge. The instrument will pass or fail this electronic test depending on whether or not it measures these signals within limits specified in the instrument software.

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

Calibration Verification

Standardization is the process by which a manufacturer establishes "true" values for representative samples. A multi-point calibration is derived for each sensor by this standardization process. These calibration curves are stable over many lots.

A one-point calibration is performed each time a cartridge requiring calibration is used. During the first part of the testing cycle, the calibrant solution is automatically released from its foil pack and is positioned over the sensors. The signals produced by the sensors' responses to the calibrant solution are measured. This one-point calibration adjusts the offset of the stored calibration curve. Next, the instrument automatically moves the sample over the sensors and the signals produced by the sensors'

responses to the sample are measured. While coefficients are used rather than graphic calibration curves, the calculation of the result is equivalent to reading the sample's concentration from an adjusted calibration curve.

EXPECTED VALUES

TEST	UNITS *	REPORTABLE RANGE	REFERENCE RANGE *(arterial)*	*(venous)*
MEASURED				
Na	mmol/L(mEq/L)	100-180	138-146 [6]	
K	mmol/L(mEq/L)	2.0–9.0	3.5–4.9 [6] **	
iCa	mmol/L	1.0–10.0	1.12–1.32 [7]	
	mg/dL	0.25–2.50	4.5–5.3 [7]	
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:

- **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.
- **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.

i-STAT Alinity does not have default reference ranges programmed into the instrument. The reference ranges 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 EG7+ 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) 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.

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*O$_2$**

The i‑STAT System test for partial pressure of oxygen measures the partial pressure of oxygen in arterial, venous, or capillary whole blood (dimension kPa) for *in vitro* diagnostic use. *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$_2$**

The i‑STAT System test for partial pressure of carbon dioxide measures the partial pressure of carbon dioxide in arterial, venous, or capillary whole blood (dimension kPa) for *in vitro* diagnostic use. *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.

PERFORMANCE CHARACTERISTICS

The performance data summarized for Sodium and Hematocrit was collected by professionals trained in the use of the i‑STAT Alinity System and comparative methods. The performance data summarized for all other tests listed below was collected at Abbott Point of Care. Representative cartridges were used to collect the data.

Precision*
A multiday precision study was performed with aqueous calibration verification materials in representative cartridges. Duplicates of each aqueous fluid were tested twice a day for 20 days.

Test	Units	Aqueous Cal Ver	n	Mean	SD (Standard Deviation)	CV (%) [Coefficient of Variation (%)]
Na	mmol/L or mEq/L	Very Low Abnormal	80	99.5	0.32	0.3
		Low Abnormal	80	121.2	0.32	0.3
		Normal	80	133.7	0.34	0.3
		High Abnormal	80	160.8	0.38	0.2
		Very High Abnormal	80	180.2	0.56	0.3
K	mmol/L	Very Low Abnormal	80	2.31	0.010	0.4
		Low Abnormal	80	2.90	0.015	0.5
		Normal	80	3.81	0.023	0.6
		High Abnormal	80	6.16	0.026	0.4
		Very High Abnormal	80	7.81	0.039	0.5
iCa	mmol/L	Very Low Abnormal	80	0.32	0.006	2.0
		Low Abnormal	80	0.82	0.008	1.0
		Normal	80	1.29	0.012	1.0
		High Abnormal	80	1.56	0.015	1.0
		Very High Abnormal	80	2.38	0.027	1.1
Hct	%PCV	Very Low Abnormal	80	16.9	0.46	2.7
		Low Abnormal	80	33.9	0.51	1.5
		High Abnormal	80	55.2	0.49	0.9
		Very High Abnormal	80	65.0	0.39	0.6
pH		Very Low Abnormal	80	6.562	0.005	0.08
		Low Abnormal	80	7.031	0.004	0.06
		Normal	80	7.469	0.003	0.04
		High Abnormal	80	7.769	0.003	0.04
		Very High Abnormal	80	7.986	0.004	0.05
$\boldsymbol{P}O_2$	mmHg	Very Low Abnormal	80	72.1	2.02	2.80
		Low Abnormal	80	84.2	1.60	1.90
		Normal	80	118.8	2.10	1.77
		High Abnormal	80	152.1	3.49	2.29
		Very High Abnormal	80	377.1	8.52	2.26
$\boldsymbol{P}CO_2$	mmHg	Very Low Abnormal	80	17.4	0.43	2.5
		Low Abnormal	80	21.7	0.40	1.8
		Normal	80	28.7	0.57	2.0
		High Abnormal	80	56.2	1.18	2.1
		Very High Abnormal	80	84.5	1.93	2.3

*Note: Representative data, individual laboratories may vary from these data.

Method Comparison

Method comparison was demonstrated in a study comparing the i-STAT Alinity to the i-STAT 1 Wireless (i-STAT 1W) using representative cartridges. The studies were based on CLSI guideline EP9-A3. [9] Whole blood samples anticoagulated with lithium heparin were evaluated. Samples were analyzed in duplicate on both systems. A weighted Deming regression analysis was performed using the first replicate result from the i-STAT Alinity versus the mean of the duplicates from the i-STAT 1W.

In the method comparison table, n is the number of specimens, and r is the correlation coefficient.

Test	Units		Comparative Method i-STAT 1W
Na	mmol/L	n	174
		Slope	1.0
		r	0.999
		intercept	-1
		X_{min}	115
		X_{max}	173
K	mmol/L	n	195
		Slope	1.00
		r	1.00
		intercept	-0.01
		X_{min}	2.0
		X_{max}	9.0
iCa	mmol/L	n	194
		Slope	1.005
		r	1.000
		intercept	-0.001
		X_{min}	0.40
		X_{max}	2.44
Hct	%PCV	n	229
		Slope	1.02
		r	0.993
		intercept	-0.36
		X_{min} (%PCV)	18
		X_{max} (%PCV)	70
pH		n	187
		Slope	0.990
		r	0.999
		intercept	0.075
		X_{min}	6.592
		X_{max}	8.189
PO_2	mmHg	n	192
		Slope	0.986
		r	0.998
		intercept	0.0
		X_{min}	9
		X_{max}	705
PCO_2	mmHg	n	149
		Slope	0.989
		r	0.999
		intercept	0.3
		X_{min}	5.1
		X_{max}	129.8

FACTORS AFFECTING RESULTS

The following substances were evaluated in plasma for relevant analytes at the test concentrations recommended in CLSI guideline EP7-A2 [10] 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	
		iCa	Yes	Decreased results

Substance	Test Concentration (mmol/L)	Analyte	Interference (Yes/No)	Comment
Acetaminophen (therapeutic)	0.132	iCa	No	
Acetylcysteine	10.2	Na	No	
		K	No	
		iCa	Yes	Decreased results
Acetylcysteine (therapeutic)	0.30 [11 12]	iCa	No	
Ascorbate	0.34	Na	No	
		K	No	
		iCa	No	
Bromide	37.5	Na	Yes	Increased results. Use another method.
		K	Yes	Increased result and rate or star (***) outs. Use another method.
		iCa	Yes	Increased results. Use another method.
		Hct	Yes	Increased rate of star (***) outs
Bromide (therapeutic)	2.5 [13 14 15]	Na	No	
		K	No	
		iCa	No	
		Hct	No	
β-Hydroxybutyrate	6.0 [16]	Na	No	
		K	No	
		iCa	No	
Lactate	6.6	Na	No	
		K	No	
		iCa	Yes	Decreased results by up to 0.07 mmol/L.
Leflunomide	0.03	iCa	Yes	Decreased results
Magnesium Chloride	1.0	Na	No	
		K	No	
		iCa	Yes	Increased results by up to 0.04 mmol/L.
Nithiodote (Sodium thiosulfate)	16.7 [17]	Na	Yes	Increased results
		K	Yes	Decreased results
		iCa	Yes	Decreased results
Salicylate	4.34	Na	No	
		K	No	
		iCa	Yes	Decreased results
Salicylate (therapeutic)	0.5 [18]	iCa	Yes	Decreased results by up to 0.03 mmol/L
Thiocyanate	6.9	iCa	Yes	Decreased results. Use another method

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 Acetaminophen, Acetylcysteine, Bromide, Leflunomide, Nithiodote and Salicylate are noted below:

- Acetaminophen has been shown to interfere with i-STAT ionized calcium results at a 1.32 mmol/L, a toxic concentration that is proscribed by the CLSI guideline. Acetaminophen at 0.132 mmol/L, which represents the upper end of the therapeutic concentration range, has been shown not to significantly interfere with i-STAT ionized calcium results.
- Acetylcysteine has been tested at two levels: the CLSI recommended level of 10.2 mmol/L and a concentration of 0.30 mmol/L. The latter is 3 times the peak therapeutic plasma concentration associated with treatment to reverse acetaminophen poisoning. APOC has not identified a therapeutic condition that would lead to levels consistent with the CLSI recommended level.
- 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.
- Leflunomide has been shown to interfere with ionized calcium results at 0.03 mmol/L. 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 (0.23 mmol/L) after 24 weeks of maintenance dose at 25 mg/day [19] when treating inflammatory polyarthropathy.
- Nithiodote (sodium thiosulfate) has been shown to interfere with sodium, potassium and ionized calcium 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." [18]
- Salicylate has been shown to significantly decrease ionized calcium results at a concentration proscribed by the CLSI guideline, 4.34 mmol/L, which represents a toxic concentration. Salicylate at 0.5 mmol/L, which represents the upper end of the therapeutic concentration, has been shown to decrease ionized calcium results by approximately 0.03 mmol/L.

OTHER FACTORS AFFECTING RESULTS

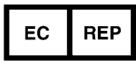
Factor	Analyte	Effect
Sodium heparin	Na	Sodium heparin may increase sodium results up to 1 mmol/L. [20]
Venous stasis	iCa	Venous stasis (prolonged tourniquet application) and forearm exercise may increase ionized calcium due to a decrease in pH caused by localized production of lactic acid. [21]
	pH	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. [21] 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. [21] Use only non-heparinized sample transfer devices when using i-STAT aqueous control and calibration verification materials.

Factor	Analyte	Effect
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	
	HCO_3	
	TCO_2	
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	
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	Allowing blood to stand (without exposure to air) before testing will increase ***P***CO_2
	HCO_3	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.
	TCO_2	
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	K	Potassium values obtained from skin puncture samples may vary due to hemolysis or an increase in tissue fluid from improper technique during the collection procedure.
Under fill or partial draw	***PC***O_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.
	HCO_3	
	TCO_2	
Method of calculation	sO_2	Calculated sO_2 values from a measured *P*O_2 and an assumed oxyhemoglobin dissociation curve may differ significantly from the direct measurement. [3]
Clinical conditions	HCO_3	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.

<table>
<tr><th>Factor</th><th>Analyte</th><th>Effect</th></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 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>Propofol (Diprivan®) or thiopental sodium</td><td>$\boldsymbol{P}CO_2$</td><td>The use of EG7+ cartridge is recommended, which is free from clinically significant interference at all relevant therapeutic doses.</td></tr>
<tr><td>$\boldsymbol{P}O_2$ sensitivity</td><td>$\boldsymbol{P}CO_2$</td><td>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 $\boldsymbol{P}O_2$.</td></tr>
</table>

Factor	Analyte	Effect
		For example, if an oxygenated patient has a measured ***P***O_2 of 200 mmHg, and a normal ***P***O_2 is 100 mmHg, the impact to the ***P***CO_2 result may be increased by approximately 1.5 mmHg.

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
	The authorized representative in the European Community.
	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
	Compliance to the European directive on *in vitro* diagnostic devices (98/79/EC)
	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. Clinical and Laboratory Standards Institute (CLSI). Measurement Procedure Comparison and Bias Estimation Using Patient Samples; Approved Guideline—Third Edition. *CLSI document EP09-A3*. 2013.
10. Clinical and Laboratory Standards Institute. Interference Testing in Clinical Chemistry; Approved Guideline—Second Edition. *CLSI document EP7-A2*. 2005.
11. Whillier S, Raftos JE, Chapman B, Kuchel PW. Role of N-acetylcysteine and cystine in glutathione synthesis in human erythrocytes. *Redox Report*. 2009;14(3):115-121.
12. Ventura P, Panini R, Pasini MC, Scarpetta G, Salvioli G. N-acetyl-cysteine reduces homocysteine plasma levels after single intravenous administration by increasing thiols urinary excretion. *Pharmacological Research*. 1999;40(4):345-350.
13. 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.
14. 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.
15. 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.

16. 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.
17. 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.
18. Borthwick GM, Johnson AS, Partington M, Burn J, Wilson R, Arthur HM. Therapeutic levels of aspirin and salicylate directly inhibit a model of angiogenesis through a Cox-independent mechanism. *FASEB Journal*. October 2006;20(12):2009-2016.
19. Sanofi-Aventis Canada Inc. Product Monograph PrARAVA® Submission, Control No.: 187857. Date of Revision: December 23, 2015. Available at: http://products.sanofi.ca/en/arava.pdf.
20. 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.
21. Fraser D, Jones G, Kooh SW, Raddle I. Calcium and Phosphate Metabolism. In: C.A. Burtis and E.R. Ashwood, ed. *Tietz Textbook of Clinical Chemistry*. Second Edition ed. Philadelphia: W.B. Saunders Company; 1994.

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

Abbott