i-STAT CHEM8+ Cartridge

Intended for US only

NAME

i-STAT CHEM8+ Cartridge (REF 09P31-26)

INTENDED USE

The i-STAT CHEM8+ cartridge with the i-STAT 1 System is intended for use in the *in vitro* quantification of sodium, potassium, chloride, ionized calcium, glucose, blood urea nitrogen, creatinine, hematocrit, and total carbon dioxide in arterial or venous whole blood in point of care or clinical laboratory settings.

Analyte	Intended Use
Sodium (Na)	Sodium measurements are used for monitoring electrolyte imbalances.
Potassium (K)	Potassium measurements are used in the diagnosis and monitoring of diseases and clinical conditions that manifest high and low potassium levels.
Chloride (Cl)	Chloride measurements are primarily used in the diagnosis, monitoring, and treatment of electrolyte and metabolic disorders including, but not limited to, cystic fibrosis, diabetic acidosis, and hydration disorders.
Ionized Calcium (iCa)	Ionized calcium measurements are used in the diagnosis and treatment of parathyroid disease, a variety of bone diseases, chronic renal disease and tetany.
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.
Blood Urea Nitrogen (BUN/Urea)	Blood urea nitrogen measurements are used for the diagnosis, monitoring, and treatment of certain renal and metabolic diseases.
Creatinine (Crea)	Creatinine measurements are used in the diagnosis and treatment of renal diseases, in monitoring renal dialysis, and as a calculation basis for measuring other urine analytes.
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 and erythrocytosis. The i-STAT Hematocrit test has not been evaluated in neonates.
Total Carbon Dioxide (TCO_2)	Carbon dioxide measurements are used in the diagnosis, monitoring, and treatment of numerous potentially serious disorders associated with changes in body acid-base balance.

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 of 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.

Chloride (Cl)

Tests for chloride 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 chloride include prolonged diarrhea, renal tubular disease, hyperparathyroidism, and dehydration. Some causes for decreased values for chloride include prolonged vomiting, burns, salt-losing renal disease, overhydration, and thiazide 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.

Blood Urea Nitrogen (BUN/Urea)

An abnormally high level of urea nitrogen in the blood is an indication of kidney function impairment or failure. Some other causes of increased values for urea nitrogen include prerenal azotemia (e.g., shock), postrenal azotemia, GI bleeding, and a high protein diet. Some causes of decreased values for urea nitrogen include pregnancy, severe liver insufficiency, overhydration, and malnutrition. Endogenous ammonium ions will not affect results.

Creatinine (Crea)

Elevated levels of creatinine are mainly associated with abnormal renal function and occur whenever there is a significant reduction in glomerular filtration rate or when urine elimination is obstructed. The concentration of creatinine is a better indicator of renal function than urea or uric acid because it is not affected by diet, exercise, or hormones.

The creatinine level has been used in combination with BUN to differentiate between prerenal and renal causes of an elevated urea/BUN.

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.

Total Carbon Dioxide (TCO_2)

Measurement of TCO_2 as part of an electrolyte profile is useful chiefly in evaluating 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. 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).

TEST PRINCIPLE

Measured:

Sodium (Na), Potassium (K), Chloride (Cl) 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. The i-STAT System uses direct (undiluted) electrochemical methods. Values obtained by direct methods may differ from those obtained by indirect (diluted) methods. [1]

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 which is proportional to the sample glucose concentration.

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

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

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

BUN/Urea

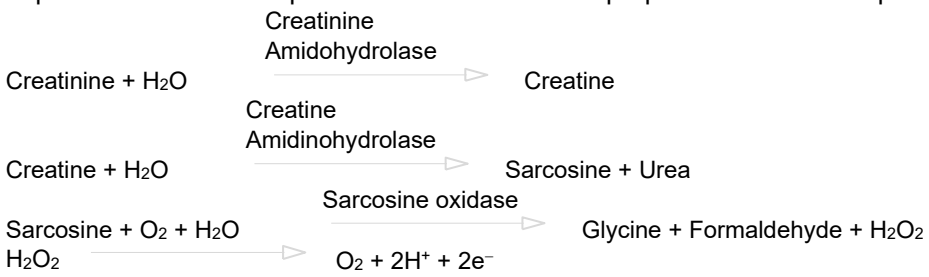
Urea is hydrolyzed to ammonium ions in a reaction catalyzed by the enzyme urease.

$$\text{Urea} + H_2O + 2H^+ \xrightarrow{\text{urease}} 2NH_4^+ + CO_2$$

The ammonium ions are measured potentiometrically by an ion-selective electrode. In the calculation of results for urea, concentration is related to potential through the Nernst Equation. The i-STAT System uses direct (undiluted) electrochemical methods. Values obtained by direct methods may differ from those obtained by indirect (diluted) methods. [1]

Creatinine (Crea)

Creatinine is measured amperometrically. Creatinine is hydrolyzed to creatine in a reaction catalyzed by the enzyme creatinine amidohydrolase. Creatine is then hydrolyzed to sarcosine in a reaction catalyzed by the enzyme creatine amidinohydrolase. The oxidation of sarcosine, catalyzed by the enzyme sarcosine oxidase, produces hydrogen peroxide (H_2O_2). The liberated hydrogen peroxide is oxidized at the platinum electrode to produce a current which is proportional to the sample creatinine concentration.



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

Hematocrit (Hct)

The i-STAT Hematocrit test is determined conductometrically. The measured conductivity, after correction for electrolyte concentration, is inversely related to the hematocrit.

Total Carbon Dioxide (TCO_2)

The measured TCO_2 test method is calibrated to the International Federation of Clinical Chemistry (IFCC) TCO_2 reference method [2] with an algorithm based on the Henderson-Hasselbalch equation, which uses pH, $\boldsymbol{P}CO_2$, and ionic strength (Na) measurements. [3]

On the CHEM8+ cartridge, TCO_2 is metrologically traceable to the IFCC TCO_2 reference method. The implication of direct traceability to this TCO_2 reference method – and not to pH and $\boldsymbol{P}CO_2$ standard reference materials – is subtle but significant: the CHEM8+ is independent of the pH and $\boldsymbol{P}CO_2$ traceability. Given the metrological traceability of the CHEM8+ TCO_2 measurement, the traceable TCO_2 is considered to be a measured analyte.

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

Calculated:

Anion Gap (AnGap)

Anion Gap is calculated in the CHEM8+ cartridge as follows:

Anion Gap (CHEM8+) = (Na + K) – (Cl + (TCO_2 – 1))

For reporting the difference between the commonly measured cations sodium and potassium and the commonly measured anions chloride and bicarbonate the size of the anion gap reflects the unmeasured cations and anions and is therefore an analytical gap. Physiologically, a deficit of anions cannot exist, but, while relatively nonspecific, anion gap as calculated is useful for the detection of organic acidosis due to an increase in anions that are difficult to measure and in classifying metabolic acidosis into high and normal anion gap types.

Hemoglobin (Hb)
The calculated hemoglobin is determined as follows:

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. [4]

REAGENTS

Contents

Each i-STAT CHEM8+ cartridge contains a reference and ground electrode, and potentiometric, amperometric, and conductometric sensors 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 for the i-STAT CHEM8+ 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
Cl	Chloride (Cl^-)	N/A	91 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
BUN/Urea	Urea	N/A	4 mmol/L
	Urease	*Canavalia ensiformis*	0.12 IU
Crea	Creatinine	N/A	158.4 µmol/L
	Creatine Amidinohydrolase	Microbial	0.01 IU
	Creatinine Amidohydrolase	Microbial	0.02 IU
	Sarcosine Oxidase	Microbial	0.001 IU
TCO_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 System automatically runs a comprehensive set of quality checks of both the analyzer 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 analyzer, cartridge or sample does not meet certain internal specifications. When a QCC occurs, a single code number, the type of problem and the next step to be taken will be displayed on the i-STAT 1 Analyzer. The failure rate for a single cartridge due to QCCs may be as high as 4%. The rate of failure for two consecutive cartridges due to QCCs may be as high as 1.7%

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

Storage Conditions

- Refrigeration at 2 to 8 ºC (35 to 46 ºF) until expiration date.
- Room Temperature at 18–30 ºC (64–86 ºF). Recommended shelf life is 14 days.

INSTRUMENTS

The CHEM8+ cartridge is intended for use with 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 or venous whole blood

Sample volume: 95 µL

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

Analyte	Syringes*	Test Timing	Evacuated Tubes	Test Timing
Ionized Calcium TCO_2	Without anticoagulant	3 minutes	Without anticoagulant	3 minutes
	With balanced heparin anticoagulant or lithium heparin anticoagulant (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

Analyte	Syringes*	Test Timing	Evacuated Tubes	Test Timing
Sodium Potassium Chloride Glucose BUN/Urea Creatinine Hematocrit	Without anticoagulant	3 minutes	Without anticoagulant	3 minutes
	With balanced heparin anticoagulant or lithium heparin anticoagulant (syringe must be filled to labeled capacity) • Remix thoroughly before filling cartridge.	30 minutes	With lithium heparin anticoagulant (tubes must be filled to labeled capacity) • Remix thoroughly before filling cartridge.	30 minutes

* Do Not Use Heparin lock flush solution syringes.

PROCEDURE FOR PATIENT TESTING

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

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

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

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

Performing Patient Analysis

1. Press the power button to turn on the 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 that are used to verify the performance of a batch of cartridges when they are first received or when storage conditions are in question. The performance of this procedure is not a Manufacturer's Quality System Instruction (MQSI).
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 procedure is intended to verify the accuracy of results over the entire measurement range of a test as may be required by regulatory or accreditation bodies. The performance of this procedure is not a Manufacturer's Quality System Instruction (MQSI). While the Calibration Verification Set contains five levels, verification of the measurement range could be accomplished using the lowest, highest and mid-levels.

EXPECTED VALUES

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*	REFERENCE RANGE *venous*
MEASURED				
Na	mmol/L (mEq/L)	100–180	138–146 [5]	
K	mmol/L (mEq/L)	2.0–9.0	3.5–4.9 [5] **	
Cl	mmol/L (mEq/L)	65–140	98–109 [5]	
iCa	mmol/L	0.25–2.50	1.12–1.32 [6]	
	mg/dL	1.0–10.0	4.5–5.3 [6]	
Glu	mmol/L	1.1–38.9	3.9–5.8 [6]	
	mg/dL	20–700	70–105 [6]	
	g/L	0.20–7.00	0.70–1.05 [6]	
BUN/Urea	mg/dL	3–140	8–26 [5]	
Urea	mmol/L	1–50	2.9–9.4 [5]	
	mg/dL	6–300	17–56 [5]	
	g/L	0.06–3.00	0.17–0.56 [5]	
Crea	mg/dL	0.2–20.0	0.6–1.3 [7]	
	µmol/L	18–1768	53–115 [7]	
Hematocrit/Hct***	%PCV (packed cell volume)	15–75	Female: 38-46 [5]	Male: 43-51 [5]
	Fraction	0.15–0.75	Female: 0.38–0.46 [5]	Male: 0.43-0.51 [5]
TCO_2	mmol/L	5–50	23–27 ****	24–29 ****
CALCULATED				
AnGap	mmol/L	(-10)–(+99)	10–20	
Hemoglobin/Hb	g/dL	5.1–25.5	Female: 12–15.6 [5]	Male: 14-17 [5]
	g/L	51–255	Female: 120–156 [5]	Male: 140-170 [5]
	mmol/L	3.2–15.8	Female: 7–10 [5]	Male: 9-11 [5]

* The i-STAT System can be configured with the preferred units. (See “Unit Conversion Comments” below.)

** The reference range for potassium has been reduced by 0.2 mmol/L from the range cited in Reference 5 to account for the difference in results between serum and plasma.

*** Hematocrit reference ranges by age and sex are provided in the table below.

**** Calculated from Siggard-Andersen nomogram. [8]

Unit Conversion Comments

- **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.
- **BUN/Urea**: To convert a BUN result in mg/dL to a urea result in mmol/L, multiply the BUN result by 0.357. To convert a urea result in mmol/L to a urea result in mg/dL, multiply the mmol/L result by 6. To convert a urea result in mg/dL to a urea result in g/L, divide the mg/dL result by 100.
- **Creatinine (Crea):** To convert mg/dL to µmol/L, multiply the mg/dL value by 88.4.
- **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. [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 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)

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, and heritage, it is recommended that reference ranges be determined for the population being tested.

Each facility should establish its own reference range to assure proper representation of specific populations.

METROLOGICAL TRACEABILITY

The measured analytes in the i-STAT CHEM8+ 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), Potassium (K), Chloride (Cl) and Ionized Calcium (iCa)
The respective analyte values assigned to 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.

Blood Urea Nitrogen (BUN/Urea)
BUN/Urea 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 SRM909.

Creatinine (Crea)
Creatinine 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 SRM967.

Hematocrit (Hct)
Hematocrit values assigned to i-STAT working calibrators are traceable to the Clinical and Laboratory Standards Institute (CLSI) H7-A3 procedure for determining packed cell volume by the microhematocrit method. [9]

Total carbon dioxide (TCO_2)
TCO_2 values assigned to i-STAT System controls and calibration verification materials are traceable to the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) Reference Measurement Procedure for Substance Concentration Determination for Total Carbon Dioxide in Blood, Plasma or Serum. [2]

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

PERFORMANCE CHARACTERISTICS

The typical performance of the i-STAT CHEM8+ cartridge tests with i-STAT 1 System are summarized below.

Precision

Precision studies were performed using five levels of aqueous materials for Na, K, Cl, iCa, Glu, BUN/Urea, Crea, and TCO_2 and using four levels of aqueous materials for Hct. Duplicates of each level were tested twice a day for 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.

Analyte	Units	Fluid Level	N	Mean	SD	CV (%)
Na	mmol/L	CV L1	81	100.0	0.27	0.3
		CV L2	81	121.6	0.35	0.3
		CV L3	81	134.8	0.31	0.2
		CV L4	80	160.4	0.41	0.3
		CV L5	80	178	0.42	0.2
K	mmol/L	CV L1	81	2.07	0.006	0.3
		CV L2	81	2.83	0.011	0.4
		CV L3	81	3.69	0.010	0.3
		CV L4	80	6.17	0.018	0.3
		CV L5	80	7.75	0.033	0.4
Cl	mmol/L	CV L1	81	70.9	0.47	0.7
		CV L2	81	76.2	0.53	0.7
		CV L3	81	89.2	0.33	0.4
		CV L4	80	107.9	0.43	0.4
		CV L5	80	122.3	0.48	0.4
iCa	mmol/L	CV L1	81	2.328	0.0132	0.6
		CV L2	81	1.484	0.0103	0.7
		CV L3	81	1.299	0.0067	0.5
		CV L4	80	0.724	0.0038	0.5
		CV L5	80	0.262	0.0040	1.5
Glu	mg/dL	CV L1	80	26.7	0.49	1.8
		CV L2	81	40.9	0.52	1.3
		CV L3	81	123.0	0.47	0.4
		CV L4	80	286.5	1.40	0.5
		CV L5	80	608.1	5.56	0.9
BUN/Urea	mg/dL	CV L1	81	107.3	0.91	0.8
		CV L2	81	59.7	0.92	1.5
		CV L3	81	10.5	0.12	1.1
		CV L4	80	8.1	0.18	2.2
		CV L5	80	4.1	0.15	3.7
Crea	mg/dL	CV L1	81	15.90	0.337	2.1
		CV L2	81	4.23	0.101	2.4
		CV L3	81	1.69	0.035	2.1
		CV L4	80	0.51	0.029	5.7
		CV L5	80	0.18	0.028	15.6

Analyte	Units	Fluid Level	N	Mean	SD	CV (%)
Hct	%PCV	CV L2	80	20.5	0.22	1.1
		CV L3	80	32.4	0.31	1.0
		CV L4	81	53.2	1.02	1.9
		CV L5	80	63.9	0.87	1.4
TCO_2	mmol/L	CV L1	81	12.2	0.29	2.4
		CV L2	80	18.2	0.31	1.7
		CV L3	80	23.6	0.64	2.7
		CV L4	80	31.8	1.36	4.3
		CV L5	81	44.3	0.93	2.1

Whole blood precision was evaluated using whole blood specimens collected with lithium heparin targeted to three levels within the test reportable range.

Analyte	Units	Level	Site	N	Mean	SD	CV (%)
Sodium	mmol/L	≤134	01	21	110.3	0.49	0.4
			02	21	123.9	0.38	0.3
			03	21	108.3	0.49	0.5
		135-145	01	21	139.2	0.58	0.4
			01	21	138.0	0.22	0.2
			01	21	136.5	0.68	0.5
			02	20	138.3	0.45	0.3
			02	14	141.8	0.46	0.3
			02	21	141.9	0.31	0.2
			02	21	140.0	0.38	0.3
			02	21	138.9	0.48	0.3
			02	21	138.3	0.53	0.4
			03	21	140.9	0.36	0.3
			03	21	141.0	0.22	0.2
			03	21	142.1	0.31	0.2
			03	21	143.0	0.22	0.2
			03	21	139.8	0.44	0.3
		≥146	01	21	150.1	0.62	0.4
			02	21	163.2	0.49	0.3
			03	21	150.1	0.38	0.3
Potassium	mmol/L	2.75-3.25	1	21	2.80	0.022	0.8
			2	21	2.80	0.000	0.0
			3	21	3.05	0.058	1.9
		>3.25 - <5.55	1	21	4.30	0.000	0.0
			1	21	4.00	0.022	0.6
			1	21	3.98	0.049	1.2
			2	20	4.95	0.059	1.2
			2	14	4.20	0.000	0.0
			2	21	4.13	0.053	1.3
			2	21	4.24	0.058	1.4
			2	21	4.29	0.038	0.9
			2	21	4.10	0.000	0.0
			3	21	4.80	0.032	0.7
			3	21	3.97	0.053	1.3
			3	21	4.00	0.000	0.0
			3	21	3.40	0.000	0.0

Analyte	Units	Level	Site	N	Mean	SD	CV (%)
		5.55 - 6.05	1	21	5.80	0.022	0.4
			2	21	5.85	0.058	1.0
			3	21	5.71	0.038	0.7
		7.25 - 7.75	1	21	7.60	0.000	0.0
			2	21	7.64	0.053	0.7
			3	21	7.73	0.053	0.7
Chloride	mmol/L	<80	01	21	77.0	0.53	0.7
			02	21	77.4	0.95	1.2
			03	21	76.9	0.66	0.9
		90-112	01	21	102.0	0.62	0.6
			01	21	97.0	0.32	0.3
			01	21	102.3	0.53	0.5
			02	21	100.2	0.37	0.4
			02	21	101.3	0.53	0.5
			02	21	103.5	0.52	0.5
			02	21	102.1	0.31	0.3
			02	21	101.4	0.51	0.5
			02	21	101.0	0.22	0.2
			03	21	104.0	0.50	0.5
			03	21	104.0	0.62	0.6
			03	21	103.1	0.54	0.5
			03	21	101.0	0.32	0.3
			03	21	99.8	0.44	0.4
		>120	01	21	126.1	0.58	0.5
			02	21	123.8	0.69	0.6
			03	21	123.2	0.55	0.4
Glucose	mg/dL	30-110	01	21	95.3	0.98	1.0
			01	21	72.3	1.23	1.7
			02	21	95.1	0.90	0.9
			02	21	95.5	0.69	0.7
			02	21	80.0	0.38	0.5
			03	21	101.3	0.76	0.8
			03	21	87.8	0.58	0.7
			03	21	98.9	0.63	0.6
		111 – 150	01	21	148.2	0.62	0.4
			02	20	143.0	0.85	0.6
			02	14	143.3	1.25	0.9
			03	21	142.2	0.79	0.6
		151 – 400	01	21	385.7	2.98	0.8
			02	21	318.0	3.25	1.0
			03	21	151.8	1.02	0.7
		401 – 700	01	21	618.4	7.95	1.3
			02	21	444.2	2.23	0.5
			03	21	582.0	2.93	0.5

Analyte	Units	Level	Site	N	Mean	SD	CV (%)
BUN	mg/dL	<10	01	21	5.0	0.00	0.0
			01	21	5.5	0.51	9.4
			02	21	7.0	0.00	0.0
			03	21	6.9	0.36	5.3
		10-25	01	21	14.0	0.00	0.0
			02	20	18.0	0.23	1.3
			02	14	23.5	0.60	2.5
			02	21	20.9	0.38	1.8
			02	21	10.0	0.00	0.0
			03	21	11.0	0.22	2.0
			03	21	14.0	0.00	0.0
			03	21	13.9	0.31	2.2
		25-50	01	21	38.0	0.50	1.3
			02	21	46.0	1.12	2.4
			03	21	27.8	0.71	2.6
		>110	01	21	111.8	2.82	2.5
			02	21	125.0	1.97	1.6
			03	21	118.6	1.83	1.5
Creatinine	mg/dL	<1	01	21	0.82	0.044	5.4
			01	21	0.60	0.038	6.3
			01	21	0.52	0.049	9.4
			02	20	0.96	0.051	5.3
			02	21	0.96	0.053	5.5
			02	21	0.56	0.058	10.4
			02	21	0.87	0.049	5.6
			03	21	0.81	0.031	3.8
			03	21	0.70	0.032	4.6
			03	21	0.59	0.031	5.3
		1 – 1.5	03	21	1.23	0.049	4.0
			03	21	1.17	0.049	4.2
		1.5 – 2.0	01	21	1.53	0.049	3.2
			02	14	1.83	0.053	2.9
			02	21	1.97	0.062	3.1
			03	21	1.70	0.058	3.4
		5.0 – 7.0	01	21	5.62	0.172	3.1
			02	21	6.31	0.246	3.9
			03	21	5.30	0.072	1.4
		7.0 – 12	02	21	9.47	0.155	1.6
		>12	01	21	14.37	0.388	2.7
			02	21	14.90	0.515	3.5
			03	21	14.30	0.558	3.9

For TCO_2, whole blood precision is provided for venous and arterial specimens separately. The repeatability analysis was conducted using the data collected across three point of care sites. Two hundred and seventy-nine samples (178 venous and 101 arterial) were measured in duplicate. The mean values for each sample were divided into four subintervals for each sample type taking into consideration the medical decision levels of 6, 20, and 33 mmol/L.

Analyte	Sample Type	Sample Range (mmol/L)	N	Mean (mmol/L)	SD	CV (%)
TCO_2	Venous Whole Blood	7 - 15	15	9.43	0.483	5.1
		15 - 25	61	21.25	0.665	3.1
		25 - 35	82	27.72	0.625	2.3
		35 - 47	20	39.33	1.037	2.6
	Arterial Whole Blood	14 - 15	3	14.33	0.577	4.0
		15 - 25	46	22.29	0.521	2.3
		25 - 35	48	28.10	0.520	1.9
		35 - 50	4	39.50	0.866	2.2

For iCa, whole blood precision is provided for venous and arterial specimens separately. The repeatability analysis was conducted using the data collected across three point of care sites. Two hundred and forty-one samples (132 venous and 109 arterial) were measured in duplicate. The mean values for each sample were divided into four subintervals for each sample type taking into consideration the lower and upper limits of the reference interval, 1.12 mmol/L and 1.32 mmol/L.

Analyte	Sample Type	Sample Range (mmol/L)	N	Mean (mmol/L)	SD	CV (%)
iCa	Venous Whole Blood	0.25-0.75	10	0.438	0.0097	2.2
		0.75- 1.2	93	1.094	0.0173	1.6
		1.2-1.5	22	1.278	0.0134	1.0
		1.5-2.5	7	2.109	0.0183	0.9
	Arterial Whole Blood	0.25-0.75	3	0.445	0.0041	0.9
		0.75- 1.2	73	1.110	0.0329	3.0
		1.2-1.5	27	1.244	0.0105	0.8
		1.5-2.5	6	1.725	0.0091	0.5

For hematocrit, whole blood precision is provided for venous and arterial specimens separately. The repeatability analysis was conducted using the data collected across three point of care sites. One hundred and ninety samples (123 venous and 67 arterial) were measured in duplicate. The mean values for each sample were divided into three subintervals for each sample type.

Analyte	Sample Type	Sample Range (%PCV)	N	Mean (% PCV)	SD	CV (%)
Hct	Venous Whole Blood	≤35	48	28.6	0.44	1.6
		36-50	66	42.5	0.60	1.4
		>50	9	60.0	0.47	0.8
	Arterial Whole Blood	≤35	40*	27.2	1.93	7.1
		36-50	21	39.9	0.82	2.0
		>50	6	62.9	0.65	1.0

*outliers included

Method Comparison

Method comparison data was demonstrated in a study based on CLSI guideline EP09cED3. [11]

Lithium heparin venous and arterial whole blood specimens were evaluated and analyzed in singlicate on the i STAT 1 analyzer against the comparative method. A Passing Bablok linear regression analysis was performed using the first replicate result from the i-STAT 1 versus the singlicate result of the comparative method. For iCa, the first replicate result from the i-STAT 1 was compared to the mean result of the comparative method.

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

Method comparison results comparing the i-STAT Sodium, Potassium, Chloride, Ionized Calcium, Glucose, BUN/Urea, Creatinine, Hematocrit and TCO_2 performance on the i-STAT 1 to comparative methods are shown in the table below.

Analyte	Comparative Method	N	Slope	Intercept	R	Xmin	Xmax
Sodium/Na	BeckmanDxC	187	1.00	2.00	0.96	100 mmol/L	173 mmol/L
Potassium/K	BeckmanDxC	189	1.00	0.00	0.99	2.1 mmol/L	8.2 mmol/L
Chloride/Cl	BeckmanDxC	176	1.00	0.00	0.96	76 mmol/L	127 mmol/L
Ionized Calcium/iCa	Siemens epoc® Blood Analysis System	250	1.00	-0.02	0.99	0.290 mmol/L	2.475 mmol/L
Glucose/Glu	BeckmanDxC	185	0.98	0.00	1.00	26 mg/dL	617 mg/dL
BUN/Urea	BeckmanDxC	184	0.94	1.68	0.99	4 mg/dL	142 mg/dL
Creatinine/Crea	BeckmanDxC	180	1.04	-0.06	1.00	0.36 mg/dL	16.10 mg/dL
Hematocrit/Hct	i-STAT Alinity System	194	1.03	-0.53	1.00	16 %PCV	73 %PCV
TCO_2	BeckmanDxC	294	1.04	0.17	0.97	5.1 mmol/L	44.0 mmol/L

The accuracy of the TCO_2 assay on the i-STAT CHEM8+ (blue) cartridge on the i-STAT 1 Analyzer was evaluated by a method comparison study for agreement with the predicate device. The study was conducted across three point of care sites. A total of 294 specimens, 183 lithium heparin venous whole blood specimens and 111 lithium heparin arterial whole blood specimens were tested. Twenty-one of 294 samples (7.14%) were contrived.

For TCO_2, the data was analyzed separately for venous whole blood and arterial whole blood samples by Passing-Bablok regression analysis comparing the first replicate of the candidate device results to the singlicate result of lithium heparin plasma samples on the predicate device. Results are presented in the table below.

Analyte	Sample Type	Site	N	Sample Range Tested (mmol/L)	Regression Equation	r
TCO_2	Venous Whole Blood	1	23	19–33	y = 1.83 + 0.98x	0.87
		2	50	9–41	y = 0.00 + 1.00x	0.98
		3	93	15–46	y = 0.00 + 1.08x	0.98
		combined	183*	6–46	y = -0.01 + 1.05x	0.98
	Arterial Whole Blood	1	53	14–39	y = 3.58 + 0.97x	0.96
		2	48	15–50	y = 1.00 + 1.00x	0.96
		3	6	23–29	N/A	
		combined	111**	7–50	y = 1.07 + 1.03x	0.94

* Includes 17 contrived specimens.
** Includes 4 contrived specimens.

For iCa, the data was analyzed separately for venous whole blood and arterial whole blood samples by Passing-Bablok regression analysis comparing the first replicate of the candidate device results to the mean results on the predicate device. Results are presented in the table below.

Analyte	Sample Type	Site	N	I-STAT 1 Range Tested (mmol/L)	Regression Equation	r
iCa	Venous Whole Blood	1	76	0.82–1.49	y = -0.11 + 1.08x	0.96
		3	42	0.81–1.42	y = -0.07 +1.04x	0.96
		Combined	136*	0.25–2.43	y = -0.05 + 1.03x	1.00
	Arterial Whole Blood	1	66	0.76–1.61	y = 0.02 + 0.96x	0.95
		2	48	0.33–2.32	y = 0.00 + 0.98x	1.00
		Combined	114**	0.33–2.32	y = 0.01 + 0.97x	0.99

* Includes 18 contrived specimens.
** Includes 6 contrived specimens.

Method comparisons will vary from site to site due to differences in sample handling, comparative method calibration and other site-specific variables. For TCO_2, values measured on serum or plasma by chemistry analyzers may be slightly lower than TCO_2 calculated from pH and $\boldsymbol{P}CO_2$ due to loss of CO_2 during non-anaerobic handling. [12]

Linearity

Linearity studies were performed based on guidance from CLSI EP06-A [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. The compound tested to evaluate the interfering substance is presented in parenthesis.

Substance	Test Concentration mmol/L	Test Concentration mg/dL	Analyte	Interference (Yes/No)	Comments
Acetaldehyde	0.045 [a 10]	0.2	Crea	No	
			Glu	No	
Acetaminophen	1.03 [10]	15.6	BUN	No	
			Cl	No	
			Crea	No	
			Glu	No	
			iCa	No	
			K	No	
			Na	No	
Acetoacetate (Lithium Acetoacetate)	2.0	20	Glu	No	
Acetylsalicylic Acid	0.167	3.0	Na	No	
Ammonium (Ammonium Chloride)	2.0 [a]	10.7	Glu	No	
			K	No	
			Na	No	
Ascorbic Acid	0.298	5.25	K	No	
			Na	No	

Substance	Test Concentration		Analyte	Interference (Yes/No)	Comments
	mmol/L	mg/dL			
Benzalkonium (Benzalkonium Chloride)	0.03 [a]	1.13	K	No	
Bicarbonate	35.0 [a]	294	Cl	No	
			Crea	No	
Bilirubin	0.684	40	BUN	No	
			Cl	No	
			Crea	No	
			Glu	No	
			iCa	No	
			K	No	
			Na	No	
	0.342	20	TCO_2	No	
			Hct	No	
β-Hydroxybutyric Acid	6.0 [a 15]	325.69	BUN	No	
			Cl	No	
			Crea	No	
			Glu	No	
			iCa	No	
			K	No	
			Na	No	
Bromide (Lithium Bromide)	37.5 [a 17 18 19]	325.69	BUN	No	
			Cl	Yes	Bromide at ≥2.4 mmol/L showed increased results and rate of star outs (***). Refer to comment below.
			Crea	Yes	Bromide at ≥18.3 mmol/L showed increased results. Refer to comment below.
			Glu	Yes	Bromide at ≥11.8 mmol/L showed decreased results. Refer to comment below.
			Hct	Yes	Bromide ≥14.0 mmol/L decreases Hct results. Use an alternate method. Refer to comment below.
			iCa	No	
			K	No	
			Na	No	
Calcium (Calcium Chloride)	5	20	Crea	No	
			K	No	
			Na	No	
Chloride (Lithium Chloride)	3.2 [a]	13.6	K	No	
			Na	No	
Cholesterol	10.3	400	BUN	No	
			Cl	No	
			Glu	No	
			iCa	No	
			K	No	
			Na	No	
Creatine	0.382 [a]	5.01	Crea	No	
Creatinine	1.326	15	Glu	No	
Dopamine (Dopamine Hydrochloride)	4.06 µmol/L	0.0621	Crea	No	
			Glu	No	
Ethanol	130	600	Glu	No	
Fluoride (Lithium Fluoride)	0.0632	0.12	Glu	No	

Substance	Test Concentration mmol/L	mg/dL	Analyte	Interference (Yes/No)	Comments
Formaldehyde	0.133 [10]	0.399	Crea	No	
			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)	0.03 [a]	0.647	Glu	No	
Glutathione, reduced	3	3 mEq/L	Glu	No	
Glycolic Acid	10 [a]	76.05	Crea	No	
			Glu	No	
Guaifenesin	0.0227	0.45	Glu	No	
Hemoglobin	10 g/L	1000	BUN	No	
			Cl	No	
			Crea	No	
			Glu	No	
			iCa	No	
			K	No	
			Na	No	
	2 g/L	200	TCO_2	No	
Heparin (Sodium Heparin)	3.30 U/mL	330 U/dL	Glu	No	
			Na	No	
Hydroxyurea	0.405	3.08	BUN	No	
			Crea	Yes	Hydroxyurea at ≥0.03 mmol/L showed increased results. Refer to comment below.
			Glu	Yes	Hydroxyurea at ≥0.08 mmol/L showed increased results. Refer to comment below.
Ibuprofen	1.06	21.9	Glu	No	
			Na	No	
Intralipid	N/A	7092	TCO_2	No	
		5296	Hct	No	
Iodide (Sodium Iodide)	2.99 [a]	44.82	Cl	No	
			iCa	No	
Isoniazid	0.438	6	Glu	No	
Lactate (Lithium Lactate)	10	90	BUN	No	
			Cl	No	
			Crea	No	
			Glu	No	
			iCa	Yes	Lactate at ≥6.3 mmol/L showed decreased results.
			K	No	
			Na	No	
L-Ascorbic Acid	0.298	5.25	BUN	No	
			Cl	No	
			Crea	No	
			Glu	No	
			iCa	No	

Substance	Test Concentration mmol/L	mg/dL	Analyte	Interference (Yes/No)	Comments
Leflunomide	0.722 [16]	19.5	iCa	Yes	Leflunomide at ≥ 0.4 mmol/L showed decreased results. Refer to comment below.
Magnesium (Magnesium Chloride)	4.1	10	iCa	No	
			K	No	
			Na	No	
Maltose	10.5	360	Glu	No	
Mannose	1 [a]	18.02	Glu	No	
Methyldopa	107 µmol/L	2.25	Crea	No	
N-Acetyl-L Cysteine	0.92 [21 22]	15.0	BUN	No	
			Cl	No	
			Crea	No	
			Glu	No	
			iCa	No	
			K	No	
			Na	No	
Nithiodote (Sodium Thiosulfate)	16.7 [a 23]	264.04	BUN	No	
			Cl	Yes	Sodium Thiosulfate at ≥4.19 mmol/L showed increased results. Refer to comment below.
			Crea	No	
			Glu	No	
			Hct	No	
			iCa	Yes	Sodium Thiosulfate at ≥5.5 mmol/L decreased results. Refer to comment below.
			K	No	
			Na	Yes	Sodium Thiosulfate at ≥3.1 mmol/L showed increased results. Refer to comment below.
Oxalate (Sodium Oxalate)	0.09	1.206	Cl	No	
pH	8.0 pH units	N/A	BUN	No	
			Crea	No	
			Glu	No	
Potassium (Potassium Chloride)	8	59.6	iCa	No	
Pyruvate (Lithium Pyruvate)	0.570	5	Crea	No	
			Glu	No	
Salicylate (Lithium Salicylate)	0.207	2.86	BUN	No	
			Cl	No	
			Crea	No	
			Glu	No	
			iCa	No	
			K	No	
			Na	No	
Sodium (Sodium Chloride)	170	993.48	iCa	No	
Teriflunomide	0.722	19.5	iCa	Yes	Teriflunomide at ≥0.1 mmol/L showed decreased results.

Substance	Test Concentration		Analyte	Interference (Yes/No)	Comments
	mmol/L	mg/dL			
Thiocyanate (Lithium Thiocyanate)	0.898 [10 20]	5.22	BUN	No	
			Cl	No	
			Glu	No	
			iCa	Yes	Thiocyanate at ≥0.874 mmol/L showed decreased results. Refer to comment below.
Thiopental	248 µmol/L	6.01	TCO_2	No	
Total Protein	12 g/dL	12000	Hct	Yes	• Protein levels above normal (>8.0 g/dL) showed interference at 10.2 g/dL for Hct (<40 %PCV) • Protein level below normal (<6.5 g/dL) showed interference at 5.3 g/dL for Hct (<40 %PCV) Refer to **Factors Affecting Results**.
Triglyceride	16.94	1500	BUN	Yes	Triglyceride at ≥10.2 mmol/L showed increased results.
			Cl	No	
			Crea	No	
			Glu	No	
			iCa	No	
			K	No	
			Na	No	
	37	3233.8	Hct	No	
			TCO_2	No	
Uric Acid	1.4	23.5	Crea	No	
			Glu	No	
			Na	No	
Xylose	3 [a]	45.04	Glu	No	
White Blood Cells	>50000 WBC/µL	>50000 WBC/µL	Hct	Yes	WBC at >50000 WBC/µL showed increased results.

[a] The test concentration for this substance is not included in CLSI guideline EP37 1st edition. [24] The molecular weight was used to convert the test concentration from mmol/L to mg/dL. The molecular weight of each substance could vary depending on the form chosen.

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 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 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 [16] 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. [23]
- 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. [29] Thiocyanate concentrations greater than 0.874 mmol/L will lead to falsely low ionized calcium results.

Factors Affecting Results

Factor	Analyte	Effect
Sodium heparin	Na	Sodium heparin may increase sodium results up to 1 mmol/L. [25]
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. [1]
Line draw	Hct	Low hematocrit results can be caused by contamination of flush solutions in arterial or venous lines. Backflush 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. [26] 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. [26] Use only non-heparinized sample transfer devices when using i-STAT control and calibration verification materials.
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.
	TCO_2	Exposing the sample to air allows CO_2 to escape, which causes TCO_2 to be underestimated. Up to 6 mmol/L CO_2 can be lost per hour by exposure of the sample to air. [27]

Factor	Analyte	Effect
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 errors on sodium, chloride, ionized calcium, and pH results. These errors, associated with solutions that do not match the ionic characteristics of plasma, may be minimized by using physiologically balanced multi-electrolyte solutions containing low-mobility anions (e.g., gluconate).
	Cl	
	iCa	
Cold temperature	K	Potassium values will increase in iced specimens.
Allowing blood to stand	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 as a result of tissue utilization. [28]
	TCO_2	Allowing blood samples to stand (without exposure to air) before testing allows TCO_2 to be overestimated, due to metabolic processes.
Sample type	K	Serum Potassium results may be 0.1 to 0.7 mmol/L higher than Potassium results from anticoagulated samples due to the release of Potassium from platelets[1] and red blood cells during the clotting process.
Underfill or partial draw	TCO_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 TCO_2 values. Underfilling blood collection tubes may also cause decreased TCO_2 results.
Sample handling	TCO_2	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	An increase of 1.0 pH units decreases Glu results by approximately 2 mg/dL
	iCa	An increase of 0.10 pH units decreases iCa results by approximately 0.07 mmol/L.
	TCO_2	TCO_2 is dependent on pH. [3]
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 25 mmHg (3.33 kPa) at 37 °C may decrease results.
Creatine	Creatinine	The normal range of creatine concentration in plasma is 0.17–0.70 mg/dL (13–53 µmol/L) in males and 0.35–0.93 mg/dL (27–71 µmol/L) in females. [10] Creatine may be elevated in patients using creatine supplements, experiencing muscle trauma or other primary or secondary myopathies, taking statins for hyperlipidemia control, or in patients with hyperthyroidism or a rare genetic defect of the creatine transporter protein. Creatine >0.382 mmol/L was not evaluated and may increase creatinine results.
CO_2 dependence	Creatinine	The dependence of the i-STAT creatinine test with respect to carbon dioxide (CO_2) is as follows: For creatinine results ≤2.0 mg/dL, no correction for ***P***CO_2 is required. For creatinine results >2.0 mg/dL, the following correction applies: $Creatinine_{corr}$ = creatinine x (1 + 0.0025 x (pCO_2 - 40))
Erythrocyte sedimentation	Hct	The measurement of certain blood samples with high erythrocyte sedimentation rates (ESR) may be affected by analyzer angle. 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 of the i-STAT 1 analyzer.

<table>
<tr><th>Factor</th><th>Analyte</th><th>Effect</th></tr>
<tr><td>White Blood Cell (WBC) Count</td><td>Hct</td><td>WBC >50,000 white blood cell counts increase Hct results.</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>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 of TP below the normal range</td><td>Hct increased by ~1 %PCV for each increase of 1 g/dL of TP above the normal range.</td></tr>
<tr><td>HCT >40 %PCV</td><td>Hct decreased by ~1 %PCV for each decrease of 1 g/dL of TP below the normal range</td><td>Hct increased by ~0.75 %PCV for each increase of 1 g/dL of TP above the normal range</td></tr>
</table>

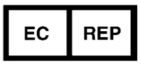
Total protein levels may be low in neonatal, infants < 1 year old, and burn patient populations, as well as in additional clinical populations listed in Statland (e.g., kidney disease, liver disease, severe malnutrition, and malabsorption conditions).[5] Total protein levels may also be decreased in patients undergoing cardiopulmonary bypass (CPB) 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>Clinical Condition</td><td>Anion Gap</td><td>The calculated anion gap may be only slightly increased in diarrhea and renal failure. The results may be elevated as much as >25-fold due to an increase in organic anions in lactic acidosis, ketoacidosis (alcoholic, diabetic, starvation) and uremia; may show an increase in inorganic anions in uremia; may show an increase in anions from drugs such a salicylate and carbenicillin or from toxins such as methanol and ethanol.</td></tr>
<tr><td rowspan="2">Altitude</td><td>Crea</td><td>The i-STAT Creatinine test has not been evaluated at altitude >6,367 feet. No impact on performance was found up to 6,367 feet of altitude.</td></tr>
<tr><td>Glu</td><td>The i-STAT Glucose test has not been evaluated at altitude >9,523 feet. No impact on performance was found up to 9,523 feet of altitude.</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>

Erroneous hematocrit results can be obtained by improper sample handling.

- 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:
  - If the sample is in a collection tube, invert the tube gently 10 times.
  - If the sample is in a syringe, roll the syringe between the palms of your hand for five seconds in one direction, then roll in a second direction for five seconds, then gently invert repeatedly for five seconds. Note that it may not be possible to adequately mix a blood sample in a 1 mL syringe. Samples from 1 mL syringes should not be used to determine hematocrit if testing is delayed. Discard one or two drops of blood from a syringe before filling a cartridge.
- 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.

For the i-STAT BUN test, endogenous ammonium ions will not affect results.

KEY TO SYMBOLS

Symbol	Definition/Use
	14 days room temperature storage at 18–30 ^{0}C.
	Use by or expiration date. The expiration date, expressed as YYYY-MM-DD, indicates the last day the product may be used.
	Manufacturer's lot number or batch code. The lot number or batch code appears adjacent to this symbol.
	Sufficient for <n> tests.
	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 Abbott company website at www.globalpointofcare.abbott.

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