510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION
DECISION SUMMARY
ASSAY ONLY

I Background Information:

A 510(k) Number

K183688

B Applicant

Abbott Point of Care Inc.

C Proprietary and Established Names

i-STAT CHEM8+ cartridge with the i-STAT 1 System

D Regulatory Information

Product Code(s)	Classification	Regulation Section	Panel
JGS	Class II	21 CFR 862.1665 - Sodium Test System	CH - Clinical Chemistry
CDS	Class II	21 CFR 862.1770 - Urea Nitrogen Test System	CH - Clinical Chemistry
CEM	Class II	21 CFR 862.1600 - Potassium Test System	CH - Clinical Chemistry
CGZ	Class II	21 CFR 862.1170 - Chloride Test System	CH - Clinical Chemistry

II Submission/Device Overview:

A Purpose for Submission:

Modification of a previously cleared device—modification to the i-STAT CHEM8+ (blue) cartridge run on the i-STAT 1 Analyzer

B Measurand:

Sodium (Na)
Potassium (K)
Chloride (Cl)
Blood Urea Nitrogen (BUN)

C Type of Test:

Quantitative, Ion Specific Electrode (Potentiometric method)

III Intended Use/Indications for Use:

A Intended Use(s):

See Indications for Use below.

B Indication(s) for 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 and blood urea nitrogen in arterial or venous whole blood in point of care or clinical laboratory settings.

Sodium measurements are used for monitoring electrolyte imbalances.

Potassium measurements are used in the diagnosis and monitoring of diseases and clinical conditions that manifest high and low potassium levels.

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.

Blood urea nitrogen measurements are used for the diagnosis, monitoring, and treatment of certain renal and metabolic diseases.

C Special Conditions for Use Statement(s):

For Prescription Use Only

For Point-of-Care or clinical laboratory setting

D Special Instrument Requirements:

i-STAT 1 Analyzer

IV Device/System Characteristics:

A Device Description:

The i-STAT 1 System consists of the i-STAT 1 Analyzer and the i-STAT CHEM+ (blue) cartridges. The system is designed for use by trained medical professionals at the patient point of care or in the clinical laboratory and is for prescription use only.

The i-STAT 1 Analyzer (previously cleared under k103195 as the i-STAT 1 Wireless Analyzer) is a handheld device designed to run only i-STAT test cartridges. The instrument interacts with the cartridge to move fluid across the sensors and generate a quantitative result.

The single-use, disposable i-STAT CHEM8+ cartridge contains test reagents to analyze whole blood at the point of care or in the clinical laboratory for sodium, potassium, chloride, blood urea nitrogen, and other analytes. The cartridge format allows all the tests in the cartridge to be performed simultaneously. The cartridges contain the required sensors, a fluid pouch, a sample entry well and closure, fluid channels, waste chamber, and the necessary mechanical features for controlled fluid movement within the cartridge. Cartridges require two to three drops of whole blood which are typically applied to the cartridge using a transfer device, by the trained user before the cartridge is placed within the analyzer.

B Principle of Operation:

The sensors are microfabricated thin film electrodes on a silicon chip. A lead line connects the sensors to contact pads. The sensors and lead line are contained within the cartridge; the contact pads are exposed to allow direct contact with the analyzer. The contact pads conduct the signals generated by the sensors to the analyzer. The analyzer connects to the contact pads of the sensor via contact pins that lower inside the analyzer upon insertion of the cartridge. When the sensor generates an electrical signal (in response to contact with the patient sample and the presence or absence of each analyte of interest), the signal is carried by the lead line to the contact pad where the signal generated by the sensor is read by the analyzer.

Ion selective methods are based on the measurement of potential difference (voltage) between the ion selective electrode and the reference electrode (both are found on the biosensors within the cartridge). The biosensor chips convert the activity of the ion dissolved in the patient sample into an electrical signal which can be measured. The concentration of sodium, potassium, chloride and BUN in the patient sample is calculated (derived from the Nernst equation) from the difference between the patient sample and the calibrant solution electrical signals.

V Substantial Equivalence Information:

A Predicate Device Name(s):

SYNCHRON Systems Sodium Reagent on UniCel DxC 600/800 SYNCHRON Clinical System, SYNCHRON Systems Potassium Reagent on UniCel DxC 600/800 SYNCHRON Clinical System, SYNCHRON Systems Chloride Reagent on UniCel DxC 600/800 SYNCHRON

Clinical System, SYNCHRON Systems BUN Reagent on UniCel DxC 600/800 SYNCHRON Clinical System.

B Predicate 510(k) Number(s):
K042291

C Comparison with Predicate(s):

Sodium

Device & Predicate Device(s):	K183688	K042291
Device Trade Name	i-STAT CHEM8+ with the i-STAT 1 System (Sodium)	YNCHRON Systems Sodium Reagent on UniCel DxC 600/800 SYNCHRON Clinical System
General Device Characteristic Similarities		
Intended Use/Indications For Use	Quantitative determination of sodium Sodium measurements are used for monitoring electrolyte imbalances.	Same
General Device Characteristic Differences		
Sample Type	Arterial and venous whole blood	Serum, plasma, urine
Sample Volume	65 µL	0.5 mL (500 µL)
Reportable Range	100-180 mmol/L	100-200 mmol/L (serum or plasma)
Traceability	NIST SRM 956	NIST SRM 919
Reagent Format	Cartridge	Reagent handling system, stored within analyzer
Analyzer Type	Handheld	Floor model

Potassium

Device & Predicate Device(s):	K183688	K042291
Device Trade Name	i-STAT CHEM8+ with the i-STAT 1 System (Potassium)	SYNCHRON Systems Potassium Reagent on UniCel DxC 600/800 SYNCHRON Clinical System
General Device Characteristic Similarities		
Intended Use/Indications For Use	Quantitative determination of potassium Potassium measurements are used in the diagnosis and monitoring of diseases and clinical conditions that manifest high and low potassium levels.	Same
General Device Characteristic Differences		
Sample Type	Arterial and venous whole blood	Serum, plasma, urine
Sample Volume	65 µL	0.5 mL (500 µL)
Reportable Range	2.0–9.0 mmol/L	1.0–15.0 mmol/L (serum or plasma)
Traceability	NIST SRM 956	NIST SRM 919
Reagent Format	Cartridge	Reagent handling system, stored within analyzer
Analyzer Type	Handheld	Floor model

Chloride

Device & Predicate Device(s):	K183688	K042291
Device Trade Name	i-STAT CHEM8+ with the i-STAT 1 System (Chloride)	SYNCHRON Systems Chloride Reagent on UniCel DxC 600/800 SYNCHRON Clinical System

General Device Characteristic Similarities		
Intended Use/Indications For Use	Quantitative determination of chloride 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.	Same
General Device Characteristic Differences		
Sample Type	Arterial and venous whole blood	Serum, plasma, urine
Sample Volume	65 µL	0.5 mL (500 µL)
Chloride Reportable Range	65-140 mmol/L	50-200 mmol/L (serum or plasma)
Traceability	NIST SRM 956	NIST SRM 919
Reagent Format	Cartridge	Reagent handling system, stored within analyzer
Analyzer Type	Handheld	Floor model

Blood Urea Nitrogen (BUN)

Device & Predicate Device(s):	K183688	K042291
Device Trade Name	i-STAT CHEM8+ with the i-STAT 1 System (BUN)	SYNCHRON Systems BUN Reagent on UniCel DxC 600/800 SYNCHRON Clinical System
General Device Characteristic Similarities		
Intended Use/Indications For Use	Quantitative determination of BUN concentration	Same

	Blood urea nitrogen measurements are used for the diagnosis, monitoring, and treatment of certain renal and metabolic diseases.	
Principle of Measurement	Ion selective electrode	Same
General Device Characteristic Differences		
Sample Type	Arterial and venous whole blood	Serum, plasma, urine
Sample Volume	65 µL	0.5 mL (500 µL)
BUN Reportable Range	3-140 mg/L	1-150 mg/dL (serum or plasma)
Traceability	NIST SRM 956	NIST SRM 919
Reagent Format	Cartridge	Reagent handling system, stored within analyzer
Analyzer Type	Handheld	Floor model

VI Standards/Guidance Documents Referenced:

CLSI EP05-A3: Evaluation of Precision of Quantitative Measurement Procedures; Approved Guideline-Third Edition

CLSI EP06-A: Evaluation of the Linearity of Quantitative Measurement Procedures: A Statistical Approach; Approved Guideline

CLSI EP07-A2: Interference Testing in Clinical Chemistry; Approved Guideline-Second Edition

CLSI EP17-A2: Evaluation of Detection Capability for Clinical Laboratory Measurement Procedures; Approved Guideline

VII Performance Characteristics (if/when applicable):

A Analytical Performance:

1. Precision/Reproducibility:

Internal site precision
A single-site precision study for the sodium, potassium, chloride, and BUN assays was conducted following the recommendations in CLSI EP05-A3. Five concentration levels of commercially available i-STAT calibration verification samples were tested using one lot of i-

STAT CHEM8+ (blue) cartridges and twelve i-STAT 1 Analyzers. Each sample was measured in duplicates per run, with two runs per day for 20-days resulting in a total of 80 test results per level. The results are summarized below.

Sodium:

Level	Mean (mmol/L)	Within-run		Between-run		Between-day		Total	
		SD	%CV	SD	%CV	SD	%CV	SD	%CV
L 1	100.0	0.25	0.3	0.07	0.1	0.07	0.1	0.27	0.3
L 2	121.6	0.33	0.3	0.09	0.1	0.10	0.1	0.35	0.3
L 3	134.8	0.28	0.2	0.09	0.1	0.10	0.1	0.31	0.2
L 4	160.4	0.39	0.2	0.10	0.1	0.10	0.1	0.41	0.3
L 5	178	0.40	0.2	0.10	0.1	0.11	0.1	0.42	0.2

Potassium:

Level	Mean (mmol/L)	Within-run		Between-run		Between-day		Total	
		SD	%CV	SD	%CV	SD	%CV	SD	%CV
L 1	2.07	0.006	0.3	0.001	0.05	0.002	0.1	0.006	0.3
L 2	2.83	0.011	0.4	0.003	0.1	0.002	0.1	0.011	0.4
L 3	3.69	0.008	0.2	0.004	0.1	0.003	0.1	0.010	0.3
L 4	6.17	0.017	0.3	0.002	0.03	0.007	0.1	0.018	0.3
L 5	7.75	0.027	0.3	0.017	0.2	0.009	0.1	0.033	0.4

Chloride:

Level	Mean (mmol/L)	Within-run		Between-run		Between-day		Total	
		SD	%CV	SD	%CV	SD	%CV	SD	%CV
L 1	70.9	0.43	0.6	0.12	0.2	0.12	0.2	0.47	0.7
L 2	76.2	0.50	0.7	0.13	0.2	0.13	0.2	0.53	0.7
L 3	89.2	0.29	0.3	0.08	0.1	0.12	0.1	0.33	0.4
L 4	107.9	0.40	0.4	0.11	0.1	0.12	0.1	0.43	0.4
L 5	122.3	0.44	0.4	0.15	0.1	0.12	0.1	0.48	0.4

BUN:

Level	Mean (mmol/L)	Within-run		Between-run		Between-day		Total	
		SD	%CV	SD	%CV	SD	%CV	SD	%CV
L 1	107.3	0.81	0.8	0.41	0.4	0.04	0.04	0.91	0.8
L 2	59.7	0.86	1.4	0.23	0.4	0.20	0.3	0.92	1.5
L 3	10.5	0.11	1.0	0.05	0.5	0.03	0.3	0.12	1.1
L 4	8.1	0.17	2.1	0.03	0.4	0.05	0.6	0.18	2.2
L 5	4.1	0.14	3.4	0.04	1.0	0.03	0.7	0.15	3.7

Point of Care precision - aqueous control material

At three-site precision study was performed using a panel of five levels of aqueous control solutions, containing different level of each analyte. Each sample was assayed at each site once per day for five days across each of six i-STAT 1 Analyzers for a total of 90

measurements. At each site, all testing was conducted by one operator using 6 lots of i-STAT CHEM8+ (blue) cartridges. The results were analyzed for within-run, between run, between day, and overall (summation of within run, between-run and between-day) and provided in the tables below:

Sodium:

		Within-day		Within-site		Overall	
	Mean (mmol/L)	SD	%CV	SD	%CV	SD	%CV
Level 1	100.1	0.32	0.3	0.32	0.3	0.33	0.3
Level 2	121.4	0.49	0.4	0.49	0.4	0.56	0.5
Level 3	135.0	0.39	0.3	0.39	0.3	0.39	0.3
Level 4	161.9	0.50	0.3	0.52	0.3	0.52	0.3
Level 5	177.5	0.57	0.3	0.59	0.3	0.59	0.3

Potassium:

		Within-day		Within-site		Overall	
	Mean (mmol/L)	SD	%CV	SD	%CV	SD	%CV
Level 1	2.10	0.000	0.0	0.000	0.0	0.000	0.0
Level 2	2.80	0.018	0.7	0.018	0.7	0.021	0.7
Level 3	3.70	0.000	0.0	0.000	0.0	0.000	0.0
Level 4	6.21	0.038	0.6	0.038	0.6	0.6	0.040
Level 5	7.85	0.049	0.6	0.049	0.6	0.059	0.8

Chloride:

		Within-day		Within-site		Overall	
	Mean (mmol/L)	SD	%CV	SD	%CV	SD	%CV
Level 1	72.1	0.61	0.8	0.63	0.9	0.063	0.9
Level 2	77.0	0.52	0.7	0.53	0.7	0.54	0.7
Level 3	89.6	0.45	0.5	0.53	0.6	0.53	0.6
Level 4	107.4	0.62	0.6	0.70	0.7	0.78	0.7
Level 5	120.6	0.56	0.5	0.62	0.5	0.64	0.5

BUN:

		Within-day		Within-site		Overall	
	Mean (mg/dL)	SD	%CV	SD	%CV	SD	%CV
Level 1	106.2	0.96	0.9	1.05	1.0	1.07	1.0
Level 2	58.8	0.56	1.0	0.57	1.0	0.57	1.0
Level 3	10.1	0.29	2.9	0.30	3.0	0.30	3.0
Level 4	8.1	0.26	3.2	0.27	3.3	0.27	3.4
Level 5	5.0	0.00	0.0	0.00	0.0	0.00	0.0

Point of Care precision - whole blood

A three-site precision study was performed using lithium heparin venous whole blood samples targeted to three levels of each analyte. The testing was conducted by multiple operators at each site. Each sample was tested three times on each of seven i-STAT 1 Analyzers on one day for a total of 21 test results. The results were analyzed for variance from within-analyzer

(repeatability) and total (combined within-analyzer and between-analyzer variance components). Results are summarized in the tables below.

Sodium:

Concentration (mmol/L)	Site	N	Mean (mmol/L)	Within-analyzer		Total	
				SD	%CV	SD	%CV
≤ 134	1	21	110.3	0.49	0.4	0.49	0.4
	2	21	123.9	0.38	0.3	0.38	0.3
	3	21	108.3	0.44	0.4	0.49	0.5
135-145	1	21	136.5	0.65	0.5	0.68	0.5
	2	21	138.3	0.53	0.4	0.53	0.4
	3	21	139.8	0.44	0.3	0.44	0.3
≥ 146	1	21	150.1	0.62	0.4	0.62	0.4
	2	21	163.2	0.49	0.3	0.49	0.3
	3	21	150.1	0.38	0.3	0.38	0.3

Potassium:

Concentration (mmol/L)	Site	N	Mean (mmol/L)	Within-analyzer		Total	
				SD	%CV	SD	%CV
2.75-3.25	1	21	2.80	0.022	0.8	0.022	0.8
	2	21	2.80	0.000	0.0	0.000	0.0
	3	21	3.05	0.058	1.9	0.058	1.9
>3.25-<5.55	1	21	3.98	0.049	1.2	0.049	1.2
	2	21	4.24	0.058	1.4	0.058	1.4
	3	21	3.97	0.053	1.3	0.053	1.3
1.35.55-6.05	1	21	5.80	0.022	0.4	0.022	0.4
	2	21	5.85	0.058	1.0	0.058	1.0
	3	21	5.71	0.038	0.7	0.038	0.7
7.25-7.75	1	21	7.60	0.000	0.0	0.000	0.0
	2	21	7.64	0.053	0.7	0.053	0.7
	3	21	7.73	0.053	0.7	0.053	0.7

Chloride:

Concentration (mmol/L)	Site	N	Mean (mmol/L)	Within-analyzer		Total	
				SD	%CV	SD	%CV
< 80	1	21	77.0	0.53	0.7	0.53	0.7
	2	21	77.4	0.95	1.2	0.95	1.2
	3	21	76.9	0.62	0.8	0.66	0.9
90-112	1	21	102.0	0.62	0.6	0.62	0.6
	2	21	101.3	0.53	0.5	0.53	0.5
	3	21	104.0	0.62	0.6	0.62	0.6
> 120	1	21	126.1	0.58	0.5	0.58	0.5
	2	21	123.8	0.69	0.6	0.69	0.6
	3	21	123.2	0.44	0.4	0.55	0.4

BUN:

Concentration (mg/dL)	Site	N	Mean (mg/dL)	Within-analyzer		Total	
				SD	%CV	SD	%CV
< 10	1	21	5.5	0.49	8.9	0.51	9.4
	2	21	7.0	0.00	0.0	0.00	0.0
	3	21	6.9	0.31	4.5	0.36	5.3
10-25	1	21	14.0	0.00	0.0	0.00	0.0
	2	21	23.5	0.60	2.5	0.60	2.5
	3	21	13.9	0.31	2.2	0.31	2.2
25-50	1	21	38.0	0.44	1.1	0.50	1.3
	2	21	46.0	1.11	2.4	1.12	2.4
	3	21	27.8	0.62	2.2	0.71	2.6
> 110	1	21	111.8	2.82	2.5	2.82	2.5
	2	21	125.0	1.72	1.4	1.97	1.6
	3	21	118.6	1.83	1.5	1.83	1.5

2. Linearity:

The linearity of the sodium, potassium, chloride, and BUN assays on i-STAT CHEM8+ (blue) cartridge was evaluated following the recommendations in CLSI EP06-A. Lithium heparin venous whole blood was obtained from a healthy subject and was altered to produce a high sample pool and a low sample pool. Samples of intermediate concentrations were prepared by intermixing the low and high pools. Each sample was measured in replicates of 3 using 5 lots of i-STAT CHEM8+ (blue) cartridges. An assessment of linearity was performed using polynomial regression analysis.

For sodium, regression analysis found that at each level, the deviation from linearity was ≤ 0.26 mmol/L or 0.18%.

For potassium, regression analysis found that at each level, the deviation from linearity was ≤ 0.04 mmol/L or 0.70%.

For chloride, regression analysis found that at each level, the deviation from linearity was ≤ 0.31 mmol/L or 0.25%.

For BUN, regression analysis found that at each level, the deviation from linearity was ≤ 1.65 mg/dL or 1.50%.

Linear regression analysis results for all five lots combined are presented in the tables below.

Sodium:

Range tested (mmol/L)	Slope	Intercept	R^2
89 - 205	1.008	-0.672	0.9994

Potassium:

Range tested (mmol/L)	Slope	Intercept	R^2
1.7 – 10.4	1.006	0.032	0.9997

Chloride:

Range tested (mmol/L)	Slope	Intercept	R^2
76 – 158	0.986	1.208	0.9981

BUN:

Range tested (mg/dL)	Slope	Intercept	R^2
2 - 160	0.910	0.263	0.9953

The observed proportional response supports the claim that the sodium, potassium, chloride and BUN assays on the i-STAT CHEM8+ (blue) are linear across the following measurement ranges:

Sodium: 100 - 180 mmol/L
Potassium: 2.0 - 9.0 mmol/L
Chloride: 65 - 140 mmol/L
BUN: 3 - 140 mg/dL

3. Analytical Specificity/Interference:

The analytical specificity of the sodium, potassium, chloride and BUN assays on the i-STAT CHEM8+ (blue) cartridge was established by conducting interference studies following the recommendations in CLSI EP07-ED3 and CLSI EP37. Interference from certain exogenous and endogenous substances was assessed using lithium heparin venous whole blood spiked at two concentrations of each analyte at low and high: sodium 135±5 mmol/L and 145±5 mmol/L; potassium 3.5±0.3 mmol/L and 5.0±0.3 mmol/L; chloride 100±5 mmol/L and 110±5 mmol/L; BUN 10±4 mg/dL and 30±4 mg/dL. Each low and high sample was further divided into two aliquots: control (with no added interferent) and test (with added interferent). Each sample was measured in replicates of 10 using one lot of the i-STAT CHEM8+ (blue) cartridges. A substance was identified as an interferent if the difference in the means between the control and test samples was outside of the predefined allowable error:

For Potassium: ± 0.5 mmol/L.

For Chloride: ± 5% of the control mean/median chloride result (mmol/L).

For BUN: the greater of ± 2 mg/dL or ± 9% of the control mean/median BUN result (mg/dL).

For any substances identified as an interferent, a dose response analysis was performed to assess the highest concentration without significant error, as defined above.

The following table lists the concentrations of each substance at which no significant interference was found:

Sodium:

Substance	Highest concentration at which no interference was observed
Acetaminophen	15.6 mg/dL
N-Acetyl-L-Cysteine	15.0 mg/dL
Acetylsalicylic Acid	3.0 mg/dL
Ammonium Chloride	10.7 mg/dL
Ascorbic Acid	5.25 mg/dL
β-Hydroxybutyric Acid	62.5 mg/dL
Bilirubin	40 mg/dL
Calcium Chloride	20 mg/dL
Cholesterol	400 mg/dL
Hemoglobin	1000 mg/dL
Ibuprofen	21.9 mg/dL
Lithium Bromide	325.69 mg/dL
Lithium Chloride	13.6 mg/dL
Lithium Lactate	90 mg/dL
Lithium Salicylate	2.86 mg/dL
Magnesium Chloride	10 mg/dL
Sodium Heparin	330 U/dL
Sodium Thiosulfate	264 mg/dL
Triglyceride	1500 mg/dL
Uric Acid	23.5 mg/dL

Potassium:

Substance	Highest concentration at which no interference was observed
Acetaminophen	15.6 mg/dL
N-Acetyl-L-Cysteine	15.0 mg/dL
Acetylsalicylic Acid	3.0 mg/dL
Ammonium Chloride	10.7 mg/dL
Ascorbic Acid	5.25 mg/dL
β-Hydroxybutyric Acid	62.5 mg/dL
Benzalkonium Chloride	1.13 mg/dL
Bilirubin	40 mg/dL
Calcium Chloride	20 mg/dL
Cholesterol	400 mg/dL
Hemoglobin	1000 mg/dL
Lithium Bromide	325.69 mg/dL
Lithium Chloride	13.6 mg/dL
Lithium Lactate	90 mg/dL
Lithium Salicylate	2.86 mg/dL
Magnesium Chloride	10 mg/dL

Substance	Highest concentration at which no interference was observed
Sodium Heparin	330 U/dL
Sodium Thiosulfate	264 mg/dL
Triglyceride	1500 mg/dL
Uric Acid	23.5 mg/dL

Chloride:

Substance	Highest concentration at which no interference was observed
Acetaminophen	15.6 mg/dL
N-Acetyl-L-Cysteine	15.0 mg/dL
Ascorbic Acid	5.25 mg/dL
Bicarbonate	294 mg/dL
Bilirubin	40 mg/dL
β-Hydroxybutyric Acid	62.5 mg/dL
Cholesterol	400 mg/dL
Hemoglobin	1000 mg/dL
Lithium Bromide	325.69 mg/dL
Lithium Chloride	13.6 mg/dL
Lithium Lactate	90 mg/dL
Lithium Salicylate	2.86 mg/dL
Lithium Thiocyanate	5.22 mg/dL
Magnesium Chloride	10 mg/dL
Sodium Iodide	44.82 mg/dL
Sodium Oxalate	1.206 mg/dl
Sodium Thiosulfate	264 mg/dL
Triglyceride	1500 mg/dL
Uric Acid	23.5 mg/dL

BUN:

Substance	Highest concentration at which no interference was observed
Acetaminophen	15.6 mg/dL
N-Acetyl-L-Cysteine	15.0 mg/dL
Ascorbic Acid	5.25 mg/dL
Bilirubin	40 mg/dL
β-Hydroxybutyric Acid	62.5 mg/dL
Cholesterol	400 mg/dL
Hemoglobin	1000 mg/dL
Hydroxyurea	3.08 mg/dL
Lithium Bromide	325.69 mg/dL
Lithium Lactate	90 mg/dL
Lithium Salicylate	2.86 mg/dL
pH	8.0 pH units
Sodium Thiocyanate	5.22 mg/dL

Substance	Highest concentration at which no interference was observed
Sodium Thiosulfate	264 mg/dL
Triglyceride	1500 mg/dL

For those substances that on initial screening where found to interfere, dose response testing was conducted to establish the concentration limit below which no significant interference is expected. The results are summarized in the table below:

Substance	Concentration	Interference
Lithium Bromide	≥ 2.4 mmol/L	Increased chloride results
Sodium Thiosulfate	≥3.1 mmol/L	Increased sodium results
Sodium Thiosulfate	≥ 4.19 mmol/L	Increased chloride results
Triglycerides	≥ 10.2 mmol/L	Increased BUN results

The sponsor includes the following statements in the labeling for the device:

Lithium Bromide at ≥ 2.4 mmol/L showed increased chloride results. 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 (***).

Nithiodote (sodium thiosulfate) at ≥3.1 mmol/L shows increased sodium results. 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.

4. Assay Reportable Range:

See section A.2. Linearity.

5. Traceability, Stability, Expected Values (Controls, Calibrators, or Methods):

The sodium, potassium, and chloride assays on the i-STAT CHEM8+ (blue) cartridges and sodium, potassium, and chloride values assigned to i-STAT controls and calibration verification materials are traceable to the U.S. National Institute of Standards and Technology (NIST) standard reference material NIST SRM 956.

The BUN assay on the i-STAT CHEM8+ (blue) cartridges and BUN values assigned to i-STAT controls and calibration verification materials are traceable to the U.S. National Institute of Standards and Technology (NIST) standard reference material NIST SRM 909.

6. Detection Limit:

The detection limits are supported by the linearity study (please see section 2 above). In addition, a limit of quantitation (LoQ) study for each analyte on the i-STAT CHEM8+ Cartridge with the i-STAT 1 Analyzer was conducted following the recommendations in CLSI EP17-A2.

LoQ
The LoQ for sodium, potassium, chloride and BUN were evaluated using four lithium venous whole blood samples that were collected on each day from a unique healthy subject. The whole blood sample was altered to low sodium (<100 mmol/L), potassium (< 2.0 mmol/L), or BUN (<3 mg/dL) concentrations. Each of the four samples was measured in 15 replicates per day for four days across each of two i-STAT CHEM8+ (blue) cartridges for a total of 120 cartridges tested. The LoQ was calculated for each of the two lots. The sponsor defined LoQ as the greater of the two lots at which the lowest concentration met the pre-defined total error goal listed in the table below for each analyte.

The results are summarized in the table below.

Analyte	Reportable Range	Total Error (TE)	LoQ
Sodium	100 – 180 mmol/L	≤ 4.00	91 mmol/L
Potassium	2.0 – 9.0 mmol/L	≤ 0.500	1.5 mmol/L
Chloride	65 – 140 mmol/L	≤ 3.25	56 mmol/L
BUN	3 – 140 mg/dL	≤ 2.00	1 mg/dL

7. Assay Cut-Off:

Not applicable.

B Comparison Studies:

1. Method Comparison with Predicate Device:

The accuracy of the sodium, potassium, chloride, BUN assays with the i-STAT CHEM8+ (blue) cartridge on the i-STAT 1 Analyzer was evaluated by a method comparison study for agreement with the predicate devices. The study was conducted across two point of care sites.

Sodium:
A total of 141 lithium heparin venous blood specimens and 46 lithium heparin arterial whole blood specimens were tested using two lots of i-STAT CHEM 8+ (blue) cartridges. Twelve specimens were contrived. The data were analyzed by passing-Bablok regression analysis comparing the first replicate of the candidate deice results to the singlicate result of the predicate device.

Site	N	Sample Range Tested (mmol/L)	Regression Equation	r
1	141	102 – 174	y = 2.00 + 1.00x	0.98
2	46	129 – 168	y = 1.00 + 1.00x	0.81
combined	187	102 - 174	y = 2.00 + 1.00x	0.96

Potassium:
A total of 143 lithium heparin venous blood specimens and 46 lithium heparin arterial whole blood specimens were tested using two lots of i-STAT CHEM 8+ (blue) cartridges. Twelve specimens were contrived. The data were analyzed by passing-Bablok regression analysis comparing the first replicate of the candidate deice results to the singlicate result of the predicate device.

Site	N	Sample Range Tested (mmol/L)	Regression Equation	r
1	143	2.1 – 8.0	y = 0.00 + 1.00x	1.00
2	46	3.1 – 5.8	y = 0.00 + 1.00x	0.96
combined	188	2.1 – 8.0	y = 0.00 + 1.00x	0.99

Chloride:
A total of 131 lithium heparin venous blood specimens and 46 lithium heparin arterial whole blood specimens were tested using two lots of i-STAT CHEM 8+ (blue) cartridges. Twelve specimens were contrived. The data were analyzed by passing-Bablok regression analysis comparing the first replicate of the candidate deice results to the singlicate result of the predicate device.

Site	N	Sample Range Tested (mmol/L)	Regression Equation	r
1	131	75 – 123	y = 0.00 + 1.00x	0.97
2	46	75 – 123	y = 0.00 + 1.00x	0.78
combined	177	75– 123	y = 0.00 + 1.00x	0.92

BUN:
A total of 13 lithium heparin venous blood specimens and 46 lithium heparin arterial whole blood specimens were tested using two lots of i-STAT CHEM 8+ (blue) cartridges. Twelve specimens were contrived. The data were analyzed by passing-Bablok regression analysis comparing the first replicate of the candidate deice results to the singlicate result of the predicate device.

Site	N	Sample Range Tested (mg/dL)	Regression Equation	r
1	138	3 – 130	y = 1.805 + 0.927x	1.00
2	46	3 – 90	y = 1.000 + 1.000x	0.98
combined	184	3 – 130	y = 1.675 + 0.940x	0.99

2. Matrix Comparison:

Not applicable. Lithium heparin whole blood is the only acceptable sample type for this device.

C Clinical Studies:

1. Clinical Sensitivity:

Not applicable.

2. Clinical Specificity:

Not applicable.

3. Other Clinical Supportive Data (When 1. and 2. Are Not Applicable):

Not applicable.

D Clinical Cut-Off:

Not applicable.

E Expected Values/Reference Range:

Expected values for the sodium, potassium, chloride and BUN assays on the i-STAT CHEM8+ (blue) cartridge are cited from literature*:

Analyte	Units	Reference Range
Sodium	mmol/L	138-146
Potassium	mmol/L	3.5-4.9
Chloride	mmol/L	98-109
BUN/Urea	mg/dL	8-26

*B.E. Statland, Clinical Decision Levels for Lab Tests (Oradell, NJ: Medical Economics Books, 1987).

VIII Proposed Labeling:

The labeling supports the finding of substantial equivalence for this device.

IX Conclusion:

The submitted information in this premarket notification is complete and supports a substantial equivalence decision.