510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION
DECISION SUMMARY
ASSAY ONLY

I Background Information:

A 510(k) Number

K220396

B Applicant

Medica corporation

C Proprietary and Established Names

EasyStat 300

D Regulatory Information

Product Code(s)	Classification	Regulation Section	Panel
JFP	Class II	21 CFR 862.1145 - Calcium test system	CH - Clinical Chemistry
CGZ	Class II	21 CFR 862.1170 - Chloride test system	CH - Clinical Chemistry
CEM	Class II	21 CFR 862.1600 - Potassium test system	CH - Clinical Chemistry

II Submission/Device Overview:

A Purpose for Submission:

New device

B Measurand:

Potassium (K+), Chloride (Cl-), ionized Calcium (Ca++)

C Type of Test:

Quantitative, ion specific electrodes

III Intended Use/Indications for Use:

A Intended Use(s):

See Indications for Use below.

B Indication(s) for Use:

The EasyStat 300 is designed for clinical laboratory use, making quantitative measurements of potassium (K+), ionized calcium (Ca++), and chloride (Cl-) in whole blood (arterial/venous) samples from Li-Heparinized Syringes. This Analyzer should only be used by trained technicians in clinical laboratories to aid in the diagnosis and treatment of patients with electrolyte and/or acid-base disturbances.

Potassium (K+) measurements are used to monitor electrolyte balance in the diagnosis and treatment of diseases conditions characterized by low or high blood potassium levels.

Calcium (Ca++) (ionized) measurements are used in the diagnosis and treatment of parathyroid disease, a variety of bone diseases, chronic renal disease and tetany (intermittent muscular contractions or spasms).

Chloride (Cl-) measurements are used in the diagnosis and treatment of electrolyte and metabolic disorders such as cystic fibrosis and diabetic acidosis.

C Special Conditions for Use Statement(s):

Rx - For Prescription Use Only

For in vitro diagnostic use only

D Special Instrument Requirements:

EasyStat 300 Analyzer

IV Device/System Characteristics:

A Device Description:

The candidate device is a small bench-top analyzer for use by health care professionals. The analyzer incorporates a replaceable EasyStat 300 ISE cartridge that is comprised of sensors for measurement of potassium, chloride, and calcium. The analyzer also incorporates a replaceable reagent module (i.e., EASYSTAT 300 REAGENT MODULE) containing calibrating solutions for the sensors. The reagent module contains encoded reagent information (calibration values and expiration date), which is read by the analyzer upon installation of the reagent module. Calibrations are performed automatically or on-demand by the user. The analyzer draws 175µL of whole blood (lithium heparinized venous whole blood and arterial blood) when operated in the syringe mode. Quality control materials (i.e., EasyQC BGME Level 1, 2, and 3), cleaning solution, replacement reference electrode, bubble detection, and troubleshoot kit are provided for the system.

The EasyStat 300 Analyzer was also cleared for making quantitative measurements of pO2 (partial pressure of oxygen), pCO2 (partial pressure of carbon dioxide), and pH (hydrogen ion activity) in K211559.

B Principle of Operation:

The potassium, chloride, and ionized calcium parameters are measured by ion-selective electrodes (ISE). When the ISE is in fluidic contact with a sample, an electrochemical potential is developed versus a reference electrode, and is proportional to the logarithm of the ionic activity, as described by the Nernst equation.

V Substantial Equivalence Information:

A Predicate Device Name(s):
EasyLyte Calcium/Chloride Analyzer

B Predicate 510(k) Number(s):
K963694

C Comparison with Predicate(s):

Device & Predicate Device(s):	K220396	K963694
Device Trade Name	EasyStat 300	EasyLyte Calcium/Chloride Analyzer
General Device Characteristic Similarities		
Intended Use/Indications For Use	For the measurement of ionized calcium and chloride.	Same
General Device Characteristic Differences		
Analytes Measured	Potassium, Ionized Calcium, and Chloride	Ionized Calcium and Chloride

The sponsor referenced K063376 to support the substantial equivalence of potassium measurements.

VI Standards/Guidance Documents Referenced:

Clinical and Laboratory Standards Institute (CLSI) EP05-A3 Evaluation of Precision of Quantitative Measurement Procedures; Approved Guideline—Third Edition.

CLSI EP07 Interference Testing in Clinical Chemistry. 3rd Edition.

CLSI EP17-A2 Evaluation of Detection Capability for Clinical Laboratory Measurement Procedures. 2nd Edition.

CLSI EP37 Supplemental Tables for Interference Testing in Clinical Chemistry. 1st Edition.

VII Performance Characteristics (if/when applicable):

A Analytical Performance:

1. Precision/Reproducibility:
The precision performance of the EasyStat 300 was evaluated in two studies.

Study #1 - Within-Device using controls
In the study, three samples of aqueous control material were assayed on each of three analyzers in duplicates per run, two runs per day for 20 days, for a total of 80 measurements per sample per analyzer. The samples were tested on the analyzer operated in syringe mode. For each of the three analyzers, the data was analyzed for repeatability (i.e., within-run) and within-device precision. The results from one representative analyzer are summarized below.

Analyte	Level	Mean, mmol/L	N	Repeatability		Within-Device	
				SD	CV	SD	CV
Potassium	1	2.6	80	0.00	0.1%	0.01	0.3%
	2	4.2	80	0.01	0.2%	0.01	0.2%
	3	6.0	80	0.01	0.2%	0.01	0.2%
Chloride	1	79	80	0.0	0.1%	0.2	0.2%
	2	101	80	0.1	0.1%	0.1	0.1%
	3	130	80	0.1	0.1%	0.1	0.1%
Calcium	1	1.73	80	0.00	0.2%	0.01	0.3%
	2	1.12	80	0.00	0.3%	0.00	0.4%
	3	0.53	80	0.00	0.3%	0.00	0.3%

Study #2 – Venous whole blood
In the study, with each analyte (K+, Cl-, and Ca++) and for each of five days, a lithium heparin venous whole blood sample was collected from a donor, and each day a different donor. Each sample per day was prepared into three analyte levels with normal analyte (n=5), spiked (n=5), and diluted (n=5) for a total of 15 samples of each level. On each of five days, the samples were each assayed in replicates of five using each of three analyzers (n=25 for each sample tested). The analyzer was operated in the syringe mode. The results were analyzed for each sample using a fully-nested random effects variance components model to compute the mean result, and the within-sensor (repeatability), between-analyzer and total (reproducibility or within-laboratory) standard deviations and associated %CVs were estimated, using the methodology as recommended in CLSI guidance document EP05-A3.

The results summarized as follows:

K+ (Syringe Mode)							
level	Mean	Repeatability		Between-Analyzer		Within Laboratory	
		SD	%CV	SD	%CV	SD	%CV
Low 1	2.46	0.004	0.2%	0.017	0.7%	0.018	0.7%
Low 2	1.86	0.011	0.6%	0.016	0.8%	0.019	1.0%
Low 3	2.18	0.004	0.2%	0.013	0.6%	0.014	0.6%
Low 4	2.60	0.009	0.3%	0.020	0.8%	0.022	0.8%
Low 5	1.75	0.010	0.6%	0.016	0.9%	0.019	1.1%
Normal 1	4.67	0.022	0.5%	0.022	0.5%	0.041	0.9%
Normal 2	4.05	0.015	0.4%	0.004	0.1%	0.022	0.5%
Normal 3	4.53	0.044	1.0%	0.002	0.1%	0.045	1.0%
Normal 4	5.14	0.018	0.4%	0.000	0.0%	0.041	0.8%
Normal 5	4.59	0.022	0.5%	0.014	0.3%	0.034	0.7%
High 1	8.13	0.025	0.3%	0.094	1.2%	0.131	1.6%
High 2	6.88	0.035	0.5%	0.000	0.0%	0.064	0.9%
High 3	8.53	0.189	2.2%	0.076	0.9%	0.203	2.4%
High 4	6.92	0.027	0.4%	0.000	0.0%	0.066	0.9%
High 5	8.38	0.069	0.8%	0.080	1.0%	0.119	1.4%

Cl- (Syringe Mode)							
level	Mean	Repeatability		Between-Analyzer		Within Laboratory	
		SD	%CV	SD	%CV	SD	%CV
Low 1	72.46	0.18	0.2%	0.00	0.0%	0.25	0.3%
Low 2	85.79	0.21	0.2%	0.00	0.0%	0.21	0.2%
Low 3	71.43	0.52	0.7%	0.09	0.1%	0.52	0.7%
Low 4	70.96	0.37	0.5%	0.37	0.5%	0.52	0.7%
Low 5	68.49	0.30	0.4%	0.18	0.3%	0.35	0.5%
Normal 1	103.13	0.20	0.2%	0.29	0.3%	0.35	0.3%
Normal 2	100.18	0.26	0.3%	0.36	0.4%	0.45	0.4%
Normal 3	103.17	0.21	0.2%	0.57	0.6%	0.63	0.6%
Normal 4	99.97	0.30	0.3%	0.58	0.6%	0.66	0.7%
Normal 5	99.23	0.31	0.3%	0.22	0.2%	0.41	0.4%
High 1	123.74	0.25	0.2%	0.55	0.4%	0.61	0.5%
High 2	121.81	0.20	0.2%	0.66	0.5%	0.73	0.6%
High 3	125.66	0.21	0.2%	0.87	0.7%	0.94	0.7%
High 4	123.84	0.24	0.2%	0.81	0.7%	0.88	0.7%
High 5	117.09	0.21	0.2%	0.65	0.6%	0.73	0.6%

Ca++ (Syringe Mode)							
level	Mean	Repeatability		Between-Analyzer		Within Laboratory	
		SD	%CV	SD	%CV	SD	%CV
Low 1	0.48	0.000	0.0%	0.006	1.2%	0.006	1.2%
Low 2	0.45	0.003	0.6%	0.002	0.4%	0.003	0.7%
Low 3	0.43	0.000	0.0%	0.000	0.0%	0.006	1.3%
Low 4	0.42	0.002	0.4%	0.000	0.0%	0.005	1.3%
Low 5	0.42	0.002	0.4%	0.003	0.8%	0.006	1.3%
Normal 1	1.27	0.004	0.4%	0.011	0.9%	0.013	1.0%
Normal 2	1.25	0.004	0.4%	0.009	0.7%	0.010	0.8%
Normal 3	1.31	0.009	0.7%	0.005	0.4%	0.010	0.8%
Normal 4	1.29	0.003	0.2%	0.004	0.3%	0.006	0.4%
Normal 5	1.31	0.008	0.6%	0.003	0.3%	0.009	0.7%
High 1	2.60	0.008	0.3%	0.038	1.4%	0.042	1.6%
High 2	2.20	0.008	0.4%	0.016	0.7%	0.020	0.9%
High 3	2.61	0.045	1.7%	0.034	1.3%	0.056	2.2%
High 4	2.50	0.006	0.2%	0.012	0.5%	0.018	0.7%
High 5	2.23	0.012	0.5%	0.009	0.4%	0.015	0.7%

2. Linearity:

A linearity study was conducted using a linearity set of 9 samples prepared from lithium heparin venous whole blood samples. Each of the 9 samples was assayed in triplicate on each of three analyzers. The study was conducted with the analyzers operated in syringe mode. For potassium, chloride, and calcium, regression analysis demonstrated first order linearity. The results of the linear regression analysis from one representative analyzer are summarized below:

Analyte	Claimed Measuring Range (mmol/L)	Sample Range Tested (mmol/L)	Slope	Intercept	R^2
Potassium	1.0 - 20	0.51 - 21.12	0.99	0.12	0.999
Chloride	50 - 150	46.6 - 165.8	0.97	-0.36	1.000
Calcium	0.25 - 5.0	0.22 - 5.28	0.96	0.01	1.000

3. Analytical Specificity/Interference:

The analytical specificity performance of the EasyStat 300 Analyzer for potassium, chloride, and calcium was evaluated by testing for interference from endogenous and exogenous substances. In the study, lithium heparin venous whole blood samples were prepared at two analyte concentrations. Each sample was further divided into two aliquots; i.e. test sample (with added interferent) and control sample (with no added interferent). Each test and control sample was assayed in replicates of five on each of three analyzers operated in syringe mode. A substance was identified as an interferent if the difference in the mean between the test and control sample was outside of the predefined allowable difference, as shown below:

Analyte	Non-significant interference limit
K+	±0.3 mmol/L or ±8%
Cl-	±5 mmol/L or 5%
Ca++	±0.10 mmol/L or ±10%

The following tables list the concentrations of each substance at which no significant interference was found.

Potassium

Substance	**Highest concentration tested at which no significant interference is observed**
Acetaminophen	16 mg/dL
Ammonium (Chloride)	0.151 mmol/L
Benzalkonium (Chloride)	5 mg/dL
(Sodium) Bromide	37.5 mmol/L
Bilirubin, conjugated	20 mg/dL
Calcium (Chloride)	5.0 mmol/L
(Sodium) Citrate	12 mmol/L
Ethanol	130 mmol/L
Heparin-Na	330 U/dL
Hydroxyurea	3.08 mg/dL
Intralipid®	1%
Ipratropium Bromide	0.08 mg/L
Lithium (Chloride)	3.2 mmol/L
Magnesium (Chloride)	4.1 mmol/L
pH	8.0 pH units
(Sodium) Perchlorate	20 mg/dL
(Sodium) Salicylate	4.3 mmol/L
Na (Chloride)	170 mmol/L

Chloride

Substance	**Highest concentration tested at which no significant interference is observed**
Acetaminophen	16 mg/dL
(Sodium) Bromide	1.5 mmol/L
Bilirubin, conjugated	20 mg/dL
Ethanol	130 mmol/L
(Sodium) Fluoride	63.2 µmol/L
Heparin-Na	330 U/dL
Hydroxyurea	3.08 mg/dL
Ibuprofen	1.06 mM
Intralipid®	1%
(Potassium) Iodide	0.55 mmol/L
Ipratropium Bromide	0.08 mg/L

Substance	Highest concentration tested at which no significant interference is observed
(Potassium) Oxalate	12.4 mg/L
pH	8.0 units
(Sodium) Perchlorate	20 mg/dL
(Sodium) Salicylate	4.3 mmol/L

Calcium

Substance	Highest concentration tested at which no significant interference is observed
Acetaminophen	16 mg/dL
Ammonium (Chloride)	0.151 mmol/L
Benzalkonium (Chloride)	0.5 mg/dL
(Sodium) Bromide	37.5 mmol/L
Bilirubin, conjugated	20 mg/dL
Ethanol	130 mmol/L
Heparin-Na	330 U/dL
Hydroxyurea	3.08 mg/dL
Ibuprofen	1.06 mM
Intralipid®	1%
(Potassium) Iodide	3 mmol/L
Ipratropium Bromide	0.08 mg/L
Lithium (Chloride)	3.2 mmol/L
Magnesium (Chloride)	12.35 mg/dL
(Potassium) Oxalate	12.4 mg/L
pH	8.0 units
(Sodium) Salicylate	4.3 mmol/L
Na (Chloride)	170 mmol/L
(Potassium) Thiocyanate	898 µmol/L

For those substances that on initial screening were 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	Affected Analyte	Interferant concentration	Interference
Fluoride	Potassium	≥ 1.0 mmol/L	Decreased results
Ibuprofen	Potassium	≥ 0.8 mM	Increased results
Perchlorate	Calcium	≥ 6.0 mg/dL	Decreased results
Perchlorate	Chloride	≥ 6.0 mg/dL	Decreased results
Thiocyanate	Chloride	≥ 225 µmol/L	Increased results
Thiosulfate	Potassium	≥ 5.0 mmol/L	Decreased results
Thiosulfate	Chloride	≥ 5.0 mmol/L	Decreased results
Thiosulfate	Calcium	≥ 5.0 mmol/L	Decreased results
Bromide	Chloride	≥ 1.5 mmol/L	Increased results

Substance	Affected Analyte	Interferant concentration	Interference
Citrate	Chloride	≥ 3.0 mmol/L	Decreased results
Intralipid	Potassium	≥ 1.0 g/dL	Decreased results
Iodide	Chloride	≥ 0.65 mmol/L	Increased results
pH	Calcium	≥ 7.55	Decreased results

The sponsor added the following limitations to their labeling:

- Potassium levels should not be relied upon in patients suspected of ibuprofen toxicity, as very high concentrations of ibuprofen may cause positive bias for potassium.
- Bromide and iodide from therapeutic drugs and ointments may cause a positive bias for chloride. Normal physiological levels of bromide and iodide do not interfere.
- This device should not be used with patients taking perchlorate.

4. Assay Reportable Range:

   See linearity.

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

   Traceability
   The metrological traceability of the EasyStat 300 for potassium, chloride, and calcium was reviewed and found acceptable.

6. Detection Limit:

   The performance at the lower end of the measuring range for potassium and chloride is supported by the linearity studies (see section VII.A.2 above). The sponsor performed a study to evaluate the limit of blank (LoB), limit of detection (LoD) and limit of quantification (LoQ) for ionized calcium following the recommendations in CLSI EP17-A2.

   LoB
   In the study, five pooled plasma samples ultracentrifuged to lower the calcium concentration were assayed in replicates of two with each of two reagent lots on one analyzer over three days, for a total of 60 measurements. The LoB was determined using parametric analysis as described in CLSI EP17-A2.

   LoD
   In the study, five pooled plasma samples ultrafiltered to lower the calcium concentration near the LoD were assayed in replicates of two with each of two reagent lots on one analyzer over three days, for a total of 60 measurements. The LoD was analyzed using parametric data analysis as described in CLSI EP17-A2.

   LoQ
   In the study, four pooled samples with concentrations near the expected LoQ were prepared, and then analyzed with each of two reagent lot on one EasyStat 300 analyzer with three replicates per day over three consecutive days total of 18 replicates per sample. The LoQ was

determined as the measured sample concentration meeting the total allowable error goals of ±0.10 mmol/L.

The detection limit studies support the claimed measuring range of 0.25-5.0 mmol/L for ionized calcium.

7. Assay Cut-Off:

Not applicable.

B Comparison Studies:

1. Method Comparison with Predicate Device:
The agreement accuracy of the candidate device was evaluated in a method comparison study versus a comparator device. In the study, lithium heparin venous and arterial whole blood samples were collected from 198 subjects across two sites (one hospital and one internal), and each tested in duplicate on the EasyStat 300 Analyzer in syringe mode, and in duplicate on the comparator. The average of the two readings using the comparator and the first of the two EasyStat 300 Analyzer reading was used in the data analysis by linear regression. To cover the measurement range, no more than 10% of the samples were diluted and/or spiked. The sponsor provided acceptable evidence to support pooling the results from venous and arterial samples in the same analysis. The results of the method comparison study are summarized as follows.

Linear regression

Analyte	Slope	Intercept	R^2	Range Tested
Potassium	0.962	0.13	0.997	1.45 - 18.24 mmol/L
Chloride	1.007	-0.38	0.981	64.3 - 145.4 mmol/L
Calcium	0.987	-0.02	0.994	0.44 - 4.5 mmol/L

Bias at medical decision levels (MDL)

Analyte	N	MDL (mmol/L)	Bias at MDL
Potassium	198	3.0	0.02
		5.8	-0.09
		7.5	-2.1%
Chloride	198	90	0.3%
		112	0.4%
Calcium	198	0.37	-0.02
		0.82	-0.03
		1.58	-2.6%

2. Matrix Comparison:

Not applicable, the device is only intended for use with lithium heparin whole blood.

C Clinical Studies:

1. Clinical Sensitivity:

   Not applicable.

2. Clinical Specificity:

   Not applicable.

3. Other Clinical Supportive Data:

   Not applicable.

D Clinical Cut-Off:

Not applicable.

E Expected Values/Reference Range:

The EasyStat 300 Analyzer operator manual lists the following expected values from scientific literature for the normal ranges in arterial, mixed venous, or venous samples:

Potassium: 3.5 – 5.1 mmol/L
Chloride: 98.0 – 106.0 mmol/L
Calcium: 1.05 – 1.32 mmol/L

Sources:
Tietz: Fundamentals of Clinical Chemistry, 4th edition, (1996)
B. Statland: Clinical Decision Levels for Lab Test, 2nd edition
Fink: Clinical Practice in Respiratory Care

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.