510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION
DECISION SUMMARY
ASSAY ONLY TEMPLATE

A. 510(k) Number:

k160402

B. Purpose for Submission:

New device

C. Measurand:

Glucose, lactate, and total bilirubin (tBili)

D. Type of Test:

Quantitative, enzymatic for glucose and lactate, spectrophotometric for total bilirubin

E. Applicant:

Instrumentation Laboratory Inc.

F. Proprietary and Established Names:

GEM Premier 5000 (Measured Parameters: Glucose, Lactate, Total Bilirubin)

G. Regulatory Information:

Product Code	Classification	Regulation Section	Panel
CGA	Class II	21 CFR 862.1345 Glucose Test System	Clinical Chemistry (75)
KHP	Class I*	21 CFR 862.1450 Lactic Acid Test System	
MQM	Class I, reserved	21 CFR 862.1113 Bilirubin (total and unbound) in the neonate test system	

* Meets the limitations of exemptions per 21 CFR 862.9(c)(9)

H. Intended Use:

1. Intended use(s):

   See Indications for use below

2. Indication(s) for use:

The GEM Premier 5000 is a portable critical care system for use by health care professionals to rapidly analyze whole blood samples at the point of health care delivery in a clinical setting and in a central laboratory. The instrument provides quantitative measurements of glucose, lactate and total bilirubin from venous, arterial and capillary heparinized whole blood. These parameters aid in the diagnosis of a patient's metabolite balance.

Glucose (Glu) measurement is used in the diagnosis and treatment of carbohydrate metabolism disturbances including diabetes mellitus, neonatal hypoglycemia, and idiopathic hypoglycemia, and of pancreatic islet cell carcinoma.

Lactate (Lac) measurement is used:

- to evaluate the acid-base status of patients suspected of having lactic acidosis;
- to monitor tissue hypoxia and strenuous physical exertion;
- in the diagnosis of hyperlactatemia

Total bilirubin measurement is used to aid in assessing the risk of kernicterus and hyperbilirubinemia in neonates.

3. Special conditions for use statement(s):

For prescription use only at point-of-care and central laboratory settings

4. Special instrument requirements:

GEM Premier 5000 analyzer

I. Device Description:

The GEM Premier 5000 system contains two key components: the GEM Premier 5000 analyzer and the GEM Premier 5000 PAK (cartridge). The GEM Premier 5000 PAK contains reagents, sensors, optical cell for Co-Ox and total bilirubin, sampler and waste bag. It enables analysis of 75 to 600 samples per cartridge. Analyzer: Employs a unique color touch screen and a simple set of menus and buttons for user interaction. The analyzer guides operators through the sampling process with simple, clear messages and prompts.

GEM Premier 5000 PAK: Houses all required components necessary to operate the instrument once the cartridge is validated. These components include the sensors, CO-Ox/tBili optical cell, Process Control (PC) Solutions, sampler, pump tubing, distribution valve and waste bag. The GEM PAK has flexible menus and test volume options to assist facilities in maximizing efficiency.

J. Substantial Equivalence Information:

1. Predicate device name(s):

GEM Premier 4000

2. Predicate 510(k) number(s):

   K133407 for glucose and lactate
   K142898 for total bilirubin

3. Comparison with predicate:

Item	GEM Premier 5000 for measurement of glucose, lactate, and total bilirubin (Candidate Device k160402)	GEM Premier 4000 for measurement of glucose, lactate, and total bilirubin (Predicate Device K133407, K112995)
Similarities and differences		
Intended Use	The GEM Premier 5000 is a portable critical care system for use by health care professionals to rapidly analyze whole blood samples at the point of health care delivery in a clinical setting and in a central laboratory. The instrument provides quantitative measurements of glucose, lactate and total bilirubin.	Same.
Intended User	Central Laboratory and Point-of-Care	Same.
Types of Measurements	Amperometry: Glucose and Lactate Spectrophotometry: Total Bilirubin	Same.
Sampling Modes and Sample Volumes	Normal Mode 150 µL Micro Mode 65 µL tBili/CO-Ox Mode 100 µL	Same.
Sample Type	Glucose: Heparinized whole blood (arterial, venous, capillary) Lactate: Heparinized whole blood (arterial, venous, capillary) Total Bilirubin: Heparinized whole blood (arterial, venous, capillary)	Glucose: Heparinized whole blood Lactate: Heparinized whole blood Total Bilirubin: Heparinized whole blood and Heparinized plasma
Measuring Range	Glucose: 4 to 685 mg/dL Lactate: 0.3 to 17.0 mmol/L tBili: 2.0 to 40.0 mg/dL	Glucose 4 to 685 mg/dL Lactate 0.3 to 17.0 mmol/L tBili 0.0 to 58.5 mg/dL

Item	GEM Premier 5000 for measurement of glucose, lactate, and total bilirubin (Candidate Device k160402)	GEM Premier 4000 for measurement of glucose, lactate, and total bilirubin (Predicate Device K133407, K112995)
Instrument Dimensions	GEM Premier 5000 Instrument: • Height: 18.6 inches • Width: 13.0 inches • Depth: 16.4 inches • Weight: 45.4 pounds	GEM Premier 4000 Instrument: • Height: 18 inches • Width: 12 inches • Depth: 15 inches • Weight: 44 pounds
Calibration	2-point calibration	Same

K. Standard/Guidance Document Referenced (if applicable):

CLSI - EP05-A3 Evaluation of Precision of Quantitative Measurement Procedures
CLSI - EP06-A Evaluation of Linearity of Quantitative Measurement Procedures
CLSI - EP07-A2. Interference Testing in Clinical Chemistry
CLSI - EP09-A3 Measurement Procedure Comparison and Bias Estimation Using Patient Samples
CLSI - EP17-A2 Evaluation of Detection Capability for Clinical Laboratory Measurement Procedures
CLSI – EP25-A Evaluation of Stability of In Vitro Diagnostic Reagents

L. Test Principle:

The glucose and lactate sensors are amperometric biosensors consisting of a platinum electrode poised at a positive potential with respect to the card reference electrode. Glucose or lactate determination is accomplished by enzymatic reaction of glucose or lactate with oxygen in the presence of glucose oxidase or lactate oxidase and the electrochemical oxidation of the resulting hydrogen peroxide at the platinum electrode. The current flow between the platinum electrode and the ground electrode is proportional to the rate at which hydrogen peroxide molecules diffuse to the platinum and are oxidized, which in turn is directly proportional to the metabolite (glucose or lactate) concentration I = (S x metabolite) + IZ, where "I" is the electrode current, "S" is the sensitivity, and IZ is the zero current. The value of S and IZ can be calculated from the Process Control Solution data for the sensor. The equation can then be solved for the metabolite concentration, where "I" becomes the electrode current produced by the blood sample.

Total bilirubin measurement is based on an optical absorbance measurement of the sample. An in-line optical assay is integrated in to the GEM PAK flow path where the hemolyzed whole blood sample provides a measure of total bilirubin and CO-Oximetry. The optical cell is a flow through channel with two parallel plate optical windows separated by a well-defined path length. The chemical lysing of the sample is implemented to minimize the scattering effect of the blood and to make the spectral measurement more reliable. The optical measurement hardware consisting of a white light-emitting diode (LED) light source, a neon

reference and a high resolution spectrometer with a holographic diffraction grating and a charge-coupled device (CCD) array are all contained in the analyzer. Only the optical cell is located in the disposable cartridge (GEM PAK) and is aligned with the analyzer optics for spectral measurements following installation of the GEM PAK.

M. Performance Characteristics (if/when applicable):

1. Analytical performance:

a. Precision/Reproducibility:

Both Internal and External Precision studies were performed in accordance with CLSI EP05-A3 guidance.

Internal Precision Studies:

1) An internal 20-day precision study was performed on the GEM Premier 5000 with GEM System Evaluator 1, 2 and 3. Each of the control levels was run on 3 GEM Premier 5000 analyzers for 20 days, with 2 runs per day and 1 replicate measured per run per level. Results are summarized below:

Material	Analyte	Level	Mean	N	Within Run SD	Within Run %CV	Total SD	Total %CV
GEM System Evaluator 1, 2, and 3	Glucose (mg/dL)	Level 1	378	120	10.9	2.9%	11.2	3.0%
		Level 2	104	120	1.6	1.6%	1.6	1.6%
		Level 3	46	120	1.3	2.7%	1.3	2.7%
	Lactate (mmol/L)	Level 1	7.3	120	0.06	0.9%	0.07	0.9%
		Level 2	0.8	120	0.03	3.7%	0.03	3.7%
		Level 3	2.5	120	0.04	1.8%	0.04	1.8%
	tBili (mg/dL)	Level 1	33.8	120	0.14	0.4%	0.16	0.5%
		Level 2	17.7	120	0.13	0.8%	0.18	1.0%
		Level 3	3.3	120	0.13	4.0%	0.16	4.9%
CVP 5 tBili	tBili (mg/dL)	NA	4.8	120	0.13	2.6%	0.18	3.7%

2) An addition internal precision study was performed using five levels of whole blood samples under normal mode (150 µL), micro capillary (65 µL) mode and tBili /CO-Ox Mode (100 µL). Due to the instability of whole blood, fresh whole blood samples were prepared each day. Testing was completed in 8 replicates per run for each level and 1 run per day for 5 days on 3 GEM Premier 5000 instruments. Results are summarized below:

Analyte	Mode	Level	Mean	N	Within Run SD	Within Run %CV	Total SD*	Total %CV*
Glucose (mg/dL)	Normal Mode	1	24	120	0.8	3.3%	0.8	3.5%
		2	42	120	0.8	2.0%	1.1	2.7%
		3	120	120	1.7	1.4%	2.5	2.1%
		4	179	120	3.1	1.7%	4.0	2.2%
		5	729	120	13.1	1.8%	13.4	1.8%
	Micro Mode	1	26	120	0.7	2.8%	0.8	3.0%
		2	44	120	0.8	1.8%	1.2	2.7%
		3	118	120	2.5	2.1%	3.0	2.6%
		4	176	120	2.9	1.7%	4.1	2.3%
		5	761	120	11.6	1.5%	24.9	3.3%
Lactate (mmol/L)	Normal Mode	1	0.5	120	0.05	9.4%	0.05	9.4%
		2	1.8	120	0.06	3.3%	0.07	3.7%
		3	4.9	120	0.09	1.7%	0.10	2.0%
		4	7.8	120	0.17	2.1%	0.18	2.3%
		5	17.9	120	0.40	2.2%	0.45	2.5%
	Micro Mode	1	0.5	120	0.04	7.5%	0.04	7.6%
		2	1.9	120	0.05	2.9%	0.06	3.1%
		3	4.9	120	0.14	2.9%	0.15	3.1%
		4	7.8	120	0.13	1.6%	0.16	2.0%
		5	18.2	120	0.31	1.7%	0.37	2.0%
tBili (mg/dL)	Normal Mode	1	3.3	120	0.12	3.5%	0.24	7.3%
		2	6.2	120	0.12	1.8%	0.29	4.6%
		3	14.1	120	0.13	0.9%	0.41	2.9%
		4	19.7	120	0.17	0.9%	0.50	2.5%
		5	29.6	120	0.18	0.6%	0.75	2.5%
	tBili/ CO-Ox Mode	1	3.3	120	0.10	2.9%	0.12	3.7%
		2	6.3	120	0.13	2.0%	0.19	3.0%
		3	14.0	120	0.14	1.0%	0.27	1.9%
		4	19.6	120	0.17	0.9%	0.36	1.8%
		5	29.4	120	0.16	0.5%	0.51	1.7%

* The day-to-day contribution was excluded in total precision evaluation for whole blood samples since different whole blood samples were prepared each day.

External Precision Studies:

3) A reproducibility study was performed at 3 external clinical point-of-care (POC) sites in hospital settings. The studies were run by a total of 9 different operators (perfusionists and respiratory therapists) on 3 different GEM Premier 5000 instruments using a single lot of GEM Premier 5000 PAK (cartridge). Each site

used the same lots of GEM System Evaluator (GSE) 1, 2 and 3, running each control level in triplicate, twice a day for 5 days, for a total of 30 replicates per level per site. The pooled repeatability and reproducibility results for these 3 POC sites are summarized below:

Analyte	Level	N	Mean	Repeatability		Reproducibility	
				SD	%CV	SD	%CV
Gluc (mg/dL)	1	90	381	2.1	0.5%	4.1	1.2%
	2	90	102	0.5	0.5%	0.8	0.8%
	3	90	45	0.5	1.2%	0.6	1.4%
Lac (mmol/L)	1	90	7.2	0.06	0.8%	0.109	1.3%
	2	90	0.8	0.02	2.3%	0.02	2.5%
	3	90	2.4	0.02	0.7%	0.06	2.3%
tBili (mg/dL)	1	90	33.7	0.14	0.4%	0.16	0.5%
	2	90	17.6	0.10	0.5%	0.13	0.7%
	3	90	3.2	0.10	3.0%	0.10	3.3%
	CVP 5 tBili	90	4.9	0.11	2.2%	0.17	3.5%

4) To evaluate whole blood imprecision on the new GEM Premier 5000 system in the central laboratory and point-of-care (POC) settings, whole blood patient samples were tested at 2 external central laboratories and 1 internal Customer Simulation Laboratory, as well as at 3 external POC locations. For the central laboratory setting, the studies were performed by 3 operators on 3 GEM Premier 5000 instruments using a single lot of GEM Premier 5000 PAK (cartridge). For the POC Setting, the studies were performed by 11 operators on 3 GEM Premier 5000 instruments, using a single lot of GEM Premier 5000 PAK (cartridge). At least two whole blood specimens were analyzed in triplicate daily for 5 days under both normal mode (150 µL) and micro capillary (65 µL) mode. Due to the use of unique whole blood samples at each clinical site, only repeatability can be evaluated. Reproducibility was not assessed for the whole blood samples. At the internal Customer Simulation Laboratory, contrived whole blood specimens were analyzed in addition to native specimens in order to cover the low and high medical decision levels of each analyte.

Individual and Multisite Results for Glucose in Normal Mode

Analyte	Sample Mode	Site	N	Mean	Min	Max	Within sample %CV
Glu (mg/dl)	Normal Mode	POC1	51	140	76	337	1.1%
		POC2	39	142	80	201	1.0%
		POC3	27	137	105	182	1.2%
		POC-All	117	140	76	337	1.1%
		CSL	33	113	79	365	1.7%
		Lab1	30	163	100	230	1.0%
		Lab2	30	132	76	261	1.0%
		Lab-All	93	135	76	365	1.2%

Individual and Multisite Results for Glucose in Micro Mode

Analyte	Sample Mode	Site	N	Mean	Min	Max	Within sample %CV
Glu (mg/dl)	Micro Mode	POC1	30	155	79	378	1.0%
		POC2	36	146	100	294	1.0%
		POC3	30	122	70	206	0.8%
		POC-All	96	141	70	378	0.9%
		CSL	33	110	74	371	0.8%
		Lab1	30	166	101	231	1.2%
		Lab2	30	136	75	298	1.4%
		Lab-All	93	136	74	371	1.1%

Individual and Multisite Results for Lactate in Normal Mode

Analyte	Sample Mode	Site	N	Mean	Min	Max	Within sample SD
Lactate (mmol/L)	Normal Mode	POC1	33	1.7	1.1	2.3	0.07
		POC2	12	1.8	1.4	2.6	0.03
		POC3	21	2.0	1.3	2.6	0.06
		POC-All	66	1.9	1.1	2.6	0.06
		CSL	30	1.7	0.7	2.2	0.03
		Lab 1	21	2.0	1.5	2.6	0.07
		Lab 2	15	2.0	1.7	2.5	0.06
		Lab-All	66	1.9	0.7	2.6	0.06

Individual and Multisite Results for Lactate in Micro Mode

Analyte	Sample Mode	Site	N	Mean	Min	Max	Within sample SD
Lactate (mmol/L)	Micro Mode	POC1	27	1.9	1.3	2.4	0.06
		POC2	33	1.6	0.8	2.5	0.05
		POC3	18	1.6	0.6	2.5	0.06
		POC-All	78	1.7	0.6	2.5	0.05
		CSL	30	1.9	0.9	2.5	0.04
		Lab 1	30	1.8	1.1	2.6	0.08
		Lab 2	12	1.9	1.5	2.7	0.06
		Lab-All	72	1.8	0.9	2.7	0.06

Individual and Multisite Results for Total Bilirubin in Normal Mode

Analyte	Sample Mode	Site	N	Mean	Min	Max	Within sample SD
tBili (mg/dL)	Normal Mode	POC1	24	18.7	5.5	37.2	0.8%
		POC2	24	16.8	3.6	36.0	2.0%
		POC3	27	11.5	4.7	21.8	1.9%
		POC-All	75	15.5	3.6	37.2	1.6%
		CSL	15	18.5	18.0	19.1	0.6%
		Lab1	6	4.9	4.0	5.2	7.5%
		Lab-All	21	14.6	4.0	19.1	2.5%

Individual and Multisite Results for Total Bilirubin in tBili/CO-Ox Mode

Analyte	Sample Mode	Site	N	Mean	Min	Max	Within sample SD
tBili (mg/dL)	tBili/ CO-Ox Mode	POC1	33	22.1	4.0	39.3	1.2%
		POC2	27	11.6	4.0	36.6	1.6%
		POC3	30	11.8	5.1	20.0	1.3%
		POC-All	90	15.5	4.0	39.3	1.4%
		CSL	15	18.3	17.9	18.9	0.7%
		Lab1	3	8.3	8.1	8.5	2.5%
		Lab-All	18	16.7	8.1	18.9	1.0%

b. Linearity/assay reportable range:

In accordance with CLSI EP06-A, nine (9) levels per analyte were prepared by spiking or diluting whole blood to challenge the claimed reportable range for each parameter. Each blood level was analyzed in triplicate on three (3) GEM Premier 5000 test analyzers and results compared to reference analyzers.

Analyte	Claimed Measuring Range	Sample Range Tested (mmol/L)	Slope	Intercept	γ2
Glucose (mg/dL)	4 to 685	1 – 777	0.982	-12.489	0.995
Lactate (mmol/L)	0.3 to 17.0	0.2 – 25.5	1.037	-0.131	0.998
Total Bilirubin (mg/dL)	2.0 to 40.0	1.4 – 43.7	1.040	0.227	0.998

The presented data demonstrates linearity across the claimed measuring range of the device for the 3 analytes (glucose, lactate, and total bilirubin).

c. *Traceability, Stability, Expected values (controls, calibrators, or methods):*

Traceability

The GEM Premier 5000 Glucose is traceable by automated spectrophotometry using hexokinase method per CDC no. 77-8330 using secondary standard prepared from NIST #917.

No reference method is established for lactate. By automated spectrophotometry using lactate oxidase with secondary standard prepared from USP #1614308.

The GEM Premier 5000 bilirubin measurement is traceable to modified Jendrassik-Grof method using NIST #916a standard reference material.

d. *Detection limit:*

In accordance with CLSI EP17-A2, LoB, LoD and LoQ were established for glucose, lactate and total bilirubin, using three (3) lots of GEM Premier 5000 PAKs (cartridges). Samples tested were all lithium heparin whole blood samples. LoB was determined by running three blank samples in 60 replicates per day over 3 days using 3 lots of GEM Premier 5000 PAKs (cartridges) on 3 different GEM Premier 5000 instruments.

LoD and LoQ were determined by running low level samples in 60 replicates per day over 3 days using 3 lots of GEM Premier 5000 PAKs (cartridges) on 3 different GEM Premier 5000 instruments. LoD is calculated based on LoB (mean) + 1.65 SD (low sample). LoQ was defined as the lowest concentration at which measured total error is less than the pre-defined total error. The results are summarized in the table below:

Analyte	LoB	LoD	LoQ
Glucose (mg/dL)	0	2	2
Lactate (mmol/L)	0.0	0.0	0.2
Total Bilirubin (mg/dL)	0.1	0.3	1.4

The claimed measuring range of the assays is summarized in the tables below:

Analyte	Claimed measuring range
Glucose	4 to 685 mg/dL
Lactate	0.3 to 17.0 mmol/L
Total Bilirubin	2.0 to 40.0 mg/dL

e. *Analytical specificity:*

Interference studies were performed according to CLSI EP-7A guidance to determine the effects from potential interferents on the electrolyte assays. Various concentrations of interferents were spiked into two levels (low and high) of each analyte. Testing was performed in singlet per level using 3 GEM Premier 5000 analyzers. The sponsor's definition of non-significant interference for each analyte was as follows: 10% for glucose, ±10% for tBili, and ±0.4 mmol/L for lactate.

The highest concentration tested that shows non-significant interference are summarized below:

Substance	Concentration	Tested analytes with no observed interference
Acetaminophen	1324 µmol/L	Glucose, Lactate, tBili
Acetoacetate	2 mmol/L	Glucose, Lactate
N-acetylcysteine	10.2 mmol/L	Glucose, Lactate
Amoxicillin	206 µmol/L	tBili
Ascorbic acid	342 µmol/L	Glucose, Lactate, tBili
Benzalkonium (Chloride)	5 mg/L	tBili
Bilirubin	20 mg/dL	tBili
Biliverdin	4 mg/dL	tBili
Ceftriaxone	1460 µmol/L	tBili
Chlorpromazine	6.3 µmol/L	Glucose, Lactate
Ciprofloxin	30.2 µmol/L	tBili

Substance	Concentration	Tested analytes with no observed interference
(Sodium) Citrate	12 mmol/L	Glucose, Lactate
Creatinine	5 mg/dL	Glucose, Lactate
Diazepam	18 µmol/L	tBili
Dobutamine	2 mg/dL	Glucose, Lactate
Dopamine	5.87 µmol/L	Glucose, Lactate
Epinephrine	0.5 µmol/L	tBili
Ethanol	86.8 mmol/L	Glucose, Lactate
Evans Blue	10 mg/L	tBili
Fetal Hemoglobin	75%	tBili
Flaxedil (Gallamine triethiodide)	5 mg/dL	Glucose, Lactate
(Sodium) Fluoride	105 µmol/L	Glucose, Lactate
Fructose	1 mmol/L	Glucose, Lactate
Galactose	0.84 mmol/L	Glucose, Lactate
Gentamycin	21 µmol/L	tBili
Glucose	1000 mg/dL	Lactate
Glycolic acid	1 mmol/L	Glucose
Hematocrit	25%	Glucose
	75%	Glucose
Hemoglobin	20 g/dL	tBili
Heparin	100,000 U/L	Glucose, Lactate
β-hydroxybutyrate	2 mmol/L	Glucose, Lactate
Ibuprofen	2425 µmol/L	Glucose, Lactate
Icodextrin	20 mg/dL	Glucose, Lactate
Indocyanine Green	10 mg/L	tBili
Isoniazide	292 µmol/L	Glucose, Lactate
Lactate	6.6 mmol/L	Glucose
Lithium (Chloride)	3.2 mmol/L	tBili
Maltose	200 mg/dL	Glucose, Lactate
Mannose	20 mg/dL	Glucose, Lactate

Substance	Concentration	Tested analytes with no observed interference
Methadone	6.46 µmol/L	tBili
Morphine	1.75 µmol/L	tBili
Omeprazole	17.4 µmol/L	tBili
(Sodium) Oxalate	500 mg/dL	Glucose, Lactate
pO_2	30 mmHg	Glucose, Lactate
Pralidoxime iodide	40 µg/mL	Glucose, Lactate
Propofol	0.05 mg/mL	tBili
Pyruvate	309 µmol/L	Glucose, Lactate
Sulfhemoglobin	10%	tBili
Suxamethonium	68 µmol/L	tBili
(Sodium) Thiocyanate	6880 µmol/L	Glucose, Lactate
Thiopental	248 µmol/L	tBili
Thyroxine	1.29 µmol/L	tBili
Urea	42.9 mmol/L	Glucose, Lactate
Uric acid	1.4 mmol/L	Glucose, Lactate
Xylose	20 mg/dL	Glucose, Lactate

The table below lists substances that demonstrated interference with glucose, lactate or total bilirubin (tBili) results and the concentration of the interfering substance, as well as the bias and its direction (positive / negative):

Interfering Substance	Affected Analyte	Analyte Concentration	Interfering Concentration Tested	Bias Observed (Mean)	Lowest Interfering Concentration with Analyte Impact	Bias Observed at the Lowest Concentration
Cyanocobalamin	tBili	4.8 mg/dL	0.18 g/L	-11%	0.16 g/L	-10%
		13.3 mg/dL	0.53 g/L	- 10%	0.47 g/L	-10%
Cyanomethemoglobin	tBili	5.2 mg/dL	1.0%	+18%	0.5%	+10%
		15.1 mg/dL	3.0%	+15%	2.1%	+10%

Interfering Substance	Affected Analyte	Analyte Concentration	Interfering Concentration Tested	Bias Observed (Mean)	Lowest Interfering Concentration with Analyte Impact	Bias Observed at the Lowest Concentration
Glycolic Acid	Lactate	1.0 mmol/L	0.250 mmol/L	+0.4 mmol/L	0.237 mmol/L	+0.4 mmol/L
		2.9 mmol/L	0.250 mmol/L	+0.4 mmol/L	0.241 mmol/L	+0.4 mmol/L
Hydroxocobalamin	tBili	5.0 mg/dL	0.18 g/L	-14%	0.12 g/L	-10%
		14.7 mg/dL	0.35 g/L	-13%	0.27 g/L	-10%
Hydroxyurea	Glucose	86 mg/dL	0.60 mg/dL	+15%	0.41 mg/dL	+10%
		115 mg/dL	0.60 mg/dL	+11%	0.57 mg/dL	+10%
Hydroxyurea	Lactate	1.0 mmol/L	0.40 mg/dL	0.4 mmol/L	0.37 mg/dL	+0.4 mmol/L
		2.8 mmol/L	0.40 mg/dL	0.5 mmol/L	0.35 mg/dL	+0.4 mmol/L
Methylene Blue	tBili	5.0 mg/dL	10 mg/L	-25%	4.6 mg/L	-10%
		14.2 mg/dL	15 mg/L	-11%	12.9 mg/L	-10%
Turbidity (Intralipid)	tBili	4.8 mg/dL	1505 mg/dL	-11%	1143 mg/dL	-10%
		14.0 mg/dL	2006 mg/dL	No Interference Observed		

f. Assay cut-off:

Not Applicable

2. Comparison studies:

a. Method comparison with predicate device:

In accordance with EP09-A3, a method comparison study was conducted on the GEM Premier 5000 in the point-of-care (POC) setting using heparinized whole blood patient samples from the intended use population.

In each setting, the performance of the GEM Premier 5000 was compared to the GEM Premier 4000, except tBili, which used the commercially available whole blood or chemistry analyzer in use at each facility.

For glucose and lactate, the pooled results from the POC sites and the IL internal Customer Simulation Laboratory (CSL) for the Normal Mode (with samples collected in syringes) are presented below:

Syringe Samples					
Analyte	N	Slope	Intercept	r	Sample Range
Glucose (mg/dL)	489	0.973	3.622	0.998	12 to 619
Lactate (mmol/L)	488	1.000	0.000	0.996	0.5 to 15.0

Another method comparison study for capillary whole blood for glucose and lactate was performed at an external POC site in a hospital and an internal laboratory. Capillary whole blood specimens were collected via capillary puncture into 2 capillary tubes containing lithium heparin, and tested immediately on GEM4000 (predicate) and GEM5000 (new device). In addition, <20% of altered capillary samples were tested internally to cover the claimed measuring ranges. The study results are summarized below:

Capillary Samples					
Analyte	N	Slope	Intercept	r	Sample Range
Glucose (mg/dL)	197	0.966	4.775	0.997	12 to 637
Lactate (mmol/L)	201	1.000	0.000	0.995	0.4 to 16.4

Results based on native capillary samples at Medical Decision Level (MDL) are shown below:

Native Capillary Samples						
Analyte	N	Range Min	Range Max	MDL	Bias at MDL	95% CI of Bias at MDL
Glu (mg/dL)	171	68	280	45	3.9	1.0 to 6.2
				120	1.8%	-0.1% to 2.9%
				180	-0.5%	-2.0% to 2.1%
				350	-0.9%	-4.0% to 1.1%
Lac (mg/dL)	171	0.4	3.7	2.0	0.00	0.00 to 0.11
				5.0	0.0%	0.00% to 10.3%

For Total Bilirubin (tBili), the pooled results*** from the POC sites, with a combination of heel-stick samples (capillary Blood) and syringe (arterial/venous), are presented below for the different instrument modes:

Normal Mode					
Predicate	N	Slope	Intercept	r	Sample Range
tBili (mg/dL) vs. Roche Cobas 6000*	53	1.062	0.630	0.996	3.1 to 39.7
tBili (mg/dL) vs. Ortho Clinical Diagnostics Vitros 5600**	76	1.076	-0.099	0.996	2.0 to 39.7

Capillary Mode					
Predicate	**N**	**Slope**	**Intercept**	**r**	**Sample Range**
tBili (mg/dL) vs. Roche Cobas 6000*	58	1.051	0.533	0.996	3.9 to 39.9
tBili (mg/dL) vs. Ortho Clinical Diagnostics Vitros 5600**	77	1.072	-0.255	0.996	2.1 to 39.4
tBili/CO-Ox Mode					
Predicate	N	Slope	Intercept	r	Sample Range
tBili (mg/dL) vs. Roche Cobas 6000*	53	1.068	0.404	0.996	2.0 to 39.7
tBili (mg/dL) vs. Ortho Clinical Diagnostics Vitros 5600**	77	1.076	-0.163	0.995	2.0 to 39.2

*tBili data against Roche Cobas 6000 were from one (1) POC site.
**tBili data against Ortho Clinical Diagnostics Vitros 5600 were from two (2) POC sites.
***8% of the total samples are spiked samples

b. Matrix comparison:

Not applicable. Sponsor stated that only lithium heparin anticoagulant whole blood is the acceptable sample type to be used for their device.

3. Clinical studies:

a. Clinical Sensitivity:

Not Applicable

b. Clinical specificity:

Not Applicable

c. Other clinical supportive data (when a. and b. are not applicable):

Not Applicable

4. Clinical cut-off**:**

Not Applicable

5. Expected values/Reference range:

Analyte	Reference Range	Unit
Glu[1,2]	65 to 95	mg/dL
Glu[1,2]	3.6 to 5.3	mmol/L
Lac[1]	0.36 to 0.75 (at rest)	mmol/L
Lac[1]	2.24 to 6.76 (at rest)	mg/dL
Lac[1]	0.56 to 1.39 (venous)	mmol/L
Lac[1]	2.0 to 12.5 (venous)	mg/dL

Analyte	Age	Reference Range	Unit
tBili[2]	Premature Infant 0 – 1 day	<8.0	mg/dL
	Premature Infant 0 – 1 day	<137	µmol/L
	Premature Infant 1 – 2 days	<12.0	mg/dL
	Premature Infant 1 – 2 days	<205	µmol/L
	Premature Infant 3 – 5 days	<16.0	mg/dL
	Premature Infant 3 – 5 days	<274	µmol/L
	Full-term Infant 0 – 1 day	1.4 – 8.7	mg/dL
	Full-term Infant 0 – 1 day	24 – 149	µmol/L
	Full-term Infant 1 – 2 days	3.4 – 11.5	mg/dL
	Full-term Infant 1 – 2 days	58 – 197	µmol/L
	Full-term Infant 3 – 5 days	1.5 – 12.0	mg/dL
	Full-term Infant 3 – 5 days	26 – 105	µmol/L
	>5 days to < 60 years	0.3 – 1.2	mg/dL
	>5 days to < 60 years	5 – 21	µmol/L

1. Burtis, Carl and David Bruns, Tietz Textbook of Clinical Chemistry and Molecular Diagnostics, Elsevier Saunders, 7th edition, 2015.
2. Wu, A., Tietz Clinical Guide to Laboratory Tests, W.B. Saunders Co., St. Louis MO, 4th Edition, 2006.

N. Proposed Labeling:

The labeling is sufficient and it satisfies the requirements of 21 CFR Part 809.10.

O. Conclusion:

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