510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION
DECISION SUMMARY
ASSAY AND INSTRUMENT

I Background Information:

A 510(k) Number

K220272

B Applicant

Roche Diagnostics

C Proprietary and Established Names

cobas® pulse blood glucose monitoring system

D Regulatory Information

Product Code(s)	Classification	Regulation Section	Panel
PZI	Class II	21 CFR 862.1345 - Glucose Test System	CH - Clinical Chemistry

II Submission/Device Overview:

A Purpose for Submission:

This submission is a Dual 510(k) and CLIA Waiver by Application (Dual Submission) for a new device, tracked as K220272 and CW220002

B Measurand:

Glucose

C Type of Test:

Quantitative aperometric assay (FAD-dependent glucose dehydrogenase)

III Intended Use/Indications for Use:

A Intended Use(s):

See Indications for Use below.

B Indication(s) for Use:

The cobas® pulse blood glucose monitoring system consists of the cobas® pulse instrument and the cobas® GLU test strips.

This system is intended for in vitro diagnostic, point of care, multiple-patient use within professional healthcare settings, including patients receiving intensive medical intervention/therapy.

The cobas® GLU test strips provide an in vitro diagnostic test that quantitatively measures glucose in arterial whole blood, neonate arterial whole blood, or neonate heel stick whole blood, on the cobas® pulse system.

For neonate heel stick, the system should only be used with single-use, auto-disabling lancing devices.

This system is not intended for use with capillary finger stick, venous whole blood, or neonate cord blood specimens.

This system is not intended for screening or diagnosis of diabetes, but is indicated for use in determining dysglycemia.

C Special Conditions for Use Statement(s):

- Rx - For Prescription Use Only
- For in vitro diagnostic use only
- This system is not intended for use with capillary finger stick, venous whole blood, or neonate cord blood specimens.
  *See section VII.C.3 for additional information on sample limitations.
- Not for alternative site testing (AST)
- This system is not intended for screening or diagnosis of diabetes.
- Use only fresh whole blood or whole blood collected in lithium heparin collection devices for arterial, neonate arterial, or neonate heel stick whole blood.
- Blood collection devices containing iodoacetate or fluoride should not be used.
- Do not use serum or plasma.
- Use only an auto-disabling single-use lancing devices for heel stick samples.
- Altitudes above 14,107 feet (4300 meters) above sea level have not been evaluated.

D Special Instrument Requirements:

cobas® pulse instrument

IV Device/System Characteristics:

A Device Description:

The cobas® pulse blood glucose monitoring system consists of a hand-held, battery powered cobas® pulse instrument, single use cobas® GLU test strips, instrument charging station, quick start guide and user guide for CLIA waived users as well as cobas® GLU test strip insert and user assistance guide for non-CLIA waived users. The cobas GLU Linearity Kit and GLU QC kit are sold separately.

B Principle of Operation:

The detection chemistry used by the cobas® pulse blood glucose monitoring system for the blood glucose result is FAD-dependent glucose dehydrogenase (FAD-GDH). When the blood is applied to the test strip, the blood induces a chemical reaction which produces a current that is transmitted through the electrodes to the instrument. The magnitude of the resultant current is proportional to the glucose concentration in the sample. The detected current signal is then calculated by the meter and the glucose concentration is then displayed on the meter. The meter reports plasma equivalent glucose concentrations.

C Instrument Description Information:

1. Instrument Name:

   cobas pulse® instrument

2. Specimen Identification:

   Arterial whole blood, neonatal arterial whole blood, and neonatal heel stick whole blood anticoagulated with lithium heparin can be used with this test system. The meter contains a laser barcode scanner that allows for scanning patient identification information that may also be entered manually. The meter prompts the user to choose from a dropdown menu of sample types prior to testing.

3. Specimen Sampling and Handling:

   All samples must be tested immediately upon collection.

4. Calibration:

   The system does not require calibration by the end-user. When the test strip is inserted into the instrument, the instrument reads the lot information from the strip that includes the calibration and expiration information for that test strip lot.

5. Quality Control:

   The cobas® GLU QC kit control solutions are aqueous solutions available at two different glucose levels (Level 1 and Level 2). Instructions on when to perform quality control testing

using both levels are included in the labeling. If the quality control testing using both QC levels is not performed when required as described in the labeling, the user is cautioned that a QC lockout is implemented and blood glucose cannot be tested until the QC tests are run successfully. The meter displays a pass or fail result once both QC tests are performed. The acceptable ranges are communicated to the meter by the user scanning the barcode on the QC bottle. The user is cautioned not to use the meter and to contact the system administrator if the quality control test fails after repeating the QC test.

V Substantial Equivalence Information:

A Predicate Device Name(s):

StatStrip Glucose Hospital Meter System

B Predicate 510(k) Number(s):

K181043

C Comparison with Predicate(s):

Device & Predicate Device(s):	K220272	K181043
Device Trade Name	cobas pulse blood glucose monitoring system	StatStrip Glucose Hospital Meter System
General Device Characteristic Similarities		
Intended Use/Indications For Use	Quantitative determination of glucose for use in determining dysglycemia in professional healthcare settings	Same
Measuring Range	10-600 mg/dL	Same
General Device Characteristic Differences		
Enzyme	FAD-dependent glucose dehydrogenase	Glucose Oxidase
Sample Types	Arterial whole blood, neonate arterial whole blood, or neonate heel stick whole blood	Capillary finger stick, venous whole blood, arterial whole blood, neonate arterial whole blood and neonate heel stick specimens

VI Standards/Guidance Documents Referenced:

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

CLSI EP07 3rd Edition Interference Testing in Clinical Chemistry.

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

CLSI EP09c 3rd Edition Measurement Procedure Comparison and Bias Estimation Using Patient Samples

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

CLSI EP21 2nd Edition Evaluation of Total Analytical Error for Quantitative Medical Laboratory Measurement Procedures

VII Performance Characteristics (if/when applicable):

A Analytical Performance:

1. Precision/Reproducibility:

Precision evaluations were conducted to evaluate repeatability (within-run precision) and intermediate precision of the cobas pulse blood glucose monitoring system according to CLSI guideline EP05-A3 as well as the FDA Guidance document: Blood Glucose Monitoring Test Systems for Prescription Point-of-Care Use (issued September 29, 2020).

Within-run Precision

Within-run precision was evaluated using whole blood samples adjusted (spiked or allowed to glycolyze) to achieve five glucose concentration ranges (30-50 mg/dL, 51-110 mg/dL, 111-150 mg/dL, 151-250 mg/dL, and 251-400 mg/dL). Each glucose level was tested with three lots of cobas GLU test strips in replicates of 10 on 10 cobas pulse instruments for a total of 300 results per glucose level. The summary of within-run precision results are presented in the table below:

Glucose Level (mg/dL)	Lot	N	Mean (mg/dL)	SD (mg/dL)	%CV
30-50	1	100	40.0	0.91	2.28
	2	100	39.6	0.871	2.20
	3	100	40.7	0.755	1.86
	Combined	300	40.1	0.945	2.36
	1	100	80.5	1.04	1.29

Glucose Level (mg/dL)	Lot	N	Mean (mg/dL)	SD (mg/dL)	%CV
51-110	2	100	79.6	1.13	1.42
	3	100	80.8	1.22	1.51
	Combined	300	80.3	1.23	1.54
111-150	1	100	129	1.62	1.25
	2	100	129	1.39	1.07
	3	100	130	1.74	1.34
	Combined	300	130	1.63	1.26
151-250	1	100	194	1.89	0.97
	2	100	195	1.80	0.92
	3	100	194	2.42	1.25
	Combined	300	194	2.09	1.08
251-400	1	100	328	5.24	1.6
	2	100	329	3.07	0.93
	3	100	327	3.34	1.02
	Combined	300	328	4.05	1.23

Intermediate Precision

Intermediate precision was evaluated using five levels of control solutions with the following glucose concentration ranges:30-50 mg/dL, 51-110 mg/dL, 111-150 mg/dL, 151-250 mg/dL, 251-400 mg/dL. Multiple operators tested the control solutions over 10 days using three lots of cobas GLU test strips and 10 cobas pulse instruments with two replicates per glucose concentration, instrument and day. The combined intermediate precision results are summarized below:

Glucose Level (mg/dL)	N	Mean (mg/dL)	SD (mg/dL)	%CV
30-50	600	41.6	0.712	1.71
51-110	600	80.3	1.17	1.45
111-150	600	130	1.66	1.28
151-250	600	201	2.03	1.01
251-400	600	316	2.42	0.76

2. Linearity:

The linearity of the cobas pulse blood glucose monitoring system was evaluated using whole blood samples with 11 glucose concentrations between 8-720 mg/dL. Each sample was tested using three lots of cobas GLU test strips and results were compared to those obtained using the comparator method (the cobas 6000 system). The results from the regression analysis are summarized below:

Lot	Linear Regression Equation	R2
1	y =1.01x +3.99	1.00
2	y =1.01x -4.10	1.00
3	y =1.03x -4.55	1.00

The results of the study support that the test system is linear from 10 – 600 mg/dL glucose. If the concentration of a sample is less than 10 mg/dL glucose, the result is flagged by the meter as "Lo". If a sample exceeds 600 mg/dL glucose, the result is flagged by the meter as "Hi". The "Lo" and "Hi" functions were validated and demonstrated to function as intended.

3. Analytical Specificity/Interference:

Interference testing was conducted to evaluate the effect of common endogenous and exogenous substances expected in the intended use population on the cobas pulse blood glucose monitoring system. Additional potential interferents were included in the testing following a detailed analysis of medications and medical conditions of the subjects evaluated in the method comparison study (please see the tables in Section VII.C.3 below for a detailed list of medications and conditions).

Whole blood samples were adjusted to achieve three glucose concentration ranges: 50-70 mg/dL, 110-130 mg/dL, 225-270 mg/dL. Each of these samples was divided into a test pool with the potential interferent added and a control sample with no added interferent. Results from the test samples on the candidate meter were compared to results obtained from the control sample on the candidate meter using three test strip lots. The % difference between the test sample and the control sample was calculated using the mean of 10 replicates. The highest tested concentrations at which no significant interference was observed (defined by the sponsor as less than ±10% bias between the test and control samples) are presented in the following table:

Endogenous Substance	Highest concentration with no significant interference (mg/dL)
β-Hydroxybutyrate sodium	265
Acetoacetic acid (Acetoacetate)	20
Acetone	100
Albumin human	6000
Biotin	3
Bilirubin, conjugated	50
Bilirubin, unconjugated	40

Endogenous Substance	Highest concentration with no significant interference (mg/dL)
Calcium (chloride)	20
Cholesterol	500
Citric acid	384.3
Creatinine	15
Fructose	18
Galactose	60
Galactose-1-phosphate	500
Glutathione, reduced	5
Glycerol	17
Hemoglobin	1000
Insulin	127 mU/L
Intralipid	2000
Lactate (Lactic acid)	200
Magnesium (chloride)	10
Maltose	480
Mannose	500
Phosphate	12
Potassium (chloride)	59.64
Sodium chloride	414
Urea	120
Uric acid	23.5

Exogenous Substance	Highest concentration with no significant interference (mg/dL)	Exogenous Substance	Highest concentration with no significant interference (mg/dL)
Acetaminophen (Paracetamol)	20	Calcium gluconate	120
Acetate	30.1	Canagliflozin	1.4
Acetylsalicylic Acid	3	Captopril	0.265
Acyclovir	6.6	Carbamazepine	4.5
Amikacin	14.4	Cefaclor	8.7
Amiodarone	4.2	Cefazolin	45
Amoxicillin	5.4	Cefepime	48
Ampicillin	7.5	Cefotaxime	52.8
Anakinra	30.86	Cefoxitin	600
Anidulafungin	3.3	Ceftazidime	60.6
Ascorbic acid (Ascorbate)	8	Ceftriaxone	84

Exogenous Substance	Highest concentration with no significant interference (mg/dL)	Exogenous Substance	Highest concentration
Azithromycin	1.11	Cefuroxime	54.3
Aztreonam	72.6	Celecoxib	0.879
Benzylpenicillin	72	Chlorothiazide	2.7
Bicarbonate	62	Cimetidine	3
Bictegravir	1.43	Clavulanate	1.2
Bromide	300	Clindamycin	5.1
Bupivacaine	1.2	Clopidogrel carboxylic acid	3.67
Cafedrine	1.8	Cyclosporin A	0.18
Caffeine	10.8	Dexamethasone	1.2
Diazepam	3	Ipragliflozin	0.52
Diclofenac	2.4	Irbesartan	2.31
Dipyridamole	3.54	Iron saccharate	3
Docusate	2.37	Isomalt	100
Dopamine	0.09	Isosorbide dinitrate	0.593
Doxycycline	1.8	Isosorbide mononitrate	0.221
D-Sorbitol	70	Ketamine	1.89
EDTA	0.1	Ketoprofen	6
Emtricitabine	0.9	Ketorolac	2.055
Enoxaparin	435 IU/dL	Lacosamide	2.61
Ephedrine	1	Lactitol	100
Erythromycin	13.8	Lactose	500
Esmolol	0.48	Lansoprazole	20
Ethanol	600	Levetiracetam	27
Fe(II) (sulfate)	0.879	Levodopa (L-Dopa)	0.75
Fenofibrate	4.5	Levofloxacin	3.6
Flecainide	0.513	Lidocaine	1.5
5-Fluorouracil	9	L-Leucine	2.82
Fluconazole	2.55	L-Methionine	0.9
Fosinopril	1.68	Lopinavir/Ritonavir	4.05/1.0125
Fosphenytoin	38.7	L-Phenylalanine	2.23
Furosemide	1.59	Maltitol	20.2
Fusidate	60	Mannitol	1800
Gabapentin	2.67	Meropenem	33.9
Gentamicin	3	Metamizole sodium	3.3
Gentisic acid	2	Metformin	1.2
Gliclazid	1.11	Methadone	0.318
Guaifenesin	0.45	Methocarbamol	12.3
Heparin	330 IU/dL	Methotrexate	136

Exogenous Substance	Highest concentration with no significant interference (mg/dL)	Exogenous Substance	Highest concentration with no significant interference (mg/dL)
HES (Hydroxyethyl starch)	3600	Methyldopa	2.25
Hydralazine	1.44	Methylprednisolone	0.783
Hydroxychloroquine	0.731	Metronidazole	12.3
Ibuprofen	50	Micafungin	6.6
Iohexol	35.7	Midazolam	0.376
Morphine	0.78	Ranitidine	1.05
Mycophenolate	4.2	Remdesivir	1.63
N-Acetyl-L-cysteine	15	Rifampicin	4.8
Nafcillin	11.1	Rocuronium bromide	1.8
Naproxen	36	Salicylate	60
Nateglinide	4.86	Sodium fluoride	0.12
Neomycin	1.2	Succinylmonocholin chloride (suxamethonium metabolite)	5
Nicotinic acid (sorbinicate metabolite)	4.23	Sucrose	500
Omeprazole	0.84	Sulbactam	24
Pancuronium bromide	0.4	Sulfamethoxazole	40
Pantoprazole	3	Tazobactam	3.05
Phenobarbital	69	Tetracycline	2.4
Phenol	4.6	Thalidomide	1.03
Phenylbutazone	32.1	Theophylline	6
Phytomenadione	0.534	Thiocyanate (nitroprusside metabolite)	5.22
Pioglitazone	0.476	Tolazamide	9
Piperacillin	110	Tolbutamide	72
Pirfenidone	3.78	Tramadol	0.314
Pralidoxime iodide (PAM)	25	Trimethoprim	4.2
Pregabalin	2.25	Valproate	31.8
Primidone	5.7	Vancomycin	12
Probenecid	44.7	Warfarin	7.5
Procainamide	4.8	Xylitol	200
Propofol	4.8	Xylose	600
2-pyridyl acetic acid (betahistine metabolite)	0.579	Zonisamide	11
Quinidine	1.5	γ-Globuline, human	1600

4. Assay Reportable Range:

   The reportable range is 10 - 600 mg/dL.

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

   Traceability

   Each measurement result is traceable to the NIST SRM 917 glucose reference material. A method comparison was performed using the candidate device and the cobas 6000 system as the comparator method (see section VII.C.3 below).

   Test Strip Stability

   Test strip stability was assessed using real time stability studies. Protocols and acceptance criteria were reviewed and found to be acceptable to support the labeling claims of a 24 month closed vial shelf life and open vial use life when stored at 4 - 30°C (39 - 86°F) and relative humidity of 10-90%. The labeling instructs the users not to freeze the test strips.

6. Detection Limit:

   Not applicable

7. Assay Cut-Off:

   Not applicable

8. Accuracy (Instrument):

   See Section VII.C.3. Other Clinical Supportive Data.

9. Carry-Over:

   Not Applicable.

B Comparison Studies:

1. Method Comparison with Predicate Device:

   See Section VII.C.3. Other Clinical Supportive Data.

2. Matrix Comparison:

   Not Applicable.

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):

   The performance of the cobas pulse glucose monitoring system was assessed in professional healthcare settings using lithium heparin arterial samples from 622 patients (adult, pediatric and neonate that included neonate arterial samples from 104 patients) and neonate heel stick samples from 147 neonates for a total of 873 patients. The study was conducted at 14 clinical sites that included patients from the general ward, operating rooms, medical intensive care units, surgical intensive care units, pediatric intensive care units, neonatal intensive care units and nurseries. Results from the cobas pulse glucose monitoring system were obtained by a total of 75 untrained operators who were also untrained in the use of the cobas pulse glucose monitoring system.

   Samples from patients, less than 24 hours old to over 81 years of age, were analyzed using a total of 3 different test strip lots throughout the study. The glucose levels of the patient samples were as follows (according to the comparator method; the cobas 6000 system): 49.0 to 461.9 mg/L for all arterial (24 samples <80 mg/dL and 10 samples >300 mg/dL); 49.0 to 461.9 mg/L (16 samples <80 mg/dL and 4 samples >300mg/dL) for neonate arterial; 18.5 mg/dL to 176.8 mg/dL (85 samples <80 mg/dL) for neonatal heelstick. In addition to glucose levels, patient conditions, medication information, pO2, sodium, and hematocrit levels were collected during the study. The study included 1617 unique patient conditions receiving a total of 709 medications representing 77 parent drug classes (see patient conditions and medication tables below).

   The results of the cobas pulse glucose monitoring system were compared with those obtained on the comparator method (cobas 6000 system) and are as follows for each specimen type (all arterial combined, neonate arterial, and neonate heel stick):

   Arterial Whole Blood (Combined)

   Glucose concentrations < 75 mg/dL

Within ±5 mg/dL	Within ±10 mg/dL	Within ±12 mg/dL	Within ±15 mg/dL	Exceeds ±15 mg/dL
6/16 (37.5%)	15/16 (93.8%)	16/16 (100.0%)	16/16 (100.0%)	0/16 (0.0%)

Glucose concentrations ≥75 mg/dL

Within ±5%	Within ±10%	Within ±12%	Within ±15%	Within ±20%	Exceeds ±20%
423/606 (69.8%)	571/606 (94.2%)	585/606 (96.5%)	596/606 (98.3%)	600/606 (99.0%)	6/606 (1.0%)

Neonatal Arterial Study

Glucose concentrations < 75 mg/dL

Within ±5 mg/dL	Within ±10 mg/dL	Within ±12 mg/dL	Within ±15 mg/dL	Exceeds ±15 mg/dL
4/10 (40.0%)	9/10 (90.0%)	10/10 (100.0%)	10/10 (100.0%)	0/10 (0.0%)

Glucose concentrations ≥75 mg/dL

Within ±5%	Within ±10%	Within ±12%	Within ±15%	Within ±20%	Exceeds ±20%
49/94 (52.1%)	87/94 (92.6%)	91/94 (96.8%)	93/94 (98.9%)	93/94 (98.9%)	1/94 (1.1%)

Neonatal Heel Stick Study

Glucose concentrations < 75 mg/dL

Within ±5 mg/dL	Within ±10 mg/dL	Within ±12 mg/dL	Within ±15 mg/dL	Exceeds ±15 mg/dL
27/69 (39.1%)	61/69 (88.4%)	66/69 (95.7%)	68/69 (98.6%)	1/69 (1.4%)

Glucose concentrations ≥75 mg/dL

Within ±5%	Within ±10%	Within ±12%	Within ±15%	Within ±20%	Exceeds ±20%
43/78 (55.1%)	70/78 (89.7%)	74/78 (94.9%)	74/78 (94.9%)	78/78 (100.0%)	0/78 (0.0%)

Usability Assessment/Operator Questionnaire

Upon completion of the clinical studies, operators completed a questionnaire to evaluate the ease of understanding of the test procedure. The participants found the cobas pulse glucose monitoring system easy to use and the instructions in the user manual and QRG clear and easy to follow.

A readability assessment demonstrated that the quick reference guide (QRG) and the instructions for the CLIA waived user in the user manual were written at a 7th grade reading level.

Patient Conditions and Medications

For all arterial, neonate arterial and neonate heel stick patients combined, there were a total of 709 different medications administered to study subjects within 24 hours of blood draw and a total of 1617 different diagnoses were observed among the study subjects. A summary of the medications and diagnosis for each sample type is shown below:

Sample Type	Number of Patients	Different Medications	Medication Classes	Different Diagnoses	System Organ Classes
Arterial	622	699	77	1562	27
Neonate Arterial	104	128	34	228	25
Neonate Heel Stick	147	100	27	158	21

The number of patients in the study by condition (organ classes) and medication classes are detailed below:

Patient Conditions

System Organ Class	Number of Patients
Blood and lymphatic system disorders	252
Cardiac disorders	560
Congenital, familial and genetic disorders	330
Ear and labyrinth disorders	29
Endocrine disorders	70
Eye disorders	113
Gastrointestinal disorders	352
General disorders and administration site conditions	125
Hepatobiliary disorders	197
Immune system disorders	69
Infections and infestations	231
Injury, poisoning and procedural complications	306

System Organ Class	Number of Patients
Metabolism and nutrition disorders	669
Musculoskeletal and connective tissue disorders	308
Neoplasms benign, malignant and unspecified (incl cysts and polyps)	148
Nervous system disorders	362
Pregnancy, puerperium and perinatal conditions	377
Psychiatric disorders	227
Renal and urinary disorders	221
Reproductive system and breast disorders	85
Respiratory, thoracic and mediastinal disorders	549
Skin and subcutaneous tissue disorders	61
Social circumstances	26
Surgical and medical procedures	399
Vascular disorders	458

Medications

Medication Class	Number of Patients
All other non-therapeutic products	59
All other therapeutic products	45
Anabolic agents for systemic use	1
Analgesics	1187
Anesthetics	332
Anti-parkinson drugs	5
Antianemic preparations	35
Antibacterials for systemic use	688
Antibiotics and chemotherapeutics dermatological use	73
Antidiarrheals, intestinal antiinflammatory/ antiinfective	13
Antiemetics and antinauseants	70
Antiepileptics	54
Antifungals for dermatological use	9
Antigout preparations	13
Antihemorrhagics	166
Antihistamines for systemic use	15
Antihypertensives	52
Antiinflammatory and antirheumatic products	33
Antimycotics for systemic use	44
Antineoplastic agents	1
Antiobesity preparations, excl. Diet products	1
Antiprotozoals	1
Antipruritics, incl. Antihistamines, anesthetics, etc.	47
Antiseptics and disinfectants	12
Antithrombotic agents	582

Medication Class	Number of Patients
Antivirals for systemic use	37
Beta blocking agents	201
Bile and liver therapy	7
Blood substitutes and perfusion solutions	1337
Calcium channel blockers	120
Calcium homeostasis	1
Cardiac therapy	602
Contrast media	49
Corticosteroids for systemic use	237
Corticosteroids, dermatological preparations	7
Cough and cold preparations	11
Digestives, incl. Enzymes	2
Diuretics	155
Drugs for acid related disorders	324
Drugs for constipation	249
Drugs for functional gastrointestinal disorders	19
Drugs for obstructive airway diseases	157
Drugs used in diabetes	187
Emollients and protectives	9
Endocrine therapy	3
General nutrients	19
Immune sera and immunoglobulins	3
Immunostimulants	1
Immunosuppressants	100
Lipid modifying agents	139
Mineral supplements	68
Muscle relaxants	409
Nasal preparations	139
Ophthalmological and otological preparations	2
Ophthalmologicals	115
Other alimentary tract and metabolism products	4
Other dermatological preparations	1
Other gynecologicals	1
Other hematological agents	1
Other nervous system drugs	12
Other respiratory system products	117
Otologicals	2
Peripheral vasodilators	23
Pituitary and hypothalamic hormones and analogues	52
Preparations for treatment of wounds and ulcers	8
Psychoanaleptics	148
Psycholeptics	405
Sex hormones and modulators of the genital system	1
Stomatological preparations	58
Thyroid therapy	44

Medication Class	Number of Patients
Topical products for joint and muscular pain	1
Urologicals	24
Vaccines	56
Vasoprotectives	1
Vitamins	85

Accuracy at extreme glucose concentrations

An additional study was conducted to further assess the performance of the cobas pulse blood glucose monitoring system at the extreme upper and lower ends of the claimed measuring range. The study was performed using whole blood samples altered to achieve glucose concentrations of less than 80 mg/dL (52 samples) and greater than 300 mg/dL (52 samples). Samples were tested on the cobas pulse instrument by intended use operators using test strips from 3 lots and results compared to the results obtained on the comparator method (cobas 6000 system). The results are summarized below:

Results for Glucose Concentrations < 80 mg/dL:

Within ±5 mg/dL	Within ±10 mg/dL	Within ±12 mg/dL	Within ±15 mg/dL
52/52 (100.0%)	52/52 (100.0%)	52/52 (100.0%)	52/52 (100.0%)

Results for Glucose Concentrations > 300 mg/dL:

	Within ±10%	Within ±12%	Within ±15%	Within ±20%
50/52 (96.2%)	52/52 (100.0%)	52/52 (100.0%)	52/52 (100.0%)	52/52 (100.0%)

Accuracy in samples representative of neonate samples

An additional study was performed using adult whole blood samples altered to achieve glucose concentrations between 10 and 50 mg/dL and adjusted to two levels of hematocrit at 40% and 65%, in order to simulate the hematocrit levels of neonatal blood. A total of 94 distinct samples were used for the study (48 samples at 40% hematocrit and 46 samples at 65% hematocrit). Samples were tested on the cobas pulse meter by intended use operators using test strips from 3 lots and results were compared to the results obtained on the comparator method (cobas 6000 system). The results are summarized below:

Results for 40% Hematocrit Concentrations

Within ±5 mg/dL	Within ±10 mg/dL	Within ±12 mg/dL	Within ±15 mg/dL
48/48 (100.0%)	48/48 (100.0%)	48/48 (100.0%)	48/48 (100.0%)

Results for 65% Hematocrit Concentrations

Within ±5 mg/dL	Within ±10 mg/dL	Within ±12 mg/dL	Within ±15 mg/dL
46/46 (100.0%)	46/46 (100.0%)	46/46 (100.0%)	46/46 (100.0%)

Capillary Fingerstick and Venous Whole Blood Limitations

The sponsor includes limitations against the use of the cobas pulse with capillary finger stick and venous whole blood. The labeling states the following:

- In comparing capillary whole blood glucose measurements using the cobas® pulse to venous plasma measurements using the comparator method, a large percentage of samples had significant bias to the comparator method.
- In comparing venous whole blood on the cobas® pulse to venous plasma on the comparator method for samples with glucose less than 75 mg/dL, 2 outliers showed significant bias to the comparator method, and protocol deviations led to a large number of venous sample exclusions resulting in uncertainty in the study.

These limitations were put in place due to risks posed by the performance of this device in these two sample types. The results of the cobas pulse glucose monitoring system were compared with those obtained on the comparator method and are as follows for each specimen type:

For capillary fingerstick samples, 54.5% (12/22) of samples with glucose concentrations <75 mg/dL were within ±12 mg/dL and 45.5% (10/22) exceeded a difference of ±15 mg/dL relative to the comparator method result. Additionally, for capillary fingerstick samples with glucose concentrations ≥75 mg/dL, 82.2% (562/684) of the samples were within ±12 mg/dL and 7.0% (48/684) exceeded a difference of ±20% relative to the comparator method results.

For venous whole blood samples, 94.6% (35/37) of samples with glucose concentrations <75 mg/dL were within ±12 mg/dL and 5.4% (2/37) exceeded a difference of ±15 mg/dL relative to the comparator method result. Additionally, protocol deviations led to the exclusion of more than 10% of venous whole blood samples from the study resulting in uncertainty in the results from this study.

D Clinical Cut-Off:

Not applicable.

E Expected Values/Reference Range:

The sponsor includes that following in the labeling: Expected blood glucose values for adults without diabetes is between 74-100 mg/dL. The normal glucose level for an adult without diabetes 2 hours post-meal is less than 140 mg/dL.

Reference:

1. Tietz (2018) Textbook of Clinical Chemistry and Molecular Diagnostics, 6th edition, ISBN:978-0-323-35921-4.
2. ElSayed NA, Aleppo G, Aroda VR, et al., American Diabetes Association. 2. Classification and diagnosis of diabetes: Standards of Care in Diabetes—2023. Diabetes Care 2023;46(Suppl. 1):S19–S40.

F Other Supportive Instrument Performance Characteristics Data:

1. Oxygen Study:
   The impact of oxygen partial pressure (pO2) in blood on measurements with the cobas pulse blood glucose monitoring system was evaluated using whole blood samples adjusted to three concentration levels of glucose (target ranges 50 - 70 mg/dL, 110 - 130 mg/dL and 225 - 270 mg/dL). Each glucose range was tested at four pO2 levels of about 30, 60, 90, and 200 mm Hg. The values were compared with the glucose measurements obtained from the comparator method (cobas 6000 system). The results of the study demonstrate that pO2 does not significantly impact the results.

2. Hematocrit Study:
   The effect of different hematocrit levels on the cobas pulse blood glucose monitoring system was evaluated using whole blood samples adjusted to hematocrit levels in 5% intervals in the range from 5 to 70% and at 5 glucose concentrations (30-50 mg/dL, 51-110 mg/dL, 111-150 mg/dL, 151-250 mg/dL, 251-400 mg/dL). The results were compared to those obtained from the comparator method (cobas 6000 system). The results of the study support the labeled hematocrit claimed range of 5-70%.

3. Cleaning and Disinfection:
   The device is intended for multiple-patient use. Disinfection efficacy studies were performed on the exterior meter materials by an outside commercial testing laboratory, demonstrating complete inactivation of Hepatitis B Virus (HBV) with the chosen disinfectants, Clorox Germicidal Wipes (EPA registration # 67619-12) and Super Sani-Cloth Germicidal Disposable Wipe (EPA registration # 9480-4). Robustness studies were also performed by the sponsor demonstrating that there was no change in performance or in the external materials of the meter after 12,045 cleaning and disinfection cycles using each of the chosen disinfectants. The robustness studies were designed to simulate cleaning and disinfection over the 3-year multiple-patient use life of the meter. Labeling was reviewed for adequate instructions for the validated cleaning and disinfection procedures.

4. System Operating Conditions Testing:
   To assess the performance of the cobas pulse glucose monitoring system when used under various operating temperature and humidity conditions, the system was tested at different temperature and relative humidity (RH) conditions including 10°C/45%RH, 42°C/45% RH, 12°C/10%RH, 12°C/90%RH, 30°C/90%RH and 40°C/10%RH. Each condition was tested

using whole blood at five blood glucose concentrations (30-50 mg/dL, 51-110 mg/dL, 111-150 mg/dL, 151-250 mg/dL, 251-400 mg/dL). The results from the cobas pulse blood glucose monitoring system under each test condition were compared to nominal control conditions. The study results support the labeled operating conditions claim of 12°C to 40°C (54 to 104 °F) and relative humidity range of 10% to 90%.

5. Altitude Study:
   To assess the effect of altitude on the performance of the cobas pulse glucose monitoring system, the system was tested at an altitude of about 15,420 ft (4,700 meters) above sea level. Whole blood samples adjusted to 3 glucose concentrations (50-65 mg/dL, 100-120 mg/dL, and 200-250 mg/dL) were tested. The results obtained from the candidate system at 15,420 ft were compared to those obtained at an altitude of 295 ft (90 meters) above sea level. The results of the study support the claim that the cobas pulse glucose monitoring system can be operated at altitudes of up to 15,420 ft (4,700 meters).

6. Sample Volume Study:
   The sponsor conducted a sample volume study using whole blood samples at 3 glucose concentrations (50-65, 100-120 and 200-250 mg/dL) tested at 5 sample volumes (0.2, 0.4, 0.6, 1.2, and 2.4 µL). Values obtained using the candidate system were compared to those obtained using the comparator method (cobas 6000 system). Results support the claimed minimum sample volume of 0.6 µL for the cobas pulse glucose monitoring system. The meter has an error message displayed if enough blood is not added to the test strip. This feature was validated and was shown to function as intended.

7. Electromagnetic Compatibility and Electrical Safety:
   The sponsor provided documentation certifying that acceptable electrical safety and electromagnetic compatibility (EMC) testing had been performed and the system was found to be compliant.

8. Flex Studies:
   Intermittent sampling, sample perturbation, drop testing, testing with used test strips, quality control lockout, transport, and vibration testing was completed by the sponsor. The testing performed demonstrated that the cobas pulse glucose monitoring system is robust to these expected use scenarios.

9. Test Strip Lot Release Protocol:
   The test strip lot release protocol and acceptance criteria were reviewed and found to be acceptable.

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.