



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

I Background Information:

A 510(k) Number

K251058

B Applicant

Truvian Health

C Proprietary and Established Names

Tru Kidney Health Test Panel; Tru Analyzer

D Regulatory Information

Product Code(s)	Classification	Regulation Section	Panel
CGX	Class II	21 CFR 862.1225 – Creatinine Test System	CH - Clinical Chemistry
CDN	Class II	21 CFR 862.1770 – Urea Nitrogen Test System	CH - Clinical Chemistry
JJG	Class I	21 CFR 862.2140 - Centrifugal Chemistry Analyzer for Clinical Use	CH - Clinical Chemistry

II Submission/Device Overview:

A Purpose for Submission:

New device

B Measurand:

Creatinine, Blood urea nitrogen (BUN)

C Type of Test:

Quantitative, photometric/colorimetric

III Intended Use/Indications for Use:

A Intended Use(s):

See Indications for Use below.

B Indication(s) for Use:

The Tru Kidney Health Test Panel is part of the TruWellness Panel™ and is intended for use on the Tru Analyzer. The Tru Kidney Health Test Panel (part of the TruWellness Panel™) is an in vitro diagnostic device and intended to be used for the quantitative determination of Creatinine (CRE) and Blood Urea Nitrogen (BUN) in lithium-heparinized venous whole blood in clinical laboratory or point-of-care settings. From the CRE determination, estimated Glomerular Filtration Rate (eGFR) is calculated by the analyzer.

The Tru Kidney Health Test Panel (part of the TruWellness Panel™) is an in vitro diagnostic test system that aids the physician in diagnosing the following disorders:

- Creatinine (CRE): Renal disease and monitoring of renal dialysis.
- Blood Urea Nitrogen (BUN): Certain renal and metabolic diseases.

Tru Analyzer is an automated, multi-assay integrated system, containing an absorbance reader, a bead scanner, and a cell imager for in vitro diagnostic use. This analyzer is intended for the quantitative determination of various analyte concentrations found in lithium-heparinized venous whole blood. It is for clinical laboratory or point-of-care use.

Use only TruWellness Panel™ test kits with the Tru Analyzer.

C Special Conditions for Use Statement(s):

Rx - For Prescription Use Only

D Special Instrument Requirements:

Tru Analyzer

IV Device/System Characteristics:

A Device Description:

The Tru Kidney Health Test Panel contains the following reagents:

Tru Kidney Health Test Panel	Quantity per single-use consumable kit
2-Oxoglutarate	75.2 µg
Adenosine-5'-Diphosphate	2.9 µg
Creatinine Amidinohydrolase	>530.5 mU
Creatinine Amidohydrolase	>375.7 mU
Glutamate Dehydrogenase	1.8 mU
Nicotinamide Adenine Dinucleotide (Reduced)	9.2 mg
Peroxidase	>975.0 mU
Sarcosine Oxidase	>88.4 mU
Urease	114.3 mU
Buffers, Preservatives, Stabilizers	

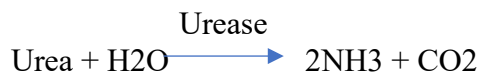
The Tru Analyzer is a benchtop instrument that automates sample processing, assay execution, and result reporting. The single-use consumable kit (i.e., the Disc (which includes the Tru Kidney Health Test Panel) and the Support Pack) and blood sample are loaded into the analyzer drawer, where all necessary processing takes place. Internally, the Tru Analyzer integrates:

- A pipettor for automated sample and reagent handling.
- Onboard centrifuge to separate whole blood into plasma.
- A closed-loop thermal control system to maintain assay temperatures.
- Detection modules for clinical chemistry testing.
- A high-definition camera for collecting assay readings, image capture, and instrument quality control checks.
- Reporting test results in approximately 30 minutes
- Power-on self-test capability

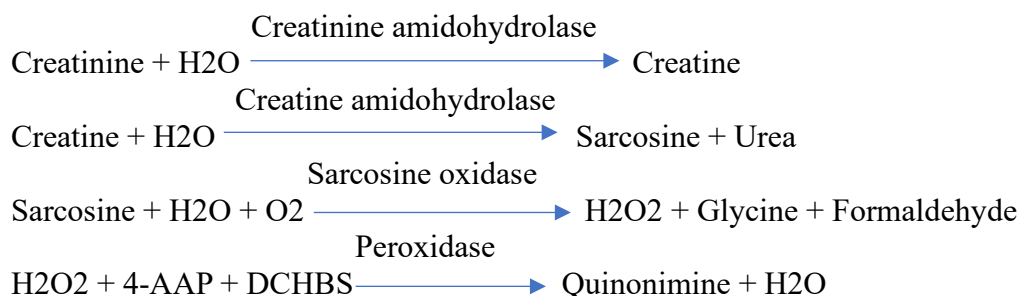
The single-use consumable kit houses all the components needed to process as well as analyze samples on the Tru Analyzer, including dried reagents, internal process control solutions, barcodes that manage the identity of the kit lot (i.e., Disc and Support Pack ID), calibration information, dilution buffers, and single-use plastic pipette tips. It also serves as a waste container which the user discards of at the end of the run. The Support Pack contains a feature to accept a standard 4 mL blood tube. The Support Pack also houses 22 pipette tips for transferring and mixing samples and reagents, 11 dilution wells to support reagent processing activities within the test system (e.g., sample dilution, reagent dilution, rehydration of dried reagents), and 6 x 2 ml tubes that contain additional wet and dry reagents.

Principle of Operation:

Blood Urea Nitrogen (BUN) is enzymatically determined. The assay employs an indirect kinetic method, using a urease/glutamate dehydrogenase coupled enzymatic technique. Urea in the sample is hydrolyzed by urease to produce ammonia and carbon dioxide. In the second reaction, catalyzed by glutamate dehydrogenase (GLDH), 2-oxoglutarate reacts with ammonia to form L-glutamate. In this same reaction, 2 moles of NADH are oxidized to NAD for each mole of urea converted. The rate of change of absorbance at wavelength of 340 nm is measured and proportional to the BUN concentration.



Creatinine is determined by an enzymatic cascade, resulting in the formation of hydrogen peroxide. Creatinine amidohydrolase catalyzes the hydrolysis of creatinine to creatine, which is then hydrolyzed to sarcosine and urea by creatine amidohydrolase. Sarcosine is oxidized to hydrogen peroxide, glycine, and formaldehyde by sarcosine oxidase. In the presence of peroxidase, hydrogen peroxide reacts with 4-aminoantipyrine (4-AAP) and dichlorohydroxybenzene sulfonic acid (DCHBS) to produce quinoneimine, a chromophore that absorbs at 510 nm. Potassium ferrocyanide and ascorbate oxidase are added to minimize bilirubin and ascorbic acid interferences, respectively. Endogenous creatine is chemically blanked out. Creatinine is quantitatively determined by the absorbance of quinoneimine using a 510-630 bichromatic blanking technique.



eGFR is a calculated value generated from the creatinine measurement. The 2021 CKD-EPI Creatinine Equation (National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). 2021 CKD-EPI Creatinine Equation. *National Institutes of Health*) is used.

B Instrument Description Information:

1. Instrument Name:

Tru Analyzer

2. Specimen Identification:

Lithium-heparinized venous whole blood

3. Specimen Sampling and Handling:

Instructions concerning specimen sampling and handling are provided in the labeling.

4. Calibration:

The Tru Analyzer is factory calibrated and utilizes a self-test with both optical sensing and electronic feedback mechanisms to confirm the analyzer is within its calibration and

operating specifications. The Tru Analyzer employs the self-test when powered on or when a single-use consumable kit is placed within the analyzer.

5. Quality Control:

Truvian recommends the usage of external quality control materials that are not supplied by Truvian. The labeling states that all quality control requirements should be performed in conformance with local, state and/or federal regulations or accreditation requirements.

The Tru Analyzer also has on-board internal quality controls. It performs a power on self-test, both at powering the unit on, or at the start of each test panel run to ensure the integrity of the hardware components. The Tru Analyzer includes built-in internal quality controls such as optical sensing and electronic feedback. Each Disc contains reagents to detect the drift in operating performance such as optical voltage, and sample integrity (e.g., test for endogenous interface, hemolysis, lipemia, and icterus). During the test process, various internal system controls (quality control checks) determine whether the disc and support pack are functioning correctly. If an error code and error description are displayed, then the internal self-test and/or other internal checks fail to meet specifications.

V Substantial Equivalence Information:

A Predicate Device Name(s):

Atellica® CH Creatinine_3 (Crea3)

B Predicate 510(k) Number(s):

K242685

C Comparison with Predicate(s):

Device & Predicate Device(s):	<u>K251058</u>	<u>K242685</u>
Device Trade Name	Tru Kidney Health Test Panel	Atellica® CH Creatinine_3 (Crea3)
General Device Characteristic Similarities		
Intended Use/Indications for Use (Assay)	Quantitative determination of Creatinine	Same
General Device Characteristic Differences		
Specimen Type	Lithium-heparinized venous whole blood	Serum, plasma (lithium heparin, dipotassium EDTA, and sodium heparin), and urine

Device & Predicate Device(s):	<u>K251058</u>	<u>K171971</u>
Device Trade Name	Tru Kidney Health Test Panel; Tru Analyzer	Comprehensive Metabolic Panel, skyla Clinical Chemistry Analyzer, Minicare C300 Clinical Chemistry Analyzer
General Device Characteristic Similarities		
Intended Use/Indications for Use (Assay)	Quantitative determination of Blood urea nitrogen	Same
Intended Use/Indications for Use (Analyzer)	In vitro quantitative determination of clinical chemistry analytes	Same
Intended Use Setting	Clinical laboratory/ Point-of-care use	Same
General Device Characteristic Differences		
Specimen Type	Lithium-heparinized venous whole blood	Lithium-heparinized venous whole blood, heparinized plasma, or serum
Detection Wavelength	BUN: 340 nm CRE: 510 nm	BUN: 340 nm CRE: 546 nm
Analytical Measuring Range	BUN: 2 – 100 mg/dL CRE: 0.2 – 20 mg/dL	BUN: 2 – 120 mg/dL CRE: 0.6 – 20 mg/dL
Test Time	30 minutes	15 minutes

VI Standards/Guidance Documents Referenced:

Clinical & Laboratory Standards Institute (CLSI) EP05-A3 - Evaluation of Precision of Quantitative Measurement Procedures; Approved Guideline - Third Edition
 CLSI EP06-A – Evaluation of Linearity of Quantitative Measurement Procedures: A Statistical Approach; Approved Guideline – Second Edition
 CLSI EP07-A3 – Interference Testing in Clinical Chemistry; Approved Guideline – Third Edition
 CLSI EP09c – Measurement Procedure Comparison and Bias Estimation Using Patient Samples; Approved Guideline - Third Edition
 CLSI EP17-A2 – Evaluation of Detection Capability for Clinical Laboratory Measurement Procedures; Approved Guideline – Second Edition
 CLSI EP37 – Supplemental Tables for Interference Testing in Clinical Chemistry - First Edition

VII Performance Characteristics (if/when applicable):

A Analytical Performance:

1. Precision/Reproducibility:

a) Reproducibility with control material: This study was designed according to CLSI EP05-A3. Precision (Reproducibility) was evaluated in this study for the candidate device using control material. The study was conducted at 3 external point-of-care (POC) sites, with 3 analyzers per site and at least 3 POC operators per site. Testing was conducted over 5 days using a single lot of consumables and consisted of 3 levels of control samples at low, medium, and high concentrations, with 6 replicates run per day, 3 run in the morning and 3 run in the afternoon (each replicate is run on an individual instrument). Overall, there were 90 replicates for each precision control sample level (3 sites x 1 sample x 3 replicates per run x 2 runs per day x 5 days = 90 replicates). The total precision as well as within run, between day, and between site precision were estimated. Results are displayed below:

Analyte		BUN (mg/dL)			CRE (mg/dL)		
Level		Low	Med	High	Low*	Med	High
N		92	91	92	92	91	92
Mean		15	27	52	0.95	1.53	4.59
Within-Run	SD	0.4	1	2	0.19	0.04	0.03
	CV%	2.9	4.1	3.5	20	2.3	0.8
Between-Run	SD	0.3	0	0	5e-06	0.0	0.0
	CV%	1.9	0.0	0.0	523.2e-06	0.0	0.0
Between-Day	SD	0	0.2	0.5	0.0	0.005	0.1
	CV%	0.0	0.9	0.9	0.0	0.3	0.2
Between-Site	SD	0.3	1	1	734.7e-06	0.02	0.03
	CV%	2.2	2.0	2.6	7.7e-06	1.5	0.7
Total Precision	SD	0.6	1	2	0.19	0.04	0.05
	CV%	4.1	4.6	4.5	20	2.8	1.0

**a replicate for Creatinine was identified as a statistical outlier and the table below provides the results without the outlier included.*

Analyte (mg/dL)	Level	N	Mean	Within-Run		Between-Run		Between-Day		Between-Site		Total Precision	
				SD	CV%	SD	CV%	SD	CV%	SD	CV%	SD	CV%
CRE	Low	91	0.94	0.02	2.0	0.004	0.4	0.00	0.0	0.02	2.1	0.03	2.9

b) Whole Blood Precision: Whole blood precision was evaluated using specimens collected across five sites from the intended-use population with normal and abnormal analyte levels. For each test subject, eight replicates were measured across four instruments and two operators. The SD and CV% Precision estimates were calculated by pooling subject standard deviations and/or % CV for predefined Low, Medium or High sub-intervals selected to represent normal and abnormal regions of the analytical measuring range and encompassing medical decision levels.

Pooled imprecision is considered a representative estimate of reproducibility that include variability of sites, instruments, operators, days and repeatability.

Analyte	Range	Subject (N)	Replicate (N)	Mean	SD	CV%
BUN (mg/dL)	Low: 2 – 24	85	650	13.5	0.6	5.2
	Medium: 24 – 40	13	102	28.4	1.3	4.1
	High: 40 – 100	14	115	55.5	3.2	5.4
CRE (mg/dL)	Low: 0.2 – 1.3	89	681	0.73	0.02	3.3
	Medium: 1.3 – 5.0	15	118	2.49	0.05	1.9
	High: 5.0 – 20.0	9	67	6.99	0.12	1.5

c) Lot-to-Lot Precision: 22 subjects consisting of 6 healthy individuals and 16 individuals in various disease states were enrolled at a single point-of-care clinical site and tested across 3 lots of the candidate panel on 3 individual Tru Analyzers by 2 operators. A total of 6 replicates per subject participant, 2 replicates per lot, were tested by 1 of the 2 operators. Results below present the number of subjects evaluated, the % difference from the median, and pooled %CV by lot and by analyte.

Analyte	Subjects per Lot	Median relative difference %			Pooled %CV		
		Lot-A	Lot-B	Lot-C	Lot-A	Lot-B	Lot-C
BUN	22	0.8	-0.2	-1.0	3.0%	3.7%	3.5%
CRE	22	1.3	0.5	-2.0	2.5%	1.8%	2.2%

d) Control Lot-to-Lot Study: To evaluate the lot-to-lot reproducibility, 3 control samples (low, medium and high) were tested on 3 Tru Analyzers using 3 lots of the candidate test. Each sample level was tested with at least five (5) replicates on one Tru Analyzer each day with each single-use consumable kit lot over 3 days to achieve a minimum of fifteen (15) replicates per sample level and kit lot. Results are displayed below:

Analyte (mg/dL)	Control Sample Concentration		Mean	Lot Mean			Standard Deviation			% CV		
	Level	Actual		Lot 1	Lot 2	Lot 3	Lot 1	Lot 2	Lot 3	Lot 1	Lot 2	Lot 3
BUN	Low	13	14.45	14.59	14.46	14.28	0.44	0.74	0.40	3.0	5.1	2.8
	Med	25	27.68	28.01	27.80	27.22	1.08	0.94	0.83	3.8	3.4	3.1
	High	48	50.75	50.92	50.38	50.96	2.57	1.94	2.22	5.0	3.9	4.4
CRE	Low	0.96	0.92	0.93	0.91	0.93	0.02	0.01	0.02	1.7	1.6	2.3
	Med	1.58	1.54	1.55	1.53	1.55	0.02	0.02	0.02	1.5	1.4	1.3
	High	4.66	4.60	4.60	4.55	4.65	0.05	0.11	0.04	1.1	2.3	0.9

2. Linearity:

A linearity study was conducted in accordance with CLSI EP06 - 2nd Edition. Linearity was assessed with multiple panels of samples. The linear range for the CRE assay was determined by testing eleven (11) samples containing varying concentrations of creatinine. The linear range for the BUN assay was determined by testing fifteen (15) samples containing varying concentrations. Each sample was tested in quadruplicate, using one (1) kit lot, across 4 Tru

Analyzers, on a single day. The results of the study supported the claimed linear interval for CRE and BUN. Within the claimed analytical measuring range, the maximum observed deviation for BUN and CRE was 6%.

3. Analytical Specificity/Interference:

This study was designed according to CLSI EP07-A3 and CLSI EP37, to verify and validate the effect of potentially interfering exogenous and endogenous substances on the BUN and CRE assays. Twenty-five (25) different potential exogenous and endogenous interferents were evaluated for CRE and BUN. Testing was performed with contrived lithium heparin whole blood samples from a healthy donor population, with two (2) analyte concentration levels targeted based on recommended levels in CLSI EP07. Potentially interfering substances were prepared in the appropriate diluent and then added to the low and high contrived whole blood samples to create test samples. For any substances identified as an interferent, dose response testing and analysis was conducted to assess the highest concentration limit below which no significant interference was observed. The results are displayed below:

Interferent	Highest Concentration Tested without Interference		
	BUN	CRE	Units
3-methyl-(triazene-1-yl)imidazole-4-carboxamide (MTIC)	0.06	N/A	mg/dL
4-methylamino-antipyrine (4-MAAP)	3.3	N/A	mg/dL
5-amino-4-imidazolecarboxamide (AIC)	0.3	N/A	mg/dL
5-Fluorocytosine	N/A	20.4	mg/dL
Acetaminophen	15.6	15.6	mg/dL
Acetylsalicylic acid	3	3	mg/dL
Acetylcysteine	15	7.5	mg/dL
Aminosalicic Acid	46.5	N/A	mg/dL
Ampicillin	7.5	7.5	mg/dL
Ascorbic Acid	5.25	5.25	mg/dL
Bilirubin, conjugated	40	11.2	mg/dL
Bilirubin, unconjugated	40	19.6	mg/dL
Biotin	0.35	N/A	mg/dL
Caffeine	10.8	10.8	mg/dL
Calcium dobesilate	6.0	0.3	mg/dL
Cefoxitin	660	495	mg/dL
Cephalexin	N/A	12.6	mg/dL
Cephalothin sodium	180	180	mg/dL
Chloramphenicol	7.8	N/A	mg/dL
Cimetidine	3.0	3.0	mg/dL
Cyclosporine A	0.18	0.18	mg/dL
Dicynone (Etamsylate, Ethamsylate)	N/A	0.25	mg/dL
Dipyrone (Metamizole)	3.3	1.32	mg/dL
Dobutamine	N/A	0.121	mg/dL
Dopamine	N/A	0.062	mg/dL

Interferent	Highest Concentration Tested without Interference		
	BUN	CRE	Units
Doxycycline	1.8	1.8	mg/dL
Ethylglycine	N/A	0.6	mg/dL
Eltrombopag	30	12	mg/dL
Glucose	N/A	1000	mg/dL
Glutathione	N/A	N/A	mg/dL
Hemolysis (Hemoglobin)	1050	390	mg/dL
Heparin	3300	3300	U/L
Ibuprofen	21.9	21.9	mg/dL
Levodopa (L-Dopa)	0.75	0.08	mg/dL
Methyldopa	2.25	0.11	mg/dL
Metronidazole	12.3	12.3	mg/dL
N-acetyl-p-benzoquinineimine (NAPQI)	N/A	0.4	mg/dL
Phenindione	N/A	0.3	mg/dL
Phenylbutazone	32.1	8.03	mg/dL
Proline	N/A	11.5	mg/dL
Rifampicin	4.8	2.4	mg/dL
Salicylic Acid	2.86	2.86	mg/dL
Streptomycin	25.8	N/A	mg/dL
Sulfapyridine	27	N/A	mg/dL
Total Protein (HSA)	N/A	15,000	g/dL
Temozolomide	2	N/A	mg/dL
Theophylline	6.0	6.0	mg/dL
Triglycerides	1140	1535	mg/dL

N/A indicates substances not evaluated

Interferences for CRE:

Substance	Substance concentration (mg/dL)	Analyte concentration (mg/dL)	% Bias
Levodopa (L-Dopa)	0.15	1.92	-18
Methyldopa	0.22	0.64	-19

4. Detection Limit and Assay Reportable Range:

A Limit of Blank (LoB) study was determined in accordance with the classical approach provided in section 5.3 of CLSI EP17-A2. The LoB study was performed on 4 Tru Analyzers over 3 days of testing each on 1 of 2 different lots of the candidate panel. 4 blank samples were tested in 5 replicates per sample for 60 total tests per lot.

The LoD and LoQ were determined based on recommendations from CLSI EP17-A2.

The results of the Detection Limit studies support the claimed range of the analytes.

Analyte	Limit of Blank	Limit of Detection	Limit of Quantification
BUN	0.47 mg/dL	1 mg/dL	2 mg/dL
CRE	0.06 mg/dL	0.11 mg/dL	0.15 mg/dL

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

The Tru Kidney Health Test Panel assay calibrators are traceable to the reference materials in the table below:

Assay	Traceable Material
BUN	NIST SRM1950 + Verichem 9500 standards
CRE	NIST SRM 967b

Sample Stability studies performed demonstrate that samples measured on the candidate tests are stable for 60-minutes post-collection.

6. Assay Cut-Off:

Not Applicable.

B Comparison Studies:

1. Method Comparison with Predicate Device:

A method comparison study was conducted to establish the performance characteristics of the Tru Kidney Health Test Panel on the Tru Analyzer when used to analyze whole blood clinical specimens. 366 samples comprised of apparently healthy patient samples and samples from patients with acute or chronic health conditions were collected from 5 point-of-care sites), tested by at least 3 point-of-care operators per site, on at least 4 Tru analyzers per site, using 5 lots of reagents. Results compared against a legally marketed comparator are displayed below. The data demonstrated that accuracy was consistent across sites.

Analyte	N	Range (mg/dL)	Slope	Intercept	R
BUN	337	4 – 100	1.03 (1.01,1.05)	-0.11 (-0.39,0.11)	0.995
CRE	336	0.24 – 19.57	0.96 (0.96, 1.00)	-0.04 (-0.06, -0.02)	0.999

2. Matrix Comparison:

Not Applicable.

C Clinical Studies:

1. Clinical Sensitivity:

Not Applicable.

2. Clinical Specificity:

Not Applicable.

3. Clinical Cut-Off

Not Applicable.

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

Not Applicable.

D Expected Values/Reference Range:

Analyte		Reference Interval (mg/dL)
Creatinine	Male	0.7 – 1.3
	Female	0.6 – 1.1
BUN		9 – 23

E Other Supportive Instrument Performance Characteristics Data:

An altitude study was conducted to evaluate BUN and CRE at sea-level and a high altitude of 2000m. The results demonstrated acceptable performance at both tested altitude conditions.

The sponsor validated their operating environmental conditions.

Electrical safety and electromagnetic compatibility (EMC) testing were performed, and the system was found to be acceptable.

Software and cybersecurity documentation was 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.
