

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

A. 510(k) Number:

k070068

B. Purpose for Submission:

Notification of intent to manufacture and market a new device

C. Measurand:

Creatinine

D. Type of Test:

Colorimetric quantitative determination of Creatinine

E. Applicant:

Nova Biomedical Corporation

F. Proprietary and Established Names:

Proprietary name – Nova StatSensor Creatinine Hospital Meter, Nova StatSensor Creatinine
Quality Control Levels 1,2,3, Nova StatSensor Creatinine Linearity
Solutions Levels 1,2,3,4,5

Established name – Creatinine Test System, Quality Control Material

G. Regulatory Information:

1. Regulation section:

21 CFR 862.1225 Creatinine Test System
21 CFR 862.1660 Quality Control Material

2. Classification:

Class II (reagent)

Class I, reserved (control material)

3. Product code:

CGL, JJX

4. Panel:

Clinical Chemistry (75)

H. Intended Use:

1. Intended use(s):

See Indications for Use below

2. Indication(s) for use:

The Nova StatSensor Creatinine Hospital Meter is intended for *in vitro diagnostic use* by health care professionals and for Point-Of-Care usage for the quantitative measurement of creatinine in capillary, venous, and arterial whole blood. Creatinine measurements are used in the diagnosis and treatment of renal diseases and in monitoring renal dialysis. Not for use in neonates.

Nova StatSensor Creatinine Test Strips are intended for use only with the StatSensor Creatinine Hospital Meter for quantitative tests. The Nova StatSensor Creatinine Hospital Meter is intended to quantitatively measure creatinine in whole blood. The Creatinine Meter is factory calibrated to provide plasma equivalent results to laboratory methods. Nova StatSensor Creatinine Test Strips are for testing outside the body (in vitro diagnostic use only).

Nova StatSensor Creatinine Control Solutions are intended for use with the Nova StatSensor Creatinine Hospital Meter and Nova StatSensor Creatinine Test Strips as a quality control check to verify the accuracy of blood creatinine test results. There are three levels of controls, (Level 1, Level 2, and Level 3). These solutions will be offered for sale separately from the meter.

Nova StatSensor Creatinine Linearity Kit solutions are used to check the linearity of the Nova StatSensor Creatinine Hospital Meter System. There are five levels of Linearity Solutions, (Level 1, Level 2, Level 3, Level 4, and Level 5).

3. Special conditions for use statement(s):

For in vitro diagnostic prescription use

Not for use in neonates

The device is intended for use in point-of-care settings and the appropriate studies were

performed.

4. Special instrument requirements:

The Nova StatSensor Creatinine meter uses Nova StatSensor Creatinine Test Strips

I. Device Description:

The Nova StatSensor Creatinine meter consists of a hand held Creatinine Hospital meter, a charging station, StatSensor Creatinine Strips, 3 Levels of Quality Control and 5 Levels of Linearity Solutions. The Nova StatSensor Creatinine meter is factory calibrated.

J. Substantial Equivalence Information:

1. Predicate device name(s):

i-Stat Creatinine Test, Beckman Synchron LX-20, Beckman Synchron LXi 725I, Bayer ADVIA 1650, Dade Dimension RXL

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

k973292, k965240, k023049, k990346, k043546

3. Comparison with predicate:

Characteristic	Proposed Nova StatSensor	Predicate Beckman Synchron LX-20	Predicate Beckman Synchron LXi 725I	Predicate Bayer ADVIA 1650	Predicate Dade Dimension RXL	Predicate i-Stat with Creatine Cartridge
K Number	New	k965240	k023049	k990346	k043546	k973292
Measuring Range	0.3-12.0 mg/dL	0.3–25 mg/dL	0.3–25 mg/dL	0.2 – 37.0 mg/dL	0.2 – 30.0 mg/dL	0.2-20 mg/dL
Operating Principle	Electrochemical biosensor test strip	Random access processing analyzer using a colorimetric, kinetic rate reaction	Random access processing analyzer using a colorimetric, kinetic rate reaction	Automated analyzer, UV rate reaction	Discrete chemistry analyzer measuring kinetic rate reaction.	Electrochemical biosensor cartridge
Intended Use	The Nova StatSensor Creatinine Hospital Meter System is intended for in vitro diagnostic use by health care professionals for the quantitative measurement of creatinine in capillary, venous, and arterial whole blood. It is	<i>In-Vitro</i> diagnostic use by health care professionals for the quantitative measurement of creatinine in serum	<i>In-Vitro</i> diagnostic use by health care professionals for the quantitative measurement of creatinine in serum	To measure the creatinine levels in serum and urine.	In-Vitro diagnostic assay for the quantization of creatinine in human serum	For the quantitative determination of Creatinine in whole blood

Characteristic	Proposed Nova StatSensor	Predicate Beckman Synchron LX-20	Predicate Beckman Synchron LXi 725I	Predicate Bayer ADVIA 1650	Predicate Dade Dimension RXL	Predicate i-Stat with Creatine Cartridge
	indicated for use in a clinical setting by healthcare professionals as an aid to monitor kidney function.					
Sample type	Whole blood	Serum	Serum	Serum	Serum	Whole Blood
Sample size	1.2 µL	20 µL	20 µL	2 µL of a 1:5 diluted solution	3 µL diluted serum	65 µL
Sample application	Test strip capillary draw	Automatic sample aspiration from sample cups	Automatic sample aspiration from sample cups	Sample Tray 84 samples, positive sample identification	Auto - sampling from vacationer type tubes or sample cups	Test cartridge syringe or capillary fill tube
Handheld meter?	Yes	No	No	No	No	Yes
Meter Calibration	Automatic, no Calibration Code	automatic, at least every 5 days	automatic, at least every 5 days	Automatic 2-point liquid calibration	Automatic	Automatic calibration with each cartridge
Data storage	1200	Unlimited using DL2000 data manager	Unlimited	70,000 patient samples	Unlimited, based on available hard disk storage space	5,000 test results
Test Time	30 seconds	25 seconds	25 seconds	20 seconds	20 seconds	120 seconds
Weight	8.8 oz.	1,620 pounds	2,701 pounds	1,178 pounds	800 pounds	18.34 oz
Bar code scanner	YES	Yes	Yes	Yes	Yes	Yes
Power source	Rechargeable 3.7 V Lithium battery	115 or 220 V outlet	115 or 220 V outlet	100-240 Volt Main	110-130 V outlet	2 9-volt batteries
Accessories:	Charging/Data Upload Station Base Unit	Data manager	Data manager, automated sample rack system	Data management system	N/A	N/A
Controls:	Liquid, 3 levels	2 levels	2 levels	3 levels	3 levels	Liquid 3 levels
Linearity Solutions	Liquid, 5 levels	5 levels	5 levels	5 levels	5 levels	Liquid 5 levels
Test Strip/Cartridge Active reagent:	Creatinine amidohydroliase, creatine amindinohydrolase and sarcosine oxidase	Jaffe rate method (kinetic alkaline picrate)	Jaffe rate method (kinetic alkaline picrate)	Enzymatic UV reaction/ alkaline picrate reagent	Alkaline picrate, colorimetry, creatinine	Creatinine amidohydroliase, creatine amindinohydrolase and sarcosine oxidase

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

EP5-A2 Evaluation of Precision Performance of Quantitative Measurement Methods
EP6-A Evaluation of Linearity of Quantitative Measurement Procedures: A Statistical

Approach; Approved Guideline Evaluation of Matrix Effects
 EP7-P Interference Testing in Clinical Chemistry
 EP9-A Method Comparison and Bias Estimation Using Patient Samples

L. Test Principle:

Colorimetric

M. Performance Characteristics (if/when applicable):

1. Analytical performance:

a. *Precision/Reproducibility:*

Precision evaluations were performed based upon CLSI EP5-A2. Day to Day precision was evaluated using two meters and two lots of test strips at the sponsor's site. Samples were run in duplicate. Control levels 1, 2 and 3 were used. Testing was performed for 20 days.

Strip Lot	Control Level	Range mg/dL	Mean	CV%	N	Duration
6080301	L1	0.8-1.5	1.06	8.39	80	20 days
	L2	1.7-2.5	2.09	5.80	80	20 days
	L3	4.0-7.0	6.14	3.35	80	20 days
6080401	L1	0.8-1.5	1.08	8.68	80	20 days
	L2	1.7-2.5	2.09	5.87	80	20 days
	L3	4.0-7.0	6.11	3.59	80	20 days

Within Run Precision

Two meters and three lots of strips were used. Three levels of controls were tested in replicates of 20 using each strip lot (the controls were prepared separately for each lot tested). Additionally three blood samples were prepared with target creatinine concentrations of 0.3-1.5, 2.5-4.5, and 6.0-12.0 mg/dL.

Within Run Precision Pooled

Blood Samples					
Strip Lot	Blood Level (mg/dL)	Mean (mg/dL)	Ref Value (mg/dL)	%CV	N
6072601	0.3-1.5	0.98	0.9	8.73	20
	2.5-4.5	2.43	2.6	2.95	20
	6.0-12.0	6.95	6.6	4.42	20
6072701	0.3-1.5	1.11	1.0	8.03	20
	2.5-4.5	3.94	4.1	3.52	20

	6.0-12.0	10.64	9.9	5.16	20
6072702	0.3-1.5	0.99	0.9	9.48	20
	2.5-4.5	3.53	3.6	4.77	20
	6.0-12.0	10.23	10.0	5.91	20
Control Samples					
Strip Lot	Control Level (mg/dL)	Mean (mg/dL)	SD	%CV	N
6072601	L1 (0.8-1.5)	1.12	0.06	5.27	20
	L2 (1.7-2.5)	2.14	0.05	2.29	20
	L3 (4.0-7.0)	6.16	0.30	4.84	20
6072701	L1 (0.8-1.5)	1.13	0.08	6.99	20
	L2 (1.7-2.5)	3.94	0.14	3.52	20
	L3 (4.0-7.0)	6.20	0.36	5.83	20
6072702	L1 (0.8-1.5)	1.10	0.06	5.52	20
	L2 (1.7-2.5)	2.16	0.05	2.33	20
	L3 (4.0-7.0)	6.25	0.31	4.91	20

Precision protocol was performed on venous whole blood samples based upon CLSI EP5-A2 at three Point of Care sites by typical Point of Care staff. There was no significant difference in precision at the various sites.

Within-run Precision Summary for Point of Care Site Studies

	Site 1			Site 2			Site 3		
	Target Range (mg/dL)			Target Range (mg/dL)			Target Range (mg/dL)		
	0.5 - 1.5	3.0-5.0	8.0-12.0	0.5 - 1.5	3.0-5.0	8.0-12.0	0.5 - 1.5	3.0-5.0	8.0-12.0
Mean	0.84	4.42	11.42	0.88	4.10	11.38	0.84	4.53	8.15
SD	0.08	0.34	0.85	0.09	0.17	0.60	0.05	0.13	0.26
%CV	9.73	7.72	7.43	10.41	4.26	5.24	5.86	2.77	3.25

b. Linearity/assay reportable range:

The Nova StatSensor Creatinine meter measuring range is 0.3 – 12.5 mg/dL. Linearity protocol was based upon CLSI EP6-A. Venous blood samples were prepared by spiking blood with 5 different concentrations of creatinine and 3 levels of hematocrit. 5 replicates were performed on 2 meters for each level. A total of 30 samples were run at each creatinine concentration. $Y=1.0068x-0.0398$. $r^2=0.9927$, $n=450$. Results of the study support the claimed linearity range.

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

The values of the Nova StatSensor Creatinine controls and linearity solutions are

traceable to the NIST SRM967 Creatinine. Acceptance criteria between the NIST Creatinine standard and Nova controls are $\pm 5\%$ (L1), $\pm 4\%$ (L2), $\pm 3\%$ (L3). Expected control range values are L1 0.8-1.5mg/dL, L2 1.7-2.5 mg/dL, and L3 4.0-7.0 mg/dL. The nominal concentrations of the Nova Linearity solutions are Level 1: 0.30-0.80mg/dL, Level 2: 0.80-1.50mg/dL, Level 3: 1.70-2.50mg/dL, Level 4: 4.00-7.00mg/dL, Level 5: 7.00-12.00mg/dL.

Opened Bottle Stability: The sponsor recommends that the Linearity/Control Solutions once opened be stored at 2-8⁰C and are stable for up to 5 weeks at 25⁰C. Stability at 25⁰C was demonstrated by real time studies. All analytes satisfied the sponsor's acceptance criteria of $\pm 15\%$ for L1 and $\pm 10\%$ for all other levels deviation from analyte concentration at day 0.

Closed Bottle Stability (Shelf Life): The sponsor's shelf life stability claim is two years from date of manufacture. All analytes were tested at 5, 25, 40 and 50⁰C for 9 weeks to predict two year stability when stored at 2-8⁰C. The percent loss is determined in comparison to Day Zero values and the product is considered stable when the loss reported is $\leq 15\%$. All analytes satisfied the sponsor's acceptance criteria verifying the closed bottle stability claim. Real time studies are ongoing.

d. Detection limit:

The detection limit for the Nova StatSensor Creatinine Hospital Meter was performed following Nova Biomedical Co.'s protocol which was prepared in accordance with CLSI EP17-A. Limitation of Blank (LoB) was determined to be 0.055 g/dL. Limit of Detection (LoD) was determined to be 0.124 mg/dL.

e. Analytical specificity:

Interference studies were performed based upon CLSI EP7-P. Several Compounds were studied to determine if their presence affected the reporting of creatinine in whole blood. Three whole blood samples were prepared with target ranges of 0.5-1.5, 2.0-4.0 and 6.0-10.0 mg/dL. The compounds were added in 4 different concentrations, 3 samples were run for each concentration. The sponsor defined interference as $\leq 15\%$ for target ranges of 0.3-1.5 mg/dL and $\leq 10\%$ for target ranges >1.5 mg/dL. The following compounds produced no interference at the spiked concentrations (mg/dL) – Acetaminophen (10), Ascorbic Acid (3.5), Bilirubin (15), Cholesterol (1000), Creatine (4), L-Dopa (0.3), Dopamine (10), Glucose (500), Heparin (120 U/dL), Maltose (100), Triglyceride (1000), Uric Acid (20) or Hemoglobin (up to 2.6 g/dL).

Hematocrit studies were performed to determine the affect of varying levels of hematocrit on creatinine results determined by the Nova StatSensor. Blood samples were spiked with 3 different levels of hematocrit (28, 43 and 59%) and 5 different creatinine concentrations (0.3 – 1.5, 1.5 – 3.0, 3.0 – 6.0, 6.0 – 9.0, 9.0 - 12.0 mg/dL).

The sponsor defined non-interference as $\leq 15\%$ for target ranges of 0.3-1.5 mg/dL and $\leq 10\%$ for target ranges >1.5 mg/dL. Device performance at hematocrit concentrations of 30 – 60% was determined to be acceptable.

Humidity and temperature testing was performed using whole blood with 3 creatinine target concentrations. Meters were placed in environmental chambers with varying humidity and temperature to determine the affects on the Nova StatSensor Creatinine meter. The sponsor defined non-interference as $\leq 15\%$ for target ranges of 0.3-1.5 mg/dL and $\leq 10\%$ for target ranges >1.5 mg/dL. The meter met these criteria for the temperature range of 15°C to 40°C and humidity range of 20% to 80%.

f. Assay cut-off:

Not Applicable

2. Comparison studies:

a. Method comparison with predicate device:

Method comparisons were performed at 5 external Point of Care sites by typical Point of Care staff untrained in the use of the device. Samples of venous, arterial and capillary whole blood were collected at each site were compared against the predicate devices. Samples were endogenous and were compared across the measuring range as indicated below (results are pooled for arterial, venous and capillary results). There was no significant difference in results at the various sites.

$$Y=0.9873x+0.0241$$
$$r^2=0.9858$$
$$n=947$$
$$\text{range}=0.30\text{-}12.9 \text{ mg/dL}$$

b. Matrix comparison:

The Nova StatSensor Creatinine Hospital Meter is designed for measurement of creatinine in whole blood only. A comparison of whole blood samples from different sources (Venous, Arterial and capillary) was performed against serum during method comparison.

Samples were compared against the predicate devices on whole venous, arterial and capillary blood. Samples were endogenous and were compared across the measuring range as indicated below. These samples are the same samples used for method comparison study described above.

Venous Blood

$$y=0.9896x+0.0244$$
$$r^2=0.9783$$

Arterial Blood

$$y=0.9792x+0.0787$$
$$r^2=0.9946$$

Capillary Blood

$$y=0.9851x+0.0031$$
$$r^2=0.9829$$

n=722	n=76	n=149
range=0.30-10.8 mg/dL	range 0.57-12.0 mg/dL	range 0.40-12.9 mg/dL

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:

Normal Creatinine value is less than 1.2mg/dL

The sponsor referenced: Burtis, Carl A and Ashwood, Edward. Ed, 1999 Tietz Textbook of Clinical Chemistry

N. Instrument Name:

Nova StatSensor Creatinine Hospital Meter, Test Strips, Controls and Linearity Solutions

O. System Descriptions:

1. Modes of Operation:

Single sample test strip assay

2. Software:

FDA has reviewed applicant's Hazard Analysis and software development processes for this line of product types:

Yes X or No _____

3. Specimen Identification:

Whole Blood (arterial, venous, capillary)

4. Specimen Sampling and Handling:

Samples are typically obtained by fingerstick but whole blood from arterial or venous sources may be used

5. Calibration:

Calibration is performed with each lot of test strips no calibration code is necessary.

6. Quality Control:

Quality control should be performed every 24 hours on at least two levels of controls.

P. Other Supportive Instrument Performance Characteristics Data Not Covered In The “Performance Characteristics” Section above:

Not Applicable

Q. Proposed Labeling:

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

R. Conclusion:

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