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

A. 510(k) Number:
k123563

B. Purpose for Submission:
New device

C. Measurand:
Lead

D. Type of Test:
Quantitative

E. Applicant:
Magellan DIAGNOSTICS, Inc.

F. Proprietary and Established Names:
LeadCare® Ultra™ Blood Lead Testing System

G. Regulatory Information:

1. Regulation section:
   21 CFR § 862.3550

2. Classification:
   Class II

3. Product code:
   DOF

4. Panel:
   Toxicology (91)

H. Intended Use:

1. Intended use(s):

   See Indications for Use below

2. Indication(s) for use:

   The LeadCare® Ultra™ Blood Lead Testing System is designed to quantitatively measure the amount of lead in a whole blood sample. The LeadCare® Ultra™ Blood Lead Testing System is intended for in vitro (external) use only. The test kit components are designed for use only with the LeadCare® Ultra™ Blood Lead Testing System.

   This test system is for prescription use only. This system is not intended for point of care use.

3. Special conditions for use statement(s):

   Prescription use only

4. Special instrument requirements:

   LeadCare® Ultra™ Blood Lead Analyzer

I. Device Description:

The LeadCare Ultra System Blood Lead Testing System consists of two parts:

1. LeadCare Ultra Blood Lead Test Kit
   The kit includes:

Item	Quantity
Sensors (8 containers of 24 ea.)	192
Treatment Reagent Tubes (250 µL of 0.34 M HCl)	192
Calibration Button	1
Lead Control Level 1 (2mL)	1
Lead Control Level 2 (2mL)	1

2. LeadCare® Ultra™ Blood Lead Analyzer
   The LeadCare® Ultra™ Blood Lead Analyzer is a multi-channel LeadCare Ultra Analyzer performing up to six blood lead tests simultaneously and uploads the completed test results to the system Computer. Test results contain unique sample records, along with sample ID, comments, test conditions, Sensor lot number, and user ID. The Analyzer is also featured with a Calibration Button Reader. This Reader allows for the download of all calibration information, analytical test parameters, and date code information for any given Sensor lot.

J. Substantial Equivalence Information:

1. Predicate device name(s):
   LeadCare II Blood Lead Testing System

2. Predicate 510(k) number(s):
   k052549

3. Comparison with predicate:

Feature	LeadCare® Ultra (Candidate device)	LeadCare® II Blood Lead Testing System (Predicate device) (k052549)
Intended Use	The LeadCare Ultra™ Blood Lead Testing System is designed to quantitatively measure the amount of lead in a whole blood sample. The LeadCare Ultra™ Blood Lead Testing System is intended for in vitro (external) use only. The test kit components are designed for use only with the LeadCare Ultra™ Blood Lead Testing System.	Same
Methodology	Anodic Stripping Voltammetry	Same
Throughput	6 samples at a time	1 sample at a time
Sensor (test strip)	Screen printed sensors with conductive inks; plastic spacer and lid; capillary fill	Same
Calibration	Electronic calibration button	Same
Blood Collection	Fingerstick or venipuncture	Same
Sample Matrix	Whole blood collected in EDTA or heparin; up to 72 hours from time of draw	Whole blood collected in EDTA or heparin; fresh up to 24 hours from time of draw
Treatment Reagent	Dilute hydrochloric acid solution in water with inert carbon particles	Dilute hydrochloric acid solution in water
Sample Handling	Uses pipet to transfer sample from reagent tube to sensor	Uses transfer dropper to transfer sample from reagent tube to sensor

Unit of Measure	Results displayed in micrograms of lead per deciliter of whole blood (µg/dL)	Same
Reportable Range	1.9 - 65 µg/dL	3.3 - 65 µg/dL
Controls	2 levels of external liquid control	Same
Power Source	AC Adapter	AC Adapter or 4 AA batteries
Test Time	3 minutes	Same
System Operating Range	Temperature range of 60° to 82°F (16° to 28°C); Relative Humidity 12%-80% non- condensing to accommodate typical laboratory use	Temperature range of 54° to 97°F (12° to 36°C); Relative Humidity 12%-80% non- condensing to accommodate field portability
Limit of Detection	1.9 µg/dL	3.3 µg/dL

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

- CEN 13640:2002 Stability Testing of In Vitro Diagnostic Reagents
- CLSI EP17-A2 Protocols for Determination of Limits of Detection and Limits of Quantitation
- CLSI EP14-A2 Evaluation of Matrix Effects
- CLSI EP7-A2 Interference Testing in Clinical Chemistry
- CLSI EP9-A2 Method Comparison and Bias Estimation Using Patient Samples
- CLSI EP6-A Evaluation of Linearity of Quantitative Measurement procedures: A Statistical Approach
- CLSI EP5-A2 Evaluation of Precision Predominance of Quantitative Measurement Methods

L. Test Principle:

The LeadCare Ultra System Blood Lead Testing System is an in vitro diagnostic device that relies on electrochemistry (Anodic Stripping Voltammetry or ASV) and a unique sensor to detect lead in whole blood. Most lead is carried within red blood cells. When a sample of whole blood is mixed with Treatment Reagent (a dilute solution of hydrochloric acid), the red blood cells are lysed and the lead becomes available for detection. When a test is run, the analyzer applies an electrical potential that causes the lead to collect on the Sensor. The analyzer measures the amount of lead on the Sensor and displays the result in micrograms per deciliter.

M. Performance Characteristics (if/when applicable):

1. Analytical performance:

a. Precision/Reproducibility:

The LeadCare Ultra Precision Study was performed using bovine blood standards at lead concentrations across the measuring range of the assay. Eighty (80) data points were collected per concentration level over a 20 day period. Samples were prepped two times per day and each sample was run in duplicate on alternating channels such that all (6) channels were used equally during the study. For concentrations around 4.5, 6.4 and 62.1 µg/dL, three sensor lots were utilized. For the remaining concentrations, one representative sensor lot was used. The combined data set is shown below for within-run and total precision:

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Lot	Conc., µg/dL	N	Within Run SD	Within Run %CV	Total SD	Total %CV
1208A	4.8	80	0.25	5.2%	0.34	7.1%
1211B	4.2	80	0.36	8.6%	0.58	13.8%
1301A	4.6	80	0.45	9.8%	0.53	11.6%
1208A	6.5	80	0.57	8.8%	0.58	8.9%
1211B	6.2	80	0.44	7.1%	0.57	9.2%
1301A	6.4	80	0.63	9.9%	0.65	10.1%
1106B	10.8	79	0.80	7.4%	0.90	8.3%
1106B	24.4	80	1.20	4.9%	1.43	5.9%
1106B	44.2	80	1.55	3.5%	1.62	3.7%
1208A	60.8	80	1.92	3.2%	2.53	4.2%
1211B	62.2	80	2.93	4.7%	4.22	6.8%
1301A	63.4	80	1.39	2.2%	2.53	4.0%

b. Linearity/assay reportable range:

A total of seven serially diluted concentrations were tested on three Sensor lots using nine donor blood samples spiked with lead concentrations of 2-5, 5-10, 15-25, 25-35, 35-45, 45-55 & 55-65 µg/dL to examine the linearity of the study.

The following are linear regression results:
Sensor lot 1: Y = 1.04x - 1. 17, R^2 = 0.997
Sensor lot 2: Y = 1.10x - 1.71, R^2 = 0.996
Sensor lot 3: Y = 1.04x - 0.58, R^2 = 0.998

The data provided support the sponsor's claim that the measuring range of this assay is 1.9 to 65 µg /dL.

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

The controls supplied in the Test Kit are the same controls (2 levels of external liquid control) already in use by the predicate device. The controls received FDA clearance under k063398. Please see k063398 for controls information.

LeadCare® Ultra™ Blood Lead Analyzer contains a featured Calibration Button Reader. This Reader allows for the download of all calibration information, analytical test parameters, and date code information for any given Sensor lot. The Calibration Button is supplied with each test kit.

d. *Detection limit:*

The Limit of Blank (LoB), Limit of Detection (LoD) and Limit of Quantitation (LoQ) were calculated based on CLSI EP17-A.

Six sample preps of the blank sample were prepared daily. Replicates of the blank samples were run on the LeadCare Ultra Analyzer over five days using two Sensor lots across all (6) analyzer channels. The limit of blank (LoB) and Limit of Detection (LoD) were determined by measuring 70 replicates of near blank NIST blood samples (0.3 µg/dL).

The LoB was calculated to be 1.5 µg/dL.

For LoD determination, seventy data points of the low sample were used to calculate the LoD based on the following equation:
LoD = LoB + 1.645 x SD of low samples
The LoD was calculated to be 1.9 µg /dL.

To calculate the Limit of Quantitation (LoQ) of the LeadCare Ultra Analyzer, 58 whole blood samples were collected in EDTA Vacutainers with blood lead values at the range (1 – 6 µg/dL). The limit of quantification LoQ was calculated using the Total Error equation:

Total Error LoQ =absolute (Bias) + (2 x SD).

The bias of 58 samples, according to GFAAS, was calculated to be 0.02 g/dL.

Based upon the results, the sponsor claims the LoQ = LoD (1.9 µg/dL).

e. *Analytical specificity:*

Each compound was tested for specificity with certain compounds and drug metabolites. Each compound was spiked into drug-free blood.

Each sample was tested in 3 replicates and was run on 3 sensors. If any positive result was observed, the compound, drug/drug metabolites were further diluted sequentially to different concentrations and tested in triplicates until the highest concentrations that generates negative results were determined. A summary of the interference study is presented in the product package insert. Results are shown below for the tested concentration of each compound that resulted in no interference.

Analyte or Compound	Tested Concentration (µg/ml)	Analyte or Compound	Tested Concentration (µg/mL)
Amoxicillin	100	Valproic Acid	500
Doxycycline	100	Carbamazepine	100
Cephalexin (Keflex)	100	Fexofenadine	25
Ciprofloxacin	100	Indinavir	100
Erythromycin	100	Fluconazole	100
Piperazine	100	Trimethoprim	100
Amphotericin	50	Nicotine	10
Nystatin	100	Sulfamethoxazole	400
Metronidazole	50	Naproxen	500
Isoniazid	100	Acetaminophen	251
Rifampicin	100	Acetylsalicylic	599
Ganciclovir (AZT)	100	Salicylic	600
Loratadine	100	Ibuprofen	500
Pseudoephedrine	100	Uric Acid	100
Phenylephrine	100	Ascorbic Acid	100
5,5-Diphenylhydramine	100	Copper	2
Methyl Phenidate HCL	100	Zinc	10
d-Amphetamine	100	Arsenic V	0.005
Hydroxyurea	250	Arsenic III	0.01
Succimer	100	Cadmium	0.05
Penicillamine	100	Aluminum	10
Diphenylhydramine - HCL	100	Warfarin (Coumadin)	100

f. Assay cut-off:
Not applicable.

2. Comparison studies:

a. Method comparison with predicate device:

A study was performed to compare the results of the LeadCare Ultra test to the Reference Method, Graphite Furnace Atomic Absorption Spectrometry (GFAAS) using 148 whole blood samples in K2EDTA Vacutainers based on

CLSI EP9-A2 guidelines. Each blood sample was run once on the LeadCare Ultra and in duplicate on the GFAAS. The range of results observed with the LeadCare Ultra test ranged from 1.9 to 65 µg/dL. Results of linear regression are as follows:

$Y = 0.989X + 0.0066$, $r = 0.978$.

b. Matrix comparison:

A total of 72 micro capillary tubes with K2EDTA samples (fingerstick) with lead concentration of 1.9, 5, 10, 20, 30, 40, 50, 60, 65 µg/dL, and 39 pairs (EDTA and sodium heparin vacutainer samples) with lead concentration of 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60 µg/dL were analyzed on the LeadCare Ultra system compared to GFAAS. Samples tested included unaltered native patient samples and spiked samples. Micro capillary tubes with K2EDTA are considered the primary tube type for this assay. Each blood sample was run in duplicate. The results are presented in the table below.

1. K2EDTA micro capillary Linear Regression Results:
   $Y = 1.04x + 0.01$
   $R^2 = 0.983$

2. EDTA Vacutainer Linear Regression Results:
   $Y = 1.03x – 0.80$
   $R^2 = 0.954$

3. Heparin Vacutainer Linear Regression Results:
   $Y = 1.07x + 0.02$
   $R^2 = 0.968$

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:

The Centers for Disease Control (CDC) reports a reference level of 5 micrograms per

deciliter to identify children with blood lead levels.

From CDC Response to Advisory Committee on Childhood Lead Poisoning Prevention Recommendations in "Low Level Lead Exposure Harms Children: A Renewed Call of Primary Prevention" (http://www.cdc.gov/nceh/lead) Information updated on August 26, 2011.

N. Instrument Name:

LeadCare® Ultra™ Blood Lead Analyzer

O. System Descriptions:

1. Modes of Operation:
   Does the applicant's device contain the ability to transmit data to a computer, webserver, or mobile device?
   Yes __X__ or No____.

   Does the applicant's device transmit data to a computer, webserver, or mobile device using wireless transmission?
   Yes __ __ or No_ X ___.

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:
   Specimen identification is based on sample ID, sensor lot number, and user ID.

4. Specimen Sampling and Handling:

   The labeling provides instructions on specimen sampling and handling and states the following user instructions:

   - Follow laboratory's procedures and regulations when handling and disposing of biohazardous materials.
   - Blood samples can transmit infectious disease. Wear protective clothing and eyewear while collecting and handling blood samples. Follow the procedures established by your institution for meeting federal, state, and local regulations.

5. Calibration:
   Calibration is done using the calibration button which is supplied in each test kit. The button is inserted into the calibration reader port of the analyzer.

6. Quality Control:

Two levels of external liquid controls are supplied with the Test Kit. The labeling states that controls should be tested as follows:

- Tested each day or shift before patient samples are tested for lead concentration.
- Prepared and tested by each analyst who prepares samples.
- Run to test the technique of new users.
- Run at any other time you wish to verify system performance.
- As required by applicable federal, state, and local guidelines to ensure compliance.

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

1) The following documentation related to the software was reviewed and found to be acceptable: level of concern (moderate), software description, device hazard analysis, software requirements specifications, software design specification, revision level history, unresolved anomalies, software development environment description, verification testing, and traceability analysis.

LeadCare Ultra software/firmware: The LeadCare Ultra software/firmware was validated pursuant to the moderate level of concern requirements. Design validation testing confirmed that the LeadCare Ultra device performs according to the stated intended use.

The firm provided documentation to support the device was designed, developed and operates under good software lifecycle processes.

2) Data transmission: Bench testing has been performed on LeadCare Ultra System to verify that the LeadCare Ultra System meets the requirements of transmitting full data memory and memory rollover via USB cable to a Laboratory Information Management System (LIMS). The results showed that all data were transmitted accurately at 100% with no data corruption.

3) The sponsor provided the appropriate documentation certifying that acceptable electromagnetic testing (EMC) had been performed.

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.