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

**A. 510(k) Number:**

k140790

**B. Purpose for Submission:**

Modification to a previously cleared device- Dimension Vista Magnesium assay (k061655)

**C. Measurand:**

Magnesium

**D. Type of Test:**

Quantitative, photometric assay

**E. Applicant:**

Siemens Healthcare Diagnostics

**F. Proprietary and Established Names:**
Dimension Vista® Magnesium Flex® reagent cartridge (MG)
Dimension Vista® Chemistry 1 Calibrator (CHEM 1 CAL)

**G. Regulatory Information:**

| Product Code | Classification | Regulation Section | Panel |
|---|---|---|---|
| JGJ | I, Reserved | 862.1495 Magnesium test system | 75-Chemistry |
| JIX | II | 862.1150, calibrator, Multi-Analyte Mixture | 75-Chemistry |

**H. Intended Use:**

1. Intended use(s):

   See Indications for use below.

2. Indication(s) for use:

The Dimension Vista Magnesium Flex reagent cartridge (MG) is an in vitro diagnostic test for the quantitative measurement of magnesium in human serum, plasma and urine on the Dimension Vista® System. Magnesium measurements are used in the diagnosis and treatment of hypomagnesemia (extremely low levels of magnesium) and hypermagnesemia (abnormally high levels of magnesium).

The Dimension Vista Chemistry 1 Calibrator (CHEM 1 CAL) is an in vitro diagnostic product for the calibration of Calcium (CA), Cholesterol (CHOL), Creatinine (CREA/CRE2), Glucose (GLU), Lactic Acid (LA), Magnesium (MG), Thyroxine (T4), Thyroxine Uptake (TU), Blood Urea Nitrogen (BUN) and Uric Acid (URCA) methods on the Dimension Vista® System.

3. Special conditions for use statement(s):

   Prescription use only

4. Special instrument requirements:

   All performance studies were conducted using the Dimension Vista 1500 Analyzer System

## I. Device Description:

The Dimension Vista® Magnesium Flex® reagent cartridge (MG) consists of 12 reagent wells. Wells 1-6 contain liquid 0.0528 g/L methyl-thymol blue, acetic acid and potassium sorbate; wells 7-12 contain liquid 0.5mM Ba-EGTA, sodium metaborate, buffer and microbial inhibitors. The Dimension Vista® Magnesium Flex® reagent cartridge has been previously cleared in k061655 and there is no formulation or packaging change for the Mg assay.

The Dimension Vista Chemistry 1 Calibrator (CHEM 1 CAL) is a liquid, frozen multi-analytes, bovine serum albumin based product used to calibrate blood urea nitrogen, calcium, cholesterol, creatinine, glucose, lactic acid, magnesium, thyroxine, thyroxine uptake and uric acid. The calibrator consists of two different concentrations of analytes, calibrator A and calibrator B. The kit consists of six 2.3 ml. vials, three vials of Calibrator A and three vials of Calibrator B.

The only change to the calibrator is the value assignment to the calibrator A for Mg assay is no longer available because the calibration scheme of Mg is to use system water as the first calibrator instead of using calibrator A. Calibrator B is still required for the calibration scheme of the Mg assay.

There is no change to the formulation, packaging or analyte content for the CHEM 1 CAL; the only change is the value assignment value for the Mg analyte was removed from calibrator A.

## J. Substantial Equivalence Information:

1. Predicate device name(s):

   Dimension® Magnesium Flex® reagent cartridge (MG)
   Dimension Vista Chemistry 1 Calibrator (CHEM 1 CAL)

2. Predicate 510(k) number(s):
   k061655
   k061838

3. Comparison with predicate:

Dimension Vista® Magnesium Flex® reagent cartridge (MG)

| **Similarities and Differences** | | |
|---|---|---|
| Item | Predicate Device Dimension® Magnesium Flex® reagent cartridge (MG) (K061655) | Candidate Device Dimension Vista® Magnesium Flex® reagent cartridge (MG) |
| Intended Use | For the quantitative determination of magnesium in human serum, heparinized plasma and urine. | Same |
| Specimen Types | Serum, lithium heparin plasma and urine | Same |
| Detection Conditions | Bi-chromatic 600 and 510 nm | Same |
| Calibration Interval | 90 days | Same |
| Assay Principle | Methyl-thymol blue (MTB) | Same |
| Measuring Range | 0.0-20.0 mg/dL | 0.3-10.0 mg/dL |

Dimension Vista Chemistry 1 Calibrator (CHEM 1 CAL)

| **Similarities and Differences** | | |
|---|---|---|
| Item | Predicate Device Chemistry 1 Calibrator (K061838) | Candidate Device Chemistry 1 Calibrator with modified calibration scheme for Mg |
| Intended Use | The Chemistry 1 Calibrator (CHEM 1 CAL) is an in vitro diagnostic product for the calibration of Blood Urea Nitrogen (BUN), Calcium (CA), Cholesterol (CHOL), Creatinine (CREA/CRE2), Glucose | Same |

| Similarities and Differences | | |
|---|---|---|
| Item | Predicate Device Chemistry 1 Calibrator (K061838) | Candidate Device Chemistry 1 Calibrator with modified calibration scheme for Mg |
| | (GLU), Lactic Acid (LA), Magnesium (MG), Thyroxine (T4), Thyroxine Uptake (TU) and Uric Acid (URCA) methods on the Dimension Vista® System. | |
| Form | Frozen Liquid | Same |
| Calibration Scheme for Magnesium | Level 1 (Cal A) and Level 2 (Cal B) from the calibrator | System water and Level 2 (Cal B) from the calibrator. |

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

- CLSI Guideline, EP07-A2 *Interference Testing of Clinical Chemistry; Approved Guideline*
- CLSI Guideline, EP09-A2 *Method Comparison and Bias Estimation Using Patient Samples; Approved Guideline*
- CLSI Guideline, EP06-A2 *Evaluation of the Linearity of Quantitative Measurement; Approved Guideline*
- CLSI Guideline, EP17-A2 *Evaluation of Detection Capability for Clinical Laboratory Measurement Procedures*
- CLSI Guideline, EP05-A2 *Evaluation of Precision Performance of Quantitative Measurement Methods; Approved Guideline*
- CLSI Guideline, EP28-A3c *Defining, Establishing, and Verifying Reference Intervals in the Clinical Laboratory; Approved Guideline Third Edition*

**L. Test Principle:**

The Dimension Vista® MG Flex® reagent cartridge uses a modified methyl-thymol blue (MTB) complexometric technique. MTB forms a blue complex with magnesium. Calcium interference is minimized by forming a complex between calcium and Ba-EGTA (chelating agent). The amount of MGMTB complex formed is proportional to the magnesium concentration and is measured using a bi-chromatic (600 and 510 nm) endpoint technique.

**M. Performance Characteristics (if/when applicable):**

1. Analytical performance:

   *a. Precision/Reproducibility:*
   Precision was evaluated according to the CLSI Document EP5 -A2, Evaluation of Precision Performance of Quantitative Measurement Methods. Precision testing

included three levels of serum based control material (Serum Control Level 1, 2 and 3), two human serum sample pools (Serum Pool 1 and 2), one level of urine based control material (Urine Level 1 Control) and one human urine sample pool (Urine Pool 1). Each sample was tested in 2 replicates per run, 2 runs per day for 20 days for a total of 80 replicates. Results from the precision study are summarized in the table as follows:

| | | | Within Run | | Total | |
|---|---|---|---|---|---|---|
| Sample | N | Mean mg/dL | SD | CV | SD | CV |
| Serum Control Level 1 | 80 | 1.1 | 0.1 | 4.8 | 0.1 | 5.1 |
| Serum Control Level 2 | 80 | 2.5 | 0.1 | 2.9 | 0.1 | 2.9 |
| Serum Control Level 3 | 80 | 4.0 | 0.1 | 1.9 | 0.1 | 2.4 |
| Serum Pool 1 | 80 | 1.9 | 0.1 | 3.4 | 0.1 | 3.7 |
| Serum Pool 2 | 80 | 4.5 | 0.1 | 1.8 | 0.1 | 2.1 |
| Urine Level 1 Control | 80 | 7.0 | 0.1 | 1.2 | 0.1 | 1.5 |
| Urine Pool 1 | 80 | 7.3 | 0.1 | 1.0 | 0.1 | 1.3 |

b. *Linearity/assay reportable range:*

Linearity was evaluated for the Dimension Vista® MG Flex® reagent cartridge method using 9 equally spaced serum and urine samples which spanned the assay range. The individual samples were prepared by blending samples with high and low magnesium concentration across the measurement range as described in CLSI Evaluation of the Linearity of Quantitative Measurement Procedures (EP06-A). Results of the linearity study are summarized in the table below.

| Sample Type | Linear regression | $R^2$ | Concentration range tested |
|---|---|---|---|
| Serum | y=1.01x - 0.01 | 0.99 | 0.4-11.4 mg/dL |
| Urine | y=0.99x + 0.06 | 0.99 | 0.3-11.4 mg/dL |

The linearity study supports the claimed measuring range of the assay of 0.3-10.0 mg/dL.

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

Traceability: The assigned values of the Dimension Vista® MG assay calibrator is traceable to NIST SRM929A reference material and was previously cleared in

k061838. Level 2 (Calibrator B) of the Chemistry 1 Calibrator has an assigned value of 21.1 mg/dL for magnesium. All the assigned values for the other analytes are the same in k061838.

Stability of the Dimension Vista® Magnesium Flex® reagent cartridge was established in k051087. Stability of the Dimension Vista Chemistry 1 Calibrator was established in k061838.

*d. Detection limit:*

The Limit of the Blank (LoB), Limit of Detection (LoD) and Limit of Quantitation (LoQ) were established following the CLSI guideline EP17- A2: Evaluation of Precision Performance of Quantitative Measurement Methods; Approved Guideline—Second Edition. Studies were performed in the following manner:

To calculate the Limit of Blank (LoB), 4 analyte free samples were measured in replicates of five for three days using two reagent lots on one Dimension Vista analyzer. To estimate the Limit of Detection (LOD), 4 samples containing low levels of magnesium were measured in replicates of five for three days using two reagent lots and one Dimension Vista Analyzer.

To estimate the Limit of Quantitation (LoQ), six samples containing low levels of magnesium were measured in replicates of five for five days using two reagent lots on one Dimension Vista analyzer.

The detection limits results are summarized as follows:

| | Serum mg/dL | Urine mg/dL |
|---|---|---|
| LoB | 0.2 | 0.2 |
| LoD | 0.3 | 0.3 |
| LoQ | 0.3 | 0.3 |

The detection limit studies support the claimed measuring range of 0.3-10 mg/dL

*e. Analytical specificity:*

The Dimension Vista® Magnesium Flex® reagent cartridge was evaluated for interferences according to CLSI EP7-A2 Interference Testing in Clinical Chemistry; Approved Guideline - Second Edition. Specificity was tested using serum pools at three levels of magnesium, approximately 1.8, 4.4 and 6.0 mg/dL. Bias is the difference in the results between the control sample (without interferent) and the test sample (contains interferent) expressed in percent. Bias exceeding 10% is considered significant interference by the sponsor. The highest concentration of interference tested that did not cause significant interference is summarized in the table below.

Serum Interference:

| Substance tested | Test Concentration (mg/dL) |
|---|---|
| Lipemia | 3000 |
| Hemoglobin | 1000 |
| Bilirubin (unconjugated) | 60 |
| Bilirubin (conjugated) | 60 |

The labeling states "Hemolyzed samples must not be used for Magnesium testing."

An additional interference study was conducted using urine samples. Urine samples were tested at two sample concentrations of approximately 2.0 mg/dL and 7.9 mg/dL. Bias is the difference between in the results between the control sample (without interferent) and the test sample (contains interferent) expressed in percent. Bias exceeding 10% is considered significant interference by the sponsor. The highest concentration of interference tested that did not cause significant interference is summarized in the table below:

Urine interference:

| Substance tested | Test Concentration (mg/dL) |
|---|---|
| Calcium | 20 |
| Copper | 0.5 |
| Iron | 0.5 |
| Zinc | 0.5 |

*f. Assay cut-off:*

Not applicable.

2. Comparison studies:

*a. Method comparison with predicate device:*

Method comparison testing was conducted using the Dimension Vista ® Magnesium Flex® reagent cartridge versus the Beckman AU Magnesium assay (k981743). A total of 114 serum and 125 lithium heparin plasma samples were evaluated using the Dimension® MG Flex® reagent cartridge (predicate device) and the Beckman AU Magnesium assay (reference device). Less than 10% of the total samples were altered.

In an additional study, 99 urine samples were tested using the Dimension Vista® MG Flex reagent cartridge versus the Beckman AU Magnesium assay. All urine samples were native.

Regression results for the Dimension Vista Flex Reagent Cartridge vs. Beckman AU Magnesium assay are summarized in the table below:

| Sample type | n | Sample range (mg/dL) | Slope | Intercept | R |
|---|---|---|---|---|---|
| Serum | 114 | 0.6-8.2 | 1.10 | -0.15 | 1.00 |
| Lithium Heparin Plasma | 125 | 0.7-7.9 | 1.05 | -0.01 | 0.9945 |
| Urine | 99 | 1.5-9.3 | 1.05 | 0.09 | 0.9950 |

Results obtained from the serum samples correlate well around the medical decision range (< 4.5 mg/dL); however results above 4.5 mg/dL start to show some scatter. However, the scatter that is seen in that part of the assay range is clinically insignificant.

*b. Matrix comparison:*

Serum, lithium heparin plasma and urine samples are acceptable to be used with this assay. Please refer to the method comparison studies in M.2.a. above.

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:

Serum/plasma: 1.6-2.6 mg/dL[1]

Urine: 12-291 mg/24 hr[1]

[1]Burtis, CA, Ashwood ER, Bruns DE. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. Elsevier., St. Louis, MO 2012, p 2158.

The labeling states “each laboratory should establish its own expected values for MG as performed on the Dimension Vista System”

**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.