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

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

k150214

**B. Purpose for Submission:**

New device

**C. Measurand:**

Capillary whole blood glucose from the fingertip

**D. Type of Test:**

Quantitative, amperometric detection, Flavin adenine dinucleotide-Glucose dehydrogenase (GDH-FAD)

**E. Applicant:**

LifeScan Europe, a Division of Cilag GmbH International

**F. Proprietary and Established Names:**

OneTouch Verio Flex Blood Glucose Monitoring System

**G. Regulatory Information:**

1. Regulation section:

   21 CFR 862.1345 Glucose Test System

2. Classification:

   Class II

3. Product code:

   NBW - Blood glucose test system, over the counter

   LFR - glucose dehydrogenase, glucose

4. Panel:

   (75) Clinical Chemistry

## H. Intended Use:

1. Intended use(s):

   See Indications for Use below.

2. Indication(s) for use:

   The OneTouch Verio Flex™ Blood Glucose Monitoring System is intended to be used for the quantitative measurement of glucose (sugar) in fresh capillary whole blood samples drawn from the fingertip. The OneTouch Verio Flex™ Blood Glucose Monitoring System is intended to be used by a single patient and should not be shared.

   OneTouch Verio Flex™ Blood Glucose Monitoring System is intended for self testing outside the body (in vitro diagnostic use) by people with diabetes at home as an aid to monitor the effectiveness of diabetes control. The OneTouch Verio Flex™ Blood Glucose Monitoring System is not to be used for the diagnosis of or screening of diabetes, or for neonatal use.

   The OneTouch® Verio Test Strips are for use with the OneTouch Verio Flex™ Blood Glucose Meter to quantitatively measure glucose drawn from the fingertips.

3. Special conditions for use statement(s):

   - The OneTouch Verio Flex™ Blood Glucose Monitoring System is intended to be used by a single patient and should not be shared.
   - The system is not to be used for the diagnosis of or screening of diabetes or for neonatal use.
   - The system is not for use on critically ill patients, patients in shock, and severely dehydrated patients or hyperosmolar patients.
   - OneTouch Verio® Family of Meters are not indicated for Alternate site testing (AST).

4. Special instrument requirements:

   OneTouch® Verio Flex Blood Glucose Meter

## I. Device Description:

The OneTouch Verio Flex™ Blood Glucose Monitoring System consists of the following components:

- OneTouch Verio Flex™ Meter
- OneTouch Verio ™Level 3 Control Solution (102–138 mg/dL, available separately), cleared in K120708
- OneTouch Verio ™ Level 4 Control Solution (298–403 mg/dL, available separately), cleard in K120708
- OneTouch Verio ™ Test Strips (available separately)
- OneTouch Delica™ Lancing Device (or alternative Lancing Device)
- OneTouch Delica™ Sterile Lancets (or alternative sterile lancets)
- Carrying Case
- OneTouch Verio Flex™Product Labeling

The OneTouch Verio Flex™ Meter uses BLUETOOTH® Smart wireless technology. The users can pair and send glucose results to compatible wireless devices following instructions provide in the meter manual.

## J. Substantial Equivalence Information:

1. Predicate device name(s):

   OneTouch® Verio® Blood Glucose Monitoring System

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

   k131363

3. Comparison with predicate:

| **Similarities** | | |
|---|---|---|
| Item | Predicate Device (k131363)<br><br>OneTouch Verio Blood Glucose Monitoring System | Candidate Device<br><br>OneTouch Verio Flex Blood Glucose Monitoring System |
| Intended Use/Indications for Use | For self-testing outside the body (in vitro diagnostic use) by people with diabetes at home as an aid to monitor the effectiveness of diabetes control. | Same |

| | | |
|---|---|---|
| Detection method | Amperometry | Same |
| Enzyme | GDH-FAD | Same |
| Calibration Coding | Non-Coding | Same |
| Sample type | Capillary whole blood | Same |
| Sample sites | Fingertip only | Same |
| Sample volume | 0.4 µL | Same |
| Sample test time | 5 seconds | Same |
| Test range | 20 - 600 mg/dL | Same |
| Operating Temperature | 43°F - 111°F (6°C - 44°C) | 50°F-104°F (10°C-40°C) |
| Operating Humidity | 10% - 90% | Same |
| Hematocrit range | 20 - 60% | Same |
| Altitude Study | Up to 10,000 feet | Same |

| **Differences** | | |
|---|---|---|
| Item | Predicate Device (k131363) OneTouch Verio Blood Glucose Monitoring System | Candidate Device OneTouch Verio Flex Blood Glucose Monitoring System |
| Meter Hardware Features | | |
| Microprocessor | 16 bit with 128K memory | Multichip Module |
| LCD | Dot matrix TFT (thin film transistor) color display | Segmented monochrome liquid crystal display |

| | | |
|---|---|---|
| Buttons | 3 button user input:<br>Up/ Down/ OK on the side of meter housing | 3 button user input:<br>Up/ Down/ OK on front of meter housing |
| Size<br>(L x W x H) | 0.99 x 2.04 x 3.15 inches | 0.63 x 2.05 x 3.39 inches |
| Weight | Approximately 3 ounces | Approximately 1.7 ounces |
| Meter Software Features | | |
| Averages | 7, 14, 30 and 90 day averages | None |
| | Tabular display | None |
| Algorithm | Gemini Blood Glucose Algorithm | Bias Corrected Gemini Blood Glucose Algorithm |
| Control Result marking | Auto detect | Manual Control Solution tagging |
| Compatible off-meter software accessories | OneTouch Diabetes Management Software (DMS) | One Touch Diabetes Management Software (DMS)<br>One Touch Zoom Pro<br>One Touch Reveal |
| Data Download | Micro USB data port | Via USB or Bluetooth Low Energy |
| Range Indicator | No | Yes.<br>The device includes a monochrome arrow on the LCD display that will point to a pre-printed Red, Green or Blue range indicator adjacent to the meter lens, corresponding to High, In Range or Low indication of glucose test values compared to the selected target range values. |

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

EP07-A2, Interference Testing in Clinical Chemistry; Approved Guideline - Second Edition (2005).

EP06-A, Evaluation of the Linearity of Quantitative Measurement Procedures: A Statistical

Approach; Approved Guideline (2003).

ISO 14971 - Medical devices — Application of risk management to medical devices (2007).

ISO 10993-1 Biological Evaluation Of Medical Devices -- Part 1: Evaluation And Testing Within A Risk Management Process Fourth Edition (2009).

**L. Test Principle:**

The OneTouch Verio Flex Blood Glucose Monitoring System employs flavin adenine dinucleotide-glucose dehydrogenase (FAD-GDH) enzyme chemistry as the standard dry reagent assay for glucose in whole blood. This enzymatic assay, with a redox chemical "mediator" reaction, is used to generate an electrical current proportional to the glucose concentration in the blood sample. The system is designed as an amperometric measurement device using the current generated from the redox reaction as the measurable response.

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

1. Analytical performance:

*a. Precision/Reproducibility:*
Within-Run Precision:
Venous blood from one donor was adjusted with glucose to 7 glucose levels (as shown in the below table) and tested on three lots of strips and 30 meters (10 meters/lot of strips). Each sample was tested in 10 replicates per meter and per strip lot, giving a total of 100 measurements/lot (n=100). Results are summarized below:

| Target Glucose Level, (mg/dL) | Strip Lot | n | Average Meter Reading (mg/dL) | SD, mg/dL | CV, % |
|---|---|---|---|---|---|
| 20 | 1 | 100 | 17.21 | 0.54 | 3.15 |
| | 2 | 100 | 18.86 | 0.78 | 4.14 |
| | 3 | 100 | 18.83 | 0.53 | 2.80 |
| 40 | 1 | 100 | 35.79 | 0.86 | 2.41 |
| | 2 | 100 | 38.47 | 0.83 | 2.15 |
| | 3 | 100 | 35.28 | 0.79 | 2.24 |
| 90 | 1 | 100 | 87.70 | 1.71 | 1.96 |
| | 2 | 100 | 89.10 | 1.71 | 1.92 |
| | 3 | 100 | 88.61 | 1.73 | 1.96 |
| 130 | 1 | 100 | 128.38 | 2.21 | 1.72 |
| | 2 | 100 | 131.58 | 2.97 | 2.26 |

| | | | | | |
|---|---|---|---|---|---|
| | 3 | 100 | 123.61 | 2.23 | 1.81 |
| 200 | 1 | 100 | 202.03 | 3.36 | 1.66 |
| | 2 | 100 | 202.76 | 4.53 | 2.24 |
| | 3 | 100 | 193.04 | 3.85 | 1.99 |
| 350 | 1 | 100 | 337.26 | 5.89 | 1.75 |
| | 2 | 100 | 345.45 | 6.20 | 1.79 |
| | 3 | 100 | 350.98 | 6.44 | 1.84 |
| 600 | 1 | 100 | 574.11 | 10.79 | 1.88 |
| | 2 | 100 | 600.07 | 10.96 | 1.83 |
| | 3 | 100 | 576.02 | 9.84 | 1.71 |

Intermediate precision was evaluated on 5 levels of Glucose control solutions designed to provide system responses at a total of 5 target glucose concentrations: 12, 40, 120, 350 and 525 mg/dL using 30 meters (10 per strip lot). The test was performed over 10 days, with 2 replicates per meter/test strip lot/control level being tested per day (N=200). Results are summarized below:

| Target Glucose Level | Strip Lot | n | Meter Reading, mg/dL | SD, mg/dL | CV, % |
|---|---|---|---|---|---|
| 12 | 1 | 200 | 11.94 | 0.70 | 5.86 |
| | 2 | 200 | 12.79 | 0.50 | 3.91 |
| | 3 | 200 | 12.65 | 0.47 | 3.71 |
| 40 | 1 | 200 | 36.73 | 0.92 | 2.50 |
| | 2 | 200 | 37.44 | 0.97 | 2.59 |
| | 3 | 200 | 37.27 | 0.88 | 2.36 |
| 120 | 1 | 200 | 117.17 | 2.38 | 2.03 |
| | 2 | 200 | 118.12 | 2.30 | 1.95 |
| | 3 | 200 | 117.76 | 2.55 | 2.16 |
| 350 | 1 | 200 | 348.89 | 9.96 | 2.86 |
| | 2 | 200 | 350.07 | 7.70 | 2.20 |
| | 3 | 200 | 348.01 | 6.98 | 2.00 |
| 525 | 1 | 200 | 515.06 | 11.26 | 2.19 |
| | 2 | 200 | 517.29 | 15.32 | 2.96 |
| | 3 | 200 | 513.20 | 13.70 | 2.67 |

b. *Linearity/assay reportable range:*

Linearity of the system was evaluated using venous blood from 9 donors adjusted to nine glucose levels at21.67, 61.58, 100.99, 200.94, 298.17, 398.83, 496.04, 602.03, 705.93 mg/dL by YSI. The meter results for each strip lot (Y) were compared with the reference value obtained from the YSI method (X). The results from regression analysis are summarized below:

Lot 1: $y = 1.013x-4.365$, $R^2=0.998$
Lot 2: $y = 1.002x-2.969$, $R^2=0.998$
Lot 3: $y = 1.003x-3.208$, $R^2=0.997$

The results of the study support the sponsor's claimed glucose measurement range of 20 to 600 mg/dL. Data from bench studies and software verification studies were provided to demonstrate that if a sample is less than 20 mg/dL, the result is flagged by the meter as LO. If a sample result exceeds 600 mg/dL, the result is flagged by the meter as HI.

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

Traceability

Traceable to NIST SRM 91, dry D-glucose.

Test strip stability:
Stability was previously established in k120708. The strips are stable for 24 months (unopened) and 6 months (opened) when stored at 41°F- 86°F (5°C-30°C), Ambient RH (65%).

Control solution stability:
Control solution stability was previously established in k120708. The Control Solutions are stable for 21 months (unopened) and 6 months (opened) when stored at 41°F- 86°F (5°C-30°C).

Value Assignment:
Value assignment for the controls was previously established in k120708.

d. *Detection limit:*

The reportable range for the OneTouch Verio Flex Blood Glucose Monitoring System is 20 to 600 mg/dL. This range was verified by the linearity study (M.1.b).

e. *Analytical specificity:*

28 endogenous and exogenous substances were tested for interference by spiking each substance at 4 concentrations (100%, 75%, 50%, 25% of the highest level tested) into 2 venous whole blood samples, one at low glucose value of 70 mg/dL, and one at high glucose value of 300 mg/dL. Each sample was tested in replicates of 10 on each of 3 strip lots. The % difference between the spiked sample and the control sample with no substance was calculated.

The substances tested and the maximum allowed concentration with no interference are summarized in the below table.

| **Type of Substance** | **Interference** | **Maximum tested concentration with no interference (mg/dL)** |
|---|---|---|
| Endogenous | Ascorbic Acid | 6.38 |
| | Bilirubin (unconjugated) | 40.41 |
| | Cholesterol | 813.8 |
| | Creatinine | 32.53 |
| | Glutathione | 46.73 |
| | Haemoglobin | 236.90 |
| | Triglycerides | 3331.11 |
| | Urea | 266.05 |
| | Uric acid | 9.87 |
| Exogenous | Acetaminophen | 12.54 |
| | Dopamine (Hydrochloride) | 0.101 |
| | EDTA | 0.10 |
| | Ephedrine | 0.21 |
| | Gentisic Acid | 1.85 |
| | Heparin | 2.15 |
| | Ibuprofen | 50.52 |
| | Levo-Dopa | 1.01 |
| | Methyl-Dopa (sesquihydrate) | 1.50 |

| Type of Substance | Interference | Maximum tested concentration with no interference (mg/dL) |
|---|---|---|
| | Pralidoxime Iodide (PAM)[5] | Below 57.41<br>(therapeutic level at 80) mg/dL) |
| | Salicylate | 58.90 |
| | Tetracycline | 1.52 |
| | Tolazamide | 15.03 |
| | Tolbutamide | 65.98 |
| Saccharides | Lactose | 4.25 |
| | Galactose | 60.39 |
| | Icodextrin | 1241.72 |
| | Maltose (monohydrate) | 363.60 |
| | Xylose | Below 45.72<br>(therapeutic level at 60) |

Based on the test results, the sponsor provided the follow table and statement in the labeling:

| Interfering Substance | OneTouch Verio Family of Meters labeled claim |
|---|---|
| Tolazamide | Concentrations greater than 10.8 mg/dL may cause falsely low results. |
| Uric Acid | Concentrations greater than 8 mg/dL may cause falsely low results |

Do not use the OneTouch Verio® Family of Blood Glucose Monitoring Systems when PAM (Pralidoxime) is known or suspected to be in the patient's whole blood sample.

The OneTouch Verio® Family of Blood Glucose Monitoring Systems should not be used for patients within 24 hours of receiving a D-xylose absorption test as it may cause inaccurately high results.

*f. Assay cut-off:*

Not applicable.

2. Comparison studies:

*a. Method comparison with predicate device:*

The sponsor performed a system accuracy evaluation comparing the candidate BGMS to YSI 2300 (reference method). The study was performed at three clinical sites. Capillary fingerstick samples were collected from 115 subjects with glucose concentrations ranging from 31.6 to 492.5mg/dL (2 of these samples were adjusted to <50mg/dL and 1 sample was adjusted to >400mg/dL). The candidate BGMS was tested in duplicate with each of three different strip lots providing a total of 6 meter results per participant. The results for a singlet set of data relative to the reference method are summarized in the tables below:

**For capillary blood glucose concentrations <75mg/dL**

| Test Strip Lot | Within ±5mg/dL | Within ±10mg/dL | Within ±15mg/dL |
|---|---|---|---|
| 1 | 13/18 (72.2%) | 18/18 (100%) | 18/18 (100%) |
| 2 | 14/18 (77.8%) | 18/18 (100%) | 18/18 (100%) |
| 3 | 15/18 (83.3%) | 18/18 (100%) | 18/18 (100%) |
| Combined | 42/54 (77.8%) | 54/54 (100%) | 54/54 (100%) |

**For capillary blood glucose concentrations ≥75mg/dL**

| Test Strip Lot | Within ±5% | Within ±10% | Within ±15% | Within ±20% |
|---|---|---|---|---|
| 1 | 62/97 (63.9%) | 91/97 (93.8%) | 96/97 (99.0%) | 96/97 (99.0%) |
| 2 | 64/97 (66.0%) | 92/97 (94.8%) | 96/97 (99.0%) | 96/97 (99.0%) |
| 3 | 57/97 (58.8%) | 93/97 (95.9%) | 95/97 (97.9%) | 97/97 (100%) |
| Combined | 183/291 (62.9%) | 276/291 (94.8%) | 287/291 (98.6%) | 289/291 (99.3%) |

**Linear Regression**

| Test Strip Lot | N | Slope | Intercept mg/dL | $r^2$ |
|---|---|---|---|---|
| 1 | 115 | 1.0 | -0.31 | 0.99 |
| 2 | 115 | 0.99 | 1.14 | 0.99 |
| 3 | 115 | 1.01 | 0.01 | 0.99 |
| Combined | 345 | 1.01 | 0.01 | 0.99 |

*b. Matrix comparaison:*

Not applicable. Capillary whole blood from the finger is the only indicated matrix.

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):*

User Performance Study:

To assess the performance of the candidate BGMS in the hands of the intended users, the sponsor performed a study with 172 untrained lay user participants at 3 different clinical sites. Each subject was asked to review the instructions for use and meter manual and perform testing on a fingertip. The health care professional collected capillary blood for YSI 2300 tests and for hematocrit testing. The range of glucose values for the samples as measured by the reference method was 42.1 to 533.3 mg/dL. Three (3) lots of test strips were randomly assigned and used in the study. The results relative to the reference method are summarized below:

For glucose concentrations <75 mg/dL

| Number of test results | Within ± 5 mg | Within ± 10 mg | Within ± 15 mg |
|---|---|---|---|
| 21 | 16/21 (76.2%) | 20/21(95.2%) | 20/21 (95.2%) |

For glucose concentrations ≥ 75 mg/dL

| Number of test results | Within ± 5% | Within ± 10 % | Within ± 15 % | Within ± 20 % |
|---|---|---|---|---|
| 151 | 88 / 151 (58.3%) | 134 / 151 (88.7%) | 148 / 151 (98.0%) | 150 / 151 (99.3%) |

Liner Regression:

$y=0.99x+2.98$; $R^2=0.98$ (N=172)

During the lay user study the participants were asked to complete a questionnaire to evaluate the ease of use of the device and the clarity of the English language labeling. The responses to the Instructions for Use Questionnaire met the acceptance criteria, with Lay Users demonstrating acceptable levels of comprehension of the user manual and the strip insert. The readability of the labeling using a Flesch-Kincaid analysis was found to be: Owners Booklet (7.7); OneTouch Verio Test Strip Insert (7.3) and OneTouch Verio Control Solution Insert (7.0)

4. Clinical cut-off**:**

   Not applicable.

5. Expected values/Reference range:

   The sponsor states the expected glucose range for non-diabetic, non-pregnant fasting adults to be under 100 mg/dL, and two hours after meals, the levels should be less than 140 mg/dL

   American Diabetes Association, Standards of Medical Care in Diabetes, Diabetes Care Vol 38, Supplement 1, S1-S94, January 2015

**N. Instrument Name:**

OneTouch® Verio® Flex Blood Glucose Meter

**O. System Descriptions:**

1. Modes of Operation:

   Each test strip is single use and must be replaced with a new strip for additional readings.

   Does the applicant's device transmit data to a computer, webserver, or mobile device using wireless transmission?

   Yes ___X___ or No _____

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:

There is no sample identification function with this device. Samples are applied directly to the test strip as they are collected.

4. Specimen Sampling and Handling:

   The glucose test is intended to be used with capillary whole blood from the finger. The whole blood sample is applied directly to the test strip by capillary action.

5. Calibration:

   The meter is automatically coded. No calibration is required by the user.

6. Quality Control:
   The sponsor provides two levels of glucose control solutions (OneTouch Verio Level 3 Control Solution and OneTouch Verio Level 4 Control Solution) that can be used with this device but are sold separately. The sponsor recommends the user to use either OneTouch Verio® Level 3 Control Solution or OneTouch Verio® Level 4 Control Solution with the OneTouch Verio Flex™ Meter.

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

1. **Hematocrit Study:**
   The effect of different hematocrit levels was evaluated using venous whole blood samples with 5 hematocrit levels (19, 30, 42, 50, 61%), each at six glucose levels (40±5, 65±5, 90±5, 120±6, 350±17, and 560±28 mg/dL). Results of samples at each hematocrit level were compared to samples with the same glucose concentration at normal (42%) hematocrit as well as to the corresponding YSI value. The data supports the claimed hematocrit range of 20 – 60%.

2. **Altitude study**:
   Venous whole blood samples collected from 3 blood donors were adjusted into 3 concentration levels (70, 240, and 450 mg/dL). The glucose meter readings at an altitude of 10,000 feet were compared to the readings at sea level as well as the YSI method. The results demonstrate acceptable bias to YSI to support the claims in the labeling that altitudes up to 10,000 feet have no significant effect on blood glucose measurements from the candidate Blood Glucose Monitoring System.

3. **Sample volume study:**
   The sponsor performed a study to verify the test strip sample volume requirement and the test strip fill error requirement established for the proposed device. Blood samples at glucose concentrations of 65 and 450 mg/dL were tested on the meter and compared to the YSI values at 4 sample volumes of 0.2, 0.3, 0.4 and 0.5 µL. The results show that accurate results are obtained at sample volume ≥ 0.4 µL. For sample volumes below 0.4 µL, the sponsor validated that 99.49% of tests generated either an accurate glucose result or a fill error message. A fill error message was computed when sample volume is

insufficient.

4. **Temperature and humidity studies**:
   The sponsor performed temperature and humidity studies using venous blood samples with glucose concentrations at 65, 150, 240, 350 and 450 mg/dL. Temperatures ranging from 43°F - 111°F (6-44$^{o}$C) and relative humidity from 10% to 90% were tested. Meter results were compared to YSI reference analyzer. Four temperature and humidity combinations were tested including low temperature/low humidity, low temperature/high humidity, high temperature/low humidity and high temperature/high humidity. The results support the claims in the labeling that the system can be used in conditions of 43°F - 111°F (6-44$^{o}$C) with relative humidity of 10 to 90%.

5. **EMC Testing:**
   The sponsor provided documentation certifying that acceptable electromagnetic testing (EMC) had been performed and the OneTouch Verio Flex Blood Glucose Monitoring System was found to be compliant.

6. **Infection Control Studies:**
   The device system is intended for single-patient use only. Disinfection efficacy studies were performed on the materials comprising the meter by an outside commercial testing laboratory demonstrating complete inactivation of hepatitis B virus (HBV) with the chosen disinfectant, Clorox Germicidal Wipes, 0.55% sodium hypochlorite (EPA Registration #67619-12). Robustness studies were also performed by the sponsor demonstrating that there was no change in performance or external materials of the meter after 412 cleaning and disinfection cycles. The robustness studies support 3 years of single-patient use. Labeling was reviewed for adequate instructions for the validated cleaning and disinfection procedures.

7. Customer service is available 8am to 10pm., 7 days a week by calling 1-888-567-3003.

**Q. Proposed Labeling:**

The labeling is sufficient and it satisfies the requirements of 21 CFR Part 809.10, and 21 CFR 801.109(b)(1) to contain the following language "Precautions: For In Vitro Diagnostic Use Only."

**R. Conclusion:**

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