

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

A. 510(k) Number:

k110074

B. Purpose for Submission:

New device

C. Measurand:

Capillary whole blood glucose

D. Type of Test:

Quantitative, amperometric, electrochemical biosensor, Glucose Oxidase

E. Applicant:

Health and Life Co., Ltd.

F. Proprietary and Established Names:

HL568 Self-Monitoring Blood Glucose System

G. Regulatory Information:

Product Code	Classification	Regulation Section	Panel
CGA glucose oxidase, glucose	Class II	21 CFR § 862.1345	Clinical Chemistry (75)
NBW system, test, blood glucose, over the counter	Class II	21 CFR § 862.1345	Clinical Chemistry (75)
JJX single (specified) analyte controls (assayed and unassayed)	Class I, reserved	21 CFR § 862.1660	Clinical Chemistry (75)

H. Intended Use:

1. Intended use(s):

See indications for use below.

2. Indication(s) for use:

HL568 Self-Monitoring Blood Glucose (SMBG) System is self-test medical device and intended for single patient home-use to monitor the blood glucose (β -D-glucose) levels in quantitative measurement from fresh capillary whole blood obtained from the finger tip. It is intended for use outside the body (*in vitro* diagnostic use) by diabetics at home to measure the glucose concentration for

aiding diabetes management. It is not intended for the diagnosis of or screening for diabetes mellitus.

HL568 Self-Monitoring Blood Glucose (SMBG) System is intended to be used by a single person and should not be shared and it is also not intended for use on neonates and should be used with HL568 Blood glucose test strip and HL568 Control Solution.

HL568 Blood glucose test strips are for use with the HL568 Blood glucose meter to quantitatively measure glucose in fresh capillary whole blood samples drawn from the fingertip.

HL568 Control Solutions are for use with the HL568 Blood glucose meter and HL568 Blood glucose test strips to check that the meter and test strips are working together properly and that the test is performing correctly.

The device is capable of transferring the storage data to the connected personal computer (PC) via USB cable. In addition, HL568 Self-Monitoring Blood Glucose System is featured with audio function; it could help the user to know the measured result by hearing but is not intended for visually impaired users.

3. Special conditions for use statement(s):

- For Over-the-Counter Use only
- Not for neonatal use
- Not for screening or diagnosis of diabetes mellitus
- Not for use on critically ill patients, patients in shock, dehydrated patients or hyper-osmolar patients
- Not intended for alternative site testing
- For single-patient use only

4. Special instrument requirements:

HL568 Blood Glucose Meter

I. Device Description:

The HL568 Self-Monitoring Blood Glucose System is comprised of the HL568 Blood Glucose Meter, HL568 Blood Glucose Test Strip, HL568 Control Solution (2 levels), a lancing device and lancets. All the measured values can be read in one LCD panel. The blood glucose meter is portable and battery operated. The device is a self-monitoring IVD medical device which is intended for quantitative measurement of blood glucose (β -D-glucose) levels from fresh capillary whole blood obtained from the fingertip and used outside the body only (*in vitro* diagnostic use). It is intended for over-the-counter, home use by a single patient to measure the glucose concentration for aiding diabetes management.

J. Substantial Equivalence Information:

Predicate device name	Predicate 510(k) number
OneTouch Ultra Blood Glucose Monitoring System	k062195

Comparison with predicate:

Similarities and Differences		
Item	Proposed Device HL568 SMBG System	Predicate Device (k062195)
Indications for Use	Same	For the quantitative measurement of glucose in fresh capillary whole blood.
Intended User	For single patient, home use.	Healthcare professional and home use.
Enzyme	Same	glucose oxidase
Detection Method	Same	Amperometric method
Measurement Range	Same	20-600 mg/dL
Hematocrit Range	Same	30-55%
Sample Type	Same	Capillary whole blood
Sample Sites	Fingertip.	Fingertip, forearm or palm.
Sample Volume	Same	>1 µl
Test Time	Same	5 seconds
Altitude Limit	Same	10,000 feet
Operating Temperature Range	50-104°F	43-111°F
Operating Humidity	10-80%	10-90%
Memory	500 measurements	150 measurements
Audio Function	Voice Adding	No
Data Transmission	USB Interface	No

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

CLSI EP05-A2: Evaluation of Precision Performance of Quantitative Measurement Methods.

CLSI EP06-A: Evaluation of the Linearity of Quantitative Measurement.

CLSI EP07-A2: Interference Testing in Clinical Chemistry.

CLSI EP09-A2: Method Comparison and Bias Estimation Using Patient Samples.

FDA Guidance: Guidance for the Content of Premarket Submissions for Software Contained in Medical Devices, May 11, 2005.

FDA Guidance: Total Product Cycle Life for Portable Invasive Blood Glucose Monitoring System, October 24, 2006.

IEC 60601-1:1988 + A1:1991 + A2:1995 Medical electrical equipment - Part 1: General requirements for safety.

IEC 60601-1-2:2007 Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral standard: Electromagnetic compatibility - Requirements and tests.

ISO 15197:2003 In vitro diagnostic test systems - Requirements for blood-glucose monitoring systems for self-testing in managing diabetes mellitus.

L. Test Principle:

The test principle is based on electrochemical biosensor technology using glucose oxidase methodology. Each test strip reacts with glucose in the blood sample to produce a current proportional to the blood glucose level. This reaction is measured by the meter and displayed as the blood glucose result.

M. Performance Characteristics (if/when applicable):

1. Analytical performance:

a. *Precision/Reproducibility:*

To evaluate the precision of the HL568 Self-Monitoring Blood Glucose System, within-run and total-run studies were performed. For the within-run precision study, ten measurements were obtained with ten glucose meters using two test strip lots on six levels of venous blood samples (n =100 measurements on each test strip at each level).

Within-Run Precision Results

Concentration (mg/dL)	Venous Whole Blood Samples					
	Test Strip Lot 1		Test Strip Lot 2		Overall	
	SD	% CV	SD	% CV	SD	% CV
40	4.6	9.7	4.6	10.7	4.6	10.3
80	3.2	3.9	3.3	4.0	3.3	4.0
130	4.8	3.8	5.1	4.1	4.9	3.8
200	7.6	3.8	7.5	3.9	7.6	3.8
325	12.8	3.8	13.0	3.8	13.1	3.9
500	18.0	3.4	19.6	3.8	18.9	3.6

For the total-run precision study, ten measurements were obtained with ten glucose meters using two test strip lots on four levels of glucose control solutions during the ten day study (n =100 measurements on each test strip at each level).

Total-Run Precision Results

Concentration (mg/dL)	Control Solutions					
	Test Strip Lot 1		Test Strip Lot 2		Overall	
	SD	% CV	SD	% CV	SD	% CV
32	3.3	10.3	3.0	9.8	3.3	10.4
105	3.9	3.7	4.3	4.1	4.3	4.1
313	11.9	3.8	12.6	4.0	12.3	3.9
436	13.7	3.1	14.0	3.2	14.3	3.3

b. *Linearity/assay reportable range:*

The linearity of the device was evaluated using a protocol based on CLSI EP6-A. Testing was performed using venous blood samples at ten different blood glucose levels, ranging from 0 to 600 mg/dL, on two lots of test strips, by five meters. The YSI 2300 glucose analyzer was used as the reference method. The sponsor claimed a measuring range of 20 to 600 mg/dL for their proposed device. The results were reviewed and found to be acceptable.

Linear Regression Analysis:

Lot 1: $y = 1.0728x - 2.4977, r^2 = 0.9936.$

Lot 2: $y = 1.0231x + 2.4535, r^2 = 0.9964.$

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

Two levels of Control Solution (Level 1 and 2) are included with each test kit. For each glucose control solution, a reference measurement was taken using an YSI 2300 analyzer. Forty measurements were performed (4 bottles * 10 measurements/per bottle) for each glucose control solution and the mean value, SD and CV were calculated. Level 1 and 2 glucose solutions were found to have ranges of 89-111 mg/dL, mean of 100 mg/dL (YSI Value: 76 mg/dL) and 247-305 mg/dL, mean of 280 mg/dL (YSI Value: 248 mg/dL), respectively.

Stability characteristics of both levels of Glucose Control Solutions were determined using real time studies at 45°C and 90% humidity. The sponsor claimed open and unopened vial stabilities are 3 and 20 months, respectively.

For the test strips, open vial (stored at 40°C and 90% humidity) and unopened shelf-life (stored at 40°C and 90% humidity) stability were determined using real-time studies. The sponsor claimed an open vial stability of 90 days and an unopened shelf-life stability of 9 months for the test strips.

d. *Detection limit:*

Please see the linearity study data in Section M1b above.

e. *Analytical specificity:*

Interference testing was assessed by spiking various endogenous and exogenous substances at therapeutic and toxic levels into whole blood samples at three glucose concentrations (60, 250 and 500 mg/dL) that were prepared and divided into a test (dosed) pool and a control pool. Studies were conducted using five HL568 Blood Glucose Meters and two lots of test strips. Significant interference is defined as a bias $\geq 10\%$ from the control group as measured on YSI 2300 analyzer. Interference was observed for the substances and concentrations shown in the table below:

Compound	Concentration with > 10% interference
Acetaminophen	> 5 mg/dL
Ascorbic Acid	> 3 mg/dL
Dopamine	Not observed up to 0.1 mg/dL
Gentisic Acid	Not observed up to 2 mg/dL
Ibuprofen	Not observed up to 40 mg/dL
L-Dopa	> 2 mg/dL
Methyl-Dopa	> 2.5 mg/dL
Sodium Salicylate	Not observed up to 50 mg/dL
Tetracycline	Not observed up to 1.5 mg/dL
Tolbutamide	Not observed up to 100 mg/dL
Galactose	Not observed up to 20 mg/dL
Maltose	Not observed up to 10 mg/dL
Xylose	Not observed up to 20 mg/dL
Hydroxyurea	> 3.8 mg/dL
Bilirubin (unconjugated)	> 20 mg/dL
Cholesterol	> 500 mg/dL
Creatinine	Not observed up to 30 mg/dL
Triglycerides	Not observed up to 3,000 mg/dL
Uric acid	> 14 mg/dL

f. *Assay cut-off:*
Not applicable

2. Comparison studies:

a. *Method comparison with predicate device:*

The sponsor conducted an accuracy study, HL568 Self-Monitoring Blood Glucose System versus YSI-2300 Glucose Analyzer, at two sites with a 127 specimens over 10 days. A healthcare professional collected fingertip capillary blood and tested the sample with HL568 Blood Glucose Meter. A venous blood sample was collected by the trained operator for hematocrit determination and analysis on the YSI 2300 analyzer. Samples spanned 23.7 to 571 mg/dL including 13 altered samples (five samples below 50 mg/dL and eight samples above 400 mg/dL).

Linear regression results were as follows:
 $y = 0.9869x + 3.1630, r^2 = 0.9882, n = 127.$

For glucose concentrations <75 mg/dL			
User	Within ± 5 mg/dL	Within ± 10 mg/dL	Within ± 15 mg/dL
Trained Operator	10/19 (53%)	16/19 (84%)	19/19 (100%)

For glucose concentrations >75 mg/dL				
User	Within ± 5 %	Within ± 10 %	Within ± 15 %	Within ± 20 %
Trained Operator	64/108 (59%)	96/108 (89%)	104/108 (96%)	108/108 (100%)

- b. *Matrix comparison:*
Not applicable
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):
A user performance study was performed to compare the lay user self-test results (with fingertip) and the YSI method. The study was conducted at three sites with 205 subjects. Each lay user participant performed their own finger stick and tested their blood on the HL568 Blood Glucose meter using only the instructions in the Owner’s Booklet and test strip insert. A trained operator then performed a second finger stick and tested the blood on the same meter. A venous blood sample was collected by the trained operator for hematocrit determination and analysis on the YSI 2300 analyzer. The total range of samples tested was 50 to 415 mg/dL. Linear regression results are presented below:

Linear Regression Analysis:

Lay user vs. YSI $y = 1.01x + 1.03, r = 0.982, n = 205$
Professional vs. YSI $y = 0.99x + 3.89, r = 0.988, n = 205$
Lay user vs. Professional $y = 0.96x + 4.64, r = 0.993, n = 205$

The study results met the ISO 15197 accuracy criteria where ninety-five percent (95%) of the individual glucose results fell within ±15mg/dL of the YSI results at glucose concentrations <75mg/dL and within ±20% at glucose concentrations ≥75mg/dL.

For glucose concentrations <75 mg/dL			
User	Within ± 5 mg/dL	Within ± 10 mg/dL	Within ± 15 mg/dL
Lay User	9/15 (60%)	15/15 (100%)	15/15 (100%)
Professional	9/15 (60%)	13/15 (87%)	15/15 (100%)

For glucose concentrations >75 mg/dL				
User	Within ± 5 %	Within ± 10 %	Within ± 15 %	Within ± 20 %
Lay User	77/190 (41%)	135/190 (71%)	164/190 (86%)	185/190 (97%)
Professional	84/190 (44%)	146/190 (77%)	168/190 (88%)	187/190 (98%)

4. Clinical cut-off:
Not applicable

5. Expected values/Reference range:

The expected glucose results for non-diabetic, non-pregnant adults are as follows:

Time	Range (mg/dL)
Normal Fasting Range	70 to 100
Two hours after meals	< 140

Reference:

American Diabetes Associations: Standards of Medical Care in Diabetes-2010, Diabetes Care, Vol. 33, Suppl. 1, 2010, p.S13.

N. Instrument Names:

HL568 Blood Glucose Meter

O. Systems 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 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:
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:
This device is intended to be used with capillary whole blood from the fingertip, which is directly applied to the test strip.

5. Calibration:
The device must be coded with the code found on the current test strip label. No further calibration is required.

6. Quality Control:
There are two levels of glucose control solution (Level 1 and 2), which are included with the test kit, which can be run with this device. Recommendations on when to test the control materials are provided in the labeling. An acceptable range for each control level is printed on the test strip vial label. The user is cautioned not to use the meter if the control result falls outside these ranges.

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

- A usability study was performed to assess the readability of the labeling by recruiting 100 lay users (aged 18-70 yrs old) who were provided with the test kit containing labeling for the US market. Participants varied in age, education, country of origin, and were about evenly divided between men and women. These lay users also completed a questionnaire in response to whether the device is easy to use and whether the Instructions for use were written in a way that makes it easy to use. The majority of the users responded that the device is very easy to use.

- Flesch-Kincaid readability assessment was conducted and the results showed that the labeling (User Manual, test strip package insert and control solution package insert) were written at less than an 8th grade level.

- A sample volume study was performed to verify the test strip sample volume requirement and the test strip fill error requirement established for the HL568 BGMS. Whole blood adjusted to four glucose concentrations (50, 120, 350 and 550 mg/dL) were measured with five meters and two test strip lots. Blood

at each concentration was applied to strips at sample volumes of 0.6 μL , 0.8 μL and 1.0 μL . Protocols and acceptance criteria were provided and found to be acceptable. Insufficient volume of less than 1.0 μL will produce an error message which alerts the user to an insufficient sample volume.

- The device system is intended for single-patient use only. Disinfection efficacy studies using Hepatitis B surface antigen were performed on the materials comprising the meter and lancing device demonstrating complete inactivation of hepatitis B virus (HBV) using Clorox Germicidal Wipes (EPA registration # 67619-12). The sponsor demonstrated that there was no change in performance or in the external materials of the meter or the lancing device after 8,000 cleaning and 8,000 disinfection cycles designed to simulate 5 years of device use. Labeling has been reviewed for adequate instructions in validated cleaning and disinfection procedures.
- The data transmission capability, data transmission port, H & L Glucose Data Transmission Software and USB connection cable was evaluated in usability study and found to be acceptable. Additionally verification and validation of these functions were conducted and found to be acceptable.
- Electromagnetic Compatibility (EMC) testing was performed, all requirements were met and a certificate was issued to Health and Life Co., Ltd.
- Hematocrit Study: Venous blood samples with varying hematocrit levels (29%, 42% and 56%) were tested at four glucose concentrations (50, 120, 350 and 550 mg/dL) against the YSI-2300 Glucose Analyzer. Each glucose level/hematocrit combination was tested on five meters and two test strip lots. The differences of the glucose meter results at each hematocrit/glucose combination were calculated against YSI-2300 Glucose Analyzer results at 42% hematocrit. The bias relative to YSI was that all results fell within $\pm 15\%$. The results were reviewed and found to be acceptable. The sponsor claimed a hematocrit range of 30% to 55% for their proposed device.
- Altitude Study: A study was conducted to evaluate the effect of altitude on the HL568 BGMS. Using ten glucose meters and one test strip lot, venous blood samples at five glucose concentrations (50, 165, 270, 380 and 500 mg/dL) were measured at five elevations (167; 6,450; 8,088; 9,082; 10,073 and 10,309 feet above sea level). Each venous blood sample was also tested by the YSI 2300 analyzer. The meter readings obtained were compared to the YSI measurement at the same altitude and the percent bias was determined at each level against the YSI results. Bias was within $\pm 10\%$ for up to 10,073 feet. Based on the data, the sponsor claims that the HL568 BGMS can be used at altitude up to 10,000 feet.

- Temperature and humidity studies: Studies were performed to demonstrate that the HL568 meter can be used at combinations of extreme temperatures from 10 to 40 °C and humidity conditions ranging from 38 to 82 %. The performance of the proposed device was evaluated on three venous blood samples (120, 250 and 450 mg/dL) using 5 meters and 2 test strip lots. Duplicate measurements were taken for each condition. The sponsor claimed a temperature range of 10 to 40°C and humidity range of 10-80% for their proposed device. The YSI 2300 glucose analyzer was used to check the glucose concentrations of the samples. The bias relative to YSI was that all results fell within $\pm 10\%$. The results were reviewed and found to be acceptable.

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.