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

A. 510(k) Number:

k163159

B. Purpose for Submission:

Modification to add compatibility with select Android mobile platforms

C. Measurand:

Glucose in fresh capillary whole blood obtained from the fingertip

D. Type of Test:

Quantitative, Amperometric Assay (Glucose Oxidase)

E. Applicant:

Labstyle Innovations Ltd.

F. Proprietary and Established Names:

Dario 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

4. Panel:

   Clinical Chemistry (75)

H. Intended Use:

1. Intended use(s):

   See Indications for Use below.

2. Indication(s) for use:

   The Dario Blood Glucose Monitoring System consists of the Dario Blood Glucose Meter, Dario Glucose Test Strips, Dario Glucose Control Solutions and the Dario App as the display component of the Dario Blood Glucose Monitoring System. The Dario Blood Glucose Monitoring System is intended for the quantitative measurement of glucose (sugar) in fresh capillary whole blood samples drawn from the fingertips. The Dario Blood Glucose Monitoring System is intended to be used by a single person and should not be shared.

   The Dario Blood Glucose Monitoring System is intended for self-testing outside the body (in vitro diagnostic use) by people with diabetes at home to monitor the effectiveness of diabetes control. The Dari Blood Glucose Monitoring System should not be used for the diagnosis of or screening of diabetes or for neonatal use.

   The Dario Blood Glucose Test Strips are for use with the Dario Blood Glucose Meter to quantitatively measure glucose (sugar) in fresh capillary whole blood samples drawn from the fingertip.

3. Special conditions for use statement(s):
   - For Over-the-Counter use
   - Single-patient use only
   - Not for testing glucose levels of neonates
   - Not for the diagnosis of, or screening for diabetes
   - Not for testing glucose levels of arterial or venous blood
   - Not for testing glucose from sites other than the fingertip
   - Not for testing patients who are critically ill, in shock, dehydrated
   - This device is not intended for use in healthcare or assisted-use settings such as hospitals, physician offices, or long-term care facilities because it has not been cleared by FDA for use in these settings, including for routine assisted testing or as part of glycemic control procedures. Use of this device on multiple patients may lead to transmission of Human Immunodeficiency Virus (HIV), Hepatitis C Virus (HCV), Hepatitis B Virus (HBV), or other bloodborne pathogens.

4. Special instrument requirements:
   Dario Blood Glucose Meter and one of the following Android Smart Mobile Device Family members: Samsung Galaxy S Family, Samsung Galaxy Note Family, or LG G family, with operating systems 4.2, 4.3, 4.4 and 5. Apple platform Smart Mobile Devices 4S, 5, 5S, SE, 6 and 6 Plus with iOS 7, 8, 9, 9.3 and 10 were previously cleared for use

with the Dario system in k150817.

I. Device Description:

The Dario Blood Glucose Monitoring System consists of the Dario Blood Glucose meter (dongle), 25 Dario Test Strips housed in a disposable cartridge (sold separately), lancets (sold separately), Dario Control Solution Levels 1 and 2 (sold separately), Disposable Covers (for the mobile devices), User Manual and Quick User Guide, the Dario Application Software (needs to be downloaded from App Store or Google Play). The Dario system can be used with Apple platform smart mobile devices, specifically iPhone 4S, 5, 5S, SE, 6, and 6 Plus, or with the following Android Smart Mobile Device Family members: Samsung Galaxy S Family, Samsung Galaxy Note Family, or LG G family. The Dario Control solutions were previously cleared in k150817.

J. Substantial Equivalence Information:

1. Predicate device name(s):

   Dario Blood Glucose Monitoring System

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

   k150817

3. Comparison with predicate:

Similarities		
Item	Candidate Device Dario Blood Glucose Monitoring System (k163159)	Predicate Device Dario Blood Glucose Monitoring System (k150817)
Indication For Use	Intended for the quantitative measurement of glucose in fresh capillary blood samples by people with diabetes at home to monitor the effectiveness of diabetes control	Same
Assay Detection Method	Amperometry	Same
Enzyme	Glucose Oxidase	Same
Measuring Range	20-600 mg/dL	Same
Hematocrit Range	20-60%	Same
Altitude	10,000 feet	Same
Sample volume	0.3 µL	Same
Test time	6 sec	Same
Sample type	Fingertip	Same

Similarities		
Item	Candidate Device Dario Blood Glucose Monitoring System (k163159)	Predicate Device Dario Blood Glucose Monitoring System (k150817)
Temperature Range	50-95°F (10-45°C)	Same)
Dimensions LxWxH (mm)	40.2 x 16.1 x 9.8	Same
Weight (g)	4.0	Same
Software Application	Dario App	Same
Display	Connected to smart-device or mobile device to display measurement results	Same
Power Source	Powered by audio phone jack connected to smartphone or mobile device	Same

Differences		
Item	Device	Predicate
Mobile Device Type	Apple iPhone 4S, 5, 5S, SE, 6, 6 Plus, 6S and 6S Plus; LG G2, G3 and G4; Samsung Galaxy S3, S4 and S5; Samsung Note 3, 4 and 5	Apple iPhone 4S, 5, 5S, SE, 6, 6 Plus, 6S and 6S Plus
Operating System	Apple iOS versions 7, 8, 9, 9.3, and 10; Android 4.2, 4.3, 4.4, 5, and 6	Apple iOS versions 7, 8, 9, 9.3, and 10

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

ISO 14971 Medical Devices- Applications of Risk Management to Medical Devices

IEC 60601-1, Medical electrical equipment Part I. General requirements for safety (2005).

IEC 60601-1-2, Medical electrical equipment Part 2. Electromagnetic compatibility - Requirements and Tests (2007).

IEC 60601-1-11 Medical Electrical Equipment- Part 1-11- Collateral Standard: Requirements for Medical Electrical Equipment and Medical Electrical Systems Used in the Home Healthcare Environment (2015).

L. Test Principle:

The Dario Blood Glucose Monitoring System measures glucose electrochemically. The glucose biosensor is capable of recognizing the glucose present in whole blood or control

solutions by virtue of the glucose specificity of the enzyme glucose oxidase present on the glucose test strip. A voltage is applied and the glucose concentration is calculated by the meter from the electrical current. The final results are communicated to the smart mobile device through the audio jack.

M. Performance Characteristics (if/when applicable):

The performance studies were conducted using representative Android devices (Samsung S3, Samsung Note 3, and LG G2).

1. Analytical performance:

a. Precision/Reproducibility:

The sponsor performed within-run precision studies using venous whole blood spiked to five (5) different glucose concentration ranges (30 to 50, 51 to 110, 111 to 150, 151 to 250, and 251 to 400 mg/dL). Samples were tested using three lots of test strips on 10 Dario Blood Glucose Monitoring Systems with 10 of each representative Android Smart mobile Device. Results are summarized below:

Within-run precision for glucose: Samsung S3

Glucose Level (mg/dL)	Mean (mg/dL)	SD (mg/dL)	CV (%)
30 to 50	40.1	1.6	3.9
51 to 110	82.4	2.5	3.0
111 to 150	135.5	3.6	2.6
151 to 250	201.7	5.3	2.6
251 to 400	332.0	8.8	2.6

Within-run precision for glucose: Samsung Note 3

Glucose Level (mg/dL)	Mean (mg/dL)	SD (mg/dL)	CV (%)
30 to 50	40.4	1.9	4.6
51 to 110	83.5	2.4	2.8
111 to 150	136.0	3.7	2.7
151 to 250	201.1	4.9	2.4
251 to 400	329.5	8.1	2.5

Within-run precision for glucose: LG G2

Glucose Level (mg/dL)	Mean (mg/dL)	SD (mg/dL)	CV (%)
30 to 50	40.2	1.7	5.3
51 to 110	82.7	2.4	2.9
111 to 150	134.2	3.3	2.4
151 to 250	202.5	5.2	2.6
251 to 400	329.8	8.6	2.6

Between-day precision was evaluated using three levels of glucose control solutions with concentrations 30 to 50, 96 to 144, and 280 to 420 mg/dL. Each sample was measured each day with three (3) test strip lots and 10 meters. These tests were performed over 10 days, for a total of 300 results per glucose level. Results are summarized below:

Between-day precision for glucose: Samsung S3

Glucose Level (mg/dL)	Mean (mg/dL)	SD (mg/dL)	% CV
30 to 50	42.9	2.0	4.8
96 to 144	121.8	3.3	2.7
280 to 420	350.5	7.6	2.2

Between-day precision for glucose: Samsung Note3

Glucose Level (mg/dL)	Mean (mg/dL)	SD (mg/dL)	% CV
30 to 50	42.6	2.0	4.8
96 to 144	121.8	3.1	2.5
280 to 420	351.1	8.7	2.5

Between-day precision for glucose: LG G2

Glucose Level (mg/dL)	Mean (mg/dL)	SD (mg/dL)	% CV
30 to 50	44.0	1.9	4.4
96 to 144	120.5	3.3	2.8
280 to 420	350.3	9.3	2.7

b. Linearity/assay reportable range:

Linearity was evaluated using three (3) test strip lots and 17 mixed pools of venous blood with glucose concentrations at 15.8, 17.1, 37.3, 58.8, 77.7, 85.6, 98.0, 119.8, 156.3, 225.5, 229.3, 367.8, 438.5, 508.8, 581.5, 651.8, and 723.3 mg/dL, as measured by the YSI laboratory method.

Each level was measured in replicate with each of three (3) test strip lots and three meters, per representative smart phone device and the values from the Dario Blood Glucose Monitoring System were compared with those obtained from the YSI-2300. Results from the regression analysis are as follows:

Samsung S3	$y = 1.004x – 0.5737$, $r^2 = 0.9994$
Samsung Note 3	$y = 1.0045x – 0.3563$, $r^2 = 0.9995$
LG G2	$y = 1.0057x – 0.5021$, $r^2 = 0.9996$

The results of the study support the sponsor's claimed glucose measurement range of 20-600 mg/dL. The meter displays "LOW" with glucose values below 20 mg/dL, and "HIGH" with glucose values over 600 mg/dL. The "Lo" and "HI" functions were validated and were demonstrated to function as intended.

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

Traceability:
As established in k150817, the Dario Blood Glucose Monitoring System is traceable to NIST SRM 917b.

Test Strip Stability:
The Dario blood glucose test strips are identical to the test strips in the predicate device, Dario Blood GLuocse Monitoring System (k150817). Stability protocols and acceptance criteria were reviewed in k150817 and support the sponsors claimed shelf life of 24 months and an open-vial stability of 1 month at the recommended storage conditions of 36°F-90°F (2°C-32°C) and 10-90% relative humidity. The instructions state not to refrigerate open test strip cartridges or put test strips in a freezer.

d. Detection limit:

As established in k150817

e. Analytical specificity:

As established in k150817

Interference studies were performed by spiking venous blood with two levels of glucose concentrations (65 and 250 mg/dL). Each of these samples was divided into a test pool and a control pool and each potential endogenous and exogenous

interfering substance was added to the test pool. Each substance was tested at three concentrations. Each sample was analyzed 10 times with the Dario meter and the % difference between the individual measurements and the reference (YSI) calculated. The sponsor defines no significant interference as ≤10% difference relative to YSI. Results are presented in the table below:

Potential Interfering Substances Tested	**Concentration with no Significant Interference (mg/dL)**
Acetaminophen	6 mg/dL
Acetyl-salicylic acid	120 mg/dL
Ascorbic Acid (Vit. C)	4 mg/dL
Bilirubin	35 mg/dL
Cholesterol	506 mg/dL
Creatinine	30 mg/dL
Dopamine	2.5 mg/dL
Ethanol	400 mg/dL
Fructose	15 mg/dL
Galactose	60 mg/dL
Gentisic Acid	1.8 mg/dL
Glutathione	4.6 mg/d
Hemoglobin	200 mg/dL
Heparin	0.003 mg/dL (3000 U/L)
Ibuprofen	50 mg/dL
Lactose	25 mg/dL
Levodopa	4 mg/dL
Maltose	132 mg/dL
Maltotetraose	120 mg/dL
Maltotriose	240 mg/dL
Mannitol	800 mg/dL
Mannose	5 mg/dL
Methyl-Dopa	2 mg/dL
Sodium Fluoride	200 mg/dL
Sodium Salicylate	63 mg/dL
Sorbitol	10 mg/dL
Tetracycline	5 mg/dL
Tolazamide	5 mg/dL
Tolbutamide	100 mg/dL
Triglyceride	900 mg/dL
Urea	500 mg/dL
Uric Acid	11 mg/dL
Warfarin	1 mg/dL
Xylitol	25 mg/dL
Xylose	50 mg/dL

The sponsor has included the following limitations in the labeling:

If you are taking acetaminophen containing drugs (e.g. Tylenol) or Vitamin C (ascorbic acid) you may get inaccurate results with this system.

If you have a disease or condition in which uric acid levels in your blood may be elevated (>11 mg/dL), such as gout, you may get inaccurate results with this system.

If you have very high levels of triglyceride (>810 mg/dL), you may get inaccurate results with this system.

This system should not be used when undergoing xylose absorption tests.

f. Assay cut-off:

Not applicable

2. Comparison studies:

a. Method comparison with predicate device:

As established in k150817

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):

To assess the performance of the Dario Blood Glucose Monitoring System in the hands of the intended users, the sponsor performed a study with 350 lay users testing each of three representative Android mobile devices. Participants obtained and tested their own fingerstick samples with the Dario Blood Glucose Monitoring System. Blood glucose results from the Dario meter obtained by the lay user were compared to the YSI 2300 comparator value. The glucose range of samples tested was 36 - 443 mg/dL as measured by YSI. The data presented in the tables below

include only the first results obtained by each subject when using each of the mobile platforms:

Glucose Concentrations < 75mg/dL

	Within ± 5 mg/dL	**Within ± 10 mg/dL**	**Within ±15 mg/dL**
Samsung Galaxy Note 3	70.0% (7/10)	80.0% (8/10)	100.0% (10/10)
Samsung Galaxy S3	86.7% (13/15)	100.0% (15/15)	100.0% (15/15)
LG G2	30.0% (3/10)	80.0% (8/10)	100.0% (10/10)

Glucose Concentrations > 75mg/dL

	Within ± 5 %	**Within ± 10 %**	**Within ± 15 %**	**Within ± 20 %**
Samsung Galaxy Note 3	49.5% (53/107)	83.2% (89/107)	98.1% (105/107)	100.0% (107/107)
Samsung Galaxy S3	50.0% (50/102)	79.4% (78/102)	97.1% (99/102)	100.0% (102/102)
LG G2	53.8% (57/106)	85.8% (91/106)	97.2% (103/106)	100.0% (106/106)

Results of linear regression analysis:
Samsung Galaxy Note 3 $y= 0.9811 + 2.372$, $R^2 = 0.9672$
Samsung Galaxy S3 $y= 0.9890 + 3.643$, $R^2 = 0.9690$
LG G2 $y= 0.9859 + 1.568$, $R^2 = 0.9859$

Subject usability was assessed using a questionnaire. 100 % of subjects reported the operation of the meter to be easy or very easy.

4. Clinical cut-off

Not applicable

5. Expected values/Reference range:

Expected glucose values without diabetes:

Status	Range
Before eating (FPG)	<100 mg/dL
Two hours after meals	<140 mg/dL

American Diabetes Association: Standard of Medical Care in Diabetes 2015, Diabetes Care, vol.38, supplement 1, S14-S87, 2015.

N. Instrument Name:

Dario Blood Glucose Meter

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 ____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, palm, and forearm only. The whole blood sample is applied directly to the test strip by capillary action.

5. Calibration:
   There is no calibration required by the user for the DA12-B1 and DA12-B2 blood glucose meters. The meters are automatically coded.

6. Quality Control:
   Two levels of glucose control solutions are available with this system, but are sold separately. Recommendations on when to test the control materials are provided in the labeling. 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:

1) Hematocrit Study: As established in k150817, to support the claimed hematocrit range of 20 to 60%.

2) Altitude study: As established in k150817 to support the claims in the labeling that altitudes up to 10,000 feet (3048 meters) have no significant effect on blood glucose measurements from the Dario meter.

3) Sample volume study: As established in k150817, to support the claimed minimum sample volume of 0.3 μL.

4) Temperature and humidity studies: The sponsor performed temperature and humidity operating condition studies using venous blood samples at five glucose concentrations (approximately 50, 100, 197, 305, and 488 mg/dL) to evaluate temperatures ranging from 12±2°C to 43±2°C and relative humidity from 15% to 85% for each of the three representative platforms. Meter results were compared to YSI values. Six temperature and humidity combinations were tested including low temperature/low humidity, low temperature/high humidity, average temperature/low humidity, average 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 50 to 95°F (10 to 45°C) with relative humidity of 15 to 85%.

5) Infection Control Studies: As established in k150817. The device is intended for single-patient use only. Disinfection efficacy studies were performed on the materials comprising the meter, test strip cartridge cap and housing by an outside commercial testing laboratory demonstrating complete inactivation of live hepatitis B virus with the chosen disinfectant, Super Sani-Cloth wipes with EPA registration #9480-4. Robustness studies were also performance by the sponsor demonstrating that there was no change in performance or in the external materials after 156 cleaning and disinfection cycles (one cycle includes one cleaning wipe plus one disinfecting wipe) to simulate 3 years of single-patient use. The sponsor provides a disposable sleeve for use with the mobile device to be used with each test strip. Labeling was reviewed for adequate instructions for the validated cleaning and disinfection procedures.

6) The sponsor provided documentation certifying that acceptable electromagnetic (EMC) testing was performed and the device was found compliant.

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.