July 18, 2018

Healthy.io Ltd
% John Smith, Partner
Hogan Lovells US LLP
555 Thirteenth Street NW
Washington, DC 20004

Re: K173327
Trade/Device Name: DIP/U.S. Urine Analysis Test System
Regulation Number: 21 CFR 862.1340
Regulation Name: Urinary glucose (nonquantitative) test system
Regulatory Class: Class II
Product Code: JIL, JIO, CEN, JMT, JIR, JRE
Dated: June 15, 2018
Received: June 15, 2018

Dear John Smith:

We have reviewed your Section 510(k) premarket notification of intent to market the device referenced above and have determined the device is substantially equivalent (for the indications for use stated in the enclosure) to legally marketed predicate devices marketed in interstate commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments, or to devices that have been reclassified in accordance with the provisions of the Federal Food, Drug, and Cosmetic Act (Act) that do not require approval of a premarket approval application (PMA). You may, therefore, market the device, subject to the general controls provisions of the Act. The general controls provisions of the Act include requirements for annual registration, listing of devices, good manufacturing practice, labeling, and prohibitions against misbranding and adulteration. Please note: CDRH does not evaluate information related to contract liability warranties. We remind you, however, that device labeling must be truthful and not misleading.

If your device is classified (see above) into either class II (Special Controls) or class III (PMA), it may be subject to additional controls. Existing major regulations affecting your device can be found in the Code of Federal Regulations, Title 21, Parts 800 to 898. In addition, FDA may publish further announcements concerning your device in the Federal Register.

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part 801 and Part 809); medical device reporting (reporting of medical device-related adverse events) (21 CFR 803); good manufacturing practice requirements as set forth in the quality systems (QS) regulation (21 CFR

Part 820); and if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR 1000-1050.

Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21 CFR Part 807.97). For questions regarding the reporting of adverse events under the MDR regulation (21 CFR Part 803), please go to http://www.fda.gov/MedicalDevices/Safety/ReportaProblem/default.htm.

For comprehensive regulatory information about medical devices and radiation-emitting products, including information about labeling regulations, please see Device Advice (https://www.fda.gov/MedicalDevices/DeviceRegulationandGuidance/) and CDRH Learn (http://www.fda.gov/Training/CDRHLearn). Additionally, you may contact the Division of Industry and Consumer Education (DICE) to ask a question about a specific regulatory topic. See the DICE website (http://www.fda.gov/DICE) for more information or contact DICE by email (DICE@fda.hhs.gov) or phone (1-800-638-2041 or 301-796-7100).

Sincerely,

Kellie B. Kelm -S

for Courtney H. Lias, Ph.D.
Director
Division of Chemistry and Toxicology Devices
Office of In Vitro Diagnostics
and Radiological Health
Center for Devices and Radiological Health

Enclosure

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Food and Drug Administration

Indications for Use

Form Approved: OMB No. 0910-0120
Expiration Date: 06/30/2020
See PRA Statement below

510(k) Number *(if known)*

K173327

Device Name

DIP | U.S. Urine Analysis Test System

Indications for Use *(Describe)*

The DIP | U.S. Urine Analysis Test System consists of a smartphone application, a proprietary Color-Board, and Urinalysis Reagent Strips. It is intended for the semi-quantitative detection of the following analytes in urine: Glucose, Specific Gravity, Blood, pH and Protein, as well as the qualitative detection of Nitrite.

The DIP | U.S. Urine Analysis Test System is intended for prescription home-use only, with results provided directly to the physician. The results can be used to guide patient management and care, and aid in the diagnosis and monitoring of metabolic or systemic diseases that affect kidney function and endocrine disorders. Physician interpretation of the results should be made in conjunction with the patient's other clinical information to determine if further confirmatory tests or consultations are necessary. Patients do not have access to the results at any point in the process.

Type of Use *(Select one or both, as applicable)*

☑ Prescription Use (Part 21 CFR 801 Subpart D) ☐ Over-The-Counter Use (21 CFR 801 Subpart C)

CONTINUE ON A SEPARATE PAGE IF NEEDED.

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510(K) SUMMARY

Healthy.io's DIP | U.S. Urine Analysis Test System

Submitter

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Contact Person: Yonatan Adiri

Date Prepared: July 2018

Name of Device: DIP | U.S. Urine Analysis Test System

Common or Usual Name: Smartphone enabled urine analyzer

510(k): K173327

Regulation Section and Classification Name:

Class I: Urinary pH, Nitrite, Urinary Protein, Specific Gravity

Class II: Urinary Glucose and Occult Blood

21 CFR § 862.1340 Urinary Glucose (Non-Quantitative) Test System
21 CFR § 864.6550 Occult Blood Test
21 CFR § 862.1550 Urinary pH (Non-Quantitative) Test System
21 CFR § 862.1645 Urinary Protein or Albumin (Non-Quantitative) Test System
21 CFR § 862.1510 Nitrite (Non-Quantitative) Test System
21 CFR § 862.2800 Refractometer for clinical use

Product Code:

JIL	Urinary Glucose (non-quant.) test system
JIO	Blood, Occult, Colorimetric, in urine
CEN	Urinary, pH (non-quant.) test system
JMT	Nitrite (urinary, non-quant.) test system
JIR	Protein or Albumin (urinary, non-quant.) test system
JRE	Specific Gravity

Classification Panel: Chemistry, Hematology

Predicate Device:

The DIP | U.S. Urine Analysis Test System is substantially equivalent to the following predicate device:

Manufacturer	Device	510(k) Number
ACON Laboratories Inc.	ACON Mission U500 Urinalysis System	K111221

Device Description

The DIP | U.S. Urine Analysis Test System consists of a smartphone application, a proprietary Color-Board, and Urinalysis Reagent Strips. It is intended for the semi-quantitative detection of the following analytes in urine: Glucose, Specific Gravity, Blood, pH and Protein, as well as the qualitative detection of Nitrite.

The DIP | U.S. Urine Analysis Test System is intended for prescription home-use only, with results provided directly to the physician. The results can be used to guide patient management and care, and aid in the diagnosis and monitoring of metabolic or systemic diseases that affect kidney function and endocrine disorders. Physician interpretation of the results should be made in conjunction with the patient's other clinical information to determine if further confirmatory tests or consultations are necessary. Patients do not have access to the results at any point in the process.

The device is provided as a kit that comprises a urine receptacle, an FDA-cleared urine test strip (ACON Mission Urinalysis Reagent Strips, 510K number K061559), a Color-Board, and a User Manual. The DIP | U.S. Urine Analysis Test System also consists of a smartphone application for use with a LG Nexus 5 device (running operating system Lollipop 5.0), and an image recognition algorithm running on the back-end.[1] Future iterations of the product will be available on additional phones and operating systems, but this submission is focused solely on the LG Nexus 5 and its respective operating system.

The software component of the DIP | U.S. Urine Analysis Test System consists of both an application and a back-end server. The App instructs the patient how to accurately administer the test and conducts a number of algorithm processes. Once analyzed, the DIP | U.S. Urine Analysis Test System's software securely transmits the clinical results directly to the patient's Electronic Medical Records for review by the physician. As stated above, the patients do not have access to the results at any point during the testing process.

[1] Back-end will henceforth refer to the system's cloud-based servers, which run the server-side algorithms, and turn the algorithms analysis into clinical results. These are then securely transmitted to the patient's Electronic Medical Record. The DIP | U.S. Urine Analysis Test System back-end is HIPAA compliant and uses advanced security protocols for data handling and transmission.

Device Components

The DIP | U.S. Urine Analysis Test System is comprised of the following components:

1. Urine Receptacle
2. A single, individually-wrapped Mission Urinalysis Reagent Strip U031-101 (ACON Laboratories Inc., K061559)
3. Color-Board
4. Smartphone App
5. Back-end, cloud-based server
6. User Manual
7. Physician compendium

Intended Use/Indication for Use

The DIP | U.S. Urine Analysis Test System consists of a smartphone application, a proprietary Color-Board, and Urinalysis Reagent Strips. It is intended for the semi-quantitative detection of the following analytes in urine: Glucose, Specific Gravity, Blood, pH and Protein, as well as the qualitative detection of Nitrite.

The DIP | U.S. Urine Analysis Test System is intended for prescription home-use only, with results provided directly to the physician. The results can be used to guide patient management and care, and aid in the diagnosis and monitoring of metabolic or systemic diseases that affect kidney function and endocrine disorders. Physician interpretation of the results should be made in conjunction with the patient's other clinical information to determine if further confirmatory tests or consultations are necessary. Patients do not have access to the results at any point in the process.

Table 3.1: Comparison Between DIP | U.S. Urine Analysis Test System **and the ACON Mission U500 Urinalysis System**

Feature	**DIP | U.S.** Urine Analysis Test System	**ACON Mission U500 Urinalysis System (K11221)**
Intended Use	Prescription-only, in vitro diagnostic home-use	Prescription-only, in vitro diagnostic use
Test Specimen	Urine	Urine
Detection Methodology	Reflectance Photometry	Reflectance Photometry
Detection device	Photosensitive Diode	Photosensitive Diode
Operating Conditions	0°-35°C [32°-95°F] 10% to 90%, Relative humidity (non-condensing)	0°-40ºC (32-104ºF); <85% Humidity (non-condensing)
Strips to be used	Mission Urinalysis Reagent Strips U031-101 (K061559)	Mission Urinalysis Reagent Strips U031-101 (K061559)
Strip Operating Conditions	15°-30°C [59°-85°F] <85% Relative humidity (non-condensing)	15°-30°C [59°-85°F] <85% Relative humidity (non-condensing)

Strip Incubation Time	1 minute	1 minute
Calibration	Automatic	Automatic
Power Source	Not Applicable	100-240 VAC, 50-60 Hz
Line Leakage Current	Not Applicable	<2.5mA (single fault)
Data Transfer	Via smartphone Internet connection from the back-end server to the patient Electronic Medical Records	Standard RS232C Port
Capabilities	Transmission to physician via Internet connection	Internal Printer (included) 25 Pin Parallel External Printer Port Connector (included) Barcode Reader (optional)
Available languages on screen	English (others as installed)	English (default), Spanish, French (Others as installed)
Measuring cycle	Approximately 1 minute per test	Approximately 1 minute per test
Smartphones	LG Nexus 5	Not Applicable
Operating Systems	Android Lollipop	Not Applicable
Dimensions	15.25 cm (H) x 8.5 cm (W) x 6.75 (L)	35.56 cm (L) x 27.43 cm (W) x 19.56 cm (H)
Weight	115 g	4 kg

Summary of Performance Data

Healthy.io conducted both bench and clinical studies to test the accuracy of the DIP | U.S. Urine Analysis Test System and its agreement with the predicate device. Healthy.io conducted several studies to characterize the analytical and clinical performance of the DIP | U.S Urine Analysis Test System Two method comparison studies were conducted – one study included 429 subjects (500 samples including spiked sample) and a second study that included 250 subjects (289 samples including spiked samples). Analytical performance characteristic testing was also conducted for each analyte measured by the device. Software validation testing was also conducted. Performance of the DIP | U.S. Urine Analysis Test System based on this testing is summarized below.

Analytical Performance Testing:

The performance characteristics of the DIP | U.S. Urine Analysis Test System were evaluated by the following analytical performance tests:

Precision. This study was comprised of two separate sub-studies, including: 1) Repeatability; and 2) Reproducibility. The precision studies were designed and executed in accordance with guidance provided by Clinical and Laboratory Standards Institute document *EP05-A3 – Evaluation of Precision of Quantitative Measurement Procedures; Approved Guideline – Third Edition.*

- **The Repeatability study** was conducted at three sites over the course of one day. Each operator tested two spiked levels of urine using twenty sticks from three lots on a Nexus phone. For each analyte, 360 total tests were taken during the Repeatability study (360 = 3 sites X 2 solutions X 3 lots X 20 sticks). The DIP | U.S. Urine Analysis Test System recorded **an exact match of 99.3%** during the course of the study.

- **The Reproducibility study** was conducted at three sites over the course of 20 days, with test operators switching locations every six-to-seven days. For each run, every operator tested three spiked levels of urine using one stick from three lots respectively on a Nexus device. For each analyte, 1,080 total tests were taken during the Reproducibility study (3 sites x 3 solutions X 3 lots x 2 runs x 20 days). The DIP | U.S. Urine Analysis Test System recorded an **exact match of 98.5%** during the course of the study.

Interference. Testing of potential interfering substances with the DIP | U.S. Urine Analysis Test System was designed and executed in accordance with guidance provided by Clinical and Laboratory Standards Institute document *EP7-A2 – Interference Testing in Clinical Chemistry; Approved Guideline – Second Edition*.

- Interference was defined as a change in output of ± 2 color block between spiked and unspiked (control) samples. Once interference was detected at one or more analytes, a dose-response study was carried out at three decreasing intervals to determine the lowest concentration level that causes interference. Both the DIP | U.S. Urine Analysis Test System and the predicate device recorded similar results during their respective interference testing.

Limit of Detection. Testing of the DIP | U.S. Urine Analysis Test System detection limits was designed and executed in accordance with guidance provided by Clinical and Laboratory Standards Institute (CLSI) document *EP17-A2 – Evaluation of Detection Capability for Clinical Laboratory Measurement Procedures; Approved Guideline – Second Edition*.

- The Detection of Limit study was based on validated spiked urine solutions at known concentrations for each analyte. The samples were divided into four separate and equal intervals between the theoretical cut-off points between each semi-quantitative level. The sponsor tested each of these solution, with the cut-off point defined as the lowest concentration at which at least 55% of the results tested positive for the desired color block. The study demonstrated the ability of the DIP | U.S. Urine Analysis Test System to

accurately detect the limits concentration of every analyte measured by the DIP | U.S. Urine Analysis Test System

Linearity. The linearity study of the DIP | U.S. Urine Analysis Test System was designed and executed in accordance with guidance provided by the Clinical and Laboratory Standards Institute (CLSI) document *EP6-A – Evaluation of Linearity of Quantitative Measurement Procedures: A Statistical Approach; Approved Guideline.*

- The Linearity study tested the ability of the DIP | U.S. Urine Analysis Test System to provide results that were directly proportional to the concentrations of analytes within each test sample. The study tested the entire range of values that the DIP | U.S. Urine Analysis Test System is designed to measure. For every value of analyte, the DIP | U.S. measured at least an 89.4% exact match and a 100% +-1 color block accuracy. There were no detectable biases disrupting the overall pattern of linearity for any of the analytes. This study successfully demonstrates linearity for the DIP | U.S Urine Analysis Test System's device.

Stability:
The stability study was designed:
1. To provide evidence of the DIP | U.S. Urine Analysis Test System's performance over time under the influence of environmental factors such as temperature and humidity.
2. To establish DIP | U.S. Urine Analysis Test System's shelf life and recommended storage conditions, under which it maintains stable performance.
The DIP | U.S. Urine Analysis Test System was tested according to International Electrotechnical Commission standards, *IEC TR 60721-4-1:2001+A1:03, Class 1K2* and *IEC TR 60721-4-1:2001+A1:03, Class 1M2*). The DIP | U.S. Urine Analysis Test System successfully passed these examinations at 6-, 12-, and 14- month time intervals.

Additional Studies: Healthy.io designed and conducted two additional studies concerning the effects of: 1) light (Illumination Study); and 2) physical boundaries (Boundary Study) on the DIP | U.S. Urine Analysis Test System. Both of these studies demonstrated the device's ability to measure accurate levels of analytes under different lighting settings and boundary conditions as described below:

- **Illumination Study:** Healthy.io designed a study to test the DIP | U.S. Urine Analysis Test System under ten common lighting conditions (spectral properties were measured with standard devices). The device measured multiple levels of all six analytes under different lighting conditions. The device measured a total exact match of **99.5%** when compared to the predetermined reagent values.

- **Boundary Study:** Healthy.io designed a study to evaluate the physical boundary conditions (angle, distance, lighting) that guide a user when scanning the dipstick – while still receiving accurate results. The DIP | U.S. Urine Analysis Test System measured all six analytes at the angular, distance, and lighting limits of the device. At these boundaries, the DIP | U.S. Urine Analysis Test System measured a total exact match of **99.5%** when compared to the predetermined reagent values.

Method Comparison Study:

Two method comparison studies were conducted to demonstrate the DIP | U.S. Urine Analysis Test System's degree of agreement with its predicate device, when operated by a lay-user in a simulated home-use environment. These studies were both designed and executed in accordance with the Clinical and Laboratory Standards Institute (CLSI) document *EP9-A2 - Method Comparison and Bias Using Estimation Samples, Approved Guideline, Second Edition.*

The primary acceptance criteria for the study were the percent exact match and ±1 color block match between DIP | U.S. Urine Analysis Test System and the predicate. Throughout the testing, the DIP | U.S. Urine Analysis Test System demonstrated high-levels of accuracy as measured by its percent of agreement with the predicate device.

The first study enrolled 429 subjects and collected 500 total samples from two U.S. clinical sites. Subjects were able to choose which device to use, based on their level of familiarity with either phone. Samples were analyzed comparing subject results using the DIP | U.S. Urine Analysis Test System and results of aliquots of the same samples measured by a laboratory professional using the predicate (ACON Mission U500 Urinalysis System).

- **Study Results - Usability**

  Of the 429 tests conducted, 424 tests were successfully completed, meaning that the user completed the test and results were sent to the physician, demonstrating a very high success rate (>99%) for the product usability among lay users. Subjects also filled out usability evaluation surveys to rank different aspects of the product's usability. The average result from these surveys was 4.9 out of 5 demonstrating overall positive feedback from subjects using the product.

- **Study Results – Accuracy**

  The overall ± 1 color block % agreement between the DIP | U.S. Urine Analysis Test System and the ACON Mission U500 Urinalysis System was above **99% across the board** for all analytes during the initial Method Comparison study. Exact match levels for Nitrites and Protein were 99% and 85%, respectively. The pH and SG analyte exact match levels are 75.7% and 63.4%, respectively. (The performance data in this submission only uses the 284 results from the LG Nexus 5 smartphones used in the experiment.)

The second study enrolled 250 subjects and collected 289 total samples from a U.S. based clinic. Samples were analyzed comparing subject results using the DIP | U.S. Urine Analysis Test System and results of aliquots of the same samples measured by a laboratory professional using the predicate (ACON Mission U500 Urinalysis System).

- **Study Results - Usability**

  249 patients, out of the 250 enrolled were able to successfully complete the test with the DIP | U.S. Urine Analysis Test System device.

- **Study Results – Accuracy**

  The exact match for Blood was 91.4% (100% +/-1 color block) and 89.6% for Glucose (100% +/-1 color block). Moreover, there were zero instances of False Negative measurements for Blood and Glucose during this study.

In conclusion, the DIP | U.S. Urine Analysis Test System, when used by a lay person, demonstrated a high degree of agreement with the predicate device for every parameter.

Software Validation:

Validation of the Dip.io device software was performed according to the clause 14 of IEC 60601-1 (third edition) Software requirements, IEC 62304:2004 to IEC 62304 – 2006/AC 2008, Medical device, and Software life-cycle processes standards. The software related documents were composed according to the specific IEEE standards and the FDA Guidance for the Content of Premarket Submissions for Software Contained in Medical Devices. The Software Validation documents summarize the validation assessment and demonstrate that the software meets the design requirements and all potential risks have been mitigated.

In accordance with the FDA's guidance for management of cyber-security in medical device, the OCR's HIPAA regulation and ISO 27001, Healthy.io conducted a comprehensive hazard analysis. The cyber security analysis report, together with the cyber security validation test report summarizes the assessment process for cyber security and demonstrates that the software meets the required level of cyber security protection.

Conclusions:

The clinical and analytical performance study results demonstrate that the DIP | U.S. Urine Analysis Test System is substantially equivalent to the predicate device ACON Mission U500 Urinalysis System (FDA 510(k): K111221).