DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
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April 1, 2016

BIOFIRE DIAGNOSTICS, LLC
KRISTEN KANACK
VICE PRESIDENT, REGULATED PRODUCTS & CLINICAL AFFAIRS
390 WAKARA WAY
SALT LAKE CITY UT 84108

Re: K160459
Trade/Device Name: FilmArray Gastrointestinal Panel (GI) for use with FilmArray Torch
Regulation Number: 21 CFR 866.3990
Regulation Name: Gastrointestinal Microorganism Multiplex Nucleic Acid-Based Assay
Regulatory Class: II
Product Code: PCH
Dated: February 18, 2016
Received: February 19, 2016

Dear Dr. Kanack:

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 Parts 801 and 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.

If you desire specific advice for your device on our labeling regulations (21 CFR Parts 801 and 809), please contact the Division of Industry and Consumer Education at its toll-free number (800) 638 2041 or (301) 796-7100 or at its Internet address http://www.fda.gov/MedicalDevices/ResourcesforYou/Industry/default.htm. 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 the CDRH's Office of Surveillance and Biometrics/Division of Postmarket Surveillance.

You may obtain other general information on your responsibilities under the Act from the Division of Industry and Consumer Education at its toll-free number (800) 638-2041 or (301) 796-7100 or at its Internet address http://www.fda.gov/MedicalDevices/ResourcesforYou/Industry/default.htm.

Sincerely yours,

Steven R. Gitterman -S

For Uwe Scherf, M.Sc., Ph.D.
Director
Division of Microbiology 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: January 31, 2017
See PRA Statement below.

510(k) Number *(if known)*
K160459

Device Name
FilmArray Gastrointestinal Panel (GI)

Indications for Use *(Describe)*
The FilmArray Gastrointestinal (GI) Panel is a qualitative multiplexed nucleic acid-based in vitro diagnostic test intended for use with FilmArray systems. The FilmArray GI Panel is capable of the simultaneous detection and identification of nucleic acids from multiple bacteria, viruses, and parasites directly from stool samples in Cary Blair transport media obtained from individuals with signs and/or symptoms of gastrointestinal infection. The following bacteria (including several diarrheagenic E. coli/Shigella pathotypes), parasites, and viruses are identified using the FilmArray GI Panel:

• Campylobacter (C. jejuni/C. coli/C. upsaliensis)
• Clostridium difficile (C. difficile) toxin A/B
• Plesiomonas shigelloides
• Salmonella
• Vibrio (V. parahaemolyticus/V. vulnificus/V. cholerae) including specific identification of Vibrio cholerae
• Yersinia enterocolitica
• Enteroaggregative Escherichia coli (EAEC)
• Enteropathogenic Escherichia coli (EPEC)
• Enterotoxigenic Escherichia coli (ETEC) lt/st
• Shiga-like toxin-producing Escherichia coli (STEC) stx1/stx2 (including specific identification of the E. coli O157 serogroup within STEC)
• Shigella/Enteroinvasive Escherichia coli (EIEC)
• Cryptosporidium
• Cyclospora cayetanensis
• Entamoeba histolytica
• Giardia lamblia (also known as G. intestinalis and G. duodenalis)
• Adenovirus F 40/41
• Astrovirus
• Norovirus GI/GII
• Rotavirus A
• Sapovirus (Genogroups I, II, IV, and V)

The FilmArray GI Panel is indicated as an aid in the diagnosis of specific agents of gastrointestinal illness and results are meant to be used in conjunction with other clinical, laboratory, and epidemiological data. Positive results do not rule out co-infection with organisms not included in the FilmArray GI Panel. The agent detected may not be the definite cause of the disease.
Concomitant culture is necessary for organism recovery and further typing of bacterial agents.
This device is not intended to monitor or guide treatment for C. difficile infection.
Due to the small number of positive specimens collected for certain organisms during the prospective clinical study, performance characteristics for E. coli O157, Plesiomonas shigelloides, Yersinia enterocolitica, Astrovirus, and Rotavirus A were established primarily with retrospective clinical specimens.
Performance characteristics for Entamoeba histolytica, and Vibrio (V. parahaemolyticus, V. vulnificus, and Vibrio cholerae) were established primarily using contrived clinical specimens.
Negative FilmArray GI Panel results in the setting of clinical illness compatible with gastroenteritis may be due to infection by pathogens that are not detected by this test or non-infectious causes such as ulcerative colitis, irritable bowel syndrome, or Crohn's disease.
A gastrointestinal microorganism multiplex nucleic acid-based assay also aids in the detection and identification of acute

gastroenteritis in the context of outbreaks.

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)

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Special 510(k) Summary
BioFire Diagnostics, LLC

FilmArray Gastrointestinal (GI) Panel for use with FilmArray Torch

Introduction: According to the requirements of 21 CFR 807.92, the following information provides sufficient detail to understand the basis for a determination of substantial equivalence.

Submitted by:
BioFire Diagnostics, LLC
390 Wakara Way
Salt Lake City, UT 84108

Contact:
Kristen J. Kanack, Ph.D.
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Date Submitted:
February 18, 2016

Trade Name:
FilmArray Gastrointestinal (GI) Panel

Classification Name:

Gastrointestinal microorganism multiplex nucleic acid-based assay (21 CFR 866.3990)

Predicate Device:
K143005 – FilmArray Gastrointestinal (GI) Panel

Intended Use:
The FilmArray Gastrointestinal (GI) Panel is a qualitative multiplexed nucleic acid-based *in vitro* diagnostic test intended for use with FilmArray systems. The FilmArray GI Panel is capable of the simultaneous detection and identification of nucleic acids from multiple bacteria, viruses, and parasites directly from stool samples in Cary Blair transport media obtained from individuals with signs and/or symptoms of gastrointestinal infection. The following bacteria (including several diarrheagenic *E. coli/Shigella* pathotypes), parasites, and viruses are identified using the FilmArray GI Panel:

- *Campylobacter* (*C. jejuni/C. coli/C. upsaliensis*)
- *Clostridium difficile* (*C. difficile*) toxin A/B
- *Plesiomonas shigelloides*
- *Salmonella*
- *Vibrio* (*V. parahaemolyticus/V. vulnificus/V. cholerae*) including specific identification of *Vibrio cholerae*

- *Yersinia enterocolitica*
- Enteroaggregative *Escherichia coli* (EAEC)
- Enteropathogenic *Escherichia coli* (EPEC)
- Enterotoxigenic *Escherichia coli* (ETEC) *lt/st*
- Shiga-like toxin-producing *Escherichia coli* (STEC) *stx1/stx2* (including specific identification of the *E. coli* O157 serogroup within STEC)
- *Shigella/*Enteroinvasive *Escherichia coli* (EIEC)
- *Cryptosporidium*
- *Cyclospora cayetanensis*
- *Entamoeba histolytica*
- *Giardia lamblia* (also known as *G. intestinalis* and *G. duodenalis*)
- Adenovirus F 40/41
- Astrovirus
- Norovirus GI/GII
- Rotavirus A
- Sapovirus (Genogroups I, II, IV, and V)

The FilmArray GI Panel is indicated as an aid in the diagnosis of specific agents of gastrointestinal illness and results are meant to be used in conjunction with other clinical, laboratory, and epidemiological data. Positive results do not rule out co-infection with organisms not included in the FilmArray GI Panel. The agent detected may not be the definite cause of the disease.

Concomitant culture is necessary for organism recovery and further typing of bacterial agents.

This device is not intended to monitor or guide treatment for *C. difficile* infection.

Due to the small number of positive specimens collected for certain organisms during the prospective clinical study, performance characteristics for *E. coli* O157, *Plesiomonas shigelloides*, *Yersinia enterocolitica,* Astrovirus, and Rotavirus A were established primarily with retrospective clinical specimens.

Performance characteristics for *Entamoeba histolytica,* and *Vibrio (V. parahaemolyticus, V. vulnificus,* and *Vibrio cholerae)* were established primarily using contrived clinical specimens.

Negative FilmArray GI Panel results in the setting of clinical illness compatible with gastroenteritis may be due to infection by pathogens that are not detected by this test or non-infectious causes such as ulcerative colitis, irritable bowel syndrome, or Crohn's disease.

A gastrointestinal microorganism multiplex nucleic acid-based assay also aids in the detection and identification of acute gastroenteritis in the context of outbreaks.

Device Description:
The FilmArray Gastrointestinal (GI) Panel is a multiplex nucleic acid test designed to be used with FilmArray systems. The FilmArray `GI pouch contains freeze-dried reagents to perform

nucleic acid purification and nested, multiplex PCR with DNA melt analysis. The FilmArray Gastrointestinal (GI) Panel simultaneously conducts 22 tests for the identification of GI pathogens from stool specimens collected in Cary Blair transport medium (Table 1). Results from the FilmArray GI Panel test are available within about one hour.

Table 1. Bacteria, Viruses, Diarrheagenic *E. coli/Shigella*, and Parasites Detected by the FilmArray GI Panel

Bacteria	**Viruses**
Campylobacter (*C. jejuni/C. coli/C. upsaliensis*) *Clostridium difficile* (toxin A/B) *Plesiomonas shigelloides* *Salmonella* *Vibrio(V. parahaemolyticus/V. vulnificus/V. cholerae)* *Vibrio cholerae* *Yersinia enterocolitica*	Adenovirus F 40/41 Astrovirus Norovirus GI/GII Rotavirus A Sapovirus (Genogroups I, II, IV, and V)
Diarrheagenic *E. coli/Shigella*	**Parasites**
Enteroaggregative *E. coli* (EAEC) Enteropathogenic *E. coli* (EPEC) Enterotoxigenic *E. coli* (ETEC) *lt/st* Shiga toxin-producing *E. coli* (STEC) *stx1/stx2* *E. coli* O157 *Shigella*/Enteroinvasive *E. coli* (EIEC)	*Cryptosporidium* *Cyclospora cayetanensis* *Entamoeba histolytica* *Giardia lamblia*

A test is initiated by loading Hydration Solution into one port of the FilmArray pouch and a stool sample (in Cary Blair transport medium) mixed with the provided Sample Buffer into the other port of the FilmArray GI pouch and placing it in the FilmArray Instrument. The pouch contains all of the reagents required for specimen testing and analysis in a freeze-dried format; the addition of Hydration Solution and sample/Sample Buffer Mix rehydrates the reagents. After the pouch is prepared, the FilmArray Software guides the user though the steps of placing the pouch into the instrument, scanning the pouch barcode, entering the sample identification, and initiating the run.

The FilmArray instrument contains a coordinated system of inflatable bladders and seal points, which act on the pouch to control the movement of liquid between the pouch blisters. When a bladder is inflated over a reagent blister, it forces liquid from the blister into connecting channels. Alternatively, when a seal is placed over a connecting channel it acts as a valve to open or close a channel. In addition, electronically controlled pneumatic pistons are positioned over multiple plungers in order to deliver the rehydrated reagents into the blisters at the appropriate times. Two Peltier devices control heating and cooling of the pouch to drive the PCR reactions and the melt curve analysis.
Nucleic acid extraction occurs within the FilmArray pouch using mechanical and chemical lysis followed by purification using standard magnetic bead technology. After extracting and purifying nucleic acids from the unprocessed sample, a nested multiplex PCR is executed in two stages. During the first stage, a single, large volume, highly multiplexed reverse transcription

PCR (rt-PCR) reaction is performed. The products from first stage PCR are then diluted and combined with a fresh, primer-free master mix and a fluorescent double stranded DNA binding dye (LC Green® Plus, BioFire Defense, LLC). The solution is then distributed to each well of the array. Array wells contain sets of primers designed specifically to amplify sequences internal to the PCR products generated during the first stage PCR reaction. The 2nd stage PCR, or nested PCR, is performed in each well of the array. At the conclusion of the 2nd stage PCR, the array is interrogated by melt curve analysis for the detection of signature amplicons denoting the presence of specific targets. A digital camera placed in front of the array captures fluorescent images of the PCR2 reactions and software interprets the data.

The FilmArray software automatically interprets the results of each DNA melt curve analysis and combines the data with the results of the internal pouch controls to provide a test result for each organism on the panel.

Device Comparison:

The purpose of this submission is to add FilmArray Torch as an additional instrument system for use with the FilmArray Gastrointestinal (GI) Panel. There have been no changes to the previously cleared FilmArray GI Panel reagent kit itself. In order to increase throughput capacity, the FilmArray 2.0 was modified to develop the FilmArray Torch by organizing densely packaged instruments (now called FilmArray Torch Modules) into a "tower" configuration having the computer with touchscreen interface incorporated into the system base. Pouches are now inserted horizontally rather than from the top. This configuration allows the FilmArray Torch Modules to be stacked directly on top of each other to minimize system footprint.

The following table compares the FilmArray GI Panel for use with the FilmArray Torch to the previously cleared FilmArray GI Panel for Use with the FilmArray 2.0 (K143005) The table outlines the similarities and differences between the two systems.

Table 2. Comparison of the FilmArray Gastrointestinal (GI) Panel for use with the FilmArray Torch to the current FilmArray Gastrointestinal (GI) Panel.

Element	Modified Device: FilmArray Gastrointestinal (GI) Panel for use with the FilmArray Torch	Predicate: FilmArray Gastrointestinal (GI) Panel (K143005)
Organisms Detected	*Campylobacter (C. jejuni/C. coli/C. upsaliensis), Clostridium difficile (C. difficile) toxin A/B, Plesiomonas shigelloides, Salmonella, Vibrio (V. parahaemolyticus/V. vulnificus/V. cholerae)* including specific identification of *Vibrio cholera, Yersinia enterocolitica, Enteroaggregative Escherichia coli* (EAEC), *Enteropathogenic Escherichia coli* (EPEC), *Enterotoxigenic Escherichia coli* (ETEC) *lt/st, Shiga-like toxin-producing Escherichia coli* (STEC) *stx1/stx2* (including specific identification of the *E. coli O157* serogroup within STEC), *Shigella/Enteroinvasive Escherichia coli*	Same

Element	Modified Device: FilmArray Gastrointestinal (GI) Panel for use with the FilmArray Torch	Predicate: FilmArray Gastrointestinal (GI) Panel (K143005)
	(EIEC),*Cryptosporidium, Cyclospora cayetanensis, Entamoeba histolytica, Giardia lamblia* (also known as *G. intestinalis* and *G. duodenalis*), Adenovirus F 40/41, Astrovirus, Norovirus GI/GII, Rotavirus A, and Sapovirus (Genogroups I, II, IV, and V).	
Analyte	RNA/DNA	Same
Specimen Types	Human stool in Cary Blair transport medium	Same
Technological Principles	Nested multiplex RT-PCR followed by high resolution melting analysis to confirm identity of amplified product.	Same
Instrumentation	Single instrument FilmArray System, FilmArray 2.0 System, or FilmArray Torch System	Single instrument FilmArray System or FilmArray 2.0 System
Instrument-Software Communication	Communication for multiple FilmArray Torch Modules travels via Ethernet cable/port.	Same (multiple instruments)
Time to result	About 1 hour	Same
Test Interpretation	Automated test interpretation and report generation. User cannot access raw data.	Same
Reagent Hydration and Sample Loading	FilmArray Injection Vial-based loading procedure	Same
Sample Preparation Method	Sample Processing is automated in the FilmArray GI pouch.	Same
Reagent Storage	Reagents are stored at room temperature.	Same
Controls	Two controls are included in each reagent pouch to control for sample processing and both stages of PCR and melt analysis.	Same
User Complexity	Moderate/Low	Same

Performance Characteristics of FilmArray GI Panel on FilmArray Torch

Contrived samples containing each FilmArray GI analyte at low positive levels (1x LoD) were tested on three complete FilmArray Torch systems (12 FilmArray Torch Modules per system) over four days (32 replicates per analyte per system) for 96 total replicates per analyte. Reproducible detection at LoD was confirmed for each FilmArray GI Panel analyte with the expected Detected results for ≥99.0% of samples tested on FilmArray Torch systems. One exception was for *Giardia lamblia*, which was detected in <95% of replicate samples; comparison testing of these samples on original FilmArray systems was also <95%, indicating

lower than expected organism levels in the prepared samples. Agreement with expected negative results (Not Detected or N/A) on the Torch systems was >99.0% for each analyte.

Conclusion:
The intended use and fundamental scientific technology of the FilmArray GI Panel used with the modified device, FilmArray Torch, is unchanged from use of the legally marketed FilmArray GI Panel on FilmArray and FilmArray 2.0 systems. Non-clinical validation studies have established that the performance characteristics of FilmArray GI, including reproducibility, are substantially equivalent on FilmArray, FilmArray 2.0, and FilmArray Torch. These data demonstrate that the device performs as well as the predicate device.