510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION
DECISION SUMMARY
ASSAY ONLY

I Background Information:

A 510(k) Number

K220607

B Applicant

Becton, Dickinson and Company

C Proprietary and Established Names

BD MAX Enteric Viral Panel

D Regulatory Information

Product Code(s)	Classification	Regulation Section	Panel
PCH	Class II	21 CFR 866.3990 - Gastrointestinal Microorganism Multiplex Nucleic Acid-Based Assay	MI - Microbiology
OOI	Class II	21 CFR 862.2570 - Instrumentation for clinical multiplex test systems	CH - Clinical Chemistry

II Submission/Device Overview:

A Purpose for Submission:

To obtain a substantial equivalence determination for BD MAX Enteric Viral Panel (BD MAX EVP) on the BD MAX System with stool specimens collected using the Copan FecalSwab Collection, Transport and Preservation System (Copan FecalSwab) and BD FecalSwab Collection, Transport and Preservation System (BD FecalSwab). The Copan FecalSwab is also co-branded as the BD FecalSwab Collection, Transport and Preservation System (BD FecalSwab) and has been FDA-cleared under K142094 (Copan Italia SpA, legal manufacturer); the terms Copan FecalSwab, BD FecalSwab, and FecalSwab may be used interchangeably.

B Measurand:

The BD MAX Enteric Viral Panel detects nucleic acids from
• Norovirus GI & GII
• Rotavirus A
• Adenovirus F40/41
• Sapovirus (genogroups I, II, IV, V)
• Human Astrovirus (hAstro)

C Type of Test:

The BD MAX EVP is a qualitative real-time polymerase chain reaction (PCR) assay for the amplification and detection of DNA and RNA from Norovirus, Rotavirus, Adenovirus, Sapovirus, and Astrovirus.

III Intended Use/Indications for Use:

A Intended Use(s):
See Indications for Use below.

B Indication(s) for Use:
The BD MAX Enteric Viral Panel performed on the BD MAX System, is an automated in vitro diagnostic test for the direct qualitative detection and differentiation of enteric viral pathogens. The BD MAX Enteric Viral Panel detects nucleic acids from

- Norovirus GI & GII
- Rotavirus A
- Adenovirus F40/41
- Sapovirus (genogroups I, II, IV, V)
- Human Astrovirus (hAstro)

Testing is performed on unpreserved soft to diarrheal or Cary-Blair preserved stool specimens from symptomatic patients with suspected acute gastroenteritis, enteritis or colitis. The test is performed directly on the specimen, utilizing real-time polymerase chain reaction (PCR) for the amplification of relevant gene target DNA/RNA. The test utilizes fluorogenic gene-specific hybridization probes for detection of the amplified DNA.

This test is intended for use, in conjunction with clinical presentation, laboratory findings, and epidemiological information, as an aid in the differential diagnosis of Norovirus GI & GII, Rotavirus A, Adenovirus F40/41, Sapovirus (genogroups I, II, IV, V), and hAstro infections. Results of this test should not be used as the sole basis for diagnosis, treatment, or other patient management decisions. Positive results do not rule out co-infection with other organisms that are not detected by this test, and may not be the sole or definitive cause of patient illness. Negative 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.

C Special Conditions for Use Statement(s):
Rx - For Prescription Use Only

D Special Instrument Requirements:
For use with the BD MAX System.

IV Device/System Characteristics:

A Device Description:

The BD MAX Enteric Viral Panel (BD MAX EVP) is a gastrointestinal bacterial panel multiplex nucleic acid-based assay system comprised of an instrument with associated hardware and accessories, disposable microfluidic cartridges, real-time PCR master mixes, unitized reagent strips, extraction reagents, and sample buffer tubes (SBT). The instrument automates sample preparation including target lysis, DNA extraction and concentration, reagent rehydration, and target nucleic acid amplification and detection using real-time PCR. The assays include a Sample Processing Control (SPC) that is present in the Extraction Tube. The SPC monitors DNA extraction steps, thermal cycling steps, reagent integrity and the presence of inhibitory substances. The BD MAX System software automatically interprets test results. The BD MAX Enteric Viral Panel performed on the BD MAX system is FDA cleared under K181427.

The BD MAX Enteric Viral Panel instructions for use include testing of unpreserved stool specimens collected and transported to the laboratory in a dry, clean container, Cary-Blair preserved stool specimens collected using a plastic paddle (scoop) to place a stool sample into 15 mL of Cary-Blair media for transport, or stool specimens collected and transported using the Copan FecalSwab Collection, Transport, and Preservation System (Copan FecalSwab). Stool specimens from rectal swabs or fixed stools have not been validated with the BD MAX EVP.

The Copan FecalSwab is comprised of a nylon flocked specimen collection swab co-packaged with a tube filled pre-filled with 2 mL of a modified Cary-Blair preservative. The Copan FecalSwab is also co-branded as the BD FecalSwab Collection, Transport and Preservation System (BD FecalSwab); the terms Copan FecalSwab, BD FecalSwab, and FecalSwab are used interchangeably.

For the BD MAX EVP a test result may be called as POS, NEG or UNR (Unresolved) based on the amplification status of the targets and of the Sample Processing Control. IND (Indeterminate) or INC (Incomplete) results are due to BD MAX System failure.

B Principle of Operation:

A stool specimen is collected and transported to the laboratory in a dry, clean container (for unpreserved specimens), in Cary-Blair transport media, or using the Copan FecalSwab Collection, Transport, and Preservation System. Unpreserved stool samples and Cary-Blair

preserved stool samples are placed in a BD MAX SBT using a 5 µL transfer loop for analysis on the BD Max System.

To use the Copan FecalSwab stool specimens, the operator transfers fecal material from an unpreserved stool specimen to the vial of FecalSwab transport medium using the nylon flocked specimen collection swab. The operator unscrews the cap of the FecalSwab transport medium tube and transfers the swab with sample into the tube. The operator breaks the swab shaft at the break point line molded into the shaft, discards the handle part of the swab shaft, and screws the cap onto the FecalSwab tube to close. Before analysis on the BD MAX system, FecalSwab stool samples are vortexed and then 25 µL of sample is pipetted into a BD MAX SBT.

The SBT is closed with a septum cap and vortexed. A worklist is created and the SBT, unitized reagent strips, master mix, extraction tubes, and PCR cartridges are loaded onto the BD MAX System. The BD MAX System automates sample preparation including cell lysis, DNA extraction and concentration, reagent rehydration, and target nucleic acid amplification and detection using real-time PCR. Amplified targets are detected with hydrolysis probes labeled with quenched fluorophores. The amplification, detection and interpretation of the signals are done automatically by the BD MAX System.

C Interpretation of Results

Targets amplified by both mastermixes D6 and D5 are detected with hydrolysis probes (TaqMan probes) labelled at one end with a fluorescent reporter dye and at the other end with a quencher moiety. Six separate probes labelled with different reporter dyes are used to detect, in four different BD MAX System optical channels, the amplicons generated by their respective primers for MM D6 Enteric Viral Panel targets (Astrovirus, Sapovirus, and a sample processing control) and eight probes for MM D5 Enteric Viral Panel targets (Adenovirus, Norovirus, Rotavirus, and a sample processing control). The BD MAX System monitors several amplification curve metrics including: the fluorescence height at the end of the amplification curve (EP fluorescence), the location and value of the curve's first derivative, the location and value of the curve's second derivative, the threshold cycle value with an additional quality control applied to prevent false positives due to signal drift (Ct.Score), and measurements of system noise along the PCR amplification curve. Curve metrics are transformed into results via comparison of the metrics to cutoffs and the use of logic statements. Specifically, cutoffs are applied to the Ct.Score and EP values to determine amplification status with other metrics serving as quality controls.

Results are available on the "Results" tab in the "Results" window on the BD MAX System monitor. The BD MAX System software automatically interprets test results. Results are reported for each of the analytes and for the Sample Processing Control. A test result may be called as NEG (negative), POS (positive) or UNR (unresolved) based on the amplification status of the target and of the Sample Processing Control. IND (Indeterminate) or INC (Incomplete) results are due to BD MAX System failure and require sample repeat testing. A sample can be re-tested directly from the already prepared Sample Buffer Tube or following the preparation of a new Sample Buffer Tube inoculation. In the case of a partial UNR, where one or more targets have a POS result and all other targets have a UNR result, the targets with a UNR result will not be called NEG. This will be reported on a per Master Mix basis.

Erroneous results may occur from improper specimen collection, handling, storage, technical error, specimen mix-up or because the number of organisms in the specimen is below the analytical sensitivity of the test.

The Sample Processing Control has been added to the test to aid in the identification of samples that contain inhibitors to PCR amplification and as a control for reagent integrity and of the assay system as a whole. The Sample Processing Control does not indicate if nucleic acid has been lost due to inadequate collection, transport or storage of samples, or whether viral capsids have been adequately lysed.

V Substantial Equivalence Information:

A Predicate Device Name(s):
BD MAX Enteric Viral Panel

B Predicate 510(k) Number(s):
K181427

C Comparison with Predicate(s):

Device & Predicate Device(s):	K220607	K181427
Device Trade Name	BD MAX Enteric Viral Panel	BD MAX Enteric Viral Panel
General Device Characteristic Similarities		
Intended Use/Indications For Use	The BD MAX Enteric Viral Panel performed on the BD MAX System, is an automated in vitro diagnostic test for the direct qualitative detection and differentiation of enteric viral pathogens. The BD MAX™ Enteric Viral Panel detects nucleic acids from • Norovirus GI & GII • Rotavirus A • Adenovirus F40/41 • Sapovirus (genogroups I, II, IV, V) • Human Astrovirus (hAstro)	Same

	Testing is performed on unpreserved soft to diarrheal or Cary-Blair preserved stool specimens from symptomatic patients with suspected acute gastroenteritis, enteritis or colitis. The test is performed directly on the specimen, utilizing real-time polymerase chain reaction (PCR) for the amplification of relevant gene target DNA/RNA. The test utilizes fluorogenic gene-specific hybridization probes for the detection of the amplified DNA. This test is intended for use, in conjunction with clinical presentation, laboratory findings, and epidemiological information, as an aid in the differential diagnosis of Norovirus GI & GII, Rotavirus A, Adenovirus F40/41, Sapovirus (genogroups I, II, IV, V), and hAstro infections. Results of this test should not be used as the sole basis for diagnosis, treatment, or other patient management decisions. Positive results do not rule out co-infection with other organisms that are not detected by this test, and may not be the sole or definitive cause of patient illness. Negative 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.	
Organisms Detected	• Norovirus GI & GII • Rotavirus A • Adenovirus F40/41 • Sapovirus (genogroups I, II, IV, V) • Human Astrovirus (hAstro)	Same
Assay Format	Amplification: PCR Detection: Fluorogenic target-specific hybridization	Same
Assay Format	Amplification: PCR Detection: Fluorogenic target-specific hybridization	Same
Assay Targets	Presence of *RdRp and VP1* genes specific for Norovirus GI & GII · non-coding sequence after *nsp-3* gene specific for Rotavirus A · *hexon* gene specific for Adenovirus F40/41 · *RdRp* and *VP1* genes specific to Sapovirus (genogroups I, II, IV, V) · *RdRp* gene specific to Human Astrovirus (hAstro)	Same
Interpretation of Test Results	Automated (BD MAX System diagnostic software)	Same
Analysis Platform	BD MAX System	Same
PCR Sample Preparation	Automated by the BD MAX System	Same
Detection probes	TaqMan Probe	Same
Assay Controls	Sample Processing Control (SPC)	Same

General Device Characteristic Differences		
Specimen Type	• Unpreserved stool • Cary-Blair preserved stool • FecalSwab (modified Cary-Blair) preserved stool	• Unpreserved stool • Cary-Blair preserved stool
Sample Volume Tested	• 25 µL via Pipette from the FecalSwab collection tube • 5 µL Transport Loop from the unpreserved or Cary-Blair preserved stool	• 5 µL Transport Loop from the unpreserved or Cary-Blair preserved stool

VI Standards/Guidance Documents Referenced:

Class II Special Controls Guideline: Gastrointestinal Microorganism Multiplex Nucleic Acid-Based Assays for Detection and Identification of Microorganisms and Toxin Genes from Human Stool Specimens, November 2, 2015.

VII Performance Characteristics (if/when applicable):

A. Analytical Performance:

1. Precision/Reproducibility:

   Within-lab precision and reproducibility studies were evaluated previously using unpreserved stool specimens. This represents the most challenging specimen type and therefore additional studies were not conducted. Please see K181427.

2. Linearity:

   Not applicable.

3. Analytical Specificity/Interference:

   Analytical Specificity/Cross-Reactivity: Analytical specificity/cross-reactivity was evaluated previously in the presence of unpreserved stool that represents the most challenging specimen type. Please refer to K181427. No specificity issues were identified from additional studies conducted to support testing FecalSwab stool specimens.

Interference Substances (exogenous/endogenous): Interfering substances were previously evaluated in the presence of unpreserved stool which contains the highest concentration of potential inhibitors. Please refer to K181427.

4. Assay Reportable Range:

   Not applicable.

5. Traceability, Stability, Expected Values (Controls, Calibrators, or Methods):

   Please refer to K181427.

   An additional specimen stability study was conducted to evaluate specimen stability in FecalSwab collection tube and corresponding SBT meet the following BD MAX EVP assay specimen stability claims:

   A. FecalSwab stool specimens before testing: 25 ± 2 ˚C up to 48 hours (2 days), or 2-8˚C (5 °C ± 3 °C) up to 120 hours (5 days)
   B. Specimen added to the BD MAX Sample Buffer Tube (SBT): 25 ± 2˚C up to 48 hours (2 days) or 2-8˚C up to 120 hours (5 days)

   FecalSwab collection tubes were prepared with the positive and negative matrices for testing. Four positive FecalSwab tubes and one negative FecalSwab tube from each of three lots were prepared for each time point. Two BD MAX Sample Buffer Tubes were prepared from each FecalSwab tube. A minimum of 24 test results for positive specimens and six test results for negative specimens were performed at each test point. To determine stability, contrived samples containing Rotavirus A strain Va70, Adenovirus Type F41, and Astrovirus Type 4 were prepared from viral stocks. Stability testing for Norovirus GII and Sapovirus GI utilized quantitated clinical specimens. All positive samples contained analyte levels at 3X LoD.

   Table 1 below describes the stability conditions and timepoints.

Table 1: Nested FecalSwab Specimen Stability Conditions and Timepoints

<table>
<tr><th rowspan="2">Test Point</th><th colspan="2">FecalSwab
Storage Condition 1</th><th colspan="2">SBT
Storage Condition 2</th><th>Total Storage Time</th></tr>
<tr><td>1 (Baseline)</td><td colspan="5">N/A</td></tr>
<tr><td>2</td><td rowspan="6">25 °C ± 2 °C</td><td rowspan="5">2 days</td><td colspan="2">N/A</td><td>2 days</td></tr>
<tr><td>3</td><td rowspan="2">25 °C ± 2 °C</td><td>2 days</td><td>4 days</td></tr>
<tr><td>4</td><td>3 days</td><td>5 days</td></tr>
<tr><td>5</td><td rowspan="2">5 °C ± 3 °C</td><td>5 days</td><td>7 days</td></tr>
<tr><td>6</td><td>6 days</td><td>8 days</td></tr>
<tr><td>7</td><td>3 days</td><td colspan="2">N/A</td><td>3 days</td></tr>
<tr><td>8</td><td rowspan="2"></td><td rowspan="2">5 days</td><td colspan="2">N/A</td><td>5 days</td></tr>
<tr><td>9</td><td></td><td>2 days</td><td>7 days</td></tr>
</table>

10	5 °C ± 3 °C		25 °C ± 2 °C	3 days	8 days
11			5 °C ± 3 °C	5 days	10 days
12				6 days	11 days
13		6 days	N/A		6 days

The acceptance criteria for the study were 100% of spiked positive samples at baseline should report "POS" as the result and 100% of un-inoculated negative samples at baseline should report "NEG" as the result. For all subsequent time points, ≥95% of spiked positive samples should report "POS" as the result and 100% of un-inoculated negative samples should report "NEG" as the result. A minimum of 24 valid results for positive and 6 valid results for negative samples at each test point was required.

All target organisms passed the prespecified acceptance criteria, therefore the data were considered acceptable for the proposed stability claim. Stool preserved in FecalSwab can be stored for up to 120 hours (5 days) at 2 - 8 °C or for up to 48 hours at 2 – 25 °C. Inoculated Sample Buffer Tube can be stored at 2 - 8 °C for a maximum of 120 hours (5 days) or at 2 - 25 °C for a maximum of 48 hours (2 days).

6. Limit of Detection - Equivalency Study

The LoD for each target on the BD MAX EVP panel was previously determined in unpreserved stool specimens and Cary-Blair preserved stool specimens (see K181427). A LoD equivalency study was performed to demonstrate comparable analytical sensitivity for the BD MAX EVP panel testing Cary-Blair preserved stool samples and FecalSwab preserved stool samples.

Viral stocks were used for LoD serial dilution testing of Rotavirus A strain Va70, Adenovirus Type F41, and Astrovirus Type 4. Quantitated positive stools diluted to a working solution were used to generate the LoD dilutions for Norovirus GII and Sapovirus GI. One viral stock or positive stool was tested for each of the above viruses. Testing was performed with BD MAX EVP reagents, three lots of FecalSwab (4 FecalSwab replicates per reagent lot, 2 SBTs per FecalSwab), and one lot of Cary-Blair preserved specimen medium. A five-fold serial titration resulting in a total of five dilutions, was performed for each of the 5 assay targets and tested in both sample types (Cary-Blair and FecalSwab). Sample Buffer Tubes (SBT) were created by pipetting 25 µL from FecalSwab or looping 5 µL loop from Cary-Blair, altogether 24 SBTs each. The SBTs were tested on the BD MAX System.

Equivalence between the specimen collection methods was confirmed when LoDs for each target were within one five-fold dilution of each other. LoD is defined as when positivity is greater than 95% (23/24 or more POS or NEG results).

The LoDs using Cary-Blair preserved stool specimens and FecalSwab stool specimens were within one five-fold dilution of each other for all EVP targets. All analytes met the acceptance criteria and the results demonstrated comparable analytical sensitivity when FecalSwab preserved stool specimens and Cary-Blair preserved stool specimens were tested with BD MAX EVP targets on the BD MAX System.

7. Carry-Over:

Carry-over was established previously using unpreserved stool in EBP sample buffer which represents the worst-case scenario for carry-over contamination; therefore, additional studies were not necessary. Please refer to K181427.

8. Assay Cut-Off:

Assay cut-offs remain unchanged from the previously cleared version of the multiplex panel (see K181427).

9. User Variability:

The objective of this study was to determine whether the preparation of the FecalSwab collection tube by different users introduces variability in the expected results for the BD MAX EVP assay on the BD MAX System.

Two different FecalSwab collection tubes were prepared by six different operators for each of the five panel members. The test panel included contrived specimens co-spiked with Norovirus and Astrovirus at the following levels: one negative sample, three samples at 2x LoD, and one sample at 4x LoD. These targets were selected to represent each of the two PCR Master Mix formulations of the BD MAX Enteric Viral Panel. All steps subsequent to the FecalSwab preparation (i.e., pipetting to the BD MAX SBT, application of the septum cap, final vertexing, and initiating the run on the BD MAX) were performed by a single experienced BD MAX user.

For acceptance criteria, 100% negative results for the 12 negative samples, ≥95% positive results for the 36 samples tested at 2X LoD, and 100% positive for the 12 samples tested at 4X LoD.

Table 2 below presents results for user variability testing with Norovirus and Astrovirus.

Table 2: User Variability Assay Results

Organism	Load	Assay Results (POS/NEG/Total)	Pass/Fail Acceptance Criteria
Norovirus	2x LoD	36 / 0 / 36	Pass
	4x LoD	12 / 0 / 12	
	NEG	0 / 12 / 12	
Astrovirus	2x LoD	36 / 0 / 36	
	4x LoD	12 / 0 / 12	
	NEG	0 / 12 / 12	

Tables 3 and 4 present results for user variability testing with Norovirus and Astrovirus, respectively.

Table 3: User Variability of the FecalSwab Collection Tube with Norovirus

EVP Target: Norovirus				
Panel	**2X LOD**	**4X LOD**	**Negative**	**Grand Total**

Result	NEG	POS	NEG	POS	NEG	POS	
User 1	0	6	0	2	2	0	10
User 2	0	7[a]	0	2	2	0	1 1
User 3	0	6	0	2	2	0	10
User 4	0	6	0	2	2	0	10
User 5	0	6	0	2	2	0	10
User 6	0	6	0	2	2	0	10
Grand Total	0	37	0	12	12	0	61

[a]One sample had an invalid result and was retested. This sample tested positive for that target in the repeat run.

Table 4: User Variability of the FecalSwab Collection Tube with Astrovirus

EVP Target: Astrovirus							
Panel	**2X LOD**		**4X LOD**		**Negative**		**Grand Total**
Result	**NEG**	**POS**	**NEG**	**POS**	**NEG**	**POS**	
User 1	0	6	0	2	2	0	10
User 2	0	7[a]	0	2	2	0	11
User 3	0	6	0	2	2	0	10
User 4	0	6	0	2	2	0	10
User 5	0	6	0	2	2	0	10
User 6	0	6	0	2	2	0	10
Grand Total	0	37	0	12	12	0	61

[a]One sample had an invalid result and was retested. This sample tested positive for that target in the repeat run.

Results for both targets met the acceptance criteria. Differences in specimen workflow between the FecalSwab and Cary-Blair collection procedures did not demonstrate an observable effect on expected results with the BD MAX EVP on the BD MAX System.

B. Comparison Studies:

1. Method Comparison with Predicate Device:

   A method comparison study was performed to demonstrate equivalent performance between testing FecalSwab stool specimens and Cary-Blair preserved stool specimens with the BD MAX EVP on the BD MAX System.

   The study was conducted in accordance with the Declaration of Helsinki and in compliance with applicable regulations and ICH Good Clinical Practice (GCP). Informed consent was not needed because only de-identified remnant specimens were enrolled and tested. Fresh prospective specimens were collected at six external sites. Previously characterized retrospective specimen were collected at two external sites and one internal site at BD. Samples were also contrived, where applicable, at an internal BD site. The following inclusion and exclusion criteria were used for prospective and retrospective specimen collection:

   - *Prospective inclusion criteria:* unpreserved soft to diarrheal stool specimen from a pediatric or adult patient admitted to a healthcare facility (e.g., hospital, outpatient

clinica, or long term care facility) and suspected of having acute hasteroenteritis, enteritis, or colitis for which diagnostic tests were indicated and/or ordered
- *Prospective exclusion criteria*: unlabeled or mislabeled solid/formed stools or rectal swabs and specimen from patients suspected and/or confirmed *Clostridioides* (*Clostridium*) *difficile* diarrheal disease
- *Retrospective inclusion criteria*: unpreserved stool specimen confirmed positive for one of the EVP
- *Retrospective exclusion criteria*: unlabeled or mislabeled specimens

Adenovirus contrived specimens were prepared such that a minimum of 50% of the specimens contained analyte concentrations corresponding to 1.5x - 2x LoD in a unique specimen matrix consisting of negative stool and collected using the FecalSwab. A total of 53 positive and 53 negative contrived samples were prepared using 53 unique negative specimen matrices, all of which had been previously determined to be negative for all targeted analytes.

Table 5: Adenovirus Contrived Samples Panel Target Level Description

xLoD	***Adenovirus***
2	27
4	7
10	7
25	6
1000	6
Negative	53
Total	106

A total of 594 prospective specimens and 211 retrospective specimens were enrolled in the clinical evaluation. Three prospective specimens were excluded from the data analysis due to specimen exclusion criteria.

Table 6 presents the BD MAX positivity rate for BD MAX EVP assay, by specimen origin, device type and site. The NYH and TGH sites were the only sites actively collecting retrospective specimens during study enrollment. All other retrospective specimens had been collected during previous studies.

The 802 (591 prospective and 211 retrospective) compliant specimens enrolled by patient age, sex, and specimen type. Ten (10) additional prospective samples were excluded from the data analysis due to Sample Buffer Tube or instrument level exclusion criteria. The final data analysis included 581 compliant prospective and 211 compliant retrospective subjects for Norovirus GI & GII, Rotavirus A, Adenovirus F40/41, Sapovirus (genogroups I, II, IV, V), and Human Astrovirus (hAstro) targets.

Table 5 presents the BD MAX positivity rate for BD MAX EVP assay, by specimen origin, device type and site. The NYH and TGH sites were the only sites actively collecting retrospective specimens during study enrollment. All other retrospective specimens had been collected during previous studies.

Table 6: Compliant Clinical Trial Enrollment Summary by Age, Sex, and Specimen Type

Specimen Type	Mean Age in years (SD)	Median Age in years	Min Age in years	Max Age in years	Sex of Total N
Prospective Total N = 591	47.0 (22.7)	49.0	<1	95	Male: 44.8%
Unknown Age: 0					Female: 55.2%
Known Age: 591					Unknown: 0.0%
Retrospective Total N = 211	42.0 (24.4)	46.0	<1	88	Male: 41.2%
Unknown Age: 59					Female: 53.1%
Known Age: 152					Unknown: 5.7%
Overall Total N = 802	46.0 (23.1)	49.0	<1	95	Male: 43.9%
Unknown Age: 59					Female: 54.6%
Known Age: 743					Unknown: 1.5%

The primary study endpoint was to demonstrate equivalent performance of testing FecalSwab stool specimens to the performance of testing Cary-Blair stool specimen with the BD MAX EVP on the BD MAX System. Acceptance criteria were established as a PPA of ≥ 95% for each target and an NPA of ≥ 90% for each target with 95% lower bound of the confidence interval of ≥ 90% for each target for both PPA and NPA.

Percent agreement comparing the FecalSwab specimen performance to the Cary-Blair specimen performance with the BD MAX EVP targets is presented in Tables 7-13.

Table 7: Norovirus PPA and NPA of the BD MAX Enteric Viral Panel – FecalSwab Compared to Cary-Blair Preserved

Norovirus		Cary-Blair		Total
Specimen Origin	FecalSwab	Positive	Negative	
Prospective	Positive	20	2	22
	Negative	3	554	557
	Total	23	556	579
PPA: 87.0% (67.9%, 95.5%) NPA: 99.6% (98.7%, 99.9%)				
Retrospective	Positive	104	6	110
	Negative	1	100	101

Norovirus		Cary-Blair		Total
Specimen Origin	FecalSwab	Positive	Negative	
	Total	105	106	211
PPA: 99.0% (94.8%, 99.8%) NPA: 94.3% (88.2%, 97.4%)				

Table 8: Rotavirus PPA and NPA of the BD MAX Enteric Viral Panel – FecalSwab Compared to Cary-Blair Preserved

Rotavirus		Cary-Blair		Total
Specimen Origin	FecalSwab	Positive	Negative	
Prospective	Positive	3	0	3
	Negative	0	576	576
	Total	3	576	579
PPA: 100.0% (43.9%, 100.0%) NPA: 100.0% (99.3%, 100.0%)				
Retrospective	Positive	39	3 [a]	42
	Negative	7 [a]	162	169
	Total	46	165	211
PPA: 84.8% (71.8%, 92.4%) NPA: 98.2% (94.8%, 99.4%)				

[a]9/10 specimens with discrepant results have target at or near the LoD.

For the BD FecalSwab Collection, Transport and Preservation System, the BD MAX™ Enteric Viral Panel identified 100.0% and 99.5% of the prospectively collected Adenovirus positive and negative specimens, respectively, and 100.0% and 99.0% of the retrospectively collected Adenovirus positive and negative specimens, respectively (refer to Table 9).

Table 9: Adenovirus PPA and NPA of the BD MAX EVP FecalSwab Compared to Cary Blair Preserved

Adenovirus		Cary-Blair		Total
Specimen Origin	FecalSwab	Positive	Negative	
Prospective	Positive	1	3	4
	Negative	0	575	575

Adenovirus		Cary-Blair		Total
Specimen Origin	FecalSwab	Positive	Negative	
	Total	1	578	579
PPA: 100.0% (20.7%, 100.0%) NPA: 99.5% (98.5%, 99.8%)				
Retrospective	Positive	9	2	11
	Negative	0	200	200
	Total	9	202	211
PPA: 100.0% (70.1%, 100.0%) NPA: 99.0% (96.5%, 99.7%)				

Due to the small number of Adenovirus positive specimens in the study, contrived specimens were also evaluated. The BD FecalSwab Collection, Transport and Preservation System on the BD MAX Enteric Viral Panel identified 100.0% of the Adenovirus contrived positive and negative specimens, when compared to expected results (refer to Table 10).

Table 10: Adenovirus Contrived FecalSwab Specimen Results

Adenovirus	Expected Result		
FecalSwab	Positive	Negative	Total
Positive	52	0	52
Negative	0	53	53
Total	52	53	105
PPA: 100.0% (93.1%, 100.0%) NPA: 100.0% (93.2%, 100.0%)			

Table 11: Adenovirus Contrived FecalSwab Specimen Results Compared to Cary-Blair contrived Specimen Results

Adenovirus	Cary-Blair		
FecalSwab	Positive	Negative	Total
Positive	50	2	52
Negative	0	53	53

Adenovirus	Cary-Blair		
FecalSwab	**Positive**	**Negative**	**Total**
Total	50	55	105
PPA: 100.0% (92.9%, 100.0%) NPA: 96.4% (87.7%, 99.9%)			

For the BD FecalSwab Collection, Transport and Preservation System, the BD MAX Enteric Viral Panel identified 50.0% and 99.3% of the prospectively collected Sapovirus positive and negative specimens, respectively (refer to Table 12).

Table 12: Sapovirus PPA and NPA of the BD MAX Enteric Viral Panel – FecalSwab Compared to Cary-Blair Preserved

Sapovirus		Cary-Blair		Total
Specimen Origin	**FecalSwab**	**Positive**	**Negative**	
Prospective	Positive	1	4	5
	Negative	1 [a]	574	575
	Total	2	578	580
PPA: 50.0% (9.5%, 90.5%) NPA: 99.3% (98.2%, 99.7%)				
Retrospective	Positive	22	4	26
	Negative	0	185	185
	Total	22	189	211
PPA: 100.0% (85.1%, 100.0%) NPA: 97.9% (94.7%, 99.2%)				

[a]One missed sample by the FecalSwab was at or near the LoD.

Table 13: Astrovirus PPA and NPA of the BD MAX Enteric Viral Panel – FecalSwab Compared to Cary-Blair Preserved

Astrovirus		Cary-Blair		Total
Specimen Origin	**FecalSwab**	**Positive**	**Negative**	
Prospective	Positive	1	4 [a]	5
	Negative	0	575	575
	Total	1	579	580

Astrovirus		Cary-Blair		Total
Specimen Origin	**FecalSwab**	**Positive**	**Negative**	
PPA: 100.0% (20.7%, 100.0%) NPA: 99.3% (98.2%, 99.7%)				
Retrospective	Positive	26	6 [a]	32
	Negative	1 [a]	178	179
	Total	27	184	211
PPA: 96.3% (81.7%, 99.3%) NPA: 96.7% (93.1%, 98.5%)				

[a]Seven out of eleven of the discrepant samples were at or near the LoD.

These results demonstrate the FecalSwab specimen collection type has comparable and acceptable performance when compared to the predicate Cary-Blair specimen type with all targets in the BD MAX EVP on the BD MAX System.

Non-Reportable Results:

The rates of unresolved (UNR) results due to sample processing control (SPC) failure and the rates of indeterminate (IND) results due to a BD MAX system failure were also estimated for FecalSwab stool specimens and Cary-Blair stool specimens tested with the EVP assay. The total non-reportable rates (NRR= UNR+IND) observed in the clinical study was 0% (0/581) and 0% (0/581) for FecalSwab and Cary-Blair stool specimens, respectively.

2. Matrix Comparison:

   Not applicable.

C. Clinical Studies:

1. Clinical Sensitivity:

   Clinical performance of the BD MAX EVP was established previously with prospective clinical studies. Please see K181427 for additional details.

2. Clinical Specificity:

   Clinical performance of the BD MAX EVP was established previously with prospective clinical studies. Please see K181427 for additional details.

3. Other Clinical Supportive Data (When 1. and 2. Are Not Applicable):

   Not applicable

D. Clinical Cut-Off:

Not applicable

E. Expected Values/Reference Range:

The expected values/reference range for analytes on the BD MAX EVP was established previously. See K181427.

VIII Proposed Labeling:

The labeling supports the finding of substantial equivalence for this device.

IX Conclusion:

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