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

A. 510(k) Number:

K122718

B. Purpose for Submission:

To obtain substantial equivalence for the BD Veritor™ System for Rapid Detection of Group A Streptococcus (Group A Strep)

C. Measurand:

Group A Streptococcus Carbohydrate Antigen in Throat Swabs

D. Type of Test

Qualitative, immunochromatographic assay

E. Applicant:

Becton, Dickinson and Company

F. Proprietary and Established Names:

BD Veritor™ System for Rapid Detection of Group A Strep

G. Regulatory Information:

Product Code	Classification	Regulation Section	Panel
GTY - Antigens, All Groups, Streptococcus spp.	Class I	21 CFR 866.3740 – *Streptococcus spp*. Serological Reagents	Microbiology (83)

H. Intended Use:

1. Intended use:

The BD Veritor™ System for Rapid Detection of Group A Strep test is a rapid chromatographic immunoassay for the direct and qualitative detection of Group A Streptococcus antigen from throat swabs of symptomatic patients. It is intended to be used in conjunction with the BD Veritor™ System Reader as an aid in the diagnosis of Group A Strep. All negative test results should be confirmed by bacterial culture because negative results do not preclude Group A Strep infection and should not be used as the sole basis for treatment. The BD Veritor™ System

for Rapid Detection of Group A Strep test is intended for use in point-of-care or laboratory settings.

2. Indication(s) for use:

The BD Veritor™ System for Rapid Detection of Group A Strep test is a rapid chromatographic immunoassay for the direct and qualitative detection of Group A Streptococcus antigen from throat swabs of symptomatic patients. It is intended to be used in conjunction with the BD Veritor™ System Reader as an aid in the diagnosis of Group A Strep. All negative test results should be confirmed by bacterial culture because negative results do not preclude Group A Strep infection and should not be used as the sole basis for treatment. The BD Veritor™ System for Rapid Detection of Group A Strep test is intended for use in point-of-care or laboratory settings.

3. Special conditions for use statement:

For prescription use only

4. Special instrument requirements:

BD Veritor System Reader

I. Device Description:

The BD Veritor™ System for rapid detection of Group A Strep is a qualitative, lateral flow immunoassay for the detection of Strep A carbohydrate antigen in a throat swab. In this test, antibody specific to Strep A carbohydrate antigen is coated on the test line region of the. Assay device. During testing, the processed throat swab specimen reacts with an antibody to Strep A that is conjugated onto detector particles. The mixture migrates up the membrane to react with the antibody to Strep A on the membrane and is captured by the line of antibody on the membrane. A positive result for Strep A is determined by the BD Veritor ™ System Reader when antigen-conjugate is deposited at the Test "T" position and the Control "C" position on the BD Veritor™ System Strep A assay device.

The following components are included in the BD Veritor™ System for Rapid Detection of Group A Strep test kit.

Veritor™ System Group A Strep Test Devices	30 Devices	Foil pouched device containing one reactive strip with one test line of polyclonal antibody specific to Strep A antigen, a positive control line containing purified Strep A antigen and a negative control line of polyclonal antibody.
GAS Reagent 2	30 tubes w/ 300 µL reagent	Sodium nitrite and EDTA with less than 0.1% sodium azide
GAS Reagent 1	Bottle with 4 mL reagent	Dilute acetic acid solution
Throat Swab	30 each	Swab for specimen collection
Control Positive Swab	1 each	Strep A Positive Control Swab (purified Strep A antigen) with less than 0.1% sodium azide
Control Negative Swab	1 each	Strep A Negative Control Swab with less than 0.1% sodium azide

Materials Required But Not Provided: BD Veritor™ System Reader (Cat. No. 256055)**,** Timer, Tube Rack for specimen testing

J. Substantial Equivalence Information:

1. Predicate Device Name:

   Clearview Advanced™ Strep A test

2. Predicate 510(k) Number:

   K091489

3. Comparison with Predicate:

Similarities		
Item	**DEVICE (K122718)** **BD Veritor™ System for Rapid Detection of Group A Strep test**	**PREDICATE (K091489)** **Clearview Advanced™ Strep A test**
Intended Use	Qualitative, Chromatographic Immunoassay	Qualitative, Chromatographic Immunoassay
Test Format	Chromatographic Immunoassay	Chromatographic Immunoassay
Target	Group A Streptococcus	Group A Streptococcus
Specimen Types	Throat Swab	Throat Swab
Controls	Positive and negative	Positive and negative

Differences		
Item	**DEVICE (K122718)** **BD Veritor™ System for Rapid Detection of Group A Strep test**	**PREDICATE (K091489)** **Clearview Advanced™ Strep A test**
Controls	Internal control lines on strip	No internal control lines on strip
Reading	Opto-electronic transmission	Visible Light Transmission
Total Assay	5 minutes	3 minutes

L. Test Principle:

The BD Veritor™ System for Rapid Detection of Group A Strep is a chromatographic assay to qualitatively detect the presence of the Group A Strep antigen. For each test, three drops of GAS Reagent 1 are added to a prefilled tube of GAS Reagent 2, the swab added and incubated for two minutes. A filter tip is attached to the tube and three drops of solution are dispensed into the sample well of a BD Group A Strep test device. After five minutes at room temperature the device is inserted into the BD Veritor™ System Reader for interpretation.

The extracted specimens are added to the test device where Group A Strep carbohydrate antigens bind to antibodies conjugated to detector particles on the test strip. The antigen-conjugate complex migrates across the test strip to the reaction area and is captured by an antibody line on the membrane. The assay utilizes a proprietary enhanced colloidal-gold particle captured at the test line as the means for identifying the presence of the analyte. The assay test strips are designed with spatially-distinct zones including positive and negative control line positions, a test line position (labeled 'T' on the device) for the analyte, and a background zone. The onboard positive control ensures the sample has flowed correctly and is indicated on the test device as 'C'. The onboard negative control zone addresses non-specific signal generation and is not labeled on the test device. The remaining distinct zone on the test device is closest to the sample well and the location is not labeled. This zone is used to measure the assay background. The test kit also contains external swab controls to ensure the assay has been performed correctly and that the entire system is performing as intended.

The BD Veritor™ System Reader is a portable electronic device used to interpret BD Veritor lateral flow test devices. It is a battery powered electronic reader which uses a reflectance-based measurement method to evaluate the line signal intensities on the assay test strip, and applies specific algorithms to determine the presence or absence of any target analyte(s). The reader determines the line intensity at each of the spatially-defined test and control line positions, interprets the results using the scoring algorithm, and reports a positive, negative, or invalid result based on pre-set thresholds. A liquid crystal display (LCD) on the instrument communicates status and results to the operator. The reader supports the use of different assays by reading an assay-specific barcode on the test cartridge. The instrument is not configurable by the user and is maintenance free with a finite lifetime based on either the number of tests performed, the number of days from first use by the end user, or a maximum shelf-life from the date of manufacture.

The bacterial antigens detected by the BD Veritor™ System for Rapid Detection of Group A Strep test are carbohydrate antigens, not M proteins. Organisms classified as Group A Strep are prone to minor point mutations (i.e., antigenic drift) of the surface M proteins. The BD Veritor™ System for Rapid Detection of Group A Strep test is not affected by antigenic drift and shift because it detects the carbohydrate antigen and not the M protein.

M. Performance Characteristics:

1. Analytical performance:

a. Precision/Repeatability

A study was conducted to demonstrate the BD Veritor™ System for Rapid Detection of Group A Strep has acceptable precision near the Limit of Detection (LOD), and that performance characteristics are independent of normal variances that occur between operator to operator and day to day activities.

The sponsor conducted the study over a period of 12 days with two different operators in order to evaluate the precision of the BD Group A Strep test. Each day each operator tested a group of swabs samples that were blinded and randomized and ranged from negative to 5% positive, 95% positive and 100% positive. To assess the day-to-day repeatability, one operator also tested 24 blind and randomized swabs.

Swabs were prepared in the same manner that the control swabs are normally prepared. In this case the swabs were dipped in solutions containing various dilutions of Strep A to achieve the requested levels. The swabs were allowed to completely dry and were then pouched with desiccant. These dilutions were determined based on the criteria that one sample be targeted around a high negative, the second sample was targeted to a low positive sample, and the final dilution was targeted to a moderate positive.

All positive and negative swab specimens were masked and randomized prior to testing with the BD Strep A test. For each test, three drops of GAS Reagent 1 were added to a

prefilled tube of GAS Reagent 2 and incubated for two minutes. A filter tip was attached to the tube and three drops of solution were dispensed into the sample well of a BD Group A Strep test device. After five minutes at room temperature the device was inserted into the BD Veritor™ System Reader for interpretation. All processed samples were tested in triplicate.

Operator-to-Operator Repeatability Study									
Operator 1					**Operator 2**				
Sample	**Positive/total tested swabs**	**Average Positivity**	**95% CI Lower bound**	**95% CI Upper bound**	**Sample**	**Positive/total tested swabs**	**Average Positivity**	**95% CI Lower bound**	**95% CI Upper bound**
Negative	0/24	0.0	0.0	14.2	**Negative**	0/22*	0	0	15.4
"5" %	0/24	0.0	0.0	14.2	**"5" %**	0/24	0	0	14.2
"95" %	14/24	58.3	36.3	77.9	**"95" %**	18/24	75.0	53.3	90.2
"100" %	24/24	100.0	85.8	100.0	**"100" %**	24/24	100	85.8	100

***** 2 samples that were mislabeled were excluded

Single Operator Single day				
Operator 2				
Sample	**Positive/total tested swabs**	**Average Positivity**	**95% CI Lower bound**	**95% CI Upper bound**
Negative	0/24	0	0	14.2
"5"%	0/24	0	0	14.2
"95"%	11/24	45.8	25.6	67.2
"100"%	24/24	100	85.8	100

The results tables above indicate that similar rates of positivity were obtained within each sample category by both operators for all samples tested and that the confidence intervals overlapped indicating that the BD Strep A test met acceptable criteria for precision.

Reproducibility:

The reproducibility of the BD Veritor™ System for Rapid Detection of Group A Strep was evaluated at one clinical and two point-of-care (POC) sites. The panel was composed of 4 simulated Group A Strep samples. These included high negative samples (i.e., samples containing a very low concentration of Group A Strep), a low positive sample (near the limit of detection), a moderate positive sample and a negative sample. The panel was tested by two operators at each site over five days. The results are summarized below.

BD Veritor™ Group A Strep Reproducibility				
Sample	**Site 1**	**Site 2**	**Site 3**	**Total**
High negative	3.3% (1/30) (0.6%, 16.7%)	0% (0/30) (0%, 11.3%)	0% (0/30) (0%, 11.3%)	1.1% (1/90) (0.2%, 6%)
Low positive	96.7% (29/30) (83.3%, 100%)	83.3% (25/30) (66.4%, 92.7%)	93.3% (28/30) (78.7%, 98.2%)	91.1% (82/90) (83.4%, 95.4%)
Moderate positive	100% (30/30) (88.6%, 100%)	96.7% (29/30) (83.3%, 99.4%)	100% (30/30) (88.6%, 100%)	98.9% (89/90) (94.0%, 99.8%)
Negative	0% (0/30) (0%, 1.3%)	0% (0/30) (0%, 11.3%)	0% (0/30) (0%, 11.3%)	0% (0/90) (0%, 4.1%)

Reproducibility studies are acceptable.

b. Linearity/assay reportable range:

Not Applicable

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

Stability:

Various types of transport media commonly used for the preservation and transport of respiratory specimens were evaluated for specimen storage and stability with the BD Veritor™ System for Rapid Detection of Group A Strep test. Testing was performed using dilutions of a liquid culture of *S. pyogenes* diluted to a test signal corresponding to a low positive. BD determined that for a transport medium to be considered acceptable for specimen storage, the BD Group A Strep test must generate a positive test for all spiked samples. Spiked samples that generate a false negative result would not be acceptable for specimen storage.

In this study, various transport media were stored at 2-8°C and brought to ambient temperature prior to spiking. The two transport media and normal saline were spiked with *S. pyogenes* to an amount corresponding to a low positive and tested in triplicate. 50 µL were added to Veritor System™ Strep A combined GAS Reagents 1 and 2 (360 µL). After one minute the processing solution was tested according to the Veritor System™ Strep A Package Insert. The remaining spiked transport media and spiked saline were stored at 30°C and in the refrigerator for additional time points. An amount of *S. pyogenes* corresponding to the antigen concentration near to the cutoff was applied to dry swabs and dried for 2 hours at 18-25°C and RH ≤15%. Three swabs were extracted and tested immediately at the 2 hour time point. The remaining dry swabs were stored at 30°C and in the refrigerator for additional time points.

Strep A antigen (associated with intact bacteria) was observed to be stable on dry Rayon swabs up to 96 hours (the duration of testing in this study) either refrigerated or stored at room temperature (15-30°C). Test values ranged between 50 and 100% of values observed at time zero. In liquid Amies and liquid Stuart medium stored at 2-8°C Strep A antigen levels were stable up to 96 hours. In liquid Amies and liquid Stuart medium stored at 30°C Strep A antigen levels increased approximately 4-fold over 96 hours, indicating bacterial growth under these conditions. In normal saline stored at either 2-8°C or 30°C Strep A antigen levels decreased continuously with storage time. A 50% decrease was observed between 24 and 48 hours. Testing within 72 hours regardless of transport conditions would appear to be a reasonable recommendation for dry swabs and swabs in either liquid Amies or Stuart Medium. Storage and transport in saline beyond 24 hours is not recommended,

Strep A antigen was shown to be stable either refrigerated or at room temperature on Rayon swabs either dry, or in contact with liquid Amies or liquid Stuart media for up to 96 hours. Normal saline is not indicated as an acceptable storage or transport medium beyond 24 hours.

Kit Stability Dating:

A combination of real time and accelerated was used to establish the current kit dating of 24 months at 2-30°C.

d. Detection limit

The limit of detection for *Streptococcus pyogenes* was established with the BD Veritor™ System for Rapid Detection of Group A Strep test. For this study, the limit of detection (LOD) is defined as the lowest concentration that produces an approximate 95% positive reaction when tested with 60 replicates.

Testing was performed on Lancefield Group A *Streptococcus pyogenes* ATCC 12384, 19615 and 25663. A frozen liquid culture of *S. pyogenes* (4.4×10^7 CFU/mL) was thawed to room temperature and serial ten-fold dilutions were performed using saline. For each test, three drops of GAS Reagent 1 were added to a prefilled tube of GAS Reagent 2. 50µL of each 10-fold dilution was added to the combined extraction reagent and incubated for 2 minutes. A filter tip was attached to the tube and three drops of solution were dispensed into the sample well of a BD Group A Strep test device. After five minutes at room temperature the device was inserted into the BD Veritor™ System Reader for interpretation. All processed samples were tested in triplicate. The lowest ten-fold dilution that was detected as positive in all three BD Group A Strep test devices was further diluted in two-fold serial increments in saline and tested as described above to determine the LOD.

The Limit of Detection for *S. pyogenes* was calculated to be 1.0×10^5 CFU/mL.
The sponsor tested 3 strains of *S. pyogenes* to determine LoD.

Limit of Detection studies are acceptable.

e. Analytical specificity:

Interference Studies:
The substances listed in the table below were evaluated for potential interference with the BD Veritor™ System for Rapid Detection of Group A Strep test at concentrations comparable to or greater than levels that may be present in patient respiratory samples.

Substance	Concentration Tested	Interference with Group A Result
4-Acetamidophenol	10 mg/mL	No
Acetylsalicylic acid	20 mg/mL	No
Albuterol	0.083 mg/mL	No
Amantadine	500 ng/mL	No
Ascorbic acid chewable tablets	5% by weight	No
Beclomethasone	500 ng/mL	No
Benzocaine throat spray (Cepacol)	5% by volume	No
Blood, type A	2% (v/v)	No
Blood, type B	2% (v/v)	No
Blood, type AB	2% (v/v)	No
Blood, type O	2% (v/v)	No
Budesonide	500 ng/mL	No
Chlorpheniramine maleate	5 mg/mL	No
Dexamethasone	10 mg/mL	No
Dextromethorphan (10 mg/mL)	10 mg/mL	No
Dyclonine HCl lozenges (Sucrets)	5% w/v	No
Diphenhydramine HCl	5 mg/mL	No
Fexofenadine	500 ng/mL	No
FluMist	1% v/v	No
Fluticasone	500 ng/mL	No
Guaiacol Glyceryl Ether	20 mg/mL	No
Ibuprofen	10 mg/mL	No
Loratidine	100 ng/mL	No
Menthol Throat Lozenges	5% w/v	No
Mometasone	500 ng/mL	No
Mouthwash (at 5% by volume) Listerine	5% (v/v)	No
Mouthwash Scope	5% v/v	No
Mouthwash CVS	5% v/v	No
Mucin, salivary protein, purified	1 mg/mL	No
Nasal Spray	5% v/v	No
Nasal Spray	5% v/v	No
Nasal Spray	5% v/v	No
Oseltamivir	500 ng/mL	No
Oxymetazoline	0.05 mg/mL	No
Phenol throat spray (Chloraseptic)	5% v/v	No
Phenylephrine	1 mg/mL	No
Pseudoephedrine HCl	20 mg/mL	No
Throat drops: CVS	5% w/v	No
Throat drops: Pedia Care	5% w/v	No
Throat drops: Triaminic	5% w/v	No

Tobramycin	500 ng/mL	No
Triamcinolone	500 ng/mL	No
Zanamivir	1 mg/mL	No
Zicam throat spray (Zn / benzalkonium chloride)	5% v/v	No
Zinc Lozenges	5% w/v	No

To screen for potential interference, Group A positive samples were prepared to yield a final concentration corresponding to a weak positive. All potentially interfering substances were evaluated by spiking Group A positive samples with the concentrations listed in the table above. Prior to spiking antigen suspensions, the solid interfering substances were dissolved in water or DMSO.

Fifty microliters of each solution were added to the unitized tube containing GAS Reagents 1 and 2. The sample processed for one minute and the attached filter tip was snapped in place. Three drops of the sample were added to a BD Group A Strep test device. After five minutes at room temperature the device was inserted into the BD Veritor™ System Reader for interpretation. All determinations were performed in triplicate.

Substances were considered non-interfering with the BD Group A test if the following criteria were met:

- All three replicates showed a Negative result on the Veritor™ System Reader display for Group A Strep using a Strep A Strep negative sample
- All three replicates showed a Positive result on the Veritor ™ System Reader display for Group A Strep using a Group A Strep Positive sample

Of the substances tested in this study, none exhibited interference when either Group A positive or Group A negative samples were tested with the BD Veritor™ System for Rapid Detection of Group A Strep test.

Media Compatibility:

Various types of transport media and culture plate media commonly used in Strep A testing were evaluated for compatibility with the BD Veritor™ System for Rapid Detection of Group A Strep test. The effects of frozen storage of transport media samples on the stability of the antigen were evaluated in this study. The media tested were: Modified Amies, Modified Stuart's, Normal Saline and Phosphate Buffered Saline. The agar tested were Tryptic Soy Agar with 5% Sheep Blood and Selective Strep Agar.

Of the four media tested in this evaluation, all four demonstrated the expected results and met the acceptance criteria for both room temperature and overnight frozen storage conditions. Therefore, this suggests that these four media are all compatible with the BD Group A Strep test. Although the media were non-interfering, dry swab transport and storage is recommended for testing with the BD Group A Strep test. Storage and transport of Strep A specimens in liquid transport will likely dilute the antigen while streaking on

solid culture media may remove some organism from the swab, thus resulting in a lower number of bacteria introduced into the extraction reagent.

No interference was seen with the agars tested. Interference studies are acceptable.

Cross-Reactivity Studies:

The cross-reactivity of various Streptococcal strains was determined with the BD Veritor™ System for Rapid Detection of Group A Strep test. Lancefield Groups A, B, C, D, F and G were tested at $1X10^9$ CFU/mL in triplicate and yielded negative results. Various microorganisms (including bacteria and yeasts) that might be found in specimens were evaluated for potential cross reactivity with the BD Veritor™ System for Rapid Detection of Group A Strep test.

BD Veritor™ System for Rapid Detection of Group A Strep Cross Reactivity Study Results – Bacteria and Yeast		
Microorganism Name	**Concentration Tested**	**Group A Strep Test Result**
Arcanobacterium haemolyticum	$1x10^9$ CFU/mL	Negative
Bordetella pertussis	$5x10^8$ CFU/mL	Negative
Candida albicans	$1.x10^9$ CFU/mL	Negative
Corynebacterium diphtherium sp (Corynebacterium sp)	$1x10^9$ CFU/mL	Negative
Enterococcus faecalis	$1x10^9$ CFU/mL	Negative
Enterococcus faecium	$1x10^9$ CFU/mL	Negative
Escherichia coli	$1.5x10^9$ CFU/mL	Negative
Fusobacterium necrophorum	$1x10^9$ CFU/mL	Negative
Haemophilus influenzae	$1x10^9$ CFU/mL	Negative
Haemophilus parahemolyticus	$1.2x10^5$ CFU/mL	Negative
Haemophilus parainfluenzae	$1x10^9$ CFU/mL	Negative
Klebsiella pneumoniae	$1.5x10^9$ CFU/mL	Negative
Lactobacillus sp (Lactobacillus casei)	$1x10^9$ CFU/mL	Negative
Moraxella catarrhalis	$1x10^9$ CFU/mL	Negative
Moraxella lacunata	$1x10^9$ CFU/mL	Negative
Mycobacterium tuberculosis avirulent	$5x10^6$ CFU/mL	Negative
Neisseria gonorrhoeae	$1x10^9$ CFU/mL	Negative
Neisseria lactamica	$1x10^9$ CFU/mL	Negative
Neisseria meningitidis	$1x10^9$ CFU/mL	Negative
Neisseria mucosa	$1x10^6$ CFU/mL	Negative
Neisseria sicca	$1x10^9$ CFU/mL	Negative
Neisseria subflava	$1x10^9$ CFU/mL	Negative
Proteus vulgaris	$1x10^9$ CFU/mL	Negative
Pseudomonas aeruginosa	$1x10^9$ CFU/mL	Negative
Serratia marcescens	$1x10^9$ CFU/mL	Negative
Staphylococcus aureus	$1x10^9$ CFU/mL	Negative
Staphylococcus epidermidis	$1x10^9$ CFU/mL	Negative
Staphylococcus haemolyticus	$1x10^9$ CFU/mL	Negative
Streptococcus anginosus	$1x10^9$ CFU/mL	Negative
Streptococcus mitis	$1x10^9$ CFU/mL	Negative
Streptococcus mutans ATCC25173	$3x10^9$ CFU/mL	Negative

BD Veritor™ System for Rapid Detection of Group A Strep Cross Reactivity Study Results – Bacteria and Yeast		
Microorganism Name	**Concentration Tested**	**Group A Strep Test Result**
Staphylococcus oralis	$1x10^9$ CFU/mL	Negative
Streptococcus pneumoniae	$1x10^9$ CFU/mL	Negative
Streptococcus salivarius	$1x10^9$ CFU/mL	Negative
Staphylococcus sanguis	$1x10^9$ CFU/mL	Negative
Streptococcus sp. Group B	$1x10^9$ CFU/mL	Negative
Streptococcus sp. Group C	$1x10^9$ CFU/mL	Negative
Streptococcus sp. (bovis II) Group D	$1x10^9$ CFU/mL	Negative
Streptococcus sp. Group F	$1x10^9$ CFU/mL	Negative
Streptococcus sp. Group G	$1x10^9$ CFU/mL	Negative
Yersinia enterocolitica	$1x10^9$ CFU/mL	Negative
Adenovirus Type 1	$1.6x10^6$ $TCID_{50}$ /mL	Negative
Adenovirus Type 7	$2.81x10^5$ $TCID_{50}$/mL	Negative
Cytomegalovirus	$8.9x10^3$ $TCID_{50}$/mL	Negative
Enterovirus (VR-28 Human Coxsackievirus)	$8.9x10^6$$TCID_{50}$/mL	Negative
Epstein Barr Virus	N/A	Negative
HSV Type 1 (HF)	$8.89x10^6$ $TCID_{50}$/mL	Negative
Human coronavirus OC43	$2.81x10^4$ $TCID_{50}$/mL	Negative
Human metapneumovirus (HMPV-27 A2)	$2.8x10^6$ $TCID_{50}$/mL	Negative
Human parainfluenza	$2.8x10^6$ $TCID_{50}$/mL	Negative
Measles	$1.6x10^4$ $TCID_{50}$/mL	Negative
Mumps virus	$1.6x10^5$ $TCID_{50}$/mL	Negative
Respiratory syncytial virus VR-26	1.6×10^7 $TCID_{50}$/mL	Negative
Rhinovirus	$2.8x10^6$ $TCID_{50}$/mL	Negative

Of the microorganisms tested, none demonstrated cross-reactivity with the BD Veritor™ System for Rapid Detection of Group A Strep test.

Cross-reactivity studies are acceptable.

Analytical Reactivity:

The reactivity of various Streptococcal strains was determined with the BD Veritor™ System for Rapid Detection of Group A Strep test by evaluating a panel of six Streptococcal strains representing Lancefield Groups A, B, C, D, F and G. In this study, Bacterial strains obtained from the American Type Culture Collection (ATCC) were grown on Trypticase Soy Agar with 5% Sheep Blood and further isolated by centrifugation and resuspended in normal saline. Lancefield Groups B, C, D, E, F and G were tested at a concentration of 1×10^9 CFU/mL. Fifty microliters of each diluted bacterial suspension were added to the unitized tube containing GAS Reagents 1 and 2 and the attached filter tip was snapped in place. Three drops of the extracted sample were added to the test well of a BD Group A Strep device. After five minutes at room temperature the device was inserted into the BD Veritor™ System Reader for interpretation. All determinations were performed in triplicate. Analytical Reactivity testing was considered acceptable if the Lancefield

Group A samples produce a positive Strep A reaction with the BD Group A Strep test while all other Lancefield Groups result in a negative Strep A test.

Analytical Reactivity Acceptance Criteria	
Test Sample Type	**Acceptance Criteria**
Spiked with Lancefield Group A	Three replicates; positive test result for Strep A
Spiked with Lancefield Groups B, C, D, F, G	Three replicates; negative test result for Strep A

The following table summarizes the results of the six Streptococcal strains tested with the BD Group A Strep test. All triplicate results were concordant with the exception of one replicate of Lancefield Group F which produced a positive result. Second stage testing was performed with seven additional replicates, all of which were concordant and negative.

Strain Reactivity Study Results			
Streptococcal Strain	**Lancefield Group**	**Concentration Tested**	**Group A Strep Test Result**
S. pyogenes, ATCC 12384	A	1×10^8 CFU/mL	Positive[1]
S. agalactiae, ATCC 12386	B	1×10^9 CFU/mL	Negative[2]
S. dysgalactiae, ATCC 12388	C	1×10^9 CFU/mL	Negative
S. bovis, ATCC 35034	D	1×10^9 CFU/mL	Negative
Streptococcus sp., ATCC 12392	F	1×10^9 CFU/mL	Negative
S. dysgalactiae, ATCC 12394	G	1×10^9 CFU/mL	Negative

[1]Positive = presence of Strep A antigen
[2]Negative = absence of Strep A antigen

A total of six Streptococcal strains were tested with the BD Group A Strep test. Triplicate test results were concordant for all strains evaluated. All Lancefield Group A strains were correctly detected as positive by the test and all other Lancefield Groups were detected as negative.

This study demonstrated that the BD Veritor™ System for Rapid Detection of Group A Strep test accurately detects strains of *Streptococcus* containing Lancefield Group A antigen.

Analytical Reactivity Studies are acceptable.

f. Assay cut-off:

Not Applicable.

2. Comparison studies:

a. Method comparison with predicate device:

Not Applicable

b. Matrix comparison:

Not Applicable

3. Clinical studies:

a. Clinical Sensitivity:

Performance characteristics were established for the BD Veritor™ System for Rapid Detection of Group A Strep POC kit as compared to the reference method (culture) using diagnostic specimens from symptomatic pediatric and adult patients. A multi-center, prospective study was conducted at four POC centers located in geographically diverse areas within the United States and one clinical laboratory site. The clinical specimen type collected for this study was a throat swab (2 swabs collected simultaneously, one for standard of care and one for the investigational study).

Patient and specimen inclusion and exclusion criteria were as follows.

Patient and Specimen Inclusion/Exclusion Criteria		
Category	**Inclusion**	**Exclusion**
Subject	▪ Male and female patients of all age groups. ▪ Patients seeking medical attention exhibiting two or more symptoms of pharyngitis (i.e., pharyngeal pain [with or without swallowing], tonsilar swelling with exudates, pharyngeal erythema, tender cervical lymphadenopathy, and fever).	▪ Patients currently receiving antibiotics or having received antibiotics within the past 14 days
Specimen Criteria	▪ Only one specimen collected from the same patient may be included.	▪ Specimens from patients not presenting with the listed inclusion criteria
Collection, Preparation, Storage and Transport	▪ The paired swab specimens were held together and collected at the same time. ▪ The swab specimens were inoculated onto paired separate blood agar plates. One swab was then tested with the site's SOC test and the other swab was tested with the BD Veritor Group A Strep assay, following the procedure provided in the IUO package insert, within eight hours of collection.	▪ Room temperature specimens (20-25˚C) greater than 8 hours old

For the investigational study, one swab specimen was inoculated onto a TSA blood agar plate (BAP) and then tested with the BD Veritor Group A Strep assay following the

procedure provided in the Instructions for Use (IUO) package insert. The second paired swab was inoculated onto a separate blood agar plate and then tested with the site's standard of care rapid assay.

Bacterial culture was performed following the procedure in the Manual of Clinical Microbiology, 9th Edition: A bacitracin disk was placed on each BAP and the plates were incubated for 18-24 hours at 35-37°C. Presence of beta-hemolytic colonies >0.5 mm in diameter and any zone of growth inhibition around the bacitracin disk was considered presumptive for Group A streptococci. Beta-hemolytic colonies from the BAP were confirmed as Group A streptococci using a commercially available streptococcal latex agglutination test. If the bacterial culture was negative at 18-24 hours the BAP was re-incubated and read again at 48 hours. If beta-hemolytic growth was found at 48 hours, preliminary identification and confirmation were conducted as described above. If no beta-hemolytic colonies were found on the bacterial culture plate at 48 hours, the specimen was considered negative for Group A streptococci.

The following Table displays the BD Veritor™ System Reader Results Interpretation.

BD Veritor™ System Reader Results Interpretation	
Reader Display	**Interpretation**
STREP: +	Positive Test for Strep A (Strep A antigen present)
STREP: −	Negative Test for Strep A (no antigen detected)
CONTROL INVALID	Control line error Test Invalid

The following table shows the overall performance for the BD Veritor Group A Strep:

Performance Data – All Sites			
BD Veritor Group A Strep Assay	Culture-BD		*Total*
	P	N	
P	144	29	*173*
N	5	618	*623*
Total	*149*	*647*	*796*
Reference Method: Culture Sensitivity: 96.6% (95% CI: 92.4%, 98.6%) Specificity: 95.5% (95% CI: 93.6%, 96.9%)			

The following table shows the performance by site for the BD Veritor Group A Strep:

Performance Data – By Site				
		Culture-BD		
Site Code	**Veritor**	**P**	**N**	***Total***
C1*	**P**	20	2	22
	N	0	82	82
Total		20	84	104
Reference Method: Culture Sensitivity: 100% (83.8%, 100%) Specificity: 97.6% (91.7 %, 99.4%)				
P1**	**P**	54	3	*57*
	N	5	188	*193*
Total		*59*	*191*	*250*
Reference Method: Culture Sensitivity: 91.5% (81.7%, 96.3%) Specificity: 98.4% (95.5%, 99.5%)				
P2**	**P**	21	9	*30*
	N	0	111	*111*
Total		*21*	*120*	*141*
Reference Method: Culture Sensitivity: 100% (84.5%, 100%) Specificity: 92.5% (86.4%, 96.0%)				
P3**	**P**	21	7	*28*
	N	0	106	*106*
Total		*21*	*113*	*134*
Reference Method: Culture Sensitivity: 100% (84.5%, 100%) Specificity: 93.8% (87.8%, 97.0%)				
P4**	**P**	28	8	*36*
	N	0	131	*131*
Total		*28*	*139*	*167*
Reference Method: Culture Sensitivity: 100% (87.9%, 100%) Specificity: 94.2% (89.1%, 97.1%)				

C* Clinical Site
** POC Site
C1 and P3 are in different areas of the same Company

Clinical performance studies data are acceptable.

*b. Clinical specificity**:***

See 3(a) above

c. Other clinical supportive data (when a. and b. are not applicable):

Not Applicable

4. Clinical cut-off**:**

   Not Applicable

5. Expected values/Reference range:

   Approximately 15% of pharyngitis in children ages 3 months to 5 years is caused by group A beta-hemolytic *Streptococcus*. In school-aged children and adults, the incidence of Strep throat infection is about 40%. This disease usually occurs in the winter and early spring in temperate climates.

N. Instrument Name:

BD Veritor System Reader

O. System Descriptions:

1. Modes of Operation:

   The Veritor System Reader is a small, battery powered, bench top instrument that is used to read the Veritor lateral flow test cassette. After the extracted patient sample has been added to the test cassette, the test is developed at room temperature for 10 minutes. The cassette is then placed into the reader where it is scanned. The cassette is divided into distinct zones where the analyzer reads the negative background, positive control, and the Influenza A and B specific zones. The reader applies an algorithm to determine the background of the test as well as the specific signal from the A or B test zones. The reader has a finite number of reads and will prompt the end-user as the total reads approaches the lifetime of the unit.

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:

   Not Applicable

4. Specimen Sampling and Handling:

   Not Applicable

5. Calibration:

The Veritor Reader is not configurable by the end user and is designed to have a finite lifetime based on number of tests performed or shelf life from date of manufacture. Device calibration is not required, however, a verification device is provided with the reader to QC the device function.

6. Quality Control:

During the course of the clinical studies, quality control (QC) testing was performed for the BD Veritor Group A Strep assay each day testing was performed. QC for the system consisted of a verification cartridge for the instrument, a Group A Strep positive control for the system and a Group A Strep negative control for the system. Results were not used if the QC failed. A QC summary is shown in the Table below:

Overall QC Report												
	QC POS				**QC NEG**				**VERIFY**			
	Pass		Fail		Pass		Fail		Pass		Fail	
	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent
Site												
C1	68	100.0	0	0.0	68	100.0	0	0.0	67	100.0	0	0.0
P1	79	100.0	0	0.0	79	100.0	0	0.0	79	100.0	0	0.0
P2	50	100.0	0	0.0	49	98.0	1	2.0	46	100.0	0	0.0
P3	64	100.0	0	0.0	64	100.0	0	0.0	63	100.0	0	0.0
P4	67	100.0	0	0.0	65	98.5	1	1.5	60	100.0	0	0.0
Total	328	100.0	0	0.0	325	99.4	2	0.6	315	100.0	0	0.0

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

Not Applicable

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.