510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION
DECISION SUMMARY
ASSAY ONLY

I Background Information:

A 510(k) Number

K231221

B Applicant

Streck

C Proprietary and Established Names

MDx-Chex for BC-GP

D Regulatory Information

Product Code(s)	Classification	Regulation Section	Panel
PMN	Class II	21 CFR 866.3920 - Assayed Quality Control Material For Clinical Microbiology Assays	MI - Microbiology

II Submission/Device Overview:

A Purpose for Submission:

To obtain a substantial equivalence determination for the MDx-Chex for BC-GP.

B Measurand:

Multi-analyte quality control materials

C Type of Test:

MDx-Chex for BC-GP is intended for use as an external positive and negative assayed control to monitor the performance of the qualitative detection of Gram-positive bacteria and associated antimicrobial resistance genes, by the Luminex VERIGENE Gram-Positive Blood Culture Nucleic Acid Test (BC-GP) on Luminex VERIGENE systems. The MDx-Chex for BC-GP

Positive and Negative Controls are composed of a buffered solution with stabilized erythrocytes and leukocytes in a matrix of blood culture media components. Positive Control: Gram-positive bacteria: *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Staphylococcus lugdunensis*, *Streptococcus agalactiae*, *Streptococcus pneumoniae*, *Streptococcus pyogenes*, *Enterococcus faecalis*, *Enterococcus faecium*, *Streptococcus anginosus* group; Species: *Staphylococcus spp*., *Streptococcus spp*., *Listeria spp*.; antimicrobial resistance genes: *mecA*, *vanA*, *vanB*. Negative Control: buffered solution only.

III Intended Use/Indications for Use:

A Intended Use(s):

See Indications for Use below.

B Indication(s) for Use:

MDx-Chex for BC-GP is intended for use as an external positive and negative assayed control to monitor the performance of the qualitative detection of Gram-positive bacteria and associated antimicrobial resistance genes, by the Luminex VERIGENE Gram-Positive Blood Culture Nucleic Acid Test (BC-GP) on Luminex VERIGENE systems. The MDx-Chex for BC-GP Positive and Negative Controls are composed of a buffered solution with stabilized erythrocytes and leukocytes in a matrix of blood culture media components. Positive Control: Gram-positive bacteria: *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Staphylococcus lugdunensis*, *Streptococcus agalactiae*, *Streptococcus pneumoniae*, *Streptococcus pyogenes, Enterococcus faecalis*, *Enterococcus faecium*, *Streptococcus anginosus* group; Species: *Staphylococcus* spp., *Streptococcus* spp., *Listeria* spp.; antimicrobial resistance genes: *mecA*, *vanA*, *vanB*. Negative Control: buffered solution only. This product is not intended to replace manufacturer controls provided with the device.

C Special Conditions for Use Statement(s):

Rx - For Prescription Use Only

For in vitro diagnostic use only

D Special Instrument Requirements:

The MDx-Chex for BC-GP is only for use on the Luminex VERIGENE system.

IV Device/System Characteristics:

A Device Description:

MDx-Chex for BC-GP is a quality control kit consisting of positive and negative controls for the Luminex VERIGENE Gram-Positive Blood Culture Test (BC-GP). The MDx-Chex for BC-GP Positive Control is positive for Gram-positive bacterial pathogens and antimicrobial resistance gene markers in the VERIGENE BC-GP test (Table 1). The MDx-Chex for BC-GP Negative Control is negative for Gram-positive bacterial pathogens and antimicrobial resistance gene markers in the VERIGENE BC-GP test. The MDx-Chex for BC-GP matrix consists of blood and blood culture media components that have been identified as inhibitors to DNA hybridization assays (e.g., hemoglobin, leukocyte DNA, and anticoagulants).

Table 1: **Bacterial pathogens and antimicrobial resistance genes found in MDx-Chex for BC-GP and detected by the Luminex VERIGENE Gram-Negative Blood Culture Test on the Luminex VERIGENE system**

Gram-Positive Bacterial Pathogens	
Enterococcus faecalis	*Enterococcus faecium*
Listeria species	*Streptococcus species*
Staphylococcus species	*Streptococcus agalactiae*
Staphylococcus aureus	*Streptococcus anginosus* group
Staphylococcus epidermis	*Streptococcus pneumoniae*
Staphylococcus lugdunensis	*Streptococcus pyogenes*
Resistance Genes	
mecA (methicillin)	*vanB* (vancomycin)
vanA (vancomycin)	

The MDx-Chex for BC-GP quality control kit contains stabilized blood components, blood culture media components, and inactivated, intact microorganisms resulting in a full-process, cellular-based control for the Luminex VERIGENE BC-GP panel. Full-process controls evaluate the entire analytical process, including sample lysis, nucleic acid isolation, DNA hybridization detection, and analysis, as well as the impact of inhibitors present in blood culture samples and pre-analytical variables.

B Principle of Operation:

Not applicable.

V Substantial Equivalence Information:

A Predicate Device Name(s):
MDx-Chex for BCID2

B Predicate 510(k) Number(s):
K212576

C Comparison with Predicate(s):

Device & Predicate Device(s):	K231221	K212576
Device Trade Name	MDx-Chex for BC-GP	MDx-Chex for BCID2
General Device Characteristic Similarities		
Intended Use/Indications For Use	MDx-Chex for BC-GP is intended for use as an external positive and negative assayed control to monitor the performance of the	MDx-Chex for BCID2 is intended for use as an external positive and negative assayed control to monitor the performance of the

	qualitative detection of Gram-positive bacteria and associated antimicrobial resistance genes, by the Luminex VERIGENE Gram-Positive Blood Culture Nucleic Acid Test (BC-GP) on Luminex VERIGENE systems. The MDx-Chex for BC-GP Positive and Negative Controls are composed of a buffered solution with stabilized erythrocytes and leukocytes in a matrix of blood culture media components. Positive Control: Gram-positive bacteria: *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Staphylococcus lugdunensis*, *Streptococcus agalactiae*, *Streptococcus pneumoniae*, *Streptococcus pyogenes*, *Enterococcus faecalis*, *Enterococcus faecium*, *Streptococcus anginosus* group; Species: *Staphylococcus spp*., *Streptococcus spp*., *Listeria spp*.; antimicrobial resistance genes: *mecA*, *vanA*, *vanB*. This product is not intended to replace manufacturer controls provided with the device.	qualitative detection of yeast, Gram positive and Gram-negative bacteria, as well as associated antimicrobial resistance genes, by the BioFire FilmArray Blood Culture Identification 2 (BCID2) Panel on FilmArray systems. Control 1 - GN: Gram negative bacteria: *Acinetobacter colcoaceticus-baumannii* complex, *Bacteroides fragilis, Enterobacter cloacae* complex, *Escherichia coli, Klebsiella aerogenes, Klebsiella oxytoca, Klebsiella pneumoniae* group, *Proteus* spp., *Salmonella* spp., *Serratia marcescens, Haemophilus influenza, Neisseria meningitides, Pseudomonas aeruginosa, Stenotrophomonas maltophilia*; antimicrobial resistance genes: KPC, CTX-M, IMP, NDM, OXA-48-like, VIM, *mcr-1*. Control 2 - GPY: Gram positive bacteria: *Enterococcus faecalis, Enterococcus faecium, Listeria monocytogenes, Staphylococcus aureus, Staphylococcus epidermidis, Staphylococcus lugdunensis, Streptococcus agalactiae, Streptococcus pneumonia, Streptococcus pyogenes*; yeast: *Candida albicans, Candida auris, Candida glabrata, Candida*

		krusei, Candida parapsilosis, Candida tropicalis, Cryptococcus neoformans/gatti; antimicrobial resistance genes: *mecA/C* and MREJ, *vanA/B*. This product is not intended to replace manufacturer controls provided with the device.
Physical Format	Ready-to-Use Liquid	Same
Directions for Use	Process like a patient sample	Same
Composition	Intact inactivated bacteria, human erythrocytes and leukocytes, and relevant components of blood culture media	Same
General Device Characteristic Differences		
Assay Steps Monitored	Lysis, nucleic acid isolation/purification/inhibitor removal, DNA hybridization, detection, identification/data reporting	Lysis, nucleic acid isolation/purification/PCR inhibitor removal, amplification, detection, identification/data reporting
Number of Targets monitored in one assay	15 targets	>30 targets

VI Standards/Guidance Documents Referenced:

None.

VII Performance Characteristics (if/when applicable):

A Analytical Performance:

1. Precision/Reproducibility:

Reproducibility

A multi-site reproducibility study was conducted with the MDx-Chex for BC-GP where testing was completed at three sites with seven operators and consisted of ten positive control samples and ten negative control samples for each of three lots of MDx-Chex for BC-GP for a total of 30 samples per control and 60 samples per lot. Both positive and negative controls

were tested on different days (2 vials x 1 lot x 1 day, for 10 days and 3 different lots) for a total of 180 runs (90 runs per MDx-Chex for BC-GP positive and negative control) were generated for data analysis from all testing sites and all MDx-Chex for BC-GP lots.

All samples were prepared and analyzed on the Luminex VERIGENE System Instrument per the control Instructions for Use. This resulted in a positive percent agreement (PPA) of 100% (90/90) for the MDx-Chex for BC-GP Positive Control (Table 1) and a negative percent agreement (NPA) of 100% (90/90) for the MDx-Chex for BC-GP Negative Control (Table 2).

Table 1: MDx-Chex for BC-GP Positive Control Multi-Site Reproducibility Summary

Category	Site #1		Site #2		Site #3		PPA for All Sites Combined	95% Confidence Interval
	# Observed/# Expected Results	PPA	# Observed/# Expected Results	PPA	# Observed/# Expected Results	PPA		
MDx-Chex for BC-GP Positive Control	30/30	100%	30/30	100%	30/30	100%	100% (90/90)	96%-100%

Table 2: MDx-Chex for BC-GP Negative Control Multi-Site Reproducibility Summary

Category	Site #1		Site #2		Site #3		NPA for All Sites Combined	95% Confidence Interval
	# Observed/# Expected Results	NPA	# Observed/# Expected Results	NPA	# Observed/# Expected Results	NPA		
MDx-Chex for BC-GP Negative Control	30/30	100%	30/30	100%	30/30	100%	100% (90/90)	96%-100%

The results support the reproducibility of the MDx-Chex for BC-GP across three separately manufactured control lots between sites, days, and operators when used with the Luminex BC-GP panels on different Luminex VERIGENE systems.

Repeatability

An internal repeatability study was conducted to assess performance of MDx-Chex for BC-GP using at least two Luminex VERIGENE systems. The testing schedule consisted of evaluating MDx-Chex for BC-GP positive and negative controls across three lots for over 20 days for a total of 120 runs. Samples were prepared according to MDx-Chex for BC-GP control instructions. Samples were analyzed on the Luminex VERIGENE System per the Instructions for Use. Five to six operators tested each control using 3-4 Luminex BC-GP panel lots and 4 Luminex VERIGENE systems. This resulted in a PPA of 100% (60/60) for the MDx-Chex for BC-GP Positive Control (Table 3) and a NPA of 100% (60/60) for the MDx-Chex for BC-GP Negative Control (Table 4).

Table 3: MDx-Chex for BC-GP Positive Control Repeatability Study Summary

Category	# Observed/ #Expected Results	PPA	95% Confidence Interval
MDx-Chex for BC-GP Positive Control	60/60	100%	94%-100%

Table 4: MDx-Chex for BC-GP Negative Control Repeatability Summary

Category	# Observed/ #Expected Results	NPA	95% Confidence Interval
MDx-Chex for BC-GP Negative Control	60/60	100%	94%-100%

The results support repeatability of the MDx-Chex for BC-GP across three separately manufactured control lots when used with the Luminex BC-GP panels on the Luminex VERIGENE system.

Lot-to-Lot Reproducibility

Lot-to-lot reproducibility was demonstrated by testing three lots of MDx-Chex for BC-GP. Samples were prepared per the control Instructions for Use (IFU) prior to testing with the same Luminex BC-GP panel lot on one Luminex VERIGENE System over multiple days. Ten positive and negative MDx-Chex for BC-GP control tubes were tested on the same VERIGENE System for 60 data points total (30 per lot per positive and negative control). All MDx-Chex for BC-GP positive and negative control lots passed with ≥ 90% positive or negative agreement with expected results, respectively. Results are presented in Tables 5 and 6.

Table 5: Lot-to-Lot Reproducibility for MDx-Chex for BC-GP Positive Controls

Category	Lot #	# Observed/ # Expected Results	PPA	95% Confidence Interval
MDx-Chex for BC-GP, Positive Control	22343	9/10*	90%	55-100%
	22353	10/10	100%	69-100%
	22355	9/10*	90%	55-100%

* One positive control for lots #22343 and #22355 produced initial false negative results which upon a single retest produced the expected results. The retest runs are not included in the above calculations.

Table 6: Lot-to-Lot Reproducibility for MDx-Chex for BC-GP Negative Controls

Category	Lot #	# Observed/ # Expected Results	PPA	95% Confidence Interval
MDx-Chex for BC-GP, Negative Control	22343	10/10	100%	69-100%
	22353	10/10	100%	69-100%
	22355	10/10	100%	69-100%

The results support reproducibility of the MDx-Chex for BC-GP across three separately manufactured lots when used with the Luminex VERIGENE BC-GP panel.

2. Linearity:

Not applicable.

3. Analytical Specificity/Interference:
   Not applicable.

4. Assay Reportable Range:
   Not applicable.

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

   Closed-vial Stability

   A real-time closed-vial stability study is ongoing using three lots of MDx-Chex for BC-GP with currently available data summarized below. Twenty positive and negative control samples representing three different lots of MDx-Chex for BC-GP were stored at room (25˚C) and refrigerated temperatures (2-8˚C) and collected at different timepoints for testing. Samples were tested at day zero (ship date) and later time points for each lot and storage condition. Samples were prepared and analyzed on the Luminex VERIGENE systems per MDx-Chex for BC-GP assay Instructions for Use.

   The study is ongoing and will support the use of the MDx-Chex for BC-GP control kit throughout their labeled shelf life.

   Shipping Stability

   A shipping stability study was performed to validate the stability of MDx-Chex for BC-GP during shipment. One of the MDx-Chex for BC-GP lots from each storage temperature (2°C and 25°C) was subjected to simulated winter and summer shipping temperature profiles over 5 days. Data was collected from 20 samples per positive and negative control for each simulated shipping profile within the 60-day closed-vial stability testing period. Temperature stress conditions for summer and winter include a 120-hour exposure period with the following temperature profile presented in Table 7:

Table 7: Temperature Stress Conditions

Duration of Incubation (hours)	Summer Temperature	Winter Temperature
5h	22°C	22°C
14h	26°C	15°C
5.5h	22°C	22°C
5.5h	25°C	17°C
10h	22°C	22°C
2h	40°C	-10°C
15h	29°C	10°C
5h	40°C	-10°C
17.5h	26°C	15°C
11.5h	29°C	10°C
10h	22°C	22°C
7.5h	30°C	8°C
11.5h	24°C	18°C

Samples at each storage temperature (2-8°C and 20-25°C) were exposed to either winter or summer temperature extremes and then were stored back at each respective temperature for a week prior to being tested using Luminex BC-GP panel. All results met the predefined acceptance criteria of PPA or NPA ≥90% and are presented in Tables 8 and 9.

Table 8: Shipping Stability Study Results for the MDx-Chex for BC-GP Positive Control

Category	Storage Temperature	# Observed/ # Expected Results	PPA	95% Confidence Interval
Summer	2-8˚C	20/20	100%	83-100%
	20-25˚C	20/20	100%	83-100%
Winter	2-8˚C	20/20	100%	83-100%
	20-25˚C	20/20	100%	83-100%

Table 9: Shipping Stability Study Results for the MDx-Chex for BC-GP Negative Control

Category	Storage Temperature[#]	# Observed/ # Expected Results	NPA	95% Confidence Interval
Summer	2-8˚C	20/20	100%	83-100%
	20-25˚C	20/20	100%	83-100%
Winter	2-8˚C	20/20	100%	83-100%
	20-25˚C	20/20	100%	83-100%

Results demonstrate the MDx-Chex for BC-GP control kit is stable and functional after exposure to extreme summer and winter shipping temperature conditions.

6. Detection Limit:

   Not applicable.

7. Assay Cut-Off:

   Not applicable.

B Comparison Studies:

1. Method Comparison with Predicate Device:

   Not applicable.

2. Matrix Comparison:

   The matrix of MDx-Chex for BC-GP is made of stabilized blood components (erythrocytes and leukocytes) in a simulated blood culture media. Since the matrix is not identical to that of the routine Luminex BC-GP assay sample, blood culture media, a test was performed to investigate the effect of the matrix on the assay.

   To confirm that the simulated blood culture matrix does not impact performance of the Luminex BC-GP panel, *Streptococcus agalactiae* (5.0×10^7 cells/mL final concentration)

was spiked into one lot of MDx-Chex for BC-GP matrix as well as into BD BACTEC Plus Aerobic/F culture vial with negative whole blood to simulate a clinical sample. These samples were then tested in triplicate using the Luminex BC-GP. Three replicates of each simulated matrix with no spike-in organism were also tested to serve as negative controls. The results presented in Tables 10 and 11 showed PPA and NPA of 100%, respectively.

Table 10: Matrix Equivalency Study Results for Control and Clinical Matrix Spiked with *Streptococcus agalactiae*

Matrix Type	# Observed/# Expected Results	PPA	95% Confidence Interval
MDx-Chex for BC-GP Matrix, Positive Control	3/3	100%	29-100%
Clinical Matrix, Positive Control	3/3	100%	29-100%

Table 11: Matrix Equivalency Study Results for Unspiked Control and Clinical Matrix

Matrix Type	# Observed/# Expected Results	NPA	95% Confidence Interval
MDx-Chex for BC-GP Matrix, Negative Control	3/3	100%	29-100%
Clinical Matrix, Negative Control	3/3	100%	29-100%

The results demonstrate that MDx-Chex for BC-GP matrix has no effect on target detection (no inhibition and/or false negative results) when tested with the Luminex BC-GP panel.

C Clinical Studies:

1. Clinical Sensitivity:

   Not applicable.

2. Clinical Specificity:

   Not applicable.

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:

MDx-Chex for BC-GP is a qualitative control and the expected results are listed in Table 12 below.

Table 12: Bacterial Pathogens and Antimicrobial Resistance Genes Detected by MDx-Chex for BC-GP Positive and Negative Controls

Gram-Positive Bacteria		
Pathogen	**Positive Control**	**Negative Control**
Enterococcus faecalis	Detected	Not Detected
Enterococcus faecium	Detected	Not Detected
Listeria spp.	Detected	Not Detected
Staphylococcus spp.	Detected	Not Detected
Staphylococcus aureus	Detected	Not Detected
Staphylococcus epidermidis	Detected	Not Detected
Staphylococcus lugdunensis	Detected	Not Detected
Streptococcus spp.	Detected	Not Detected
Streptococcus agalactiae	Detected	Not Detected
Streptococcus anginosus group	Detected	Not Detected
Streptococcus pneumoniae	Detected	Not Detected
Streptococcus pyogenes	Detected	Not Detected
Antimicrobial Resistance Genes		
Gene	**Positive Control**	**Negative Control**
mecA (methicillin)	Detected	Not Detected
vanA (vancomycin)	Detected	Not Detected
vanB (vancomycin)	Detected	Not Detected

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.