510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION
DECISION SUMMARY

A. 510(k) Number:

K182692

B. Purpose for Submission:

To obtain clearance for a new device, BD MAX CTGCTV2 on BD MAX System

C. Measurand:

Chlamydia trachomatis (CT), *Neisseria gonorrhoeae* (GC), and *Trichomonas vaginalis* (TV) DNA

D. Type of Test:

Nucleic acid amplification assay (real-time polymerase chain reaction)

E. Applicant:

Becton, Dickinson and Company (BD)

F. Proprietary and Established Names:

BD MAX CTGCTV2 (assay)
BD MAX (instrument)

G. Regulatory Information:

1. Regulation section:

   21 CFR 866.3860 - *Trichomonas vaginalis* nucleic acid assay

2. Classification:

   Class II

3. Product code:

   OUY *Trichomonas vaginalis* Nucleic Acid Amplification Test System
   MKZ DNA Probe, Nucleic Acid Amplification, *Chlamydia*
   LSL DNA-Reagents, *Neisseria*

4. Panel:

   Microbiology (83)

H. Intended Use:

1. Intended use(s):

   The BD MAX CTGCTV2 assay, performed on the BD MAX System, incorporates automated DNA extraction and real-time polymerase chain reaction (PCR) for the direct, qualitative detection of DNA from:

   - *Chlamydia trachomatis* (CT)
   - *Neisseria gonorrhoeae* (GC)
   - *Trichomonas vaginalis* (TV)

   The assay may be used for detection of CT, GC and/or TV DNA in patient- or clinician-collected vaginal swab specimens (in a clinical setting), and male and female urine specimens. The assay may also be used for the detection of CT and GC DNA in endocervical swab and Liquid-Based Cytology (LBC) specimens in PreservCyt® Solution using an aliquot that is removed prior to processing for the ThinPrepTM Pap test.

   The assay is indicated for use with asymptomatic and symptomatic individuals to aid in the diagnosis of chlamydial urogenital disease, gonococcal urogenital disease and/or trichomoniasis.

   Ancillary Collection kits:

   The BD MAX 3-in-1 Swab Collection Kit is intended to be used in clinical settings according to the instructions provided for collection and transport of vaginal and endocervical swab specimens. This transport system is for use for testing with BD MAX products.

   The BD MAX Urine Transport Kit is intended to be used in clinical settings according to the instructions provided for collection, preservation and transport of urine specimens. This transport system is for use for testing with the BD MAX products.

   The BD MAX LBC Sample Buffer Tubes are intended to be used in clinical settings according to the instructions provided for the preservation and transport of Liquid-Based Cytology (LBC) specimens. This transport system is for use for testing with the BD MAX products.

2. Indication(s) for use:

   Same as the Intended use above.

3. Special conditions for use statement(s):

   For prescription use only.

4. Special instrument requirements:

   BD MAX System

I. Device Description:

The BD MAX System and the BD MAX CTGCTV 2 assay are comprised of an instrument with associated hardware and accessories, and a reagent kit. Each reagent kit contains a PCR cartridge with the master mix, Unitized Reagent Strips (URS), extraction reagent, and sample buffer tubes, sufficient for 24 tests.

Urogenital specimens are collected using proprietary collection kits (BD MAX Urine Transport Kit, the BD MAX LBC Sample Buffer Tubes or the BD MAX 3-in-1 Swab Collection Kit) and transported to a laboratory. The Unitized Reagent Strips needed for the run are placed in the sample rack and securely seated. Foil-sealed dried Extraction Tubes and PCR reagent tubes are snapped into the appropriate positions on each Unitized Reagent Strip. The PCR cartridge is placed in a designated place on the instrument and the specimens are loaded onto a sample rack. As the run is initiated, the reagents are rehydrated and the cells in the sample are lysed releasing DNA which is then bound to magnetic beads. After a washing step, the PCR master mix is added and the specific targets, if present, are amplified followed by detection of the generated fluorescent signal.

Specimens collected in PreservCyt solution (Liquid-based Cytology (LBC) specimens) require a pre-warming step prior to loading on the BD MAX instrument, using the BD Pre-Warm Heater. Following the pre-heating, a 0.5 mL aliquot of the specimen is transferred to the BD MAX LBC Sample Buffer Tube and loaded onto the instrument.

The instrument consists of a sample processing sub-system with a fluid handling robot, and the integrated readers, which perform thermal cycling and optical detection. 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.

A Sample Processing Control is included in every Extraction Tube and serves to detect a reagent or a procedure failure during the extraction and thermal cycling steps. The probes used for the amplification are labeled with a fluorophore which generates fluorescence in the presence of complementary sequences. The BD MAX software interprets the emitted fluorescence to generate final qualitative results. The following table shows the result interpretation for the BD MAX CTGCTV2 assay.

Result Interpretation

Assay Result Reported	Interpretation of Results
CT POS	*Chlamydia trachomatis* DNA Detected
CT NEG	No *Chlamydia trachomatis* DNA Detected
CT UNR	Unresolved – inhibitory sample or reagent failure; no target or Sample Processing Control amplification
GC POS	*Neisseria gonorrhoeae* DNA Detected
GC NEG	No *Neisseria gonorrhoeae* DNA Detected
GC UNR	Unresolved – inhibitory sample or reagent failure; no target or Sample Processing Control amplification
TV POS	*Trichomonas vaginalis* DNA Detected
TV NEG	No *Trichomonas vaginalis* DNA Detected
TV UNR	Unresolved – inhibitory sample or reagent failure; no target or Sample Processing Control amplification
IND	Indeterminate result due to BD MAX System failure (with Warning or Error Codes)
INC	Incomplete Run (with Warning or Error Codes)

J. Substantial Equivalence Information:

1. Predicate device name(s):

   BD MAX CT/GC/TV

2. Predicate 510(k) number(s):

   K151589

3. Comparison with predicate:

Similarities and Differences

Item	BD MAX CTGCTV2 K182692	BD MAX CTGCTV K151589
Regulation	866.3860	866.3860
Intended Use	The BD MAX CTGCTV2 assay, performed on the BD MAX System, incorporates automated DNA extraction and real-time polymerase chain reaction (PCR) for the direct, qualitative detection of DNA from: • *Chlamydia trachomatis* (CT) • *Neisseria gonorrhoeae* (GC) • *Trichomonas vaginalis* (TV)	The BD MAX CT/GC/TV assay, as performed using the BD MAX System incorporates automated DNA extraction and real-time polymerase chain reaction (PCR) for the direct, qualitative detection of DNA from *Chlamydia trachomatis* (CT), *Neisseria gonorrhoeae* (GC) and/or *Trichomonas vaginalis* (TV). The assay may be used for detection of CT and/or GC DNA in male urine specimens, and the detection

Item	BD MAX CTGCTV2 K182692			BD MAX CTGCTV K151589		
	The assay may be used for detection of CT, GC and/or TV DNA in patient- or clinician-collected vaginal swab specimens (in a clinical setting), and male and female urine specimens. The assay may also be used for the detection of CT and GC DNA in endocervical swab and Liquid-Based Cytology (LBC) specimens in PreservCyt® Solution using an aliquot that is removed prior to processing for the ThinPrep Pap test. The assay is indicated for use with asymptomatic and symptomatic individuals to aid in the diagnosis of chlamydial urogenital disease, gonococcal urogenital disease and/or trichomoniasis.			of CT, GC and/or TV DNA in female urine specimens, clinician-collected female endocervical swab specimens and patient-collected vaginal swab specimens (in a clinical setting). The assay is indicated for use to aid in the diagnosis of chlamydial urogenital disease, gonococcal urogenital disease and/or trichomoniasis in asymptomatic and symptomatic individuals.		
Ancillary Collection/ Transport Kits	• Swab Sample Buffer Tube (2.0 mL) (same formulation as UVE Sample Buffer) • Urine Sample Buffer Tube (0.5 mL) • LBC Sample Buffer Tube (1.5 mL)			• UVE Sample Buffer Tube (1.5 mL), swab/urine		
Assay Results	Qualitative			Qualitative		
Organisms Detected	*Chlamydia trachomatis* *Neisseria gonorrhoeae* *Trichomonas vaginalis*			*Chlamydia trachomatis* *Neisseria gonorrhoeae* *Trichomonas vaginalis*		
Instrument	BD MAX System			BD MAX System		
Technology	Real-time PCR			Real-time PCR		
Specimens	For CT and GC: • Clinician-collected vaginal swab • Patient-collected vaginal swab • Endocervical swab • PreservCyt LBC • Urine (female and male) For TV: • Clinician-collected vaginal swab, • Patient-collected vaginal swab • Urine (female and male)			For CT, GC and TV: • Endocervical swab, • Patient-collected vaginal swab, • Urine (female and male)		
Assay Controls	Sample Processing Control			Sample Processing Control		
Target Detection	**Target**	**Dye**	**Channel**	**Target**	**Dye**	**Channel**
	CT	FAM	FAM	CT	FAM	FAM
	CT	FAM	FAM	CT	FAM	FAM

Item	BD MAX CTGCTV2 K182692			BD MAX CTGCTV K151589		
	GC (GC1)	CFO	VIC	GC (GC1)	CFO	VIC
	GC (GC2)	Q705	CY5.5	NA	NA	NA
	TV	Q670	CY5	TV	Q670	CY5
Sample Prep	• 1 swab added to Swab Sample Buffer Tube • 2.0 mL urine added to Urine Sample Buffer Tube • 0.5 mL LBC added to LBC Sample Buffer Tube			• 1 swab added to UVE Sample Buffer Tube • 1.0 ml urine added to UVE Sample Buffer Tube		
Pre-analytical	Prewarm only LBC samples prior to extraction			Prewarm all UVE samples prior to extraction		
Extraction	Magnetic affinity beads with protease			Magnetic affinity beads with protease		
On-board lysis	On-board lysis of all specimens			No on-board lysis		

K. Standard/Guidance Document Referenced (if applicable):

Class II Special Controls Guideline: Nucleic Acid Amplification Assays for the Detection of *Trichomonas vaginalis* Guideline for Industry and Food and Drug Administration Staff, issued August 4, 2015

EP-07-A2, 2012 - Interference Testing in Clinical Chemistry; Approved Guideline

MM03-ED3, 2015 – Molecular Diagnostic Methods for Infectious Diseases, Approved Guideline

EP12-A2, 2008 – User protocol for Evaluation of Qualitative Test performance, Approved Guideline

M29-A4, 2014 – Protection of laboratory workers from occupationally acquired infections, Approved Guideline

L. Test Principle:

The assay utilizes real-time polymerase chain reaction (PCR) for amplification of specific genetic sequences in the DNA of the target microorganisms. The nucleic acids from the target organisms are released during cell lysis and are captured on magnetic affinity beads. The beads are washed using Wash Buffer and the nucleic acids are then eluted by a combination of heat and pH. Eluted DNA is neutralized using Neutralization Buffer and transferred to the Master Mix to rehydrate the PCR reagents. After reconstitution, the BD MAX System dispenses a fixed volume of PCR-ready solution containing extracted nucleic acids into the BD MAX PCR Cartridge. Microvalves in the BD MAX PCR Cartridge are sealed by the system prior to initiating PCR in order to contain the amplification mixture, thus preventing evaporation and contamination.

The amplified DNA targets are detected using hydrolysis (TaqMan) probes, labeled at one end with a fluorescent reporter dye (fluorophore), and at the other end with a quencher moiety. Probes labeled with different fluorophores are used to detect amplicons for target analytes and the Sample Processing Control in five different optical channels of the BD MAX System. When the probes are in their native state, the fluorescence of the fluorophore is quenched due to its proximity to the quencher. However, in the presence of target DNA, the probes hybridize to their complementary sequences and are hydrolyzed by the 5'-3' exonuclease activity of the DNA polymerase as it synthesizes the nascent strand along the DNA template. As a result, the fluorophores are separated from the quencher molecules and fluorescence is emitted. The BD MAX System monitors these signals at the end of each cycle and interprets the data at the end of the reaction to provide qualitative test results for each analyte (i.e., positive or negative).

M. Performance Characteristics:

1. Analytical performance:

a. Precision

Within-laboratory precision was evaluated for the BD MAX CTGCTV2 assay at one site with one lot of reagents. Testing was performed over 12 days, by two technologists, alternating each day to perform two runs (total of 24 runs). The test panel consisted of four samples prepared in pooled negative vaginal, urine, and PreservCyt specimen matrix. Each of the three organisms, *Chlamydia trachomatis* (Serovar D), *Neisseria gonorrhoeae*, and *Trichomonas vaginalis*, was spiked into the respective matrices at the following target concentrations relative to the established limit of detection (LoD):

- True negative (TN): no target (expected negative 100% of the time)
- Low Positive (LP): 1.5x LoD (expected positive 95% to 100% of the time)
- High Negative (HN): below assay LoD (expected negative 5% to 95% of the time)
- Moderate Positive (MP): 3x LoD (expected positive 100% of the time)

The following 10 panel members were prepared:

Precision Test Panel

Panel Member	Target Level		
	CT	GC	TV
1	MP	TN	TN
2	LP	TN	TN
3	HN	TN	TN
4	TN	MP	TN
5	TN	LP	TN
6	TN	HN	TN
7	TN	TN	MP
8	TN	TN	LP

Panel Member	Target Level		
	CT	GC	TV
9	TN	TN	HN
10	TN	TN	TN

Each sample was tested in duplicate in each run and one pair of positive and negative External Controls was included in each test run.

The within-laboratory qualitative and quantitative precision data by target are presented below. The mean values with the associated variance components (SD and %CV) are based on ct.score values, the internal numeric instrument output used to determine the final assay result. The within-laboratory precision results for the BD MAX CTGCTV2 are shown below.

Overall Precision (Within Laboratory) Using One Lot of the BD MAX CTGCTV2

Category	Percent Agreement with Expected Results							
	Chlamydia trachomatis (n), 95% CI			*Neisseria gonorrhoeae* (n), 95% CI			*Trichomonas vaginalis* (n), 95% CI	
	Swab	Urine	LBC[c]	Swab	Urine	LBC[c]	Swab	Urine
TN[a]	100% (336/336) 98.9-100	100% (336/336) 98.9-100	99.4% (334/336) 97.9-99.8	100% (336/336) 98.9-100	100% (336/336) 98.9-100	100% (336/336) 98.9-100	100% (336/336) 98.9-100	100% (336/336) 98.9-100
HN[b]	31.3% (15/48) 19.9-45.3	31.3% (15/48) 19.9-45.3	18.8% (9/48) 10.2-31.9	27.1% (13/48) 16.6-41.0	29.2% (14/48) 18.2-43.2	16.7% (8/48) 8.7-29.6	37.5% (18/48) 25.2-51.6	68.8% (33/48) 54.7-80.1
LP	100% (48/48) 92.6-100	100% (48/48) 92.6-100	100% (48/48) 92.6-100	97.9% (47/48) 89.1-99.6	100% (48/48) 92.6-100	100% (48/48) 92.6-100	97.9% (47/48) 89.1-99.6	100% (48/48) 92.6-100
MP	100% (48/48) 92.6-100	100% (48/48) 92.6-100	100% (48/48) 92.6-100	100% (48/48) 92.6-100	100% (48/48) 92.6-100	100% (48/48) 92.6-100	100% (48/48) 92.6-100	100% (48/48) 92.6-100

[a] For the True Negative (TN) category, the reported agreement indicates the percent of negative results.
[b] For the High Negative (HN) category, the reported agreement indicates the percent of positive results.
[c] PreservCyt Solution

***Chlamydia trachomatis* Within-laboratory Precision, Quantitative, by Matrix**

Matrix	Sample	Agree/N	Mean	Within Run		Between Run		Between Day		Between Operator		Total	
				SD	% CV	SD	% CV	SD	% CV	SD	% CV	SD	% CV
Swab	HN	15/48	36.5	0.9	2.4	2.0	5.5	0.0	0.0	0.0	0.0	2.2	6.0
	LP	48/48	33.2	0.6	1.8	0.3	0.8	0.0	0.0	0.2	0.6	0.7	2.1
	MP	48/48	32.3	0.5	1.7	0.1	0.4	0.0	0.0	0.0	0.0	0.6	1.7
Urine	HN	15/48	37.4	2.1	5.5	0.0	0.0	0.0	0.0	0.0	0.0	2.1	5.5
	LP	48/48	32.7	0.7	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.7	2.2
	MP	48/48	34.0	1.1	3.1	0.0	0.0	0.4	1.1	0.0	0.0	1.1	3.3
LBC[a]	HN	9/48	38.7	1.7	4.4	0.1	0.4	1.4	3.7	0.0	0.0	2.2	5.8

Matrix	Sample	Agree/N	Mean	Within Run		Between Run		Between Day		Between Operator		Total	
				SD	% CV	SD	% CV	SD	% CV	SD	% CV	SD	% CV
	LP	48/48	34.9	1.1	3.0	0.7	1.9	0.0	0.0	0.0	0.0	1.2	3.6
	MP	48/48	33.3	0.6	1.7	0.3	0.8	0.0	0.0	0.1	0.2	0.6	1.9

[a]PreserveCyt Solution

Neisseria gonorrhoeae Within-laboratory Precision, Quantitative, by Matrix

Target	Matrix Type	Sample	Agree /N	Mean	Within Run		Between Run		Between Day		Between Operator		Total	
					SD	% CV	SD	% CV	SD	% CV	SD	% CV	SD	% CV
GC1	Swab	HN	13/48	35.4	1.6	4.6	0.0	0.0	0.0	0.0	0.0	0.0	1.6	4.6
		LP	47/48	32.5	1.1	3.4	0.0	0.0	0.4	1.2	0.2	0.5	1.2	3.7
		MP	48/48	31.3	0.5	1.7	0.0	0.0	0.1	0.2	0.0	0.0	0.5	1.7
	Urine	HN	14/48	37.1	2.8	7.7	0.0	0.0	0.0	0.0	0.5	1.3	2.9	7.8
		LP	48/48	32.4	0.8	2.4	0.1	0.2	0.0	0.0	0.0	0.0	0.8	2.4
		MP	48/48	32.8	0.9	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.9	2.7
	LBC[a]	HN	8/48	37.6	3.5	9.2	0.0	0.0	0.0	0.0	0.0	0.0	3.5	9.2
		LP	48/48	31.9	0.5	1.7	0.1	0.4	0.2	0.6	0.0	0.0	0.6	1.8
		MP	48/48	30.7	0.5	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.6
GC2	Swab	HN	13/48	34.9	0.6	1.6	1.6	4.5	1.4	4.0	0.0	0.0	2.2	6.3
		LP	47/48	30.8	0.5	1.6	0.2	0.7	0.0	0.0	0.0	0.1	0.5	1.7
		MP	48/48	29.9	0.5	1.7	0.0	0.0	0.0	0.0	0.1	0.4	0.5	1.7
	Urine	HN	14/48	34.5	1.2	3.4	0.0	0.0	0.0	0.0	0.6	1.7	1.3	3.8
		LP	48/48	31.1	0.7	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.7	2.1
		MP	48/48	31.5	0.6	1.8	0.3	0.8	0.0	0.0	0.0	0.0	0.6	2.0
	LBC[a]	HN	8/48	35.8	0.6	1.8	2.3	6.5	2.4	6.7	0.0	0.0	3.4	9.5
		LP	48/48	30.4	0.4	1.3	0.2	0.8	0.0	0.0	0.1	0.4	0.5	1.5
		MP	48/48	29.3	0.4	1.5	0.2	0.6	0.0	0.0	0.1	0.4	0.5	1.6

[a]PreservCyt Solution

Trichomonas vaginalis Within-laboratory Precision, Quantitative, by Matrix

Matrix Type	Cat	Agree /N	Mean	Within Run		Between Run		Between Day		Between Operator		Total	
				SD	% CV	SD	% CV	SD	% CV	SD	% CV	SD	% CV
Swab	HN	18/48	36.6	2.1	5.7	0.0	0.0	0.0	0.0	0.0	0.0	2.1	5.7
	LP	47/48	32.9	0.6	1.9	0.0	0.0	0.0	0.0	0.3	0.8	0.7	2.0
	MP	48/48	32.1	0.5	1.6	0.0	0.0	0.2	0.5	0.1	0.5	0.6	1.8
Urine	HN	33/48	37.3	2.3	6.2	1.5	3.9	0.0	0.0	0.3	0.8	2.8	7.4
	LP	48/48	32.3	0.5	1.4	0.0	0.0	0.1	0.2	0.0	0.0	0.5	1.4
	MP	48/48	33.6	0.6	1.9	0.1	0.4	0.0	0.0	0.0	0.0	0.6	1.9

Based on the evaluation of precision of the BD MAX CTGCTV2 assay system, conducted at one site, with one lot of reagents, the overall variability (for positive samples), across all matrices and across all analytical targets, expressed as %CV, ranged from 3.8% to 9.5% for

the High Negative samples; from 1.4% to 3.7% for the Low Positive samples; and from 1.5% to 3.3% for the Moderate Positive samples.

b. Reproducibility

Site-to-Site Reproducibility

A site-to-site reproducibility of the BD MAX CTGCTV2 assay was evaluated at three testing sites (two external and one internal), using one lot of reagents. Testing was performed on eight distinct days, by two technologists, alternating each day to perform two runs per day (16 runs per site, a total of 48 runs across the sites). Each site was provided the same panels as described for the Precision study, above. Each sample was tested in duplicate in each run and one pair of positive and negative External Controls was included in each test run.

The data was analyzed for percent agreement with the expected qualitative results. Additionally, quantitative analyses of the PCR parameters were performed for each target (for positive results only).

Site-to-Site Reproducibility, Qualitative, Across Sites

Percent Agreement with Expected Results								
Sample	***Chlamydia trachomatis* (n), 95% CI**			***Neisseria gonorrhoeae* (n), 95% CI**			***Trichomonas vaginalis* (n), 95% CI**	
	Swab	**Urine**	**LBC[c]**	**Swab**	**Urine**	**LBC[c]**	**Swab**	**Urine**
TN[a]	99.6% (669/672) 98.7-99.8	100% (672/672) 99.4-100	100% (672/672) 99.4-100	100% (672/672) 99.4-100	100% (672/672) 99.4-100	99.9% (671/672) 99.2-100	99.9% (671/672) 99.2-100	100% (672/672) 99.4-100
HN[b]	20.8% (20/96) 13.9-30.0	35.4% (34/96) 26.6-45.4	21.9% (21/96) 14.8-31.1	34.4% (33/96) 25.6-44.3	28.1% (27/96) 20.1-37.8	11.5% (11/96) 6.5-19.4	37.5% (36/96) 28.5-47.5	78.1% (75/96) 68.9-85.2
LP	100% (96/96) 96.2-100	100% (96/96) 96.2-100	100% (96/96) 96.2-100	99.0% (95/96) 94.3-99.8	99.0% (95/96) 94.3-99.8	97.9% (94/96) 92.7-99.4	99.0% (95/96) 94.3-99.8	99.0% (95/96) 94.3-99.8
MP	100% (96/96) 96.2-100	99.0% (95/96) 94.3-99.8	100% (96/96) 96.2-100	100% (96/96) 96.2-100	100% (96/96) 96.2-100	100% (96/96) 96.2-100	100% (96/96) 96.2-100	97.9% (94/96) 92.7-99.4

[a] For the True Negative (TN) category, the reported agreement indicates the percent of negative results.
[b] For the High Negative (HN) category, the reported agreement indicates the percent of positive results.
[c] PreservCyt Solution

Chlamydia trachomatis Site-to-Site Reproducibility, Quantitative, by Matrix

Matrix Type	Sample	Agree /N	Mean	Within Run		Between Run		Between Day		Between Operator		Between Site		Total	
				SD	% CV	SD	% CV	SD	% CV	SD	% CV	SD	% CV	SD	% CV
Swab	HN	20/96	36.6	1.1	3.1	1.8	4.9	0.1	0.4	0.0	0.0	0.0	0.0	2.1	5.8
	LP	96/96	33.2	0.7	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	2.1
	MP	96/96	32.1	0.6	2.0	0.0	0.0	0.2	0.5	0.0	0.0	0.1	0.4	0.7	2.1
Urine	HN	34/96	36.8	1.6	4.3	0.0	0.0	0.8	2.1	0.0	0.0	0.4	1.0	1.8	4.9
	LP	96/96	32.9	0.7	2.3	0.0	0.0	0.7	2.0	0.3	0.9	0.0	0.0	1.1	3.2
	MP	95/96	33.9	1.1	3.1	0.1	0.4	0.2	0.4	0.0	0.0	0.0	0.0	1.1	3.2
LBC[a]	HN	21/96	38.1	0.7	1.9	2.0	5.1	0.0	0.0	1.4	3.8	0.0	0.0	2.5	6.6
	LP	96/96	34.6	1.1	3.2	0.4	1.2	0.3	0.9	0.0	0.0	0.7	2.0	1.4	4.0
	MP	96/96	33.1	0.6	1.8	0.0	0.0	0.2	0.7	0.0	0.0	0.2	0.7	0.7	2.1

[a]PreservCyt Solution

Neisseria Gonorrhoeae Site-to-Site Reproducibility, Quantitative, by Matrix

Target	Matrix	Sample	Agree /N	Mean	Within Run		Between Run		Between Day		Between Operator		Between Site		Total	
					SD	%CV	SD	%CV	SD	%CV	SD	%CV	SD	%CV	SD	%CV
GC1	Swab	HN	33/96	36.3	2.1	5.7	0.9	2.5	0.0	0.0	0.0	0.0	0.6	1.7	2.3	6.4
		LP	95/96	32.5	0.9	2.8	0.0	0.0	0.3	0.9	0.0	0.0	0.1	0.3	1.0	2.9
		MP	96/96	31.4	0.5	1.5	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.5	1.5
	Urine	HN	27/96	36.5	2.1	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.7	2.0	2.2	6.1
		LP	95/96	32.5	1.1	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	1.1	3.5
		MP	96/96	32.8	0.9	2.6	0.4	1.3	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.9
	LBC[a]	HN	11/96	35.5	1.4	3.9	0.0	0.0	0.9	2.7	0.0	0.0	0.0	0.0	1.7	4.7
		LP	94/96	32.1	0.5	1.6	0.4	1.2	0.3	1.0	0.1	0.4	0.1	0.4	0.7	2.3
		MP	96/96	30.7	0.5	1.5	0.5	1.5	0.0	0.0	0.0	0.0	0.4	1.2	0.7	2.4
GC2	Swab	HN	33/96	34.2	1.1	3.2	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1.1	3.2
		LP	95/96	30.9	0.7	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	2.2
		MP	96/96	29.8	0.4	1.3	0.0	0.0	0.0	0.0	0.1	0.4	0.2	0.7	0.4	1.5
	Urine	HN	27/96	34.8	1.4	4.0	0.9	2.5	0.0	0.0	0.4	1.1	0.5	1.5	1.8	5.1
		LP	95/96	31.0	0.7	2.4	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.7	2.4
		MP	96/96	31.2	0.6	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.8	0.6	2.1
	LBC[a]	HN	11/96	35.3	0.8	2.2	1.1	3.1	0.0	0.0	0.0	0.0	0.8	2.3	1.6	4.5
		LP	94/96	30.5	0.4	1.2	0.4	1.3	0.3	1.1	0.0	0.0	0.2	0.8	0.7	2.2
		MP	96/96	29.2	0.3	1.1	0.4	1.3	0.2	0.7	0.1	0.5	0.3	1.0	0.6	2.2

[a]PreservCyt Solution

***Trichomonas vaginalis* Site-to-Site Reproducibility, Quantitative, by Matrix**

Matrix	Sample	Agree/ N	Mean	Within Run		Between Run		Between Day		Between Operator		Between Site		Total	
				SD	% CV	SD	% CV	SD	% CV	SD	% CV	SD	% CV	SD	% CV
Swab	HN	36/96	36.9	1.8	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	5.0
	LP	95/96	33.2	0.7	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	0.8	2.3
	MP	96/96	32.3	0.5	1.6	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.5	1.6
Urine	HN	75/96	37.2	2.4	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	6.6
	LP	95/96	32.5	0.7	2.2	0.0	0.0	0.3	0.9	0.2	0.6	0.2	0.5	0.8	2.5
	MP	94/96	33.7	0.8	2.4	0.3	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	2.6

Based on the evaluation of reproducibility of the BD MAX CTGCTV2 assay system, conducted at three sites, with one lot of reagents, the overall variability (for positive samples), across all matrices and across all analytical targets, expressed as % CV, ranged from 3.2% to 6.6% for the High Negative samples; from 2.1% to 4.0% for the Low Positive samples; and from 1.5% to 3.2% for the Moderate Positive samples.

Lot-to-Lot Reproducibility

A lot-to-lot reproducibility was evaluated at one (internal) site using three lots of reagents. The testing was performed over eight days, by two technologists, alternating each day to perform two runs per day. Using the same test panels as described for the Precision study, above, there were 16 runs performed on each lot of reagents, for a total of 48 runs. Each sample was tested in duplicate in each run and one pair of positive and negative External Controls was included in each test run.

The data was analyzed for percent agreement with the expected qualitative results. Additionally, quantitative analyses of the PCR parameters were performed for each target (for positive results only).

Lot-to-Lot Reproducibility, by Organism, Qualitative

Category	Percent Agreement with Expected Results							
	Chlamydia trachomatis			*Neisseria gonorrhoeae*			*Trichomonas vaginalis*	
	Swab	Urine	LBC[c]	Swab	Urine	LBC[c]	Swab	Urine
TN[a]	99.4% (668/672) 98.5-99.8	100% (672/672) 99.4-100	99.6% (669/672) 98.7-99.8	99.9% (671/672) 99.2-100	100% (672/672) 99.4-100	100% (672/672) 99.4-100	100% (672/672) 99.4-100	100% (672/672) 99.4-100
HN[b]	22.9% (22/96) 15.6-32.3	37.5% (36/96) 28.5-47.5	15.6% (15/96) 9.7-24.2	24.0% (23/96) 16.5-33.4	24.0% (23/96) 16.5-33.4	10.4% (10/96) 5.8-18.1	40.6% (39/96) 31.3-50.6	63.5% (61/96) 53.6-72.5
LP	100% (96/96) 96.2-100	100% (96/96) 96.2-100	99.0% (95/96) 94.3-99.8	99.0% (95/96) 94.3-99.8	95.8% (92/96) 89.8-98.4	100% (96/96) 96.2-100	99.0% (95/96) 94.3-99.8	99.0% (95/96) 94.3-99.8
MP	100% (96/96) 96.2-100	100% (96/96) 96.2-100	100% (96/96) 96.2-100	100% (96/96) 96.2-100	95.8% (92/96) 89.8-98.4	100% (96/96) 96.2-100	100% (96/96) 96.2-100	100% (96/96) 96.2-100

[a] For the True Negative (TN) category, the reported agreement indicates the percent of negative results.
[b] For the High Negative (HN) category, the reported agreement indicates the percent of positive results.
[c] PreservCyt Solution

Chlamydia trachomatis Lot-to-Lot Reproducibility, Quantitative, by Matrix

Matrix	Sample	Agree /N	Mean	Within Run		Between Run		Between Day		Between Operator		Between Lot		Total	
				SD	%CV	SD	%CV	SD	%CV	SD	%CV	SD	%CV	SD	%CV
Swab	HN	22/96	37.3	1.1	2.9	2.2	5.9	1.2	3.1	0.0	0.0	0.0	0.0	2.7	7.3
	LP	96/96	33.6	1.0	2.9	0.4	1.2	0.0	0.0	0.2	0.6	0.3	0.7	1.1	3.3
	MP	96/96	32.6	0.8	2.3	0.0	0.0	0.3	1.0	0.1	0.4	0.1	0.3	0.8	2.6
Urine	HN	36/96	38.0	2.9	7.8	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.8	3.0	7.8
	LP	96/96	32.9	0.6	1.8	0.5	1.6	0.0	0.0	0.2	0.5	0.0	0.0	0.8	2.4
	MP	96/96	34.0	1.0	3.0	0.1	0.4	0.0	0.0	0.3	0.8	0.2	0.6	1.1	3.2
LBC[a]	HN	15/96	38.8	1.8	4.7	1.4	3.6	0.0	0.0	1.2	3.0	0.0	0.0	2.6	6.7
	LP	95/96	34.8	1.1	3.0	0.4	1.0	0.0	0.0	0.3	0.9	0.0	0.0	1.2	3.3
	MP	96/96	33.4	0.7	2.0	0.3	1.0	0.4	1.3	0.2	0.7	0.0	0.0	0.9	2.7

[a] PreservCyt Solution

Neisseria Gonorrhoeae Lot-to-Lot Reproducibility, Quantitative, by Matrix

Target	Matrix	Sample	Agree /N	Mean	Within Run		Between Run		Between Day		Between Operator		Between Lot		Total	
					SD	%CV	SD	%CV	SD	%CV	SD	%CV	SD	%CV	SD	%CV
GC1	Swab	HN	23/96	36.4	1.5	4.1	0.0	0.0	1.3	3.6	1.0	2.9	1.1	2.9	2.5	6.8
		LP	95/96	32.7	1.5	4.4	0.6	1.7	0.0	0.0	0.0	0.0	0.0	0.0	1.6	4.7
		MP	96/96	31.6	0.7	2.2	0.1	0.4	0.0	0.0	0.0	0.0	0.2	0.7	0.8	2.4
	Urine	HN	23/96	36.8	2.5	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.7	2.0	2.6	7.1
		LP	92/96	32.6	1.3	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.3	4.0
		MP	92/96	32.8	0.9	2.8	0.2	0.8	0.0	0.0	0.0	0.0	0.1	0.2	1.0	2.9
	LBC[a]	HN	10/96	37.8	2.9	7.6	0.0	0.0	0.0	0.0	0.0	0.0	3.5	9.4	4.6	12.1
		LP	96/96	32.1	0.6	1.8	0.0	0.1	0.1	0.5	0.2	0.7	0.0	0.0	0.6	2.0
		MP	96/96	30.7	0.5	1.7	0.3	0.9	0.4	1.4	0.3	1.0	0.0	0.0	0.8	2.6
GC2	Swab	HN	23/96	35.4	1.1	3.2	1.1	3.0	1.7	4.8	0.0	0.0	1.0	2.8	2.5	7.1
		LP	95/96	31.1	0.7	2.2	0.3	0.8	0.0	0.0	0.0	0.0	0.2	0.6	0.8	2.4
		MP	96/96	30.2	0.6	2.1	0.2	0.5	0.0	0.0	0.0	0.0	0.2	0.8	0.7	2.3
	Urine	HN	23/96	35.1	1.8	5.2	1.3	3.7	1.0	2.9	0.0	0.0	0.0	0.0	2.5	7.0
		LP	92/96	31.1	0.8	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.7
		MP	92/96	31.6	0.7	2.4	0.0	0.0	0.0	0.0	0.2	0.6	0.0	0.0	0.8	2.4
	LBC[a]	HN	10/96	36.0	1.1	3.0	0.0	0.0	1.2	3.3	0.0	0.0	1.1	3.0	1.9	5.3
		LP	96/96	30.6	0.4	1.2	0.5	1.5	0.1	0.3	0.2	0.8	0.0	0.0	0.7	2.1
		MP	96/96	29.4	0.4	1.5	0.3	1.1	0.3	1.2	0.3	1.0	0.0	0.0	0.7	2.4

[a]PreservCyt Solution

Trichomonas vaginalis Lot-to-Lot Reproducibility, Quantitative, by Matrix

Matrix Type	Cat	Agree /N	Mean	Within Run		Between Run		Between Day		Between Operator		Between Lot		Total	
				SD	%CV	SD	%CV	SD	%CV	SD	%CV	SD	%CV	SD	%CV
Swab	HN	39/96	36.8	2.1	5.8	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0	2.1	5.8
	LP	95/96	33.4	1.2	3.7	0.0	0.0	0.3	0.9	0.0	0.0	0.3	1.0	1.3	4.0
	MP	96/96	32.4	0.7	2.3	0.1	0.4	0.1	0.3	0.1	0.2	0.0	0.0	0.8	2.4
Urine	HN	61/96	37.0	1.9	5.2	0.0	0.0	0.5	1.2	0.0	0.0	0.0	0.0	2.0	5.4
	LP	95/96	32.5	0.7	2.1	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.4	0.7	2.1
	MP	96/96	33.8	1.0	3.1	0.0	0.0	0.0	0.0	0.2	0.5	0.0	0.0	1.1	3.1

Based on the evaluation of precision of the BD MAX CTGCTV2 assay system, conducted at one site, with three lots of reagents, the overall variability (for positive samples), across all matrices and across the three analytes, expressed as %CV, ranged from 5.3% to 12.1% for the High Negative samples; from 2.0% to 4.7% for the Low Positive samples; and from 2.3% to 3.2% for the Moderate Positive samples.

c. Linearity/assay reportable range:

Not applicable

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

Controls:

The BD MAX CTGCTV2 assay includes a Sample Processing Control (SPC) in each Extraction Tube which serves to monitor the DNA extraction and thermal cycling steps, as well as to detect reagent deterioration and the presence of inhibitory substances. If the Sample Processing Control result fails to meet the specific acceptance criteria written in the software, the result of the specimen will be reported as Unresolved; however, any positive (POS) assay result will be reported and no targets will be called NEG. An Unresolved result is indicative of specimen-associated inhibition or reagent failure. Any specimen reported as Unresolved must be retested.

External controls are not provided by the manufacturer. Laboratories must establish the number, type, and frequency of testing of control materials according to guidelines or requirements of local, provincial, state and federal and/or country regulations, or accreditation organizations in order to monitor the effectiveness of the entire analytical process. An External Positive Control is intended to monitor for substantial reagent failure. An External Negative Control is intended to detect reagent or environmental contamination (or carry-over) by target nucleic acids.

Commercially available control material or a previously characterized clinical sample known to be positive may be used as a positive control. The BD MAX CTGCTV2 Swab Buffer Tube without the addition of organism or a previously characterized sample known to be negative is recommended for use as an external negative control. External positive and negative controls were included in all analytical and clinical studies performed in support of this submission.

Specimen Stability Studies:

Specimen stability (i.e., stability of the amplifiable DNA in the specimen) was evaluated for urine, vaginal swabs, and endocervical specimens collected in PreservCyt solution (LBC specimen). Test samples were prepared in pooled negative clinical matrix (i.e., swab, urine and LBC) by spiking with the target organisms to concentrations targeted at 2x LoD and processing them according to the directions in the collection kit appropriate for the matrix. Baseline testing was performed on the same day as the samples were prepared. Specimen stability was evaluated at 2-8ºC, 30ºC and -20ºC. All positive (spiked) samples were tested in 20 replicates at each time point. All negative samples were tested in four replicates at each time point. The data generated during the study support specimen stability at the following storage conditions:

Urine specimens, when transferred immediately to the MAX Urine SBT, are stable up to 21 days at 2-30ºC and then additional 30 days at -20ºC.

Endocervical and vaginal swab specimens, when transferred immediately to the MAX Swab SBT, are stable up to 21 days at 2-30ºC and then additional 30 days at -20ºC.

Neat PreservCyt specimens must be transferred to the MAX LBC SBT within 14 days of

collection when stored at 2-30°C. PreservCyt in MAX LBC SBT prior or post-prewarm can be stored for up to 21 days at 2-30°C and then an additional 30 days at -20°C before testing.

e. Detection limit:

Analytical Sensitivity

The Limit of Detection (LoD) for the BD MAX CTGCTV2 assay was determined in urine, vaginal swab specimen matrix, and in PreservCyt liquid based cytology (LBC) specimen matrix. The study included two representative strains of each: CT (serovars D and H), GC, and TV organisms.

The CT, GC, and TV stock cultures were obtained from the ATCC either as lyophilized or frozen cultures. Each organism was re-grown in the appropriate media designated for that organism and quantified stocks were prepared for use in the study. CT EBs were enumerated by direct immunofluorescent staining using a labeled antibody directed toward the Major Outer Membrane Protein. The EBs were counted using a fluorescent microscope. GC was enumerated by preparing a suspension of cells and measuring the optical density to calculate the number of organisms/mL. TV was enumerated using a Neubauer hemocytometer under a light microscope to obtain the total count of organisms/mL

For each strain to be tested, pooled female urine, pooled vaginal swab matrix, and pooled PreservCyt samples (pre-screened negative for CT, GC and TV) were individually spiked with different concentrations of CT, GC or TV organisms. After determining a putative LoD (serial dilutions tested in 12 replicates, to determine the highest dilution (the lowest target level) yielding 100% positivity rate), a confirmation of LoD study was conducted in each matrix. Dilutions prepared at organism concentration levels below and above the putative LoD were tested with the BD MAX CTGCTV2 assay in 20 replicates. Confirmation of LoD was achieved when ≥ 95% positivity rate was observed, i.e., at least 19 out of 20 results per dilution were positive. Additional intermediate dilutions were tested when the observed results were 100% positive at one level and < 85% at the next lower concentration. The testing was performed across nine BD MAX instruments using three lots of reagents. The confirmed Limit of Detection by serovar/strain and specimen type is shown below.

Limit of Detection of the BD MAX CTGCTV2 Assay, by Organism and Matrix

Organism	Strain	Specimen Type	LoD	Units
Chlamydia trachomatis	Serovar H	Urine	2.5	EB/mL
		Swab	2.5	EB/mL
		PreservCyt	5	EB/mL
	Serovar D	Urine	1.25	EB/mL
		Swab	5	EB/mL
		PreservCyt	5	EB/mL
Neisseria gonorrhoeae	ATCC 19424	Urine	30	Cells/mL
		Swab	15	Cells/mL
		PreservCyt	30	Cells/mL
	ATCC 49226	Urine	15	Cells/mL
		Swab	30	Cells/mL
		PreservCyt	60	Cells/mL
Trichomonas vaginalis	ATCC 30001	Urine	5	TV/mL
		Swab	7.5	TV/mL
	ATCC 50143	Urine	2.5	TV/mL
		Swab	1.88	TV/mL

Analytical Reactivity (Inclusivity)

The reactivity of the BD MAX CTGCTV2 assay was evaluated with additional clinically relevant and geographically diverse serovars and/or strains of *Chlamydia trachomatis* (CT), *Neisseria gonorrhoeae* (GC), and *Trichomonas vaginalis* (TV). The study included 13 serovars of *Chlamydia trachomatis* (A, B, C, E, vE, F, G, I, J, K, LGV1, LGV2, and LGV3), 30 strains of *Neisseria gonorrhoeae* and eight strains of *Trichomonas vaginalis*. Organism stocks were obtained from ATCC either as lyophilized or frozen cultures. Each organism was grown on/in the appropriate media designated for that organism and quantified. Each organism was evaluated in swab, urine, and PreservCyt matrix in 20 replicates at the pre-determined LoD (1x) concentration, using at least three reagent lots. All organisms, except four of the *Neisseria gonorrhoeae* strains, were positive in at least 19 out of 20 (≥ 95%) replicates tested. Three of the remaining four *N. gonorrhoeae* strains were titered to a 1.5x LoD concentration in vaginal matrix and retested. One additional strain was re-titered to a 1.5x LoD concentration in urine and retested. All four organisms were detected in at least 19 out of 20 replicates when tested at 1.5x LoD concentration. The results of the analytical reactity testing are shown below.

Analytical Reactivity for *Chlamydia trachomatis*

Organism	Serovar	Swab		Urine		PreservCyt	
		EBs/mL	% Pos	EBs/mL	% Pos	EBs/mL	% Pos
Chlamydia trachomatis	A	5	100	2.5	100	5	100
	B	5	100	2.5	100	5	100
	C	5	≥ 95	2.5	100	5	100
	E	5	100	2.5	100	5	100
	F	5	100	2.5	100	5	100
	G	5	100	2.5	100	5	100
	I	5	100	2.5	100	5	100
	J	5	100	2.5	100	5	100
	K	5	100	2.5	100	5	100
	LGV1	5	100	2.5	100	5	100
	LGV2	5	100	2.5	100	5	100
	LGV3	5	100	2.5	100	5	100
	vE	5	100	2.5	100	5	20/20

Analytical Reactivity for *Neisseria gonorrhoeae*

Organism	Number Strains	Swab		Urine		PreservCyt	
		Cells/mL	% POS	Cells/mL	% POS	Cells/mL	% POS
Neisseria gonorrhoeae	30	NA	NA	NA	NA	60	≥95
	27	30	≥95	NA	NA	NA	NA
	3	45	≥95	NA	NA	NA	NA
	29	NA	NA	30	≥95	NA	NA
	1	NA	NA	45	100	NA	NA

Analytical Reactivity for *Trichomonas vaginalis*

Organism	ATCC Strain	Swab		Urine	
		TV/mL	% POS	TV/mL	% POS
Trichomonas vaginalis	30092	7.5	100	5	100
	30184	7.5	≥95	5	100
	30185	7.5	100	5	100
	30186	7.5	≥95	5	100
	30235	7.5	100	5	100
	30236	7.5	100	5	100
	30238	7.5	≥95	5	100
	30240	7.5	100	5	100

f. Analytical specificity:

Cross-reactivity with Other Microorganisms

The analytical specificity of the MAX CTGCTV2 assay was evaluated with well-characterized isolates of microorganisms that are phylogenetically related or likely to be found in urogenital specimens. The bacterial strains, viruses, parasites, and yeast species commonly found in urogenital specimens were added to the Sample Buffer Tubes and tested in three replicates across two lots of assay reagents. Bacteria, parasites, and yeast were grown and quantified to achieve final test concentrations of $\geq 1x10^6$ organisms/mL. Quantified viruses were obtained from commercial vendors and diluted to achieve final test concentration in the Sample Buffer Tube of $\geq 1x10^5$ pfu or genomic equivalents/mL. All samples were negative for CT, GC, and TV in all three replicates tested, except for *Pentatrichomonas hominis* and *Trichomonas tenax*. *Pentatrichomonas hominis* (commensal of the large intestine) produced positive results for TV at a concentration $\geq 1.00 \times 10^5$ TV/mL; *Trichomonas tenax* (commensal of the oral cavity) produced positive results for TV at a concentration ≥ 1.88 TV/mL. Both organisms produced negative results for CT and GC (i.e., no cross-reactivity).

Organisms Tested with the BD MAX CTGCTV2 Assay for Cross-reactivity

Organism	Organism	Organism
Achromobacter xerosis	*Escherichia coli*	*Neisseria mucosa* (3) [a]
Acinetobacter calcoaceticus	*Escherichia vulneris*	*Neisseria perflava*
Acinetobacter lwoffi	*Fuseobacterium nucleatum*	*Neisseria polysaccharea*
Actinomyces israelii	*Gardnerella vaginalis*	*Neisseria sicca* (3)
Actinomyces pyogenes	*Gemella haemolysans*	*Neisseria subflava* (14) [a]
Aerococcus viridans	*Haemophilus ducreyi*	*Paracoccus denitrificans*
Aeromonas hydrophilia	*Haemophilus influenzae*	*Pentatrichomonas hominis*
Agrobacterium radiobacter	Herpes Simplex Virus I	*Peptostreptococcus anaerobius*
Alcaligenes faecalis	Herpes Simplex Virus II	*Peptostreptococcus productus*
Atopobium vaginae	HIV 1	*Plesiomonas shigelloides*
Bacillus subtilis	HPV 16	*Prevotella bivia*
Bacteroides fragilis	*Kingella dentrificans*	*Propionibacterium acnes*
Bacteroides ureoeolyticus	*Kingella kingae*	*Proteus mirabilis*
Bifidobacterium adolescentis	*Klebsiella oxytoca*	*Proteus vulgaris*
Bifidobacterium brevi	*Klebsiella pneumoniae*	*Providencia stuartii*
Blastocystis hominis	*Lactobacillus acidophilus*	*Pseudomonas aeruginosa*
Branhamella catarrhalis	*Lactobacillus brevis*	*Pseudomonas fluorescens*
Brevibacterium linens	*Lactobacillus jensenii*	*Pseudomonas putida*
Campylobacter jejuni	*Lactobacillus lactis*	*Rahnella aquatilis*
Candida albicans	*Lactobacillus vaginalis*	*Rhodospirilium rubrum*
Candida gabralta	*Legionella pneumophilia* (2) [a]	*Saccharomyces cerevisiae*
Candida parapsilosis	*Leuconostoc paramensenteroides*	*Salmonella minnesota*
Candida tropicalis	*Listeria monocytogenes*	*Salmonella typhimurium*
Chlamydiophila pneumoniae	*Micrococcus leutus*	*Serratia marcescens*
Chlamydiophila psittaci (2) [a]	*Mobiluncus curtisii*	*Staphylococcus aureus*,non-protein A
Chromobacterium violaceum	*Moraxella lacunata*	*Staphylococcus aureus*, protein-A producing
Citrobacter freundii	*Moraxella osloensis*	*Staphylococcus epidermidis*
Clostridium difficile	*Morganella morganii*	*Staphylococcus saprophyticus*

Clostridium perfringens	*Mycobacterium smegmatis*	*Streptcoccus bovis*
Corynebacterium genitalium biovar1	*Mycoplasma genitalium*	*Streptococcus agalactiae* (Group B)
Corynebacterium xerosis	*Mycoplasma hominis*	*Streptococcus mitis*
Cryptococcus neoformans	*Neisseria cinerea* (4)[a]	*Streptococcus mutans*
Cytomegalovirus	*Neisseria denitrificans*	*Streptococcus pneumoniae*
Deinococcus radiodurans	*Neisseria elongate* (3)[a]	*Streptococcus pyogenes* (Group A)
Derxia gummosa	*Neisseria flava*	*Streptococcus salivarius*
Eikenella corrodens	*Neisseria flavescens* (2)[a]	*Streptococcus sanguis*
Elizabethkingia meningosepticum	*Neisseria lactamica* (9)[a]	*Streptomyces griseinus*
Enterobacter aerogenes	*Neisseria meningitidis* A	*Trichomonas tenax*
Enterobacter cloacae	*Neisseria meningitidis* B	*Ureaplasma urealyticum*
Enterococcus avium	*Neisseria meningitidis* C (4)[a]	*Vibrio parahaemolyticus*
Enterococcus faecalis	*Neisseria meningitidis* D	*Yersinia enterocolitica*
Enterococcus faecium	*Neisseria meningitidis* W135	
Erysipelothrix rhusiopathiae	*Neisseria meningitidis* Y	

[a]The number in parenthesis indicates the number of strains tested.
**Pentatrichomonas hominis* produced positive results for TV at a concentration ≥ 1.00 x 10^5 TV/mL; and negative results for CT and GC;
***Trichomonas tenax* produced positive results for TV at a concentration ≥ 1.88 TV/mL and negative results for CT and GC

Interference from Endogenous and Exogenous Substances

Potential interference/inhibition from endogenous and exogenous substances that may be present in urogenital specimens was evaluated by testing specimens contrived in negative matrix at low concentrations of the target analytes (CT, GC and TV), in the presence of each of the substances listed in the table below. Two serovars of CT, two strains of GC, and one strain of TV were spiked into urine, swab, and PreservCyt matrices at target concentrations of 3x LoD. The interferents tested were added to each of the samples containing the target analytes. Each sample was tested in triplicate, in accordance with the test procedure. Twenty six of the substances were evaluated in urine, 23 were tested in vaginal swab matrix, and 22 were tested in PreservCyt media. Each of the substances was titrated to determine the concentration at which no interference was observed. There was no interference observed up to the concentrations tested, as shown below.

Exogenous and Endogenous Substances Tested for Interference in Urine

Substance	Concentration
Norethindrone	16 ng/mL
17-α-Ethinylestradiol	0.96 ng/mL
4-Acetamidophenol	160 µg/mL
Acetylsalicylic Acid	521.6 µg/mL
Naproxen	400 µg/mL
Ibuprofen	400 µg/mL
Human Serum Albumin	0.8 mg/mL
Glucose	0.96 mg/mL
Amoxicillin Trihydrate	60.16 µg/mL
Metronidazole	96 µg/mL

Substance	Concentration
Tetracycline Hydrochloride	12 µg/mL
Azithromycin	9.6 µg/mL
Ceftriaxone	648.8 µg/mL
Sulfamethoxazole	320 µg/mL
Trimethoprim	32 µg/mL
Erythromycin	48 µg/mL
Mucous (Bovine Cervical)	4% v/v
Whole Blood	0.6% v/v [a]
Semen	4% v/v
Leukocytes	$2x10^6$ cells/mL
Phenazopyridine Hydrochloride	160 µg/mL
High pH (NaOH)	pH 9
Low pH (HCl)	pH 4
Bilirubin	0.16 mg/mL
Feminine Deodorant Spray	0.68% v/v
Talcum Powder	2.64% v/v

[a] May interfere with the BD MAX CTGCTV2 assay when at concentrations higher than shown.

Endogenous and Exogenous Substances Tested for Interference in Swab Specimens

Substance	Concentration
VCF Contraceptive Foam	15 µL/mL[a]
VCF Contraceptive Film	0.5 µL/mL[a]
Conceptrol Contraceptive Gel	3 µL/mL[a]
Gyne-Lotrimin 3	50 µL/mL
Monistat 3 Cream	0.1 µL/mL[a]
Tioconazole 1	50 µL/mL
Vaginal Anti-Itch Cream	0.1 µL/mL[a]
Vaginal Lubricant Liquid - water based	50 µL/mL
Preparation H Hemorrhoid Gel	50 µL/mL
Antiviral (Zovirax – Acyclovir)	0.01 µL/mL[a]
Metronidazole Gel (AntiProtozoal)	1.25 µL/mL[a]
Replens (Vaginal Moisturizer)	0.1 µL/mL[a]
Douche	50 µL/mL
Feminine Deodorant Spray	50 µL/mL
Progesterone	20 ng/mL
Estradiol	1.2 ng/mL
Mucous (Bovine Cervical)	4.5% v/v[a]
Semen	5% v/v
Whole Blood	8 µL/mL[a]
Leukocytes	$1x10^6$ cells/mL
Aquagel	0.0345 mg/mL[a]

Substance	Concentration
McKesson Lubricating Jelly	0.445 mg/mL[a]
Surgilube	0.41 mg/mL[a]
KY Lubricating Jelly	137.5 mg/mL

[a] May interfere with the BD MAX CTGCTV2 assay when at concentrations higher than shown

Endogenous and Exogenous Substances Tested for Interference in PreservCyt LBC Specimens

Substance	*Concentration*
Vaginal Lubricant	2% v/v
Douche	2% v/v
Vaginal Deodorant Spray	2% v/v
Progesterone	20 ng/mL
Estradiol	1.2 ng/mL
Leukocytes	1 x 10^6 cells/mL
Semen	2% v/v
Monistat 3	2% v/v
Clotrimazole 7	2% v/v
Tioconazole 1	2% v/v
Vaginal contraceptive film	2% v/v
Vaginal contraceptive foam	2% v/v
Contraceptive gel	2% v/v
Vaginal anti-itch Cream	1% v/v[a]
Zovirax (Acyclovir) Cream	2% v/v
Metronidazole Gel 0.75%	0.01% v/v[a]
Replens (Vaginal Moisturizer)	0.1% v/v[a]
Mucous (Bovine Cervical)	1.9% v/v[a]
Whole Blood	0.5% v/v[a]
Aquagel	0.276 mg/mL[a]
McKesson Lubricating Jelly	3.56 mg/mL[a]
Surgilube	328 mg/mL[a]
KY Lubricating Jelly	1,100 mg/mL

[a] May interfere with the BD MAX CTGCTV2 assay when at concentrations higher than shown.

g. Assay cut-off:

For all analytes in the CTGCTV2 assay, the cutoff was determined using a training dataset and later validated by the clinical study. With the exception of GC2, the chemistry of the CTGCTV2 assay is identical to the previously cleared CT/GC/TV assay (K151589), and therefore presented a unique opportunity to use the previous clinical study as a training dataset for those analytes.

For each analyte, an acceptable threshold range was established for each sample type in the study, setting a minimum threshold at a point where no false positives were caused by system

noise. System noise was evaluated subjectively, using expert analysis of individual signal curves to distinguish them from true PCR amplification. A maximum threshold was then set as the highest value with no new false negatives. Positive results are reported when any Ct score is calculated and, by definition, there are no Ct values for negative specimens (note: instrument reports a -1 for negative specimens).

However, since GC2 was not included in the CT/GC/TV study, the cutoff for that analyte was determined using a separate analytical dataset. Multiple GC LoD titration studies were performed and the data was evaluated over a range of Ct thresholds. The studies used contrived samples at varying concentrations including true negatives, high negatives (below LoD), low positives (at LoD), and moderate positives (2-4x LoD) in both vaginal and urine matrix. True negatives were 100% negative across the entire Ct threshold. As a result, thresholds were selected to maximize sensitivity.

The assay cutoff was then verified based on the results of the clinical study, using all samples with valid reference results (3756 for CT and for GC and 3735 for TV). The infected/non-infected status was determined by the agreed PIS algorithm for all specimens, except for urine, which was evaluated by comparison to a Composite Comparator Algorithm (CCA), consisting of three NAATs (with a 2 out of 3 rule).

h. Competitive Inhibition:

A study was conducted to evaluate the performance of the assay in the presence of mixed infection, i.e., the potential inhibition of one of the targets by the presence of the second (or third) analyte. The urine, vaginal, and PreservCyt specimens were spiked with different combinations of high and low concentrations of the organisms to determine the impact, if any, of mixed infections on assay results. The Low concentration was prepared at 1.5X LoD (as shown below) and the high concentration was prepared at $\geq 10^6$ units/mL.

Target Concentration of the Test Samples

Organism	Matrix	Low Concentration	Units/mL
Chlamydia trachomatis	Urine	1.88	EB/mL
	Swab	7.5	
	PreservCyt	7.5	
Neisseria gonnorhoeae	Urine	22.5	Cells/mL
	Swab	45	
	PreservCyt	90	
Trichomonas vaginalis	Urine	7.5	TV/mL
	Swab	11.25	

Each sample was tested in 20 replicates. All targets were detected in 20/20 replicates, except for TV in vaginal swab matrix which was detected in 19/20 replicates (within the acceptance criteria of a ≥95%).

Mixed Infection Study Results

Matrix	Low Target Organism (1.5x LoD)	High Target Mix ($\geq 10^6$ units/mL)	Positive (for Low Target)
Urine	*C. trachomatis*	CT/GC	20/20
	N. gonorrhoeae	CT/TV	20/20
	T. vaginalis	GC/TV	20/20
Swab	*C. trachomatis*	CT/GC	20/20
	N. gonorrhoeae	CT/TV	20/20
	T. vaginalis	GC/TV	19/20
PreservCyt	*C. trachomatis*	CT/GC	20/20
	N. gonorrhoeae	CT/TV	20/20

The observed shift in the signal, expressed in Ct-score values, for all samples tested across the three matrices, ranged from -0.1 to 4.5 for CT, from -1.8 to 5.8 for GC, and from 1.0 to 4.8 for TV.

i. Carryover/Contamination:

A study was conducted to estimate the rate of carryover/cross-contamination for the MAX CTGCTV2 assay on the BD MAX System when processing specimens with a high concentration of an analyte. The study was performed using high positive samples alternated with negative samples. PreservCyt matrix was used as a representative specimen type in this study because of its high alcohol content and thus most likely to result in cross-contamination. The High Positive samples were prepared at a concentration $\geq 10^6$ EB/mL in the LBC Sample Buffer Tubes. Negative samples consisted of LBC Sample Buffer Tubes without target added.

Eighteen runs were conducted, each containing 12 replicates of the High Positive sample and 12 replicates of the negative sample (24 samples per run). The samples were loaded in an alternating fashion (positive, negative, positive, etc.) and were equally distributed across BD MAX sample racks for a total of 432 measurements. The testing was performed by two operators over two days, using 3 instruments in total.

Data was analyzed by comparing the proportion of false positive results observed in the negative samples. Among the 216 negative specimens analyzed there were two positive results, with the contamination rate estimate of 0.93% (95% CI: 0.25%; 3.31%).

2. Comparison studies:

a. Method comparison with predicate device:

Not applicable

b. Matrix comparison:

Not applicable

3. Clinical studies:

Twelve geographically diverse clinical collection centers participated in this study. Two additional sites participated in the study and performed reference testing only. Clinical centers represented high and low prevalence settings and included sexually transmitted disease (STD) clinics, family planning clinics, research facilities and obstetrics and gynecology clinics (OB/GYN). Of the 12 collection sites, five sites enrolled both female and male subjects, six sites enrolled females only, and one site enrolled males only. Enrollment occurred between July 6, 2016 and June 2, 2017, during which a total of 2,547 female subjects and 1,159 male subjects were enrolled. Specimens were collected from asymptomatic and symptomatic subjects. The collected specimens were distributed and tested with the BD MAX CTGCTV2 assay across five clinical testing sites.

Male subjects provided a urine specimen which was aliquoted into four transport devices for testing with the BD MAX assay and three comparator assays.

A total of eight specimens were collected from each female and included one urine specimen (aliquoted into four transport devices), two patient-collected vaginal swabs (in a clinical setting), two clinician-collected vaginal swabs, two endocervical swabs, and one LBC specimen (in ThinPrep PreservCyt Solution).

Standard of care specimens were collected either separately or first within the specimen category prior to the remaining collection used in the investigational study.

Samples were prepared for BD MAX CTGCTV2 testing in accordance with the appropriate BD MAX specimen collection kit package insert instructions. Specimens intended for reference testing were prepared in accordance with the instructions for use in the appropriate specimen collection kit package insert.

Of the total subjects enrolled in the study, 11 females and 10 males were excluded due to enrollments issues. The remaining 2,536 female subjects and 1,149 male subjects provided specimens for testing with the BD MAX CTGCTV2 assay and the comparator assays. After specimen exclusion for reasons such as missing specimens, transport errors, collection errors, shipping errors, processing errors, missing reference test results or non-reportable BD MAX test results (Indeterminate, Unresolved or Invalid), the final data analysis of performance estimates, using evaluable specimens, included:

- For *Chlamydia trachomatis,* there were 2,508 patient-collected vaginal swabs, 2,502 clinician-collected vaginal swabs, 2,512 endocervical swabs, 2,469 PreservCyt LBC, 2,416 female urine and 1,140 male urine specimens;
- For *Neisseria gonorrhoeae,* there were 2,506 patient-collected vaginal swabs, 2,503 clinician-collected vaginal swabs, 2,511 endocervical swabs, 2,470 PreservCyt LBC, 2,419 female urine and 1,142 male urine specimens;
- For *Trichomonas vaginalis,* there were 1,742 patient-collected vaginal swabs, 1,732 clinician-collected vaginal swabs, 1,646 female urine and 1,141 male urine specimens.

Clinical Performance of the BD MAX CTGCTV2 Assay for the Detection of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* Infections

a. In Females with Vaginal Swabs, Endocervical Swabs, and LBC Specimens

The clinical performance of the BD MAX CTGCTV2 for the detection of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections in females was calculated compared to a Patient Infected Status (PIS) based on testing urine and cervical specimens with two different FDA-cleared NAATs. Female subjects were designated as infected if at least one different reference NAAT was positive for urine and for the cervical specimen. For the purpose of data analysis, women who tested negative in swabs with both NAATs and positive with the two comparator NAATs in urine only, were considered non-infected (Negative PIS) when calculating the performance of the assay with vaginal or endocervical specimens.

The clinical sensitivity of the BD MAX CTGCTV2 for the detection of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections in female vaginal swabs (patient- and clinician-collected vaginal swabs) and cervical specimens (endocervical swab and PreservCyt LBC) is shown below.

Clinical Performance for *C. trachomatis* and *N. gonorrhoeae* in Females (Vaginal and Endocervical Specimens)

Gender	Specimen Type	Symptom Status	*Chlamydia trachomatis*		*Neisseria gonorrhoeae*	
			% Sens N 95% CI	% Spec N 95% CI	% Sens N 95% CI	% Spec N 95% CI
Female	Vaginal Clinician	A	98.2 55/56 90.6-99.7	98.8 1,076/1,089 98-99.3	100 15/15 79.6-100	99.8 1,129/1,131 99.4-100
		S	98.6 71/72 92.5-99.8	99.0 1,272/1,285 98.3-99.4	96.4 27/28 82.3-99.4	99.9 1,328/1,329 99.6-100
		All	98.4 126/128 94.5-99.6	98.9 2,348/2,374 98.4-99.3	97.7 42/43 87.9-99.6	99.9 2,457/2,460 99.6-100
	Vaginal Self	A	98.2 55/56 90.6-99.7	98.9 1,077/1,089 98.1-99.4	100 15/15 79.6-100	99.6 1,126/1,130 99.1-99.9
		S	98.6 71/72 92.5-99.8	98.5 1,271/1,291 97.6-99	100 28/28 87.9-100	100 1,333/1,333 99.7-100
		All	98.4 126/128 94.5-99.6	98.7 2,348/2,380 98.1-99	100 43/43 91.8-100	99.8 2,459/2,463 99.6-99.9
	Endo-cervical	A	96.4 54/56 87.9-99	99.4 1,084/1,090 98.8-99.7	100 15/15 79.6-100	99.9 1,131/1,132 99.5-100
		S	93.1 67/72 84.8-97	99.1 1,282/1,294 98.4-99.5	92.9 26/28 77.4-98	100 1,336/1,336 99.7-100
		All	94.5 121/128 89.1-97.3	99.2 2,366/2,384 98.8-99.5	95.3 41/43 84.5-98.7	100 2,467/2,468 99.8-100
	LBC PreservCyt	A	92.6 50/54 82.4-97.1	99.7 1,076/1,079 99.2-99.9	100 15/15 79.6-100	99.9 1,118/1,119 99.5-100
		S	92.9 65/70 84.3-96.9	99.8 1,264/1,266 99.4-100	88.9 24/27 71.9-96.1	100 1,309/1,309 99.7-100
		All	92.7 115/124 86.8-96.1	99.8 2,340/2,345 99.5-99.9	92.9 39/42 81-97.5	100 2,427/2,428 99.8-100

Based on available data generated in the study, the clinical performance of the BD MAX CTGCTV2 assay for female vaginal swabs (patient- and clinician-collected vaginal swabs) and cervical specimens (endocervical swab and PreservCyt LBC) was also assessed against a PIS algorithm composed of vaginal swab and urine specimens. Comparative reference methods included two different FDA cleared molecular tests where female subjects were designated as infected if at least two different reference NAATs were positive for urine and vaginal specimens. Females who tested positive with the two comparator NAATs in urine only (negative in swabs with both NAATs), were considered non-infected

(Negative PIS) when calculating the performance of the assay with swab specimens.

The resulting clinical performance of the BD MAX CTGCTV2 when comparing to the vaginal/urine reference algorithm (PIS) for the detection of *Chlamydia trachomatis* infection in females was: 95.0% (132/139) sensitivity and 99.2% (2,340/2,359) specificity for clinician-collected vaginal swabs, 97.9% (137/140) sensitivity and 99.2% (2,348/2,368) specificity for patient-collected vaginal swabs, 89.2% (124/139) sensitivity and 99.4% (2,354/2,368) specificity for endocervical swabs, and 85.8% (115/134) sensitivity and 99.8% (2,326/2,330) specificity for PreservCyt LBC specimens.

The resulting clinical performance of the BD MAX CTGCTV2 with the vaginal/urine reference algorithm for the detection of *Neisseria gonorrhoeae* infection in females was: 100% (44/44) sensitivity and 100% (2,454/2,455) specificity for clinician-collected vaginal swabs, 97.8% (44/45) sensitivity and 99.9% (2,458/2,461) specificity for patient-collected vaginal swabs, 93.3% (42/45) sensitivity and 100% (2,461/2,461) specificity for endocervical swabs, and 90.9% (40/44) sensitivity and 100% (2,421/2,421) specificity for PreservCyt LBC specimens.

b. In Male Urine

The clinical performance of the BD MAX CTGCTV2 for the detection of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections in male urine was calculated compared to a Patient Infected Status (PIS) based on testing urine specimens with up to three different FDA cleared NAATs, where male subjects were designated as infected if at least two out of three reference NAAT results were positive. Subjects were categorized as non-infected if at least two out of three reference NAAT results were negative.

The clinical sensitivity of the BD MAX CTGCTV2 for the detection of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections in male urine is shown below.

Clinical Performance for *C. trachomatis* and *N. gonorrhoeae* in Males (Urine Specimens)

Gender	Specimen Type	Symptom Status	*Chlamydia trachomatis*		*Neisseria gonorrhoeae*	
			% Sens N 95% CI	% Spec N 95% CI	% Sens N 95% CI	% Spec N 95% CI
Male	Urine	A	97.3 71/73 90.5-99.2	99.6 667/670 98.7-99.8	100 12/12 75.8-100	100 732/732 99.5-100
		S	96.3 77/80 89.5-98.7	99.1 314/317 97.3-99.7	99.1 110/111 95.1-99.8	99.7 286/287 98.1-99.9
		All	96.7 148/153 92.6-98.6	99.4 981/987 98.7-99.7	99.2 122/123 95.5-99.9	99.9 1,018/1,019 99.4-100

c. In Female Urine

The clinical performance of the BD MAX CTGCTV2 for the detection of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections in female urine was calculated compared to a Composite Comparator Algorithm (CCA), where urine samples were tested with up to three reference NAATs to generate reference results for each analyte. Female subjects were designated as positive if at least two out of three reference NAAT results were positive. Subjects were categorized as negative if at least two out of three reference NAAT results were negative. The clinical performance of the BD MAX CTGCTV2 for the detection of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections in female urine, expressed as positive percent agreement (PPA) and negative percent agreement (NPA) with the CCA, is shown below.

Clinical Performance for *C. trachomatis* and *N. gonorrhoeae* in Females (Urine Specimens)

Specimen Type	Symptom Status	*Chlamydia trachomatis*		*Neisseria gonorrhoeae*	
		PPA N 95% CI	NPA N 95% CI	PPA N 95% CI	NPA N 95% CI
Female Urine	A	98.1 51/52 89.9-99.7	99.2 1,037/1,045 98.5-99.6	100 14/14 78.5-100	99.9 1,085/1,086 99.5-100
	S	98.6 70/71 92.4-99.8	99.4 1,241/1,248 98.8-99.7	100 25/25 86.7-100	100 1,294/1,294 99.7-100
	All	98.4 121/123 94.3-99.6	99.3 2,278/2,293 98.9-99.6	100 39/39 91.0-100	100 2,379/2,380 99.8-100

Additionally, the results obtained testing urine specimens in females with the BD MAX CTGCTV2 assay were evaluated against the PIS based on cervical and urine algorithm. In the clinical study conducted for the BD MAX CTGCTV2 assay, 5.8% fewer *Chlamydia trachomatis* infections were detected in female urine than in clinician and self-collected vaginal swabs and 1.9% fewer *Chlamydia trachomatis* infections than in endocervical swabs. Similarly, 2.4% fewer *Neisseria gonorrhoeae* infections were detected in female urine than in clinician-collected vaginal swabs and 4.7% fewer *Neisseria gonorrhoeae* infections than in patient-collected vaginal swabs. There was no difference in the detection of *Neisseria gonorrhoeae* infections when comparing female urine and endocervical swabs.

Clinical Performance of the BD MAX CTGCTV2 Assay for the Detection of *Trichomonas vaginalis* Infections

a. In Females with Vaginal Swabs

The clinical performance of the BD MAX CTGCTV2 for the detection of *Trichomonas vaginalis* infection in females, using vaginal swabs, was compared to a PIS based on testing

vaginal specimens with two different FDA-cleared molecular tests, where one of the tests utilized two instrument platforms (for a total of three comparator test results). Female subjects were designated as infected (Positive PIS) when at least two of the three test results were positive and non-infected (Negative PIS) when at least two of the three test results were negative.

The clinical sensitivity of the BD MAX CTGCTV2 for the detection of *Trichomonas vaginalis* infections in female vaginal swabs (patient- and clinician-collected vaginal swabs) is shown below.

Clinical performance for *T. vaginalis* in Females (Vaginal Specimens)

Gender	Specimen Type	Symptom Status	*Trichomonas vaginalis*	
			% Sens N 95% CI	% Spec N 95% CI
Female	Vaginal Clinician	A	98.5 66/67 92.0-99.7	99.6 687/690 98.7-99.9
		S	97.5 116/119 92.8-99.1	99.6 853/856 99.0-99.9
		All	97.8 182/186 94.6-99.2	99.6 1540/1546 99.2-99.8
	Vaginal Self	A	97.0 65/67 89.8-99.2	99.1 685/691 98.1-99.6
		S	98.4 120/122 94.2-99.5	99.2 855/862 98.3-99.6
		All	97.9 185/189 94.7-99.2	99.2 1540/1553 98.6-99.5

b. In Male Urine

The clinical performance of the BD MAX CTGCTV2 for the detection of *Trichomonas vaginalis* infections in male urine was calculated compared to a Patient Infected Status (PIS) based on testing urine specimens using up to three different FDA cleared NAATs where male subjects were designated as infected if at least two out of three reference NAAT results were positive. Subjects were categorized as non-infected if at least two out of three reference NAAT results were negative.

The clinical sensitivity of the BD MAX CTGCTV2 for the detection of *Trichomonas vaginalis* infections in male urine is shown below.

Clinical Performance for *T. vaginalis* in Males (Urine Specimens)

Gender	Specimen Type	Symptom Status	*Trichomonas vaginalis*	
			% Sens N 95% CI	% Spec N 95% CI
Male	Urine	A	96.2 25/26 81.1-99.3	99.6 678/681 98.7-99.9
		S	100 22/22 85.1-100	100 412/412 99.1-100
		All	97.9 47/48 89.1-99.6	99.7 1,090/1,093 99.2-99.9

c. In Female Urine

The clinical performance of the BD MAX CTGCTV2 for the detection of *Trichomonas vaginalis* infection in female urine was calculated compared to a Composite Comparator Algorithm (CCA), where urine samples were tested with up to three reference NAATs to generate reference results. Female subjects were designated as positive if at least two out of three reference NAAT results were positive. Subjects were categorized as negative if at least two out of three reference NAAT results were negative. The clinical performance of the BD MAX CTGCTV2 for the detection of *Trichomonas vaginalis* infections in female urine, expressed as percent agreement with CCA, is shown below.

Clinical performance for *T. vaginalis* in Females (Urine Specimens)

Specimen Type	Symptom Status	*Trichomonas vaginalis*	
		PPA N 95% CI	NPA N 95% CI
Female Urine	A	100 58/58 93.8-100	99.8 646/647 99.1-100
	S	100 115/115 96.8-100	99.4 821/826 98.6-99.7
	All	100 173/173 97.8-100	99.6 1,467/1,473 99.1-99.8

Quality Control

External quality controls were tested during the course of the clinical study. One Positive and one Negative External Control (EC) were tested in each BD MAX run. The mean, SD, and %CV were calculated for the Positive EC for each analyte at each site and overall and are presented below.

Summary of Positive EC Results from the Study (Based on Ct.score Values)

		CT			GC			TV		
	N	Mean	SD	% CV	Mean	SD	% CV	Mean	SD	% CV
Site 1	213	31.1	2.53	8.16	27.0	1.47	5.46	27.9	1.21	4.34
Site 2	56	32.5	1.11	3.41	28.0	0.49	1.74	26.4	0.43	1.64
Site 3	108	32.0	1.41	4.40	28.3	0.32	1.12	26.4	0.34	1.27
Site 4	205	32.7	0.89	2.74	28.5	0.31	1.08	26.6	0.42	1.59
Site 5	116	32.0	1.13	3.52	28.2	0.33	1.17	26.6	0.49	1.83
Overall	698	32.0	1.79	6.61	27.9	1.07	3.84	27.0	0.99	3.65

BD MAX CTGCTV2 Non-Reportable Results

Of the 13,655 specimens initially tested with the BD MAX CT/GC/TV, there were a total of 321 non-reportable results, for a total non-reportable rate of 2.35% (95% CI: 2.11%-2.62%). Among those, there were a total of 124 Unresolved results, 77 Indeterminate results, and 120 Incomplete results. Six of the samples that initially generated non-reportable results were not repeated. Of the 316 samples that were retested, 38 results remained non-reportable (0.28%, with 95% CI: 0.20%-0.38%). The tables below show the observed non-reportable results by specimen type.

Unresolved Rate by Specimen Type

Specimen Type	Initial Unresolved Rate		Final Unresolved Rate[a]	
	Percent (n)	95% CI	Percent (n)	95% CI
Vaginal Clinician-Collected	1.1% (28/2,517)	(0.8%, 1.6%)	0.3% (7/2,517)	(0.1%, 0.6%)
Vaginal Patient-Collected	1.3% (34/2,525)	(1.0%, 1.9%)	0.4% (10/2,525)	(0.2%, 0.7%)
Endocervical	0.9% (22/2,519)	(0.6%, 1.3%)	0.1% (3/2,516)	(0.0%, 0.3%)
LBC PreservCyt	0.2% (6/2,473)	(0.1%, 0.5%)	0.0% (0/2,471)	(0.0%, 0.2%)
Urine	0.9% (34/3,621)	(0.7%, 1.3%)	0.1% (3/3,620)	(0.0%, 0.2%)

[a]Based on the total number of samples that were available for retest

Indeterminate Rate by Specimen Type

Specimen Type	Initial Indeterminate Rate		Final Indeterminate Rate[a]	
	Percent (n)	95% CI	Percent (n)	95% CI
Vaginal Clinician-Collected	0.8% (20/2,517)	(0.5%, 1.2%)	0.2% (6/2,517)	(0.1%, 0.5%)
Vaginal Patient-Collected	0.9% (23/2,525)	(0.6%, 1.4%)	0.1% (3/2,525)	(0.0%, 0.3%)
Endocervical	0.8% (19/2,519)	(0.5%, 1.2%)	0.1% (2/2,516)	(0.0%, 0.3%)

Specimen Type	Initial Indeterminate Rate		Final Indeterminate Rate[a]	
	Percent (n)	95% CI	Percent (n)	95% CI
LBC PreservCyt	0.2% (6/2,473)	(0.1%, 0.5%)	0.0% (0/2,471)	(0.0%, 0.2%)
Urine	0.2% (9/3,621)	(0.1%, 0.5%)	0.1% (3/3,620)	(0.0%, 0.2%)

[a]Based on the total number of samples that were available for retest

Incomplete Rate by Specimen Type

Specimen Type	Initial Incomplete Rate		Final Incomplete Rate[a]	
	Percent (n)	95% CI	Percent (n)	95% CI
Vaginal Clinician-Collected	0.7% (17/2,517)	(0.4%, 1.1%)	0.0% (0/2,517)	(0.0%, 0.2%)
Vaginal Patient-Collected	0.6% (14/2,525)	(0.3%, 0.9%)	0.0% (1/2,525)	(0.0%, 0.2%)
Endocervical	0.6% (14/2,519)	(0.3%, 0.9%)	0.0% (0/2,516)	(0.0%, 0.2%)
LBC PreservCyt	1.2% (30/2,473)	(0.9%, 1.7%)	0.0% (0/2,471)	(0.0%, 0.2%)
Urine	1.2% (45/3,621)	(0.9%, 1.7%)	0.0% (0/3,620)	(0.0%, 0.1%)

[a]Based on the total number of samples that were available for retest

4. Clinical cut-off**:**

Not applicable

5. Expected values/Reference range:

The prevalence of infection with CT and/or NG, and/or TV in patient populations depends on risk factors such as age, gender, the type of clinic, and the sensitivity of the test used to detect infections. The observed positivity rates of the BD MAX CTGCTV2 assay in females during the clinical study are shown below.

BD MAX CTGCTV2 Observed Positivity Rate in Females

Site	*Chlamydia trachomatis*					*Neisseria gonorrhoeae*					*Trichomonas vaginalis*		
	CCVS[a]	SCVS[b]	Endo	LBC[c]	Urine	CCVS[a]	SCVS[b]	Endo	LBC[c]	Urine	CCVS[a]	SCVS[b]	Urine
1	3.4% 10/294	3.4% 10/297	3.3% 10/299	2.7% 8/298	3.1% 9/295	0.3% 1/294	0.7% 2/297	0.3% 1/299	0.3% 1/298	0.3% 1/295	23.1% 68/295	23.7% 71/299	23.4% 69/295
2	3.7% 18/486	5.1% 25/490	4.7% 23/489	3.8% 18/471	4.7% 23/489	1.0% 5/486	0.8% 4/489	0.6% 3/489	0.4% 2/471	0.8% 4/489	10.7% 52/486	12.0% 59/490	11.6% 57/491
3	5.3% 7/132	6.0% 8/133	4.5% 6/132	3.8% 5/133	4.5% 6/134	2.3% 3/132	2.3% 3/133	2.3% 3/132	2.3% 3/133	2.2% 3/134	6.8% 9/132	7.5% 10/133	7.5% 10/134
4	17.2% 5/29	17.2% 5/29	17.2% 5/29	13.8% 4/29	10.3% 3/29	3.4% 1/29	3.4% 1/29	3.4% 1/29	3.4% 1/29	3.4% 1/29	20.7% 6/29	20.7% 6/29	20.7% 6/29
5	7.1% 13/182	7.1% 13/182	5.5% 10/182	6.0% 11/182	7.7% 14/182	3.3% 6/182	3.3% 6/182	2.7% 5/182	2.7% 5/182	2.7% 5/182	14.8% 27/182	14.3% 26/182	14.3% 26/182

Site	*Chlamydia trachomatis*					*Neisseria gonorrhoeae*					*Trichomonas vaginalis*		
	CCVS[a]	SCVS[b]	Endo	LBC[c]	Urine	CCVS[a]	SCVS[b]	Endo	LBC[c]	Urine	CCVS[a]	SCVS[b]	Urine
6	7.3% 35/482	7.0% 34/483	5.4% 26/481	5.2% 25/484	6.2% 28/453	1.5% 7/482	1.7% 8/482	1.5% 7/481	1.2% 6/484	1.5% 7/453	6.6% 32/482	7.9% 38/482	6.6% 30/453
7	6.7% 5/75	6.7% 5/75	7.9% 6/76	6.4% 5/78	7.9% 6/76	0.0% 0/75	0.0% 0/75	0.0% 0/76	0.0% 0/78	0.0% 0/76	10.7% 8/75	12.0% 9/75	11.8% 9/76
8	3.9% 11/283	4.6% 13/283	3.9% 11/282	3.6% 10/276	3.7% 10/272	0.0% 0/283	0.0% 0/282	0.0% 0/282	0.0% 0/276	0.0% 0/272	1.4% 4/283	1.1% 3/282	1.1% 3/272
9	12.8% 33/257	11.6% 30/259	11.2% 29/259	10.6% 25/235	10.9% 28/256	6.2% 16/257	6.6% 17/259	6.2% 16/257	6.8% 16/235	5.5% 14/256	18.7% 48/257	18.1% 47/259	16.8% 43/256
10	9.4% 12/127	11.0% 14/127	10.2% 13/127	7.9% 10/127	7.9% 10/127	4.7% 6/127	4.7% 6/127	4.7% 6/127	4.7% 6/127	4.7% 6/127	7.9% 10/127	7.9% 10/127	7.9% 10/127
11	2.5% 4/157	1.9% 3/156	0.6% 1/157	0.0% 0/157	1.9% 3/157	0.0% 0/157	0.0% 0/156	0.0% 0/157	0.0% 0/157	0.0% 0/157	1.3% 2/157	1.3% 2/156	1.3% 2/157
Total	6.1% 153/2504	6.4% 160/2514	5.6% 140/2513	4.9% 121/2470	5.7% 140/2470	1.8% 45/2504	1.9% 47/2511	1.7% 42/2511	1.6% 40/2470	1.7% 41/2470	10.6% 266/2505	11.2% 281/2514	10.7% 265/2472

[a] Clinician-collected vaginal swab
[b] Self-collected vaginal swab
[c] PreservCyt Solution

BD MAX CTGCTV2 Observed Positivity Rate in Males

Site	*Chlamydia trachomatis*	*Neisseria gonorrhoeae*	*Trichomonas vaginalis*
1	17.0% 8/47	2.1% 1/47	0.0% 0/47
2	18.9% 28/148	23.6% 35/148	2.0% 3/148
3	12.0% 35/291	9.6% 28/291	5.2% 15/291
4	10.0% 36/359	7.2% 26/359	3.3% 12/359
5	13.3% 13/98	4.1% 4/98	5.1% 5/98
6	17.6% 35/199	14.6% 29/199	7.5% 15/199
Total	13.6% 155/1,142	10.8% 123/1,142	4.4% 50/1,142

6. Positive and Negative Predictive Values

Hypothetical Positive Predictive Value (PPV) and Negative Predictive Value (NPV) were calculated for patient- and clinician-collected vaginal swabs, endocervical swabs, male urine and PreservCyt LBC specimens and are shown in Table 8. The calculations are based on observed sensitivity and specificity for each specimen type, as compared to the Patient Infected Status.

Hypothetical Predictive Values for the BD MAX CTGCTV2 Assay

Specimen Type	Hypothetical Prevalence	*Chlamydia trachomatis*		*Neisseria gonorrhoeae*		*Trichomonas vaginalis*	
		% PPV 95% CI	% NPV 95% CI	% PPV 95% CI	% NPV 95% CI	% PPV 95% CI	% NPV 95% CI
Vaginal[a]	1%	44.9% (36.3%, 53.9%)	100% (99.9%, 100%)	87.5% (73.8%, 96.1%)	100% (99.9%, 100%)	61.7% (47.3%, 76.4%)	100% (99.9%, 100%)
	2%	62.2% (53.5%, 70.3%)	100% (99.9%, 100%)	93.4% (85.1%, 98.0%)	100% (99.8%, 100%)	76.5% (64.5%, 86.7%)	100% (99.9%, 100%)
	5%	80.9% (74.8%, 85.9%)	99.9% (99.7%, 100%)	97.3% (93.6%, 99.2%)	99.9% (99.6%, 100%)	89.4% (82.4%, 94.4%)	99.9% (99.7%, 100%)
	10%	90.0% (86.2%, 92.8%)	99.8% (99.4%, 100%)	98.7% (96.9%, 99.6%)	99.9% (99.1%, 100%)	94.7% (90.8%, 97.3%)	99.8% (99.4%, 99.9%)
	15%	93.4% (90.9%, 95.3%)	99.7% (99.0%, 99.9%)	99.2% (98.0%, 99.8%)	99.8% (98.5%, 100%)	96.6% (94.0%, 98.3%)	99.6% (99.1%, 99.9%)
	20%	95.3% (93.4%, 96.7%)	99.6% (98.6%, 99.9%)	99.4% (98.6%, 99.8%)	99.7% (97.9%, 100%)	97.6% (95.7%, 98.8%)	99.5% (98.7%, 99.8%)
	25%	96.4% (94.9%, 97.5%)	99.5% (98.2%, 99.9%)	99.6% (98.9%, 99.9%)	99.6% (97.3%, 100%)	98.2% (96.7%, 99.1%)	99.3% (98.2%, 99.7%)
Endocervical	1%	55.8% (44.5%, 66.7%)	99.9% (99.9%, 100%)	96.0% (80.8%, 99.3%)	100% (99.8%, 100%)	-	-
	2%	71.9% (61.8%, 80.2%)	99.9% (99.8%, 99.9%)	98.0% (89.5%, 99.6%)	99.9% (99.7%, 100%)	-	-
	5%	86.8% (80.7%, 91.2%)	99.7% (99.4%, 99.9%)	99.2% (95.6%, 99.9%)	99.8% (99.2%, 99.9%)	-	-
	10%	93.3% (89.8%, 95.7%)	99.4% (98.8%, 99.7%)	99.6% (97.9%, 99.9%)	99.5% (98.3%, 99.9%)	-	-
	15%	95.7% (93.3%, 97.2%)	99.0% (98.1%, 99.5%)	99.8% (98.7%, 100%)	99.2% (97.3%, 99.8%)	-	-
	20%	96.9% (95.2%, 98.0%)	98.6% (97.3%, 99.3%)	99.8% (99.0%, 100%)	98.9% (96.3%, 99.7%)	-	-
	25%	97.7% (96.4%, 98.5%)	98.2% (96.5%, 99.1%)	99.9% (99.3%, 100%)	98.5% (95.1%, 99.6%)	-	-
LBC PreservCyt	1%	81.5% (65.2%, 91.1%)	99.9% (99.9%, 100%)	95.8% (80.1%, 99.2%)	99.9% (99.8%, 100%)	-	-
	2%	89.9% (79.1%, 95.4%)	99.9% (99.7%, 99.9%)	97.9% (89.0%, 99.6%)	99.9% (99.6%, 99.9%)	-	-
	5%	95.8% (90.7%, 98.2%)	99.6% (99.3%, 99.8%)	99.2% (95.4%, 99.9%)	99.6% (99.0%, 99.9%)	-	-
	10%	98.0% (95.4%, 99.1%)	99.2% (98.5%, 99.6%)	99.6% (97.8%, 99.9%)	99.2% (97.9%, 99.7%)	-	-
	15%	98.7% (97.0%, 99.4%)	98.7% (97.7%, 99.3%)	99.7% (98.6%, 100%)	98.8% (96.8%, 99.6%)	-	-
	20%	99.1% (97.9%, 99.6%)	98.2% (96.8%, 99.0%)	99.8% (99.0%, 100%)	98.2% (95.5%, 99.4%)	-	-
	25%	99.3% (98.4%, 99.7%)	97.6% (95.8%, 98.7%)	99.9% (99.3%, 100%)	97.7% (94.0%, 99.2%)	-	-
Male Urine	1%	61.6% (42.5%, 77.8%)	100% (99.9%, 100%)	91.1% (64.4%, 98.3%)	100% (100%, 100%)	78.3% (55.1%, 91.4%)	100% (99.9%, 100%)
	2%	76.5% (59.9%, 87.6%)	99.9% (99.8%, 100%)	95.4% (78.5%, 99.2%)	100.0% (99.9%, 100%)	87.9% (71.3%, 95.5%)	100% (99.8%, 100%)
	5%	89.3% (79.4%, 94.8%)	99.8% (99.6%, 99.9%)	98.2% (90.4%, 99.7%)	100% (99.8%, 100%)	94.9% (86.5%, 98.2%)	99.9% (99.4%, 100%)
	10%	94.6% (89.1%, 97.5%)	99.6% (99.2%, 99.8%)	99.1% (95.2%, 99.8%)	99.9% (99.5%, 100%)	97.5% (93.1%, 99.1%)	99.8% (98.8%, 100%)
	15%	96.6% (92.8%, 98.4%)	99.4% (98.7%, 99.8%)	99.4% (96.9%, 99.9%)	99.9% (99.2%, 100%)	98.4% (95.5%, 99.5%)	99.6% (98.1%, 99.9%)
	20%	97.5% (94.8%, 98.9%)	99.2% (98.2%, 99.6%)	99.6% (97.8%, 99.9%)	99.8% (98.9%, 100%)	98.9% (96.8%, 99.6%)	99.5% (97.3%, 99.9%)
	25%	98.1% (96.1%, 99.1%)	98.9% (97.6%, 99.5%)	99.7% (98.4%, 99.9%)	99.7% (98.5%, 100%)	99.2% (97.6%, 99.7%)	99.3% (96.5%, 99.9%)

[a]*The sensitivity and specificity estimates for the patient-and clinician-collected vaginal swabs are similar; the PPV and NPV for vaginal swabs was calculated based on the averages of those estimates.*

N. Instrument Name:

BD MAX System

O. System Descriptions:

1. Modes of Operation:

Does the applicant's device contain the ability to transmit data to a computer, webserver, or mobile device?

Yes _____X_____ or No _____

Does the applicant's device transmit data to a computer, webserver, or mobile device using wireless transmission?

Yes _____ or No _____X___

2. Software:

a. FDA has reviewed applicant's Hazard Analysis and software development processes for this line of product types: Yes _____X_____or No _____
b. Level of Concern: Moderate
c. Device Hazard Analysis: Acceptable

The hazards exclusively related to the CTGCTV2 ADF (e.g., inaccurate temperature, incorrect magnet position, incorrect volume transfer, etc.) are included in the BD MAX System hazard analysis (HA) (BALTRM-MAXINST-APH). All hazards were properly documented and mitigated.

3. Specimen Identification:

Specimens are labeled with a unique bar code and following the BD MAX Specimen Collection Kit package insert.

4. Specimen Sampling and Handling:

Specimens are handled through the BD MAX sample processing subsystem, which utilizes a fluid handling robot for sampling. The instrument system includes the BD Pre-Warm Heater (required for LBC specimens only), which is completely controlled by the BD MAX System and does not require user intervention to operate. The specimens are loaded onto the BD MAX System where automated processing and reporting of assay results are completed.

5. Calibration:

BD MAX does not require user calibration. All maintenance procedures, other than daily and weekly cleaning procedures, are performed by BD qualified personnel.

6. Quality Control:

The assay includes a Specimen Processing Control (SPC) that is present in every Extraction Tube. The SPC monitors DNA extraction steps, thermal cycling steps, reagent integrity and the presence of inhibitory substances. External Control materials are treated as if they were patient samples; the BD MAX software does not use QC results for the interpretation of test results. External controls are not provided by BD and must be sourced by the user.

It is recommended that one External Positive Control and one External Negative Control be run at least daily until adequate process validation is achieved on the BD MAX System in each laboratory setting.

The External Positive Control is intended to monitor for substantial reagent failure. The External Negative Control is intended to detect reagent or environmental contamination (or carry-over) by target nucleic acids.

P. Other Supportive Instrument Performance Characteristics Data Not Covered in the Performance Characteristics" Section above:

Not Applicable.

Q. Proposed Labeling:

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

R. Conclusion:

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