Vela Diagnostics USA Inc.
Donald Henton
Dir. Regulatory Affairs North America
353C US Route 46 West
Suite 250
Fairfield, New Jersey 07004

February 1, 2018

Re: K172509
Trade/Device Name: Sentosa SA201 HSV 1/2 Qualitative PCR Test
Regulation Number: 21 CFR 866.3305
Regulation Name: Herpes simplex virus serological assays
Regulatory Class: Class II
Product Code: OQO
Dated: December 29, 2017
Received: January 4, 2018

Dear Donald Henton:

We have reviewed your Section 510(k) premarket notification of intent to market the device referenced above and have determined the device is substantially equivalent (for the indications for use stated in the enclosure) to legally marketed predicate devices marketed in interstate commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments, or to devices that have been reclassified in accordance with the provisions of the Federal Food, Drug, and Cosmetic Act (Act) that do not require approval of a premarket approval application (PMA). You may, therefore, market the device, subject to the general controls provisions of the Act. The general controls provisions of the Act include requirements for annual registration, listing of devices, good manufacturing practice, labeling, and prohibitions against misbranding and adulteration. Please note: CDRH does not evaluate information related to contract liability warranties. We remind you, however, that device labeling must be truthful and not misleading.

If your device is classified (see above) into either class II (Special Controls) or class III (PMA), it may be subject to additional controls. Existing major regulations affecting your device can be found in the Code of Federal Regulations, Title 21, Parts 800 to 898. In addition, FDA may publish further announcements concerning your device in the Federal Register.

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part 801 and Part 809); medical device reporting (reporting of medical device-related adverse events) (21 CFR 803); good manufacturing practice requirements as set forth in the quality systems (QS) regulation (21 CFR

Part 820); and if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR 1000-1050.

Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21 CFR Part 807.97). For questions regarding the reporting of adverse events under the MDR regulation (21 CFR Part 803), please go to http://www.fda.gov/MedicalDevices/Safety/ReportaProblem/default.htm for the CDRH's Office of Surveillance and Biometrics/Division of Postmarket Surveillance.

For comprehensive regulatory information about medical devices and radiation-emitting products, including information about labeling regulations, please see Device Advice (https://www.fda.gov/MedicalDevices/DeviceRegulationandGuidance/) and CDRH Learn (http://www.fda.gov/Training/CDRHLearn). Additionally, you may contact the Division of Industry and Consumer Education (DICE) to ask a question about a specific regulatory topic. See the DICE website (http://www.fda.gov/DICE) for more information or contact DICE by email (DICE@fda.hhs.gov) or phone (1-800-638-2041 or 301-796-7100).

Sincerely,

Uwe Scherf -S

Uwe Scherf, M.Sc., Ph.D.
Director
Division of Microbiology Devices
Office of In Vitro Diagnostics
and Radiological Health
Center for Devices and Radiological Health

Enclosure

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Food and Drug Administration

Indications for Use

Form Approved: OMB No. 0910-0120
Expiration Date: January 31, 2017
See PRA Statement below.

510(k) Number *(if known)*
K172509

Device Name

Sentosa® SA201 HSV-1/2 PCR Test

Indications for Use *(Describe)*

Intended Use

The *Sentosa*® SA201 HSV-l/2 PCR Test is a real-time PCR-based qualitative *in vitro* diagnostic test for detection and differentiation of Herpes Simplex Virus (HSV-l and HSV-2) DNA from male and female skin lesions from anogenital or oral sites. The test is intended for use as an aid in diagnosis of herpes infection in symptomatic patients.

Warning: The *Sentosa*® SA201 HSV-l/2 PCR Test is not FDA cleared for use with cerebrospinal fluid (CSF). The test is not intended to be used for prenatal screening.

Type of Use *(Select one or both, as applicable)*

☒ Prescription Use (Part 21 CFR 801 Subpart D) ☐ Over-The-Counter Use (21 CFR 801 Subpart C)

CONTINUE ON A SEPARATE PAGE IF NEEDED.

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510(k) Summary

Date summary prepared: 1/31/2018

510(k) Submitter/Holder

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Contact

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Name of Device

Trade Name:	*Sentosa*® SA201 HSV-1/2 PCR Test
Catalog Numbers:	300216
Common Name:	Herpes Simplex Virus Nucleic Acid Amplification Assay
Classification Name:	Herpes simplex virus serological assays (21 CFR § 866.3305, Class II, OQO).

Predicate Device

The *Sentosa*® SA201 HSV-1/2 PCR Test was compared to and found to be substantially equivalent to the following product of comparable type in commercial distribution:

Trade Name:	IMDx HSV-1/2 for Abbott m2000 Assay
Common Name:	Herpes Simplex Virus Nucleic Acid Amplification Assay
510(k) Number:	K140198 (cleared 05/13/2014)
Manufacturer:	Intelligent Medical Devices, Inc.

Table 1. *Sentosa*® SA201 HSV-1/2 PCR Test and Predicate Similarities Comparison

Item	Device	Predicate	Similarities / Differences
Characteristics	***Sentosa*® SA201 HSV1/2 PCR Test (K172509)**	**IMDx HSV-1/2 for Abbott *m*2000 Assay (K140198)**	
Regulation	21 CFR 866.3305	21 CFR 866.3305	Same
Product Code	OQO	OQO	Same
Device Class	Class II	Class II	Same
Intended use	The *Sentosa*® SA201 HSV-1/2 PCR Test is a real-time PCR-based qualitative *in vitro* diagnostic test for detection and differentiation of Herpes Simplex Virus (HSV-1 and HSV-2) DNA from male and female skin lesions from anogenital or oral sites. The test is intended for use as an aid in diagnosis of herpes infection in symptomatic patients. ***Warning**:* The *Sentosa*® SA201 HSV-1/2 PCR Test is not FDA cleared for use with cerebrospinal fluid (CSF). The test is not intended to be used for prenatal screening.	The IMDx HSV-1/2 for Abbott *m*2000 assay is an *in vitro* diagnostic test for the direct, qualitative detection and differentiation of Herpes Simplex Virus type 1 (HSV-1) and type 2 (HSV-2) DNA from male and female skin lesions from anogenital or oral sites. The test is intended for use as an aid in the diagnosis of HSV infection in symptomatic patients. The assay is intended to be run on the Abbott *m*2000 instrument system. ***Warning:*** The IMDx HSV-1/2 for Abbott *m*2000 assay is not FDA-cleared for use with cerebrospinal fluid (CSF). The assay is not intended for pre-natal screening.	The intended use is the same except the noted systems they are designed to be run on. The warning is the same.
Test Principle	Real-time PCR DNA amplification	Real-time PCR DNA amplification	Same

Assay Results	Qualitative detection and differentiation of HSV-1 and HSV-2 DNA	Qualitative detection and differentiation of HSV-1 and HSV-2 DNA	Same
Sample type	Male and female skin lesions from anogenital or oral sites	Male and female skin lesions from anogenital or oral sites	Same

Device Description

The *Sentosa*® SA201 HSV-1/2 PCR Test is a (4x24) configuration contains reagents and enzymes for specific amplification of a 104 bp (base-pair) fragment of the UL30 gene common to both HSV1 and HSV2, and specific probes for the direct detection and differentiation of HSV1 and HSV2 amplicons, respectively. Pathogen detection by PCR is based on the amplification of specific regions of the pathogen genome. In real-time PCR, the amplified product is detected via fluorescent dyes, which are usually linked to oligonucleotide probes that bind specifically to the target sequences. Real-time monitoring of the fluorescence intensities during a PCR run allows the detection of the accumulating product. Amplification of the targets occurs in three channels: green, orange and red on the Sentosa® SA201. Output is recorded as the increase of fluorescence over time in comparison to background signal. Monitoring the fluorescence intensities during the PCR run allows the detection of the accumulating product without having to re-open the reaction tubes after the PCR run.

The *Sentosa*® SA201 HSV-1/2 PCR Test workflow starts with extraction of nucleic acids from samples (anogenital or oral swabs) using the *Sentosa*® SX Virus Total Nucleic Acid Kit on the *Sentosa*® SX101 instrument. Following extraction, the instrument will automatically set up the PCR with the extracted nucleic acids in a 96-well PCR plate. Subsequently, the 96-well PCR plate is sealed and transferred to the *Sentosa*® SA201 for PCR amplification, followed by data analysis.

The *Sentosa*® Link facilitates data transfer between the *Sentosa*® SX101, the *Sentosa*® SA201 Reporter and existing LIS/LIMS (laboratory information systems) in the clinical lab. The *Sentosa*® SX101 instrument communicates with *Sentosa*® SA201 thermocycler. This creates a user environment that links the SX101 and the *Sentosa*® SA201 to facilitate automated workflow to export results in a LIS/LIMS-compatible format.

Intended Use

The *Sentosa*® SA201 HSV-1/2 PCR Test is a real-time PCR-based qualitative *in vitro* diagnostic test for detection and differentiation of Herpes Simplex Virus (HSV-1 and HSV-2) DNA from male and female skin lesions from anogenital or oral sites. The test is intended for use as an aid in diagnosis of herpes infection in symptomatic patients.

Warning: The *Sentosa*® SA201 HSV-1/2 PCR Test is not FDA cleared for use with cerebrospinal fluid (CSF). The test is not intended to be used for prenatal screening.

Technological Characteristics

The *Sentosa*® SA201 HSV-1/2 PCR Test contains reagents and enzymes for specific amplification of a 104 bp fragment of UL30 gene common to both HSV1 and HSV2, and specific probes for the direct detection and differentiation of HSV1 and HSV2 amplicons, respectively. Pathogen detection by PCR is based on the amplification of specific regions of the pathogen genome. In real-time PCR, the amplified product is detected via fluorescent dyes, which are usually linked to oligonucleotide probes that bind specifically to the target sequences. Real-time monitoring of the fluorescence intensities during a PCR run allows the detection of the accumulating product. Amplification of the targets occurs in three channels: green, orange and red on the *Sentosa*® SA201. Output is recorded as the increase of fluorescence over time in comparison to background signal. Monitoring the fluorescence intensities during the PCR run allows the detection of the accumulating product without having to re-open the reaction tubes after the PCR run.

The *Sentosa*® SA201 HSV-1/2 PCR Test workflow starts with extraction of nucleic acids from samples (anogenital or oral swabs) using the *Sentosa*® SX Virus Total Nucleic Acid Kit on the *Sentosa*® SX101 instrument. Following extraction, the instrument will automatically set up the PCR with the extracted nucleic acids in a 96-well PCR plate. Subsequently, the 96-well PCR plate is sealed and transferred to the *Sentosa*® SA201 for PCR amplification, followed by data analysis.

Drivers are installed on the *Sentosa*® Link to connect the Sentosa SX101 instrument and the *Sentosa*® SA201 thermocycler. This creates a user environment that links the SX101 and the *Sentosa*® SA201 to facilitate automated workflow to export results in a LIS/LIMS-compatible format.

The *Sentosa*® SA201 HSV-1/2 PCR Test uses the *Sentosa*® SX101 hardware and *Sentosa*® SA201 hardware, along with the associated consumables to operate as an automated sample extraction, PCR setup, amplification and reporting system (referred to as workflow for short).

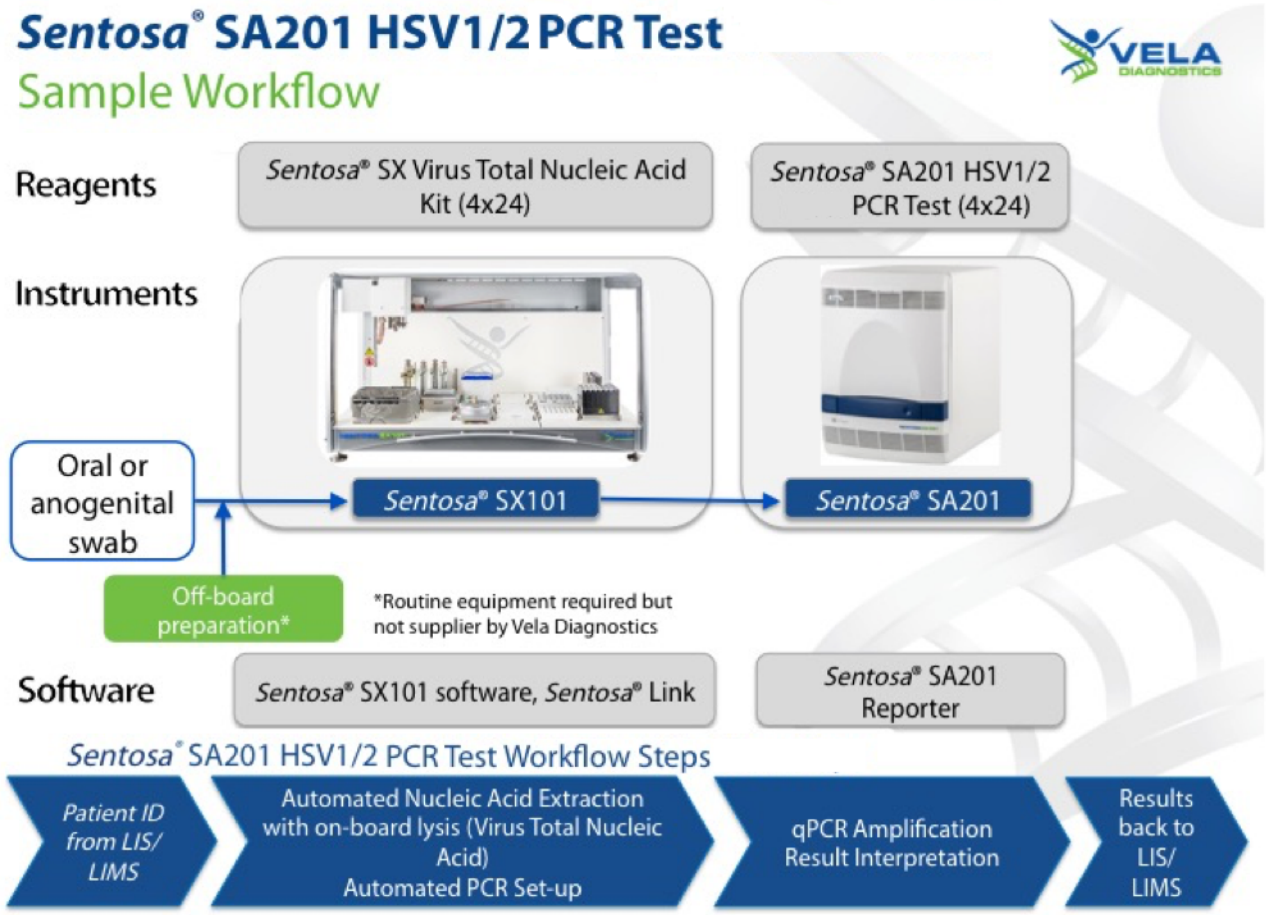

Figure 1. *Sentosa*® SA201 HSV-1/2 PCR Test Workflow Overview.

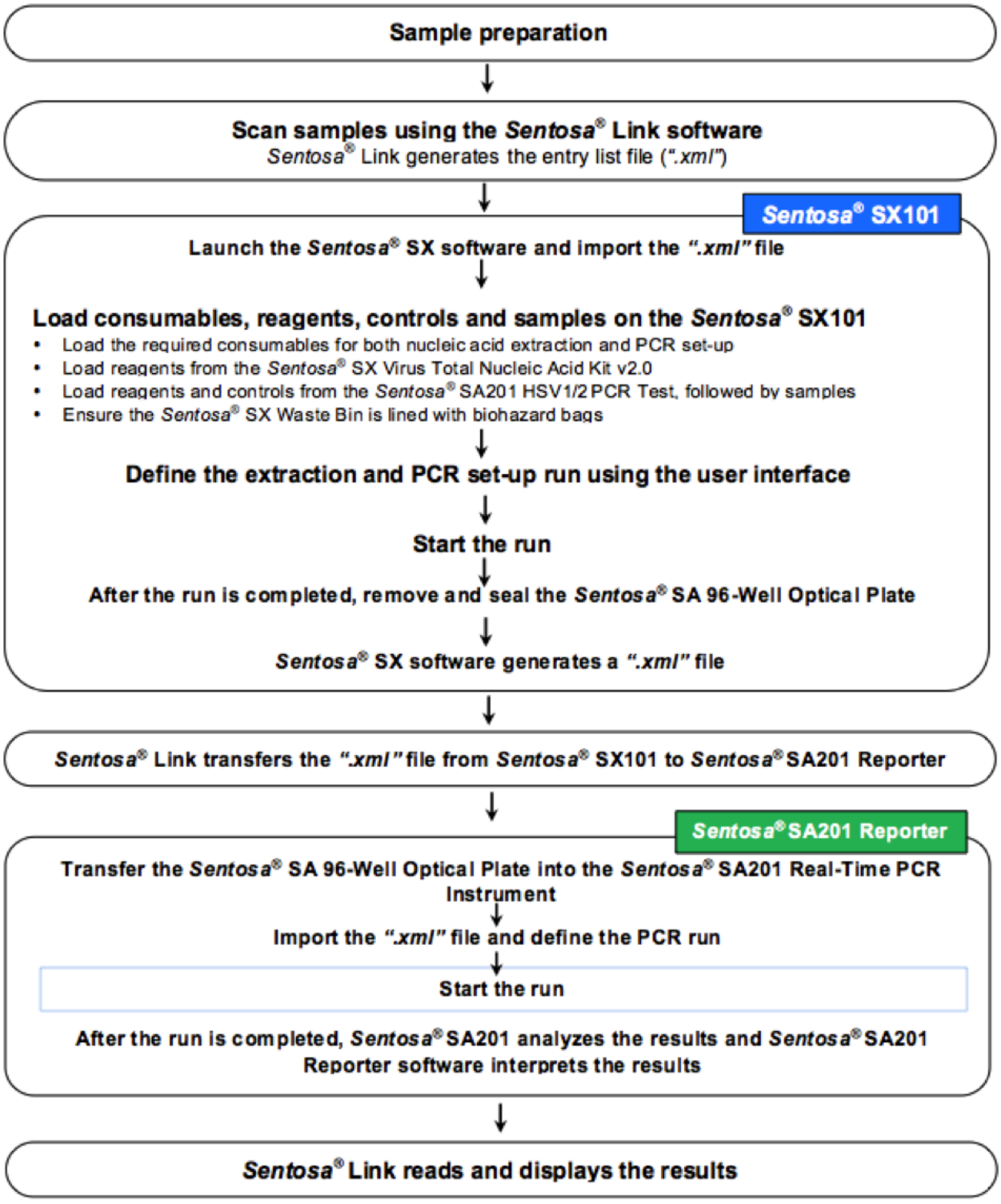

Figure 2. *Sentosa*® SA201 HSV-1/2 PCR Test Workflow Flowchart.

Performance

Analytical Studies:

1. Analytical sensitivity: The limit of detection (LoD) was assessed for the *Sentosa*® SA201 HSV-1/2 PCR Test using two strains of HSV-1 (MacIntyre and KOS) and two strains of HSV-2 (MS and G). The LoD is defined as the HSV titer (TCID50/mL) detected with a probability of 95% or greater and was determined by Probit analysis using HSV-1 MacIntyre and HSV-2 MS. The results of the analytical sensitivity of the *Sentosa*® SA201 HSV-1/2 PCR Test are summarized in the following table.

Table 2. Analytical sensitivity - Limit of Detection (LoD) HSV-1 and HSV-2

Strain	LoD ($TCID_{50}$/mL)
HSV-1 MacIntyre	40
HSV-1 KOS	40
HSV-2 MS	4
HSV-2 G	4

2. Precision: The study was conducted over a period of five (5) days with three (3) reagent lots, five (5) operators, and four (4) instrument systems at Vela Research Singapore. The test materials used in the study included NC, PC, and negative sample, 3xLoD HSV1, 1.5xLoD HSV1, 3xLoD HSV2 and 1.5xLoD HSV2. Each concentration was assayed three (3) times per run for 20 runs, resulting in 60 replicates (three (3) replicates/run x four (4) run/day x five (5) days x one (1) site = 60 replicates). The precision analysis was based on %CV of Ct values, and is presented in **Table 3** below. The quality control analysis was based on the mean and standard deviations (SD) of the Ct values. The demonstrated agreement with the results being 100% for all tested types, and the %CV being (less than) < 10%.

Table 3. Precision

Sample type	Channel	Agreement (%)	95% CI*	Mean Ct	SD
1.5x LoD HSV-1[a]	Green	60/60 (100%)	93.98% - 100%	31.79	0.81
3x LoD HSV-1[a]	Green	60/60 (100%)	93.98% - 100%	30.72	0.90
1.5x LoD HSV-2 [b]	Orange	60/60 (100%)	93.98% - 100%	30.25	1.09
3x LoD HSV-2 [b]	Orange	59/59 (100%)*	93.89% - 100%	29.35	0.54
NC	Red	60/60 (100%)	93.98% - 100%	29.08	2.24
PC	Green	60/60 (100%)	93.98% - 100%	26.09	1.10

Sample type	Channel	Agreement (%)	95% CI*	Mean Ct	SD
	Orange	60/60 (100%)	93.98% - 100%	28.51	0.69
Negative sample	Red	60/60 (100%)	93.98% - 100%	28.98	2.03

[a]1.5x LoD HSV-1 is 60 TCID50/mL and 3x LoD HSV-1 is 120 TCID50/mL
[b]1.5x LoD HSV-2 is 6 TCID50/mL and 3x LoD HSV-2 is 12 TCID50/mL
* Total number of samples is less than 60 due to exclusion of 1 invalid sample

3. Reproducibility: The Reproducibility Study was to demonstrate the performance of the *Sentosa*® SA201 HSV-1/2 PCR Test using simulated samples (with spiked-in HSV1/2 virus) using multiple sites, multiple instruments, multiple operators, and multiple lots using the matrix. The study demonstrated excellent agreement across the sites, operators, and systems with the results meeting the acceptance for all the tested types, and the %CV being (less than) < 10%. The results are summarized in the following **Table 4**.

Table 4. Reproducibility

Sample type	Channel	Agreement (%)	95% CI*	Mean C_t ± SD	% CV
1.5x LoD HSV-1[a]	Green	90/90 (100%)	95.91% - 100%	31.45 ±1.65	5.25%
3x LoD HSV-1[a]	Green	90/90 (100%)	95.91% - 100%	30.23 ±1.01	3.34%
1.5x LoD HSV-2[b]	Orange	90/90 (100%)	95.91% - 100%	29.29 ±0.47	1.60%
3x LoD HSV-2[b]	Orange	90/90 (100%)	95.91% - 100%	28.01 ±1.18	4.21%
NC	Red	90/90 (100%)	95.91% - 100%	26.93 ±0.60	2.23%
PC	Green	90/90 (100%)	95.91% - 100%	25.80 ±0.26	1.01%
	Orange	90/90 (100%)	95.91% - 100%	28.32 ±0.32	1.13%
Negative sample	Red	90/90 (100%)	95.91% - 100%	27.17 ±1.14	4.20%
Blank	Red	90/90 (100%)	95.91% - 100%	26.81 ±0.55	2.05%

4. Analytical Reactivity / Cross-reactivity: The Analytical Reactivity and Specificity Study was to demonstrate the analytical reactivity and cross-reactivity (analytical specificity) performance of the *Sentosa*® SA201 HSV-1/2 PCR Test with the *Sentosa*® workflow using high and low concentration HSV1 and HSV2 samples (with competing organisms). The results in the study showed that the 55 organisms, which are closely related to HSV1/2 or present in oral or genital swab samples at high concentrations showed no cross reactivity to HSV1/2 detection using the *Sentosa*® SA201 HSV-1/2 PCR Test. It also showed no interference with the detection of low concentration levels of HSV1 or HSV2. The results do suggest that C. glabrata, S. aureus, S. epidermidis, P. melaninogenica and HHV6 might lead to slight competitive inhibition from HSV1 to HSV2. The results also showed no cross-reactivity within the multiplex panel (HSV1 and HSV2) in the presence of either high concentration HSV1 or high concentration HSV2 strains.

Table 5. The Analytical Reactivity / Cross-reactivity tested organisms

Potential interfering organisms	
Candida glabrata, NCYC 388	Human papillomavirus type 16
Acinetobacter baumannii, 2208	Human papillomavirus type 18
Acinetobacter calcoaceticus	Human DNA
Acinetobacter Iwofii	Human herpesvirus (HHV6)
Actinomyces isralii, serotype 1	Human herpesvirus 4, B95-8
Adenovirus 1, strain Adenoid 71	Klebsiella pneumonia, NCTC 9633
Adenovirus Type 7, strain Gomen	Lactobacillus acidophilus
Bacteroides fragilis, VPI2553	Maraxella catarrhalis, strain 20
Candida albicans, strain 132	Mobiluncus curtisii, BV 345-16
Candida krusei, NRRL Y-6	Mobiluncus muleris, BV 64-5
Candida parapsilosis, NRRL-Y-12969	Mycoplasma hominis, PG21
Candida tropicalis, PK233	Neisseria gonorrhea, B-585
Chlamydia trachomatis, UW-57/Cx	Neisseria meningitides, serogroup B
Clostridium difficile, strain 4118	Prevotella melaninogenica, B282
CMV, AD-169	Rubella virus
Corynebacterium genitalium, 392-1	Staphylococcus aureus, F-182
Cryptococcus neoformans, 52	Staphylococcus aureus, FDA 209
Enterobacter cloacae, QC strain	Staphylococcus epidermidis, 255-01B
Enterococcus faecalis, AGR329	Staphylococcus saprophyticus, LRA27.02
Enterovirus type 71, BrCr	Streptococcus mitis, NCTC 12261
Epstein-Barr virus/Human herpesvirus 4, strain P-3	Streptococcus mutans, UA159
Escherichia coli O103, strain NCDC H515b	Streptococcus pneumonia, CIP 104225
Fusobacterium necrophorum subsp necrophorum, VPI2553	Streptococcus pyogenes
Fusobacterium nucleatum subsp nucleatum, 1612A	SV40 (Simian virus 40)
Gardnerella/Haemophilus vaginalis, 317	Toxoplasma gondii
Haemophilus ducreyi, CIP 542	Trichomonas vaginalis
Hepatitis A virus, strain PA21	Varicella-Zoster Virus (VZV)
HIV-1, Group M Subtype C	

5. Interfering Substances: The Interfering Substances and Competitive Interference Study to evaluate the effect of potentially interfering substances and competitive interference on the performance of the *Sentosa*® SA201 HSV1/2 PCR Test was conducted over a period of ten (10) days with one (1) reagent lot, five (5) operators, and four (4) instrument workflow systems. The test materials used in this study included 31 substances commonly found in genital and oral specimens, which were dissolved into virus transport media (VTM) at approximately 3xLoD for both HSV1 and HSV2 to approximately 10 times of the normal active concentration. Each

material was assayed in triplicate. The highest concentration for each substance with no interfering effect on device performance was reported. The test materials used in the competitive interference study were HSV1 and HSV2 spiked-in samples with different combinations of HSV1 and HSV2 concentrations. Each combination was tested in 20 replicates. The virus with the highest concentration that resulted in 100% detection of another virus was recorded, as well as the highest equal concentration combination of the two viruses. No interfering effects on the performance at concentration levels higher (5 to 10 times) than the normal active concentration of the interference substances tested. The HSV1 concentration that resulted in 100% detection rate of 3xLoD HSV2 was at least 50xLoD. The HSV2 concentration that resulted in 100% detection rate of 3xLoD HSV1 was at least 10xLoD but less than 50xLoD. No mutual interference was observed in HSV1 and HSV2 equal concentration combinations to at least 500xLoD of each virus.

Table 6. Interfering Substances and Competitive Interference Study tested substances

Substance	Active Ingredients	Tested concentration
Acyclovir	Acycloguanosine (10%)	7mg/mL
Whole blood with EDTA	N/A	7% (v/v)
Female urine	N/A	7% (v/v)
Male urine	N/A	7% (v/v)
Albumin	Albumin	3.3 mg/mL
Saliva	N/A	7% (v/v)
K.Y. Jelly lubricant	N/A	7% (w/v)
Feminine wash	N/A	5% (v/v)
Xylocaine 5%	Lidocaine (50mg)	7% (w/v)
Toothpaste	Stannous fluoride (0.454%)	0.53% (w/v)
Desitin maximum original paste	Zinc Oxide (40%)	7% (w/v)
Mentholatum lip balm	Menthol (0.7%), Camphor (1.7%)	7% (w/v)
Listerine anti-bacterial mouthwash	Eucalyptol (0.092%), Menthol (0.042%), Methy Salicylate (0.060%), Thymol (0.064%)	7% (v/v)
Casein	Casein	7 mg/mL
Douche	Providone-iodine (10% w/v)	7% (v/v)
YeastGard	Candida albicans 27X* HPUS, Candida parapsilosis 27X* HPUS Pulsatilla 27* HPUS	7% (w/v)
Vaginal contraceptive gel	Nonoxynol-9 (4%)	7% (w/v)
Vaginal contraceptive gel	Nonoxynol-9 (3%)	7% (w/v)
Monistat-7	Miconazole nitrate vaginal cream (2%)	7% (w/v)
Fleet	Benzalkonium (0.06% w/w)/EDTA	7% (w/v)
Gyno-Trosyd	Tioconazole (100mg)	7% (w/v)
Clotrimazole 1% Cream	Clotrimazole (50mg, 1%)	7% (w/v)
Anti-Inch Cream	Lidocaine ph. Eur. (2% w/w)	7% (w/v)

Substance	Active Ingredients	Tested concentration
Abreva	Docosanol (10%)	7% (w/v)
Buffy coat	White blood cell	7% (w/v)
Talcum powder	N/A	7% (w/v)
Seminal fluid	Seminal fluid	7% (v/v)
Feces	Feces	7% (w/v)
Corn starch	Corn starch	1.25 mg/mL
Paracetamol	Acetamidophenol	5 mg/mL
Aspirin	Acetylsalicyclic acid	10 mg/mL

6. Carry-over and Cross-contamination: The Cross-contamination and Carry-over studies were to evaluate the potential cross-contamination during extraction and on subsequent runs on the performance of the *Sentosa*® SA201 HSV1/2 Test with the *Sentosa*® SX101 workflow instrument in accordance with CLSI MM17-A (2008). These carry-over and cross-contamination studies were conducted over a period of four (4) days with one (1) reagent lot, two (2) operators, and two (2) *Sentosa*® workflow systems. The test materials used in the study included negative samples and 1x10^5 $TCID_{50}$/mL HSV1 (2500xLoD) for the cross-contamination study, a NC, a PC, and negative samples for the carry-over contamination study. Three (3) run matrices were used, two (2) for the cross–contamination study and one (1) for the carry-over contamination study. The results showed that the overall contamination rate of the twelve runs was 0% at a HSV1 positive sample concentration of 1x10^5 $TCID_{50}$/mL. All 96 positive samples were detected as positive, and the 183 negative samples were detected as negative (no amplification signal noted).

Clinical Studies

1. Clinical Study: This study utilized residual anogenital lesion or oral lesion samples from male and female patients with signs and symptoms of HSV infections collected from 8 sites in the USA. Samples were either tested at the same facility at which they were obtained, or were shipped to a different testing site. Each sample was tested with *Sentosa*® SA201 HSV-1/2 PCR Test (4 test sites) and the ELVIS® HSV ID and D^3 Typing Test System reference test (3 test sites). A total of 2684 samples were enrolled in the study. 389 samples were excluded, leaving a total of 2295 samples in the final analysis. Out of these, 317 were oral lesions and 1978 were anogenital lesions.

The clinical performance of *Sentosa*® SA201 HSV-1/2 PCR Test on oral samples compared to the ELVIS® HSV ID and D^3 Typing Test System (ELVIS) for sensitivity and specificity is summarized in the following tables. Discordant samples were tested using bi-directional sequencing analysis.

Table 6. HSV-1 results for anogenital lesions

***Sentosa* SA201 HSV-1/2 PCR Test**	**ELVIS Reference Method**		
	Positive	**Negative**	**Total**
Positive	281	54[b]	335
Negative	9[a]	1237	1246
Total	290	1291	1581
	Value	**Lower 95% CI**	**Upper 95% CI**
Sensitivity	96.90%	94.21%	98.36%
Specificity	95.82%	94.58%	96.78%

[a] From sequencing analysis, 4 discordant samples (HSV-1 positive by ELVIS and HSV-1 negative by *Sentosa*®) were in agreement with *Sentosa*® results, 2 were in agreement with ELVIS results and 2 were not in agreement with *Sentosa*® nor ELVIS results. 1 discordant sample was not tested due to insufficient volume.

[b] From sequencing analysis, 44 discordant samples (HSV-1 negative by ELVIS and HSV-1 positive by *Sentosa*®) were in agreement with *Sentosa*® results and 10 were in agreement with ELVIS results.

Table 7. HSV-2 results for anogenital lesions

Sentosa SA201 HSV-1/2 PCR Test	ELVIS Reference Method		
	Positive	**Negative**	**Total**
Positive	391	147[d]	538
Negative	6[c]	1434	1440
Total	397	1581	1978
	Value	**Lower 95% CI**	**Upper 95% CI**
Sensitivity	98.49%	96.74%	99.31%
Specificity	90.70%	89.17%	92.04%

[c] From sequencing analysis, 4 discordant samples (HSV-2 positive by ELVIS and HSV-2 negative by *Sentosa*®) were in agreement with *Sentosa*® results and 2 were in agreement with ELVIS results.

[d] Out of 147 discrepant samples, 142 were unique samples (3 samples were ELVIS HSV-1 positive/HSV-2 negative and *Sentosa*® HSV-1 negative/HSV-2 positive and were double-counted in the 9 samples that are ELVIS HSV-1 positive and *Sentosa*® HSV-1 negative. 2 samples were ELVIS HSV-1 negative/HSV-2 negative and *Sentosa*® HSV-1 positive/HSV-2 positive. These were double-counted in the 54 samples that are ELVIS HSV-1 negative and *Sentosa* HSV-1 positive.) From sequencing analysis, 119 discordant samples (HSV-2 negative by ELVIS and HSV-2 positive by *Sentosa*®) were in agreement with *Sentosa* results and 20 were in agreement with ELVIS results. Three discordant samples was not tested due to insufficient volume.

HSV-1 results for anogenital lesions (N=1581, 397 samples tested as HSV-2 positive by ELVIS were excluded from the 1978 anogenital lesion samples).

Table 8. HSV-1 results for oral lesions

Sentosa SA201 HSV-1/2 PCR Test	ELVIS Reference Method		
	Positive	**Negative**	**Total**
Positive	79	32[e]	111
Negative	0	203	203
Total	79	235	314
	Value	**Lower 95% CI**	**Upper 95% CI**
Sensitivity	100.00%	95.36%	100.00%
Specificity	86.38%[c]	81.41%	90.19%

[e] From sequencing analysis, 27 discordant samples (HSV-1 negative by ELVIS and HSV-1 positive by *Sentosa*®) were in agreement with *Sentosa*® results and 4 were in agreement with ELVIS results. One discordant sample was not tested due to insufficient volume.

Table 9. HSV-2 results for oral lesions

Sentosa SA201 HSV-1/2 PCR Test	ELVIS Reference Method		
	Positive	**Negative**	**Total**
Positive	2	1[g]	3
Negative	1[f]	313	314
Total	3	314	317
	Value	**Lower 95% CI**	**Upper 95% CI**
Sensitivity	66.67%	20.77%	93.85%
Specificity	99.68%	98.22%	99.94%

[f] From sequencing analysis, one sample (HSV-2 positive/HSV-1 negative by ELVIS and HSV-2 negative/HSV-1 positive by *Sentosa*®) was in agreement with *Sentosa*® results.

[g] One discordant sample (HSV-1/2 negative by ELVIS and HSV-2 positive by *Sentosa*®) was not tested due to insufficient volume.

HSV-1 results for oral lesions (N=314, 3 samples tested as HSV-2 positive by ELVIS were excluded from the 317 oral lesion samples)

Table 10. Distribution of samples according to demographics for anogenital lesions as tested by *Sentosa*® SA201 HSV-1/2 PCR Test

Age (years)	HSV-1			HSV-2		
	Female	**Male**	**Combined**	**Female**	**Male**	**Combined**
0 - 10	2/27 7.4%	1/37 2.7%	3/64 4.7%	0/27 0.0%	0/37 0.0%	0/64 0.0%
11 - 20	59/188 31.4%	8/40 20.0%	67/228 29.4%	51/232 22.0%	6/43 14.0%	57/275 20.7%
21 - 30	126/400 31.5%	19/103 18.4%	145/503 28.8%	173/538 32.2%	55/146 37.7%	228/684 33.3%
31 - 40	50/254 19.7%	7/70 10.0%	57/324 17.6%	71/300 23.7%	14/78 17.9%	85/378 22.5%
41 - 50	27/185 14.6%	4/28 14.3%	31/213 14.6%	58/221 26.2%	11/36 30.6%	69/257 26.8%
51 - 60	22/105 21.0%	1/27 3.7%	23/132 17.4%	41/139 29.5%	12/31 38.7%	53/170 31.2%
61 - 70	5/61 8.2%	2/12 16.7%	7/73 9.6%	21/77 27.3%	4/14 28.6%	25/91 27.5%
71 - 80	2/22 9.1%	0/9 0.0%	2/31 6.5%	12/30 40.0%	3/11 27.3%	15/41 36.6%
81 - 90	0/6 0.0%	0/4 0.0%	0/10 0.0%	3/9 33.3%	2/6 33.3%	5/15 33.3%
>90	0/0 0.0%	0/3 0.0%	0/3 0.0%	0/0 0.0%	1/3 33.3%	1/3 33.3%
TOTAL	293/1248 23.5%	42/333 12.6%	335/1581 21.2%	430/1573 27.3%	108/405 26.7%	538/1978 27.2%

Table 11. Distribution of samples according to demographics for oral lesions as tested by *Sentosa*® SA201 HSV-1/2 PCR Test

Age (years)	HSV-1			HSV-2		
	Female	Male	Combined	Female	Male	Combined
0 - 10	11/25 44.0%	10/28 35.7%	21/53 39.6%	0/25 0.0%	0/29 0.0%	0/54 0.0%
11 - 20	7/13 53.8%	5/18 27.8%	12/31 38.7%	0/13 0.0%	0/18 0.0%	0/31 0.0%
21 - 30	8/40 20.0%	6/26 23.1%	14/66 21.2%	0/40 0.0%	0/26 0.0%	0/66 0.0%
31 - 40	5/23 21.7%	5/16 31.3%	10/39 25.6%	1/24 4.2%	0/16 0.0%	1/40 2.5%
41 - 50	9/19 47.4%	2/6 33.3%	11/25 44.0%	0/19 0.0%	0/6 0.0%	0/25 0.0%
51 - 60	7/25 28.0%	5/9 55.6%	12/34 35.3%	0/25 0.0%	0/9 0.0%	0/34 0.0%
61 - 70	4/18 22.2%	7/14 50.0%	11/32 34.4%	1/18 5.6%	0/14 0.0%	1/32 3.1%
71 - 80	9/13 69.2%	7/14 50.0%	16/27 59.3%	0/13 0.0%	1/15 6.7%	1/28 3.6%
81 - 90	1/3 33.3%	2/4 50.0%	3/7 42.9%	0/3 0.0%	0/4 0.0%	0/7 0.0%
TOTAL	61/179 34.1%	49/135 36.3%	110/314 35.0%	2/180 1.1%	1/137 0.7%	3/317 0.9%

Positive and Negative Predictive Value: Hypothetical positive and negative predictive values (PPV & NPV) for the *Sentosa*® SA201 HSV-1/2 PCR Test are shown below. These calculations for hypothetical prevalence are based on overall sensitivity and specificity per sample type from the clinical study results. For HSV-1, these calculations are based upon an overall sensitivity and specificity of 96.90% and 95.82%, respectively, for anogenital swabs and 100.0% and 86.38%, respectively, for oral swabs. For HSV-2, these calculations are based upon an overall sensitivity and specificity of 98.49% and 90.70%, respectively, for anogenital swabs and 66.67% and 99.68%, respectively, for oral swabs.

Table 12. Prevalence vs hypothetical Predictive Values

Prevalence (%)	Anogenital				Oral			
	HSV-1		HSV-2		HSV-1		HSV-2	
	PPV	NPV	PPV	NPV	PPV	NPV	PPV	NPV
2	32.12%	99.93%	17.77%	99.97%	13.03%	100.00%	80.96%	99.32%
5	54.96%	99.83%	35.79%	99.91%	27.87%	100.00%	91.64%	98.27%
10	72.03%	99.64%	54.06%	99.82%	44.93%	100.00%	95.86%	96.42%
20	85.28%	99.20%	72.58%	99.59%	64.73%	100.00%	98.12%	92.29%
30	90.86%	98.63%	81.95%	99.29%	75.88%	100.00%	98.89%	87.47%
40	93.92%	97.89%	87.59%	98.90%	83.04%	100.00%	99.29%	81.77%
50	95.86%	96.87%	91.37%	98.36%	88.01%	100.00%	99.52%	74.94%

2. **HSV-2 oral lesion contrived specimen study:** A contrived specimen study was performed to provide additional performance data for detection of HSV-2 in oral samples. A study was performed to test 30 HSV-2-contrived oral lesion samples, along with 15 HSV-1 positive oral lesion samples and 15 HSV-1/HSV-2 negative samples. In the test, all 30 HSV-2-contrived oral lesion samples were identified as HSV-2 positive, and all 15 HSV-1 positive and 15 HSV-1/2 negative samples were correctly identified.

Conclusion:

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