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

I Background Information:

A 510(k) Number

K234091

B Applicant

Genalyte, Inc.

C Proprietary and Established Names

Maverick Diagnostic System TC1000; Maverick Test Panel A0.B0

D Regulatory Information

Product Code(s)	Classification	Regulation Section	Panel
JLW	Class II	21 CFR 862.1690 - Thyroid Stimulating Hormone Test System	CH - Clinical Chemistry
JJE	Class I	21 CFR 862.2160 - Discrete photometric chemistry analyzer for clinical use	CH - Clinical Chemistry

II Submission/Device Overview:

A Purpose for Submission:
New Device

B Measurand:
Human thyroid stimulating hormone (thyrotropin, TSH)

C Type of Test:
Sandwich immunoassay

III Intended Use/Indications for Use:

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

B Indication(s) for Use:
The Maverick Test Panel A0.B0 is an immunoassay for the quantitative determination of human thyroid stimulating hormone (thyrotropin, TSH) in human serum and K2EDTA plasma on the Maverick Diagnostic System TC1000. Measurements of thyroid stimulating hormone produced by the anterior pituitary are used in the diagnosis of thyroid or pituitary disorders.

The Maverick Diagnostic System TC1000 is an automated immunoassay analyzer intended for in vitro diagnostic use to determine analytes in a clinical laboratory. The system's assay applications utilize silicon photonics technology.

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

D Special Instrument Requirements:
Maverick Diagnostic System TC1000

IV Device/System Characteristics:

A Device Description:

The Maverick Test Panel A0.B0 consists of:

- A silicon chip spotted with capture antibody (anti-TSH mouse monoclonal antibody), and three quality control proteins housed in a carrier in foil pouch with desiccant.
- A sealed, pre-filled stripwell that contains all the reagents required to complete the test protocol. Each stripwell plate contains:
    - High salt buffer (wells A1 & A2) containing phosphate buffer and salt
    - Assay buffer (wells B1, C1, D1 & B2, C2, D2) containing PBS, Tween®-20, proprietary proteins, and preservative
    - TSH Assay Detection Reagent buffer (wells F1 & F2) containing biotinylated anti-TSH mouse monoclonal antibody in assay buffer
    - Assay pre-conditioning buffers (wells G1, H1 & G2, H2) containing borate and citrate buffers
    - Amplification buffer (wells E1 & E2) contains streptavidin reagent in assay buffer

The Maverick Diagnostic System consists of the Maverick instrument, computer, software, peripherals including a bar code reader and a monitor, and MTP A0.B0 assay specific reagent kit. The Maverick Diagnostic System TC1000 instrument is provided with necessary electronics, optics, fluidics, software and mechanical hardware to perform assays for quantitative detection of analytes. The Maverick Diagnostic System TC1000 instrument has two independently controlled bays, each of which can accept separate chip and reagent consumables. The chip carrier contains two (2) discrete channels to accommodate two (2) different samples. Two samples can be run

simultaneously in each bay, or four samples total per instrument. Each bay contains mechanisms to independently accept the reagent stripwell and chip (in carrier) assay components (consumable interface); control their positioning (Y-Z Stage); provide laser input for scanning the chip and detect light frequencies output by the chip (photodiode in optics scanner). On the side of the instrument there is a fluidics component for each bay that consists of two electronically-driven syringe pumps fluid lines, manifold. The computer component of the MDS manages the user interface, the software which controls the instrument, and provides a gateway between instrument and the cloud. The system uses cloud-based retrieval of protocols for each kit; after the test is completed, the raw data is uploaded to the cloud where algorithms evaluate the controls and process the data into assay results. Test results are returned to the laboratory's information system.

B Principle of Operation:

The assay relies on silicon photonics that uses ring resonance to measure binding of macromolecules to sensors on a miniature silicon chip. The Maverick Diagnostic System detects changes in resonance wavelength as macromolecules such as antibodies, proteins, or hormones bind to their respective antigens that are bound to the chip.

The silicon chips have two fluidic channels to run two independent assays. Each channel consists of 16 silicon clusters each with 4 rings. The chip is assembled into a chip carrier that is inserted into Maverick Diagnostic System to run the assay. The MTP A0.B0 assay consists of antibody and internal controls described below. Anti TSH antibody, Human Serum Albumin (HSA), goat anti-human IgG, and Human IgG are spotted on one cluster each per channel.

The Maverick TSH assay is a sandwich immunoassay. Patient sample is added to wells of a stripwell which already contains required buffers. The stripwell and the chip carrier are loaded into the Maverick instrument. When diluted sample is flowed over the chip, TSH in the sample binds to anti-TSH capture antibody. After a wash step detection reagent flows over the chip. TSH bound to the capture on rind sensors binds to the detection antibody and after a wash step, amplification reagent binds to the biotinylated antibody. The changes in resonant wavelength due to the binding are detected by the instrument. The raw results are converted to reportable units as μIU/mL for TSH using the lot specific calibration.

C Instrument Description Information:

1. Instrument Name:

   Maverick Diagnostic System TC1000

2. Specimen Identification:

   The specimen is held in a tube with a barcode label. Specimen identification is done by scanning the barcode.

3. Specimen Sampling and Handling:

   Sample handling instructions are provided in the device labeling.

4. Calibration:

The lot specific coefficients are entered in the MDS Cloud. The barcode for each kit contains the information about lot coefficients in the cloud. When a sample is tested, the raw Genalyte Response units (GRU) results are converted to the reportable TSH units µIU/mL using the lot specific coefficients.

5. Quality Control:

External controls are not provided with the assay kit. The sponsor recommends that users run external controls as daily controls for the instrument. Internal controls are incorporated into the assay test chip: a negative control to assess non-specific binding; a positive control that verifies specimen has been added; and a system control that assesses the system function.

V Substantial Equivalence Information:

A Predicate Device Name(s):

Access TSH (3RD IS) Assay
Unicel DxI 800 Access Immunoassay System

B Predicate 510(k) Number(s):

K153651
K023764

C Comparison with Predicate(s):

Device & Predicate Device(s):	K234091	K153651
Device Trade Name	Maverick Test Panel A0.B0	Access TSH (3rd IS) Assay
General Device Characteristic Similarities		
Intended Use/Indications For Use	For the quantitative determination of human thyroid stimulating hormone (TSH, thyrotropin) in human serum and plasma.	Same
Assay Type	Sandwich immunoassay	Same
General Device Characteristic Differences		
Assay Principle	Photonic Ring Immunoassay	Chemiluminescent Immunoassay
Solid phase	Silicone rings fabricated on a chip	Paramagnetic microparticles (beads)

Assay Measuring Range	0.2– 20.0 µIU/mL	0.01 – 50.0 µIU/mL

Device & Predicate Device(s):	K234091	K023764
Device Trade Name	Maverick Diagnostic System TC1000	Unicel DxI 800 Access Immunoassay System
General Device Characteristic Similarities		
Intended Use/Indications For Use	Intended for in vitro diagnostic use to determine analytes in a clinical laboratory	Same
General Device Characteristic Differences		
Detection/Operating Principle	Photonic Ring Immunoassay	Chemiluminescent Immunoassay

VI Standards/Guidance Documents Referenced:

CLSI EP05-A3: Evaluation of Precision of Qualitative Measurement Methods Procedures; Approved Guideline – Third Edition

CLSI EP06-Ed2: Evaluation of the Linearity of Quantitative Measurement Procedures – 2nd Edition

CLSI EP07-A3: Interference Testing in Clinical Chemistry; Approved Guideline– Third Edition

CLSI EP09c: Measurement Procedure Comparison and Bias Estimation Using Patient Samples; Approved Guideline 3rd Edition

CLSI EP28-A3c: Defining, Establishing, and Verifying Reference Intervals in the Clinical Laboratory; Approved Guideline

CLSI EP37: Supplemental Tables for Interference Testing in Clinical Chemistry– 1st Edition

IEC 62304 Edition 1.1 2015-06: Medical device software - Software life cycle processes

IEC 60601-1-2 Edition 4.1 2020-09: Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral Standard: Electromagnetic disturbances - Requirements and tests

IEC 60601-1 Edition 3.2 2020-08: Medical Electrical Equipment - Part 1: General Requirements For Basic Safety And Essential Performance

VII Performance Characteristics (if/when applicable):

A Analytical Performance:

1. Precision/Reproducibility:
   Precision studies were conducted to estimate repeatability and within-laboratory precision. Five serum samples spanning the assay measuring range were tested in 2 runs per day, per bay of the instrument, for 20 days on each bay of the instrument, for a total of 80 results per sample tested per bay of the instrument. There are two bays in an instrument and one chip per bay.

Bay 1

Sample	N	Mean (µIU/mL)	Repeatability		Between Run		Within Day		Between Day		Within Laboratory	
			SD	CV (%)	SD	CV (%)	SD	CV (%)	SD	CV (%)	SD	CV (%)
1	80	0.28	0.02	6.7	0.09	3.4	0.02	6.8	0.01	2.0	0.02	7.0
2	80	2.53	0.08	3.1	0.00	0.0	0.12	4.6	0.00	0.0	0.12	4.6
3	80	4.76	0.24	5.0	0.14	1.4	0.36	7.5	0.00	0.0	0.36	7.5
4	80	9.94	0.47	4.8	0.00	0.7	0.49	5.0	0.00	0.0	0.49	5.0
5	80	16.70	0.69	4.1	0.27	5.6	0.97	5.8	0.00	0.0	0.97	5.8

Bay 2

Sample	N	Mean (µIU/mL)	Repeatability		Between Run		Within Day		Between Day		Within Laboratory	
			SD	CV (%)	SD	CV (%)	SD	CV (%)	SD	CV (%)	SD	CV (%)
1	80	0.28	0.02	7.0	0.08	3.2	0.11	4.4	0.00	0.0	0.02	7.3
2	80	2.57	0.08	3.1	0.00	0.0	0.01	7.3	0.01	7.4	0.11	4.4
3	80	4.90	0.26	5.2	0.14	1.4	0.40	4.1	0.45	4.5	0.34	7.0
4	80	9.94	0.38	3.8	0.00	0.0	0.02	7.0	0.02	7.3	0.45	4.5
5	80	17.41	0.71	4.1	0.23	4.7	0.34	7.0	0.00	0.0	1.12	6.4

A reproducibility study was conducted to assess between lot variability. Five serum samples with different TSH concentrations spanning the assay measuring range were tested across 3 reagent lots. Each sample was tested in duplicate per run, per bay of the instrument, 3 runs per day, per reagent lot, for 5 days. The within-run (repeatability), within lot, between-lot, and reproducibility was calculated for each reagent lot. The result summary is shown below:

Sample	N	Mean	Repeatability		Within Reagent Lot		Between Reagent Lot		Reproducibility	
			SD	CV (%)	SD	CV (%)	SD	CV (%)	SD	CV (%)
1	180	0.22	0.02	7.8	0.02	7.9	0.00	0.3	0.02	7.9
2	180	1.94	0.09	4.6	0.09	4.7	0.03	1.8	0.10	5.0
3	180	4.42	0.23	5.2	0.23	5.2	0.09	2.0	0.25	5.6
4	180	12.11	0.68	5.6	0.68	5.6	0.07	0.6	0.69	5.7

5	180	18.11	0.85	4.7	0.85	4.7	0.33	1.8	0.91	5.0

A reproducibility study was conducted to assess between instrument variability. Four serum samples spanning assay measuring range were tested in duplicates per run, 3 runs per day per bay of the instrument on 3 instruments (total 6 bays) for 5 days. The result summary is shown below:

Sample	N	Mean	Repeatability		Within Instrument		Between Instrument		Reproducibility	
			SD	CV (%)	SD	CV (%)	SD	CV (%)	SD	CV (%)
1	180	0.58	0.04	7.3	0.04	7.3	0.00	0.6	0.04	7.4
2	180	5.02	0.38	7.6	0.39	7.8	0.00	0.0	0.39	7.8
3	180	13.14	1.17	8.9	1.16	8.8	0.47	3.6	1.25	9.5
4	180	15.78	0.75	4.8	0.74	4.7	0.24	1.5	0.76	4.8

2. Linearity:
   A high TSH serum pool was created using two native samples with known high TSH values. The high TSH serum pool was serially diluted with a low serum sample TSH pool to create 16 TSH serum samples distributed across the analytical measuring interval. Each level was tested in replicates of 4 using 2 instruments and one reagent kit lot. Linearity study data were analyzed by weighted linear regression and the observed values (mean of the replicates) were compared to the best fitted straight line (predicted values). The linearity regression results are shown below. The results of the linearity study were used by the sponsor to support the claimed measuring interval of 0.2 µIU/mL to 20.0 µIU/mL.

Test Range (µIU/mL)	Linear regression	Claimed Measuring Range (µIU/mL)
0.12 – 25.45	y = 1.01x – 0.004, R2 = 1.00	0.2 – 20.0

3. Analytical Specificity/Interference:

   i. Interference:
   Two serum samples containing hTSH concentrations of approximately 0.45 µIU/mL and 4.5 µIU/mL were tested by spiking with potentially interfering compounds at levels listed in the table below. Significant interference was defined as more than ±10% bias as compared to the control results. The results of the interference study are summarized in the table below:

Interferent	Concentration ≤ 10% Bias	Units
Acetaminophen	15.6	mg/dL
Acetylcysteine	15.0	mg/dL
Acetylsalicylic acid	3.00	mg/dL
Ampicillin - Na	7.50	mg/dL
Ascorbic acid	5.25	mg/dL
Biotin	0.35	mg/dL
Cefoxitin	660	mg/dL
Conjugated bilirubin	45	mg/dL
Cyclosporine	0.18	mg/dL
Hemoglobin	500	mg/dL
Heparin	330	Units/dL
Ibuprofen	500	mg/dL
Levothyroxine	0.0429	mg/dL
Liothyronine (Triiodothyronine)	450	pg/dL
Multivitamin	1.0	%V/V
Prednisolone	0.0099	mg/dL
Rheumatoid factor	40.0	IU/mL
Rifampicin	4.80	mg/dL
Total protein/Albumin	6000	mg/dL
Triglycerides	3300	mg/dL
Unconjugated bilirubin	45	mg/dL

The assay package insert instructs users not to use hemolyzed, lipemic or icteric samples.

ii. Cross-reactivity

Cross-reactivity studies were performed to evaluate the susceptibility of the Maverick Diagnostic System to cross-reactivity with the following endogenous structural analogs to human TSH: human follicle stimulating hormone (FSH), human luteinizing hormone (LH), and human chorionic gonadotropin (hCG). Four replicates of two serum samples containing hTSH concentrations of approximately 0.45 µIU/mL and 4.5 µIU/mL were tested. Significant cross reactivity was defined as ≤10% bias in expected results compared to the control. The table below shows the highest concentrations tested with no cross reactivity.

Substance	Highest concentration tested (mIU/mL)
Human Chorionic Gonadotropin	100,000
Follicle Stimulating Hormone	1000
Luteinizing Hormone	3000

iii. High Dose Hook Effect

The high-dose hook effect of the Maverick Test Panel A0.B0 assay on the MDS TC1000 system was assessed by testing 16 serial dilutions of serum pool human with high TSH

level. Each sample was tested in replicates of four using five instruments and one reagent kit lot. No high dose hook effect was observed up to 5,000 µIU/mL of TSH. Samples with TSH concentrations above the measuring interval and as high as 5,000 µIU/mL will report > 20.0 µIU/mL.

4. Assay Reportable Range:

   See section VII.A.2 Linearity.

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

   The measurand (TSH) in the Maverick Test Panel A0.B0 Calibrator is traceable to WHO 3rd International Reference Preparation, (NIBSC Coded 81/565).

6. Detection Limit

   i. Limit of Blank (LoB)
   Limit of Blank (LoB) was determined by assaying each of four TSH depleted analyte-free serum samples in replicates of six, per reagent lot on each instrument bay (two bays) with two reagent lots for three days. The LoB was determined to be 0.08 µIU/mL using the 95% non-parametric upper limit of the 144 replicates.

   ii. Limit of Detection (LoD)
   Limit of Detection (LoD) was determined by assaying four serum samples with low TSH concentrations in replicates of six, per reagent lot on each instrument bay (two bays) with two reagent lots for three days. The LoD was determined to be 0.10 µIU/mL based on the precision model, multiplied by the 95th percentile of the standard normal distribution and added to the LoB to calculate the LoD.

   iii. Limit of Quantitation (LoQ)
   Four serum samples with low levels of TSH were tested. The samples were tested in replicates of 12, per reagent lot on each instrument bay (two bays) with two reagent lots for three days. The limit of quantitation was defined as the value at which the within laboratory CV is ≤ 20% and determined to be 0.20 µIU/mL.

LoB	LoD	LoQ
0.08 µIU/mL	0.10 µIU/mL	0.20 µIU/mL

7. Assay Cut-Off:

   Not applicable.

8. Accuracy (Instrument):

   See Section VII B.1. below.

9. Carry-Over:

The chip and chip carrier are single use. Therefore, after running a test each chip will be disposed. A new chip will be used for the next assay. The flow during an assay run is one way through sippers and to the waste. There is no possibility for sample carry-over between runs.

B Comparison Studies:

1. Method Comparison with Predicate Device:

A method comparison study was performed comparing the Maverick Test Panel A0.B0 assay on the Maverick Diagnostic System TC1000 to a legally marketed comparator device. Native human serum samples were tested in single replicates on each bay of the Maverick Diagnostic System TC1000. The study was run on seven Maverick Diagnostic System TC1000 instruments with seven kit lots by three operators on three different days. A Passing Bablok regression analysis was performed to demonstrate equivalency between the MTP A0.B0 assay and the comparator device. The results of the regression analysis are summarized below:

Bay	N	Sample Range (µIU/mL)	Slope (95% CI)	Intercept (95% CI)	Correlation Coefficient (R2)
1	127	Test: 0.24 – 19.40 Predicate: 0.25 – 24.47	0.96 (0.93 to 0.99)	0.023 (-0.017 to 0.09)	0.96
2	125	Test: 0.20 – 19.67 Predicate: 0.21 – 24.47	0.95 (0.93 to 0.99)	0.038 (-0.018 to 0.098)	0.95

2. Matrix Comparison:

A matrix comparison study was conducted utilizing 55 matched K2EDTA plasma and serum samples. Five altered samples were prepared by spiking known concentrations of human TSH into both sample types. All samples were assayed in single replicates for each sample matrix on two lots of reagent, using five instruments. Weighted Deming regression analysis results are shown below:

Comparison	N	Slope	Intercept	Correlation Coefficient (r)	Range (µIU/mL)
Serum vs. K2EDTA plasma	55	0.97	0.004	0.99	Serum: 0.19 – 17.08 Plasma: 0.20 – 16.86

C Clinical Studies:

1. Clinical Sensitivity:

   Not applicable

2. Clinical Specificity:

   Not applicable

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

   Not applicable

D Clinical Cut-Off:

Not applicable.

E Expected Values/Reference Range:

To establish a normal range for the candidate assay, a total of 120 serum samples were tested from presumptively healthy individuals 21 years and older (60 males and 60 females). Non-parametric analysis was performed. The sponsor claimed the established reference range is 0.36 – 4.34 μIU/mL.

F Other Supportive Instrument Performance Characteristics Data:
Not applicable.

VIII Proposed Labeling:

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

IX Conclusion:

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