Adventist HealthCare

TRAINING UPDATE

Lab Location: All labs
Department: Core lab

Date Distributed: 3/12/26
Due Date: 3/26/26
Implementation: 3/10/26

DESCRIPTION OF PROCEDURE REVISION

Name of procedure:
AHC.C3039 High-Sensitivity Troponin I (TnIH) by Atellica IM Analyzer GEC.C280 High Sensitivity Troponin I by Dimension EXL® System
Description of change(s):
The units of measure for Troponin have been changed from pg/mL to ng/L.

Document your compliance with this training update by taking the quiz in the MTS system.

Technical SOP

Title	**High-Sensitivity Troponin I (TnIH) by Atellica IM Analyzer**	
Prepared by	Ashkan Chini	Date: 4/21/2021
Owner	Robert SanLuis	Date: 4/21/2021

Laboratory Approval	**Local Effective Date:**	
Print Name and Title	**Signature**	**Date**
Refer to the electronic signature page for approval and approval dates.		

TABLE OF CONTENTS

1. TEST INFORMATION

Assay	Method/Instrument	Test Code
High Sensitivity Troponin I	Atellica IM Analyzer	TROPI1

Synonyms/Abbreviations
Troponin, Tropi, TNIH

Department
Chemistry

2. ANALYTICAL PRINCIPLE

The Atellica IM TnIH is a 3-site sandwich immunoassay using direct chemiluminescent technology. The Solid Phase reagent consists of magnetic latex particles conjugated with streptavidin with 2 bound biotinylated capture monoclonal antibodies, each recognizing a unique cTnI epitope. The Lite Reagent comprises a conjugate with an architecture consisting of a proprietary acridinium ester and a recombinant anti-human cTnI sheep Fab covalently attached to bovine serum albumin (BSA) for chemiluminescent detection. A direct relationship exists between the amount of troponin I present in the patient sample and the amount of relative light units (RLUs) detected by the system.

3. SPECIMEN REQUIREMENTS

3.1 Patient Preparation

Component	Special Notations
Fasting/Special Diets	N/A
Specimen Collection and/or Timing	Normal procedures for collecting and storing serum and plasma may be used for samples to be analyzed by this method.
Special Collection Procedures	N/A
Other	N/A

3.2 Specimen Type & Handling

Criteria	
Type -Preferred **-Other Acceptable**	Plasma (Lithium Heparin) Serum
Collection Container	Plasma: Mint green top tube (PST) Serum: Red top tube, Serum separator tube (SST)

Criteria	
Volume - Optimum - Minimum	1.0 mL 0.5 mL
Transport Container and Temperature	Collection container or plastic vial at room temperature
Stability & Storage Requirements	Room Temperature: 8 hours
	Refrigerated: 24 hours
	Frozen: 40 days
Timing Considerations	For serum specimens, complete clot formation should take place before centrifugation. Serum should be physically separated from cells as soon as possible from the time of collection.
Unacceptable Specimens & Actions to Take	Specimens that are unlabeled, improperly labeled, or those that do not meet the stated criteria are unacceptable. Request a recollection and credit the test with the appropriate LIS English text code for "test not performed" message. Examples: Quantity not sufficient-QNS; Wrong collection-UNAC. Document the request for recollection in the LIS.
Compromising Physical Characteristics	Gross hemolysis. Reject sample and request a recollection. Credit the test with the appropriate LIS English text code explanation of HMT (Specimen markedly hemolyzed)
Other Considerations	Allow Red Top or SST to clot completely prior to centrifugation. For plasma specimens, avoid transferring white blood cells or platelets from the layer located just above the red blood cells. Before placing on system, ensure samples are free of: • Bubbles or foam • Fibrin or other particulate matter

NOTE: Labeling requirements for all reagents, calibrators and controls include: (1) Open date, (2) Substance name, (3) Lot number, (4) Date of preparation, (5) Expiration date, (6) Initials of tech, and (7) Any special storage instructions. Check all for visible signs of degradation. When placed onboard the analyzer, the instrument captures the date / time loaded and calculates and tracks the opened expiration.

4. REAGENTS

The package insert for a new lot of kits must be reviewed for any changes before the kit is used. A current Package Insert is included as a Related Document.

4.1 Reagent Summary

Reagents	Supplier & Catalog Number
High-Sensitivity Troponin I (TnIH)	Siemens, Atellica IM, Cat. No. 10997840
APW3	Siemens, Atellica IM, Cat. No. 10998580
Multi-Diluent 11	Siemens, Atellica IM, Cat. No. 10995642

4.2 Reagent Preparation and Storage

Reagent	**High-Sensitivity Troponin I (TnIH)**
Storage	• Store at 2-8°C • Store in an upright position. • Protect from heat and light sources.
Stability	Reagents are stable onboard the system for 28 days.
Preparation	Reagent is liquid and ready to use. Before loading primary reagent packs onto the system, mix them by hand and visually inspect the bottom of the reagent pack to ensure that all particles are re-suspended.

Reagent	**APW3**
Storage	• Store at 2-8°C • Store in an upright position.
Stability	It is stable onboard the system for 28 days.
Preparation	It is liquid and ready to use.

Reagent	**Multi-Diluent 11**
Storage	• Store at 2-8°C • Store in an upright position.
Stability	It is stable onboard the system for 28 days.
Preparation	It is liquid and ready to use.

5. CALIBRATORS/STANDARDS

5.1 Calibrators/Standards Used

Calibrator	Supplier and Catalog Number
TnIH CAL	Siemens Atellica IM, Cat. No. 10997840

5.2 Calibrator Preparation and Storage

Calibrator	TnIH CAL
Preparation	**Low Calibrator:**

	TnIH CAL L is liquid and ready to use. Gently mix and invert the vials to ensure homogeneity of the material. **High Calibrator:** 1. Add 1.00 mL of reagent grade water into the vial using calibrated pipette. Replace cap. 2. Let the vial stand for 15–20 minutes at room temperature to allow the lyophilized material to dissolve. 3. Gently mix and invert the vial to ensure homogeneity of the material.
Storage/Stability	• Store at 2-8°C in an upright position. • **Unopened:** stable until expiration date stamped on the box. • **Low Calibrator, Opened:** stable for 4 hours at 2-8°C or 30 days at ≤ -20°C. • **High Calibrator, Reconstituted:** stable for 4 hours at 2-8°C or 30 days at ≤ -20°C.

5.3 Calibration Parameter

Criteria	Special Notations
Reference Material	TnIH CAL
Assay Range	See Package Insert for specific assay ranges.
Suggested Calibration Level	See Reagent Package Insert for lot specific assigned values in ng/L
Frequency	• When changing lot numbers of primary reagent packs. • At the end of the lot calibration interval (47 days), for a specified lot of calibrated reagent on the system. • At the end of pack calibration interval (31 days), for calibrated reagent packs on the system. • When indicated by quality control results. • After major maintenance or service. At the end of the onboard stability interval, replace the reagent pack on the system with a new reagent pack. Recalibration is not required, unless the lot calibration interval is exceeded.
Calibration Scheme	See Package Insert for specific calibration scheme.
Procedure	Use the lot specific master curve and test definition sheet provided with the reagents. Calibrators in the kit must only be used with reagents from that assay kit lot. Do not use calibrators from another kit. Generate lot specific barcode labels to use with calibrator samples.

	To load a new lot of reagent on IM Module: Note: Calibrate the new lot of reagent as soon as it is loaded on the instrument. If the reagent sits un-calibrated for a short period of time (24 hours) then it will not be eligible for a "Lot Calibration" and another new reagent will need to be loaded onboard. 1. From the home page of the IM Module Screen (small screen attached on the IM Module) make sure the analyzer status is in Standby. 2. On the IM Module Screen select Reagent Loader. Make sure the Reagent Drawer status is unlocked. Open the reagent drawer, load the reagent and then close it. Once the reagent is scanned, the IM Module Screen will populate message "Missing TDef for lot" next to the reagent. The Reagent Drawer status remains unlocked. 3. Both Reagent Master Curve and Calibrator Package Insert need to be scanned using the Atellica Solution's main monitor. To differentiate between the two: • Reagent Master Curve has MC TDEF printed right below the assay name. • Calibrator Package Insert has CAL printed right above the assay name. 4. To scan the Reagent Master Curve, go to Set up – Test Definition – IM Test Definition. Scan the barcode. 5. To scan the Calibrator Package Insert, go to Calibration – Calibrator Definition. Scan the barcode. 6. Re-open the Reagent Drawer and close it. This time its status should change to locked, meaning the reagent is going to be loaded onboard ready for calibration.
Procedure	Refer to the Atellica Solution Operating, QC, Calibration and Maintenance procedure for specific instructions.

5.4 Tolerance Limits

IF……	THEN……
If result fall within assay-specific specification, and QC values are within acceptable limits,	proceed with analysis
If result falls outside assay-specific specification, or QC values are out of Acceptable limits,	troubleshoot the assay and/or instrument and repeat calibration

6. QUALITY CONTROL

6.1 Controls Used

Controls	Supplier and Catalog Number
InteliQ Cardiac Markers Plus Control LT, Levels 1B, 2, & 3	Bio-Rad Laboratories Cat. No. 12009959, 12009956, 12009957

6.2 Control Preparation and Storage

Control	InteliQ Cardiac Markers Plus Control LT, Levels 1B, 2, & 3
Preparation	Allow to thaw at room temperature (18-25C) for approximately 40 minutes or until completely thawed. Once thawed, gently invert the tube several times to ensure homogeneity.
Storage/Stability	**Frozen**: until the expiration date if unopened at -20 to -70C **Thawed and Onboard:** 5 days at 2-8C for troponin

6.3 Frequency

Analyze all levels of QC material after every calibration and each day of testing (notated on the QC frequency sheets posted on the instruments).

Refer to the Atellica QC Schedule and the Siemens Atellica Quick Reference Guide.

6.4 Tolerance Limits and Criteria for Acceptable QC

Step	Action
1	Acceptable ranges for QC are programmed into the instrument's Quality Control software system and Unity Real Time, and may be posted near the instrument for use during computer downtime.
2	**Run Rejection Criteria** • Anytime the established parameters are exceeded (if one QC result exceeds 2 SD), the run is considered out of control (failed) and patient results must not be reported. • The technologist must follow the procedure in the Laboratory QC Program to resolve the problem.
3	**Corrective Action**: • All rejected runs must be effectively addressed through corrective action. Steps taken in response to QC failures must be documented. Patient samples in failed analytical runs must be reanalyzed according to the Laboratory QC Program. Supervisors may override rejection of partial or complete runs only with detailed documentation and criteria for overrides that are approved by the Medical Director. Consult corrective action guidelines in Laboratory

Step	Action
	QC Program. Follow corrective action guidelines in the Laboratory QC Program. • Corrective action documentation must follow the Laboratory Quality Control Program.
4	**Review of QC** • QC must be reviewed weekly by the Group Lead or designee and monthly by the Supervisor/Manager or designee. • If the SD and/or CV are greater than established ranges, investigate the cause for the imprecision and document implementation of corrective actions.

6.5 Documentation

- QC tolerance limits are programmed into the instrument and Unity Real Time; it calculates cumulative mean, SD and CV and stores all information for easy retrieval.
- Quality control records are reviewed daily at the bench, weekly by the Group Lead or designee, and monthly by the Supervisor/Manager or designee.
- Refer to complete policies and procedures for QC documentation and for record retention requirements in the Laboratory QC Program.

6.6 Quality Assurance Program

- Each new lot number of reagent or new shipment of the same lot of reagent must be tested with external control materials and previously analyzed samples. Performance of the new lot must be equivalent to the previous lot; utilize published TEA for acceptability criteria.
- Training must be successfully completed and documented prior to performing this test. This procedure must be incorporated into the departmental competency assessment program.
- The laboratory participates in CAP proficiency testing. All proficiency testing materials must be treated in the same manner as patient samples.
- Monthly QC must be presented to the Medical Director or designee for review and signature.
- Monthly QC mean and SD are sent to Bio-Rad Laboratories for peer group comparison.
- Consult the Laboratory QC Program for complete details.

7. EQUIPMENT and SUPPLIES

7.1 Assay Platform

Siemens Atellica IM Analyzer

7.2 Equipment

- Refrigerator capable of sustaining 2–8°C.
- Freezer capable of sustaining range not to exceed -20 to -70°C.
- Centrifuge

7.3 Supplies

- System Fluids
- Assorted calibrated pipettes (MLA or equivalent) and disposable tips

8. PROCEDURE

Atellica IM High-Sensitivity Troponin I (TnIH) is required to perform this test.

TnIH is performed on the Atellica IM Analyzer after the method is calibrated and Quality Controls are acceptable.

NOTE: For all procedures involving specimens, buttoned lab coats, gloves, and face protection are required minimum personal protective equipment. Report all accidents to your supervisor.

8.1	Instrument Set-up Protocol
1.	Perform any required instrument maintenance.
2.	Ensure that the instrument has sufficient primary and ancillary reagents.
3.	Check status of cuvettes and tips. Check waste levels. Fill or empty as appropriate.
4.	Check calibration status and re-calibrate as needed.

8.2	Specimen Testing
1.	Centrifuge the specimens.
2.	Load the sample in the Atellica rack and place the rack into the Sample Handler to initiate testing. **NOTE: If not equipped with an in-line decapper unit, samples must be de-capped prior to loading on the Atellica system
3.	Refer to the general operating procedure for detailed steps.
4.	Follow protocol in section 10.6 “Repeat Criteria and Resulting” for samples with results above the analytical measurement range (AMR). Investigate any flagged results and repeat as necessary.
5.	Append the appropriate English text code qualifier messages to any samples requiring a comment regarding sample quality and/or any other pertinent factors.

NOTE: In the event that the test system becomes inoperable, notify supervision or designee for further direction. Patient specimens must be stored in a manner that maintains the integrity of the specimen.

9. CALCULATIONS

The instrument automatically calculates the concentration of High-Sensitivity Troponin I in ng/L.

10. REPORTING RESULTS AND REPEAT CRITERIA

10.1 Interpretation of Data

None required

10.2 Rounding

No rounding is necessary. Instrument reports results as a whole number

10.3 Units of Measure

ng/L

10.4 Clinically Reportable Range (CRR)

3 – 125,000 ng/L

10.5 Review Patient Data

Each result is reviewed for error messages. Resolve any problems noted before issuing patient reports.

10.6 Repeat Criteria and Resulting

All repeats must replicate the original result within the total allowable error (TEa) of the assay. Refer to TEa listing for specific information.

Values that fall below or within the AMR or CRR may be reported without repeat. Values that exceed the upper ranges must be repeated.

IF the result is …	THEN…
< 3 ng/L	Assure there is sufficient sample devoid of bubbles, cellular debris, and/or fibrin clots. Report as: < 3 ng/L
≥ 25,000 ng/L	**On Board Automated Dilution:** Results ≥ 25,000 ng/L will automatically have repeat testing performed into the instrument using dilution factor of 5. No multiplication is necessary.
> 125,000 ng/L	If the recommended dilution does not give results within the clinically reportable range, report as: "> 125,000 ng/L -REP" Bring to the attention of Tech in Charge (TIC) or Group Lead to check for integrity issues prior to release of results.

Message	Code
Verified by repeat analysis	Append –REP to the result.

11. EXPECTED VALUES

11.1 Reference Ranges

Female: < 76 ng/L
Male: < 86 ng/L

11.2 Critical Values

Initial (first) critical value: > 100 ng/L

Treatment of **subsequent critical values** is based on delta criteria:

Prior Critical Value	Delta Threshold	Example
101 - 500 ng/L	Value doubles	Prior value of 101, next value must be 202 or greater
501 – 1,000 ng/L	Increase of 250	Prior value of 600, next value must be 850 or greater
1,001 ng/L or more	Increase of 1,000	Prior value of 2,000, next value must be 3,000 or greater

If the subsequent critical value does NOT qualify to be called, document this by appending the code **TROPC** to the result. This code translates to "Laboratory value indicates a critical value previously reported."

Notes:

- Data Innovations (DI) will flag results that meet delta criteria to be called (Error code contains 'CALL' and the Error name contains 'CALL TROP').
- When DI is down, ALL critical troponin values must be called.

11.3 Standard Required Messages

The following message is automatically added by the LIS:
HS Troponin I – Interpretation

High risk of myocardial injury, including myocardial infarction.
Male/Female: >100 ng/L

Indeterminate, clinical assessment and serial result evaluation recommended.
Male: 86-100 ng/L
Female: 76-100 ng/L

Within 99th percentile of normal patients with a CV < 10%: <4 hours symptom onset, serial result evaluation recommended, > 4 hours symptom onset – low risk of myocardial injury.

Male: <86 ng/L
Female: <76 ng/L

12. CLINICAL SIGNIFICANCE

Troponin is the contractile regulatory protein complex of striated muscle. It is found periodically along the thin filament of the myofibrils, in conjunction with the protein tropomyosin. The troponin complex consists of three distinct polypeptide components: troponin-C (the calcium binding element), troponin-I (the actinomyosin ATPase inhibitory element), and troponin-T (the tropomyosin binding element). The complex serves to regulate the calcium dependent interaction of myosin and actin and thus plays an integral role in muscle contraction. Troponin-I exists in three distinct molecular forms which correspond to specific isotypes found in fast-twitch skeletal muscle, slow-twitch skeletal muscle, and heart, respectively.

Several reports in the literature have indicated that cardiac troponin-I is released into blood within hours of the onset of symptoms of myocardial infarction and that it remains elevated for several days post-infarction. The cumulative data from these reports indicate that troponin-I levels become abnormal 4–8 hours following onset of chest pain, peak at 12–16 hours, and remain elevated for 5–9 days following an infarction.

Measurement of cardiac troponin-I levels provide sensitive and specific determination of myocardial injury over a wide diagnostic window. Elevations in cardiac troponin-I levels have been observed across a spectrum of acute coronary syndromes including Q-wave MI, non-Q-wave MI and unstable angina. A significantly higher incidence of mortality has been observed in patients with non-Q-wave MI and unstable angina who have detectable levels of cardiac troponin-I. This suggests that cardiac troponin-I provides a means for risk stratification of these individuals.

13. PROCEDURE NOTES

- **FDA Status:** FDA Approved/cleared
- **Validated Test Modifications:** None

The instrument reporting system contains error messages to warn the operator of specific malfunctions. Any report slip containing such error messages should be held for follow-up.

14. LIMITATIONS OF METHOD

14.1 Analytical Measurement Range (AMR)

3 – 25,000 ng/L
Note: manufacture insert lists lower limit as 2.50, rounded to whole number to match our facility's reporting practice.

14.2 Precision

Material	Mean ng/L	Standard Deviation (%CV)	
		Repeatability	Within-Lab
Serum 1	12.72	0.55	4.3
Serum 2	127.93	2.3	1.8
Serum 3	1334.97	22.28	1.7
Serum 4	13815.89	192.05	1.4
Plasma 1	12.03	0.49	4.1
Plasma 2	131.21	2.23	1.7
Plasma 3	1363.38	27.11	2.0
Plasma 4	12862.97	212.91	1.7

14.3 Interfering Substances

- The use of a single sample type (either lithium plasma or serum) is recommended for troponin analysis when collecting serial samples from the same patient.
- Heterophilic antibodies and rheumatoid factor in human serum can react with reagent immunoglobulins, interfering with in vitro immunoassays. Patients routinely exposed to animals or to animal serum products can be prone to this interference and anomalous values may be observed. Additional information may be required for diagnosis.
- Samples from patients receiving preparations of mouse monoclonal antibodies for therapy or diagnosis may contain Human Anti-Mouse Antibodies (HAMA). Such samples may show either falsely elevated or falsely depressed values when tested with this method.
- Specimens from some individuals with pathologically high gamma globulin levels may demonstrate depressed troponin values. Additional information may be required for diagnosis.
- An unknown interference was observed in analytical spiking and dilution studies casing negative bias that may affect interpretation of patient results. The unknown interference may be due to the presence of troponin autoantibodies, which have been reported in up to 10% of patients with or without AMI and up to 20% of patients positive for rheumatoid factor. If the cTnI result is below the 99th percentile at the 1st blood draw, at least 2 additional blood samples should be drawn before results are interpreted as negative for AMI.

Hemolysis, Icterus, Lipemia (HIL), and other interferences:

Specimens that are …	Demonstrate ≤ 10% change in results up to …
Hemolyzed	500 mg/dL of hemoglobin
Icteric	40 mg/dL of conjugated bilirubin 60 mg/dL of unconjugated bilirubin
Lipemic	2000 mg/dL of triglycerides

Specimens that contain …	Demonstrate ≤ 10% change in results up to …
Biotin	3500 ng/mL
Cholesterol	500 mg/dL
Protein Albumin	6g/dL
Protein Gamma Globulin	2.5 g/dL
Total Protein	12 g/dL

14.4 Clinical Sensitivity/Specificity/Predictive Values

Detection Capability
The assay is designed to have a limit of detection (LoD) ≤ 1.6 ng/L, and a limit of quantitation (LoQ) ≤ 3.0 ng/L. The LoB of the Atellica IM TnIH assay is 0.50 ng/L. The LoD corresponds to the lowest concentration of cTnI that can be detected with a probability of 95%. The LoD for the Atellica IM TnIH assay is 1.60 ng/L.
The LoQ of the Atellica IM TnIH assay is 2.50 ng/L. Report results below the LoQ as < 2.50 ng/L.

15. SAFETY

Refer to your local and corporate safety manuals and Safety Data Sheet (SDS) for detailed information on safety practices and procedures and a complete description of hazards.

16. RELATED DOCUMENTS

1. Atellica Solution Operating, QC, Calibration and Maintenance procedure
2. Laboratory Quality Control Program
3. Atellica Solution QC Schedule
4. Laboratory Safety Manual
5. Safety Data Sheets (SDS)
6. Atellica Solution Limits Chart
7. Retention of Records and Materials (Lab Policy)
8. Atellica Solution System Error Messages Chart
9. Centrifuge Use, Maintenance and Function Checks (Lab policy)
10. Specimen Acceptability Requirements (Lab policy)
11. Repeat Testing Requirement (Lab policy)
12. Current Allowable Total Error Specifications at http://questnet1.qdx.com/Business_Groups/Medical/qc/docs/qc_bpt_tea.xls
13. Current package insert of High-Sensitivity Troponin I Reagent
14. High Sensitivity Troponin I Reference Range 99th Percentile Study (VC 956)

17. REFERENCES

1. Package Insert, TnIH Reagent, Siemens Healthcare Diagnostics Inc., 04/2019.
2. Package Insert, InteliQ Cardiac Markers Plus Control LT, Bio-Rad Laboratories, 9/2020

18. REVISION HISTORY

Version	Date	Section	Reason	Reviser	Approval
1	7/14/21	11.1	Added gender ranges	L Barrett	R SanLuis
1	7/14/21	11.3	Added interpretation comment	L Barrett	R SanLuis
1	7/14/21	16	Added reference range study	L Barrett	R SanLuis
2	10/21/25	Header Footer	Added WOMC Changed SOP prefix to AHC	D Collier	R SanLuis
3	3/12/26	5.3, 9, 10.3, 10.4, 10.6, 11.1, 11.2, 11.3, 14.1, 14.2, 14.4	Changed units of measure from pg/mL to ng/L	M Liedtke	R SanLuis

19. ADDENDA

None

Technical SOP

Title	**High Sensitivity Troponin I by Dimension EXL® System**	
Prepared by	Demetra Collier	Date: 11/2/2020
Owner	Robert SanLuis	Date: 11/2/2020

Laboratory Approval	**Local Effective Date:**	
Print Name and Title	**Signature**	**Date**
Refer to the electronic signature page for approval and approval dates.		

TABLE OF CONTENTS

1. TEST INFORMATION

Assay	Method/Instrument	Test Code
High Sensitivity Troponin I	Dimension EXL® System	TROPI1

Synonyms/Abbreviations
Troponin, Tropi, TNIH

Department
Chemistry

2. ANALYTICAL PRINCIPLE

The Dimension EXL TNIH assay is a homogeneous, sandwich chemiluminescent immunoassay based on LOCI technology. The LOCI reagents include two synthetic bead reagents and two biotinylated anti-cardiac troponin I monoclonal antibody fragments. The first bead reagent (Sensibeads) is coated with streptavidin and contains photosensitizer dye. The second bead reagent (Chemibeads) is coated with a third anti-cardiac troponin I monoclonal antibody and contains chemiluminescent dye. Sample is incubated with Chemibeads and biotinylated antibodies to form bead-cardiac troponin I-biotinylated antibody sandwiches. Sensibeads are added and bind to the biotin to form bead-pair immunocomplexes. Illumination of the complex at 680 nm generates singlet oxygen from Sensibeads which diffuses into the Chemibeads, triggering a chemiluminescent reaction. The resulting signal is measured at 612 nm and is a direct function of the cardiac troponin I concentration in the sample.

3. SPECIMEN REQUIREMENTS

3.1 Patient Preparation

Component	Special Notations
Fasting/Special Diets	N/A
Specimen Collection and/or Timing	Normal procedures for collecting and storing serum and plasma may be used for samples to be analyzed by this method.
Special Collection Procedures	N/A
Other	N/A

3.2 Specimen Type & Handling

Criteria	
Type -Preferred **-Other Acceptable**	Plasma (Lithium Heparin) Serum
Collection Container	Plasma: Mint green top tube (PST) Serum: Red top tube, Serum separator tube (SST)
Volume - Optimum **- Minimum**	1.0 mL 0.5 mL
Transport Container and Temperature	Collection container or plastic vial at room temperature
Stability & Storage Requirements	Room Temperature: 8 hours
	Refrigerated: 24 hours
	Frozen: 40 days
Timing Considerations	Serum or plasma should be physically separated from cells as soon as possible with a maximum limit of two hours from the time of collection.
Unacceptable Specimens & Actions to Take	Specimens that are unlabeled, improperly labeled, or those that do not meet the stated criteria are unacceptable. Request a recollection and credit the test with the appropriate LIS English text code for "test not performed" message. Examples: Quantity not sufficient-QNS; Wrong collection-UNAC. Document the request for recollection in the LIS.
Compromising Physical Characteristics	Gross hemolysis. Only reject sample if flagged for hemolysis by DI. Credit the test with the appropriate LIS English text code explanation of HMT (Specimen markedly hemolyzed) and request a recollection
Other Considerations	Allow Red Top or SST to clot completely prior to centrifugation.

NOTE: Labeling requirements for all reagents, calibrators and controls include: (1) Open date, (2) Substance name, (3) Lot number, (4) Date of preparation, (5) Expiration date, (6) Initials of tech, and (7) Any special storage instructions. Check all for visible signs of degradation. When placed onboard the analyzer, the instrument captures the date / time loaded and calculates and tracks the opened expiration.

4. REAGENTS

The package insert for a new lot of kits must be reviewed for any changes before the kit is used. A current Package Insert is included as a Related Document.

4.1 Reagent Summary

Reagents	Supplier & Catalog Number
High Sensitivity Troponin I	Siemens, Flex® reagent cartridge, Cat. No. RF627
CTNI Sample Diluent	Siemens Healthcare Diagnostics Cat. No. KD692

4.2 Reagent Preparation and Storage

Reagent	**High Sensitivity Troponin I**
Container	Reagent cartridge
Storage	Store at 2-8°C
Stability	• Stable until expiration date stamped on reagent cartridges. • Sealed wells on the instrument are stable for 30 days. • Open wells: 7 days for wells 1 - 8
Preparation	All reagents are liquid and ready to use.

Reagent	**CTNI Sample Diluent**
Container	Reagent bottle
Storage	Store at 2-8°C
Stability	• **Unopened:** stable until expiration date stamped on bottle • **Opened:** 30 days when recapped and stored at 2-8°C.
Preparation	CTNI SDIL is ready for use. No preparation is required.

5. CALIBRATORS/STANDARDS

5.1 Calibrators/Standards Used

Calibrator	**Supplier and Catalog Number**
LOCI TNIH CAL	Siemens Dimension EXL®, Cat. No. RC627

5.2 Calibrator Preparation and Storage

Calibrator	High Sensitivity Troponin I Calibrator (LOCI TNIH CAL)
Preparation	Before use, thaw at room temperature (18–30°C) for one hour (no more than two hours), swirl and invert gently to mix.
Storage/Stability	• Store at -15°C to -25°C • **Unopened Frozen:** stable until expiration date on the box. • **Unopened Thawed:** 3 days when stored at 2-8°C • **Opened Calibrator:** stable for 3 days when thawed, recapped and stored at 2-8°C.

5.3 Calibration Parameter

Criteria	**Special Notations**
Reference Material	LOCI TNIH CAL
Assay Range	4 – 25000 ng/L
Suggested Calibration Level	See Reagent Package Insert for lot specific assigned values in ng/L

Frequency	• Every new reagent cartridge lot. • Every 21 days for any one lot • When major maintenance is performed on the analyzer. • When control data indicates a significant shift in assay.
Calibration Scheme	5 levels, n = 5
Procedure	Refer to Calibration / Verification Siemens Dimension® EXL procedure for specific instructions.

5.4 Tolerance Limits

IF……	THEN……
If result fall within assay-specific specification, and QC values are within acceptable limits,	proceed with analysis
If result falls outside assay-specific specification, or QC values are out of Acceptable limits,	troubleshoot the assay and/or instrument and repeat calibration

6. QUALITY CONTROL

6.1 Controls Used

Controls	Supplier and Catalog Number
Liquichek™ Cardiac Markers Plus Control LT Levels 1B, 2 and 3	Bio-Rad Laboratories Cat # 27105, 147 and 148

6.2 Control Preparation and Storage

Control	Liquichek Cardiac Markers Plus Control LT, Level 1B, 2 and 3
Preparation	Allow the frozen control to thaw at room temperature (18-25°C) for approximately 30 minutes or until completely thawed. Swirl the contents gently to ensure homogeneity. (Do not use a mechanical mixer). Immediately load the vial on the analyzer. After each use, promptly replace the stopper and return to 2-8°C storage.
Storage/Stability	**Frozen**: stable until the expiration date at -20 to -70° C. **Thawed and Opened**: Once the stopper is punctured, stable for 5 days when stored at 2-8°C. Once thawed, do not re-freeze

6.3 Frequency

Analyze all levels of QC material after every calibration and each day of testing.

Refer to the Dimension EXL QC Schedule and the Dimension EXL® Quick Reference Guide.

6.4 Tolerance Limits and Criteria for Acceptable QC

Step	Action
1	Acceptable ranges for QC are programmed into the instrument's Quality Control software system and Unity Real Time, and may be posted near the instrument for use during computer downtime.
2	**Run Rejection Criteria** • Anytime the established parameters are exceeded (if one QC result exceeds 2 SD), the run is considered out of control (failed) and patient results must not be reported. • The technologist must follow the procedure in the Laboratory QC Program to resolve the problem.
3	**Corrective Action**: • All rejected runs must be effectively addressed through corrective action. Steps taken in response to QC failures must be documented. Patient samples in failed analytical runs must be reanalyzed according to the Laboratory QC Program. Supervisors may override rejection of partial or complete runs only with detailed documentation and criteria for overrides that are approved by the Medical Director. Consult corrective action guidelines in Laboratory QC Program. Follow corrective action guidelines in the Laboratory QC Program. • Corrective action documentation must follow the Laboratory Quality Control Program.
4	**Review of QC** • QC must be reviewed weekly by the Group Lead or designee and monthly by the Supervisor/Manager or designee. • If the SD and/or CV are greater than established ranges, investigate the cause for the imprecision and document implementation of corrective actions.

6.5 Documentation

- QC tolerance limits are programmed into the instrument and Unity Real Time; it calculates cumulative mean, SD and CV and stores all information for easy retrieval.
- Quality control records are reviewed daily at the bench, weekly by the Group Lead or designee, and monthly by the Supervisor/Manager or designee.
- Refer to complete policies and procedures for QC documentation and for record retention requirements in the Laboratory QC Program.

6.6 Quality Assurance Program

- Each new lot number of reagent or new shipment of the same lot of reagent must be tested with external control materials and previously analyzed samples. Performance of the new lot must be equivalent to the previous lot; utilize published TEA for acceptability criteria.
- Training must be successfully completed and documented prior to performing this test. This procedure must be incorporated into the departmental competency assessment program.
- The laboratory participates in CAP proficiency testing. All proficiency testing materials must be treated in the same manner as patient samples.
- Monthly QC must be presented to the Medical Director or designee for review and signature.
- Monthly QC mean and SD are sent to Bio-Rad Laboratories for peer group comparison.
- Consult the Laboratory QC Program for complete details.

7. EQUIPMENT and SUPPLIES

7.1 Assay Platform

Dimension EXL® System

7.2 Equipment

- Refrigerator capable of sustaining 2–8°C
- Freezer capable of sustaining range not to exceed -15 to -25°C for calibrator
- Freezer capable of sustaining range not to exceed -20 to -70°C for QC product
- Centrifuge

7.3 Supplies

- HM Reaction Vessels (Cat No. RXV1A)
- System Fluids
- Assorted calibrated pipettes (MLA or equivalent) and disposable tips

8. PROCEDURE

TNIH Flex® reagent cartridge Cat. No. RF627 is required to perform this test.

High Sensitivity Troponin I is performed on the Dimension EXL® System after the method is calibrated (see Reference Material in Calibration section) and Quality Controls are acceptable.

NOTE: For all procedures involving specimens, buttoned lab coats, gloves, and face protection are required minimum personal protective equipment. Report all accidents to your supervisor.

8.1	Instrument Set-Up Protocol
1.	For instrument set up and operation: Refer to Startup and Maintenance, Siemens Dimension® EXL procedure.
2.	Check reagent inventory
3.	Sampling, reagent delivery, mixing, processing, and printing of results are automatically performed by the Dimension® EXL system. For details of the automated parameters, see below under "Test conditions."

8.2	Specimen/Reagent Preparation
1.	Centrifuge the specimens.
2.	Specimens are placed in Dimension® EXL segments for analysis by the instrument. Refer to the Sample Processing, Dimension® EXL procedure. The sample container (if not a primary tube) must contain sufficient quantity to accommodate the sample volume plus 50 µL of dead volume. Precise container filling is not required.

8.3	Specimen Testing
1.	For QC placement and frequency, refer to the Dimension® EXL QC Schedule.
2.	Follow the instructions, outlined in the Dimension® EXL Operators Manual
3.	The instrument reporting system contains error messages to warn the user of specific malfunctions. Results followed by such error messages should be held for follow-up. Refer to the Dimension® EXL system manual "Error messages" section for troubleshooting.
4.	Follow protocol in Section 10.6 "Repeat criteria and resulting" for samples with results above or below the Analytical Measurement Range (AMR). Repeat critical values and document according to Critical Values procedure. Investigate any failed delta result and repeat, if necessary. **Note**: DI will not flag Delta failures if the result is < 83ng/L; DI will add the comment code RVT to the result.
5.	Append the appropriate English text code qualifier messages to any samples requiring a comment regarding sample quality and/or any other pertinent factors.

Test Conditions	
Sample Volume:	10 µL
Chemibead Reagent Volume:	20 µL
Biotinylated Antibody Volume:	20 µL
Sensibead Reagent Volume:	20 µL
Assay Buffer Volume:	100 µL
Reaction Time:	10 minutes
Test Temperature:	37° C
Wavelength:	680 and 612 nm
Type of measurement:	Chemiluminescence

NOTE: In the event that the test system becomes inoperable, notify supervision or designee for further direction. Patient specimens must be stored in a manner that maintains the integrity of the specimen.

9. CALCULATIONS

The instrument automatically calculates the concentration of High Sensitivity Troponin I in ng/L.

10. REPORTING RESULTS AND REPEAT CRITERIA

10.1 Interpretation of Data

None required

10.2 Rounding

No rounding is necessary. Instrument reports result as whole number.

10.3 Units of Measure

ng/L

10.4 Clinically Reportable Range (CRR)

4 – 125,000 ng/L

10.5 Review Patient Data

Each result is reviewed for error messages. Refer to the Dimension EXL system manual “Error messages” section for troubleshooting. Resolve any problems noted before issuing patient reports.

10.6 Repeat Criteria and Resulting

All repeats must replicate the original result within the total allowable error (TEa) of the assay. Refer to TEa listing for specific information.

Values that fall below or within the AMR or CRR may be reported without repeat. Values that exceed the upper ranges must be repeated.

IF the result is …	THEN…
< 4 ng/L	Assure there is sufficient sample devoid of bubbles, cellular debris, and/or fibrin clots. Report as: < 4 ng/L

IF the result is …	THEN…
≥ 25,000 ng/L	Manually dilute the specimen using CTNI Sample Diluent to obtain results within the reportable range. The maximum dilution factor is x5. Enter this dilution factor when manually programming the sample dilution.
> 125,000 ng/L	If the recommended dilution does not give results within the clinically reportable range, report as: "> 125,000 ng/L-REP" Check for integrity issues prior to releasing result.

Message	Code
Verified by repeat analysis	Append –REP to the result.

11. EXPECTED VALUES

11.1 Reference Ranges

Female: < 76 ng/L
Male: < 86 ng/L

11.2 Critical Values

Initial (first) critical value: > 100 ng/L

Treatment of **subsequent critical values** is based on delta criteria:

Prior Critical Value	Delta Threshold	Example
101 - 500 ng/L	Value doubles	Prior value of 101, next value must be 202 or greater
501 – 1,000 ng/L	Increase of 250	Prior value of 600, next value must be 850 or greater
1,001 ng/L or more	Increase of 1,000	Prior value of 2,000, next value must be 3,000 or greater

If the subsequent critical value does NOT qualify to be called, document this by appending the code **TROPC** to the result. This code translates to "Laboratory value indicates a critical value previously reported."

Notes:

- Data Innovations (DI) will flag results that meet delta criteria to be called (Error code contains 'CALL' and the Error name contains 'CALL TROP').
- When DI is down, ALL critical troponin values must be called.

11.3 Standard Required Messages

The following message is automatically added by the LIS:
HS Troponin I – Interpretation

High risk of myocardial injury, including myocardial infarction.
Male/Female: >100 ng/L

Indeterminate, clinical assessment and serial result evaluation recommended.
Male: 86-100 ng/L
Female: 76-100 ng/L

Within 99th percentile of normal patients with a CV < 10%: <4 hours symptom onset, serial result evaluation recommended, > 4 hours symptom onset – low risk of myocardial injury.
Male: <86 ng/L
Female: <76 ng/L

12. CLINICAL SIGNIFICANCE

Troponin is the contractile regulatory protein complex of striated muscle. It is found periodically along the thin filament of the myofibrils, in conjunction with the protein tropomyosin. The troponin complex consists of three distinct polypeptide components: troponin-C (the calcium binding element), troponin-I (the actinomyosin ATPase inhibitory element), and troponin-T (the tropomyosin binding element). The complex serves to regulate the calcium dependent interaction of myosin and actin and thus plays an integral role in muscle contraction. Troponin-I exists in three distinct molecular forms which correspond to specific isotypes found in fast-twitch skeletal muscle, slow-twitch skeletal muscle, and heart, respectively.

Several reports in the literature have indicated that cardiac troponin-I is released into blood within hours of the onset of symptoms of myocardial infarction and that it remains elevated for several days post-infarction. The cumulative data from these reports indicate that troponin-I levels become abnormal 4–8 hours following onset of chest pain, peak at 12–16 hours, and remain elevated for 5–9 days following an infarction.

Measurement of cardiac troponin-I levels provide sensitive and specific determination of myocardial injury over a wide diagnostic window. Elevations in cardiac troponin-I levels have been observed across a spectrum of acute coronary syndromes including Q-wave MI, non-Q-wave MI and unstable angina. A significantly higher incidence of mortality has been observed in patients with non-Q-wave MI and unstable angina who have detectable levels of cardiac troponin-I. This suggests that cardiac troponin-I provides a means for risk stratification of these individuals.

13. PROCEDURE NOTES

- **FDA Status:** FDA Approved/cleared
- **Validated Test Modifications:** None

The instrument reporting system contains error messages to warn the operator of specific malfunctions. Any report slip containing such error messages should be held for follow-up. Refer to your Dimension EXL Operator's Guide.

The expected maximum observed standard deviations for repeatability using n = 5 replicates at the following Cardiac Troponin I concentrations are:

TNIH Concentration	Acceptable S.D. Maximum
50.0 ng/L	4.8 ng/L
500.0 ng/L	33.5 ng/L

14. LIMITATIONS OF METHOD

14.1 Analytical Measurement Range (AMR)

4 – 25,000 ng/L

14.2 Precision

Material	Mean ng/L	Standard Deviation (%CV)	
		Repeatability	Within-Lab
Plasma 1	48.0	2.3	6.0
Plasma 2	71.8	2.0	3.3
Plasma 3	155.7	1.8	3.0

14.3 Interfering Substances

- Patient samples may contain cardiac troponin-specific autoantibodies that could react in immunoassays to give depressed results.
- Specimens that contain biotin at a concentration of 300 ng/mL demonstrate a less than 10% change in results. Biotin concentrations greater than this may lead to falsely depressed results for patient samples. Testing specimens from renal dysfunction patients taking biotin may lead to false negative results. Therefore, do not use this device in patients with renal impairment (eGFR<60), unless it is confirmed that the patient is not taking biotin. Patients taking more than 20 mg/day of biotin may have falsely negative results, and should not use this test.
- Dextran 40 at 60 g/L increases the troponin result in plasma at 35.1 ng/L and 1337.4 ng/L by 22% and 4% respectively.
- Protein Gamma Globulin at 6 g/dL increases the troponin result in plasma samples at approximately 40 ng/L and 1000 ng/L of troponin.

HIL Interference:
The TNIH assay was evaluated for interference according to CLSI EP07-A2.36 Bias is the difference in the results between the control sample (without the interferent) and the test sample (contains the interferent) expressed in percent. Lithium heparin plasma test sample ranges were: 40 ± 20 ng/L and 1350 ± 650 ng/L. Bias exceeding 10% is considered interference.

Substance tested	Substance Concentration	Bias %
Hemoglobin (hemolysate)	400 mg/dL	<10
Bilirubin (unconjugated)	40 mg/dL	<10
Bilirubin (conjugated)	30 mg/dL	<10
Lipemia Intralipid	3000 mg/dL	<10

14.4 Clinical Sensitivity/Specificity/Predictive Values

Not available

15. SAFETY

Refer to your local and corporate safety manuals and Safety Data Sheet (SDS) for detailed information on safety practices and procedures and a complete description of hazards.

TNIH Flex® Reagent Cartridge may cause an allergic skin reaction.
Contains: 5-chloro-2-methyl-3(2h)-isothiazolone mixture with 2-methyl-3(2h)-isothiazolone.
Wear protective gloves/protective clothing/eye protection/face protection.
IF ON SKIN: Wash with plenty of soap and water. If skin irritation or rash occurs: Get medical advice/attention.

TNIH CAL may cause an allergic skin reaction.
Contains: 5-chloro-2-methyl-4-isothiazolin-3-one and 2-methyl-2H-isothiazol-3-one (3:1).
Wear protective gloves/protective clothing/eye protection/face protection.
IF ON SKIN: Wash with plenty of soap and water. If skin irritation or rash occurs: Get medical advice/attention.

16. RELATED DOCUMENTS

1. Dimension EXL® Clinical Chemistry System Operator's Manual
2. Calibration / Verification Siemens Dimension® EXL procedure
3. Dimension EXL® Cal Accept Guidelines
4. Dimension EXL® Calibration summary
5. Sample Processing, Dimension® EXL procedure
6. Maintenance, Siemens Dimension® EXL procedure
7. Laboratory Quality Control Program
8. QC Schedule for Siemens Dimension EXL®
9. Laboratory Safety Manual
10. Safety Data Sheets (SDS)
11. Dimension EXL Limits Chart
12. Retention of Records and Materials (Lab Policy)
13. Dimension EXL® System Error Messages Chart
14. Centrifuge Use, Maintenance and Functions Checks (Lab policy)
15. Specimen Acceptability Requirements (Lab policy)
16. Repeat Testing Requirements (Lab policy)
17. Critical Values (Lab policy)
18. Current Allowable Total Error Specifications at http://questnet1.qdx.com/Business_Groups/Medical/qc/docs/qc_bpt_tea.xls

19. Current package insert TNIH Flex® Reagent Cartridge RF627
20. High Sensitivity Troponin I Reference Range 99th Percentile Study (VC 956)

17. REFERENCES

1. Package Insert, TNIH Flex® Reagent Cartridge RF627, Siemens Healthcare Diagnostics Inc., 6/11/2019
2. Package Insert, LOCI TNIH CAL, Siemens Healthcare Diagnostics Inc., 06/2020
3. Package Insert, Liquichek Cardiac Markers Plus Control LT, Levels 1, 2, 3,1A, 1B and 1C; Bio-Rad Laboratories, 06/2020
4. Package Insert, CTNI Sample Diluent, Siemens Healthcare Diagnostics Inc., 04/2019

18. REVISION HISTORY

Version	Date	Section	Reason	Reviser	Approval
1	2/25/21	3.2	Specified rejection for hemolysis	L Barrett	R SanLuis
1	2/25/21	8.2	Added note for values below 83 pg/mL	L Barrett	R SanLuis
2	7/14/21	Header	Added FWMC	L Barrett	R SanLuis
2	7/14/21	11.1	Added gender ranges	L Barrett	R SanLuis
2	7/14/21	11.3	Added interpretation comment	L Barrett	R SanLuis
2	7/14/21	16	Added reference range study	L Barrett	R SanLuis
3	3/12/26	5.3, 8.3, 9, 10.3, 10.4, 10.6, 11.1, 11.2, 11.3, 13, 14.1, 14.2, 14.3	Changed units of measure from pg/mL to ng/L	M Liedtke	R SanLuis

19. ADDENDA

None