Table. Analytical characteristics of commercial cardiac troponin I and T assays declared by the manufacturer.

Commercially available assays - Company/ platform(s)/ assay	**LoB [a] (µg/L)**	**LoD [b] (µg/L)**	**99th % (µg/L)**	**%CV at 99th %**	**10% CV (µg/L)**	**Reference population N: age range (y)**	**Epitopes recognised by Antibodies**	**Detection Antibody Tag**
Abbott AxSYM ADV	0.02		0.04	14.0	0.16		C 87-91, 41-49; D 24-40	ALP
Abbott Architect	<0.01		0.028	14.0	0.032	449: 18 – 63 (M: 224, 18 - 63 F: 225, 18 - 62)	C 87-91, 24-40; D: 41-49	Acridinium
Abbott Architect *STAT* hs-cTnI [e]	0.0007 - 0.0013	0.0011 - 0.0019	0.0262 M: 0.0342 F: 0.0156	4.0 M: 3.5 F: 5.3	0.0047	1531: 21 - 75 (M: 766, 21 - 73 F: 765, 21 - 75)	C: 24-40; D: 41-49	Acridinium
Abbott i-STAT	0.02		0.08	16.5	0.10		C: 41-49, 88-91; D: 28-39, 62-78	ALP
Alere Triage SOB	0.05		NAD	NA	NA		C: NA; D: 27-40	Fluorophor
Alere Triage Cardio 3	0.002	0.01	0.02	17.0	0.04		C: 27-39; D: 83-93, 190-196	Fluorophor
Beckman Coulter Access Accu	0.01		0.04	14.0	0.06		C: 41-49; D: 24-40	ALP
Beckman Coulter Access AccuTnI+3 / Access 2 and DxI	<0.01	0.01	0.04 0.02 (0.03 DxI (US))	10.0 20.0	0.04	1000: > 40 527: 18 - 94 (50% > 40 y)	C: 41-49; D: 24-40	ALP
bioMerieux Vidas Ultra	<0.01	<0.01	0.01	27.7	0.11	747: 20 - 81	C: 41-49, 22-29; D: 87-91, 7B9	ALP
Mitsubishi PATHFAST cTnI [e]		0.001	0.020	5.2	0.0031	380	C: 41-49; D: 71-116, 163-209	ALP
Mitsubishi PATHFAST cTnI-II [f]	0.002	0.008	0.029	5.0	0.014	490: 18 - 78	C: 41-49; D: 71-116, 163-209	ALP
Ortho VITROS Troponin I ES	0.007	0.012	0.034	10.0	0.034		C: 24-40, 41-49; D: 87-91	HRP
Radiometer AQT90 FLEX TnI		0.0095	0.023	12.3	0.027	231 (M:125; F:106)	C: 41-49, 190-196; D: 137-149	Europium
Radiometer AQT90 FLEX TnT		0.0080	0.017	15.2	0.026	260 (M: 128; F: 132)	C: 125-131; D: 136-147	Europium
Response Biomedical RAMP	0.03		0.1	20.0	0.21	180: 18 - 80 (M: 84; F: 96)	C: 85-92; D: 26-38	Fluorophor
Roche Cardiac Reader cTnT	0.03		NAD	NA	NA		C: 125-131; D:136-147	Gold particles
Roche cobas h 232 TnT	0.05		NAD	NA	NA		C: 125-131; D:136-147	Gold particles
Roche E 2010 /cobas e 411 / E 170 / cobas e 601 / 602 TnT (4th gen)	0.01		NAD	NA	0.03	533: 20 - 71 (M: 268; F: 265)	C: 125-131; D:136-147	Ruthenium
Roche E 2010/cobas e 411 / E 170 / cobas e 601 / 602 hs-TnT		0.005	0.014	10.0	0.013		C: 125-131; D: 136-147	Ruthenium
Roche E 2010/cobas e 411 / Roche E 170/cobas e 601 / 602 cTnI		0.16	0.16 [c]	NA	0.3		C: 87-91, 190-196; D: 23-29, 27-43	Ruthenium
Siemens ADVIA Centaur® TnI-Ultra™	0.006		0.04	8.8	0.03	648: 17 - 91	C: 41-49, 87-91; D: 27-40	Acridinium
Siemens Dimension® EXL™ TNI	0.010	0.017	0.056	10.0	0.05	241	C: 27-32; D: 41-56	Chemiluminescence
Siemens Dimension® RxL CTNI	0.04 [d]		0.07	15 - 22	0.14	342: 18 - 83	C: 27-32; D: 41-56	ALP
Siemens Dimension VISTA® CTNI	0.015		0.045	10.0	0.04	199	C: 27-32; D: 41-56	Chemiluminescence
Siemens IMMULITE® 1000 Turbo [e]	0.15		0.30	14	0.59	300	C: 87-91; D: 27-40	ALP – Chemiluminescence

Siemens IMMULITE® 1000 [e]	0.1		0.19	11	0.22	300	C: 87-91; D: 27-40	ALP – Chemiluminescence
Siemens IMMULITE® 2000 XPi [e]	0.2		0.29	10.3	0.32	300	C: 87-91; D: 27-40	ALP – Chemiluminescence
Siemens IMMULITE® 1000 Turbo [f]	0.15		NA	NA	0.64		C: 87-91; D: 27-40	ALP – Chemiluminescence
Siemens Stratus® CS cTnI	0.03 [d]		0.07	10.0	0.06	101	C: 27-32; D: 41-56	ALP
Tosoh ST AIA-PACK cTnI (2nd gen)	0.06		0.06 [c]	8.5	NA		C: 41-49; D: 87-91	ALP
Tosoh ST AIA-PACK cTnI(3rd gen) [e]		0.008	0.04	10	0.035	343	C:NA; D: NA	ALP

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[a] LoB, limit of blank, formerly called the limit of detection; [b] LoD, limit of detection, was determined according to Clinical and Laboratory Standards Institute guideline protocol CLSI EP17-A (**1**); NAD, the 99th percentile concentration of the value distribution of a reference population is indeterminate; NA, data are not available; [c] a 99th percentile concentration equal to an assay's LoD is unlikely to have acceptable imprecision for reliable troponin measurement; [d] analytical sensitivity determined by running 20 replicates of a zero concentration sample; [e] Claims are valid for use outside of the US; [f] Claims are valid for use in the US; 99th %, 99th percentile concentration; 10% CV, lowest concentration that has been shown to have a 10% CV (total imprecision); epitopes (amino acid residues) recognised by antibodies were supplied by manufacturers; C, capture antibody(s); D, detection antibody(s); ALP, alkaline phosphatase; hs, high sensitivity designation per manufacturers; HRP, horseradish peroxidase. NB – assays cannot be compared by the stated values in the table since they are derived with different metrics for the various assays.

Preamble

The IFCC WG-TNI has revised the table of troponin analytical characteristics such that two tables are available on the website, one showing troponin concentrations in µg/L and the other in ng/L. These will assist those laboratories that are reporting troponin in whole numbers in ng/L. Note that the non-SI units ng/mL and pg/mL are not recommended.

A Reference List of published peer-reviewed papers that describe the analytical characteristics of troponin I and hs-TnT assays is also available on the IFCC website. The cited papers give a realistic assessment of the performance of manufacturer's assays in routine clinical laboratories.

An interpretation of some nomenclature is given as follows:

1. *Highly sensitive (hs) cTn assay* – refers to a more analytically sensitive assay than current contemporary cTnI and cTnT assays. Evidence for application of the term to an assay may be: 1) ability to yield reliable, valid measurements in more than 80% of samples from healthy subjects; 2) troponin concentration corresponding to a CV of <10% is significantly lower than the 99th percentile value of the healthy reference population; and 3) clinical studies in chest pain and ACS patients using these assays should show increased prognostic ability over contemporary assays in detection of cardiac events (2-4).
2. *Limit of Detection (LoD)* – refers to the lowest amount of troponin detected with 99% probability, using an estimation procedure partly based on nonparametric statistics. LoD is the *lowest troponin concentration* likely to be reliably distinguished from the limit of blank (LoB) which is the highest measurement result for a sample that contains no troponin (blank sample). Estimates of LoB and LoD of troponin assays should be obtained using the CLSI EP17-A protocol (1). Manufacturers are expected to obtain this estimate using multiple analysers and reagent lots to encompass the variability that users can expect to encounter in the field. In order to reduce the effects of lack of analytical robustness, the LoB of a troponin assay should be ~5-fold lower than the 99th percentile reference limit calculated for the same assay. Note that rigorous determination of LoD for commercially available troponin I assays is quite incomplete (Table).
3. *Limit of Quantitation (LoQ)* – for clinical application of troponin the most important assay characteristic is LoQ, defined as the lowest amount of troponin that can be quantitatively determined with stated acceptable (i.e. "clinically meaningful") imprecision and bias. The allowable analytical

performance should be defined and applied to the concentration corresponding to the 99th percentile upper reference limit that, to be clinically usable, cannot be lower than the LoQ of the troponin assay. Necessarily LoQ is ≥ LoD.

4. *Troponin quality goals* – an imprecision goal of total CV <10% together with an assay bias within ±15% may reasonably represent a good compromise for minimum requirements (5). This is consistent with the minimum total error goal for serum troponin measurement estimated at ~33% where total error was calculated as '[bias + (1.65 x imprecision)]' and is based on biological variability data of troponin I (CVintraindividual 9.7%; CVinterindividual 56.8%) obtained by Wu et al. (6). Shifts in calibration of greater than ±15% can cause a change in the number of patients reported as positive or negative at diagnosis (7).
5. *The (99th percentile) URL of a healthy reference population* – if troponin concentrations from a healthy reference population are ranked in centiles from least to greatest, the upper reference limit (URL) is given by the 99th centile. A sample size of at least 300 individuals per sex- and age-matched reference population should avoid the effect of outliers and achieve a 95% probability that at least 99% of the population will have a troponin concentration representative of health. Different studies using manufacturer's troponin methods and platforms have shown variability of the 99th percentile concentration depending on the reference population used, the skewness of the distribution and the number of outliers. Depending on which 99th percentile is used, different clinical classification is likely for laboratories using different cTnI assays or different cut-off values for the same assay. Clinicians should refer to their local laboratory for information about the analytical performance of the troponin assay and the clinical decision limit in use at their site.
6. *Interferences* - hemolysis, icterus, lipemia, heterophilic antibodies, autoantibodies, anticoagulant(s), and sample storage may interfere with the measurement of troponin in some assays resulting in either false-positive or false-negative values (8). Hemolysis can interfere with some troponin immunoassays and is likely to be more clinically significant at low troponin concentration close to the decision limit, where troponin values may be falsely low (cTnT) or high (most cTnI assays) compared with at higher troponin concentrations where the values remain positive (9,10). Clinicians should be aware of analytic conditions (e.g. presence of hemolysed sample, circulating antibodies) associated with greater likelihood of erroneous measurement and that these may be prevalent using highly sensitive troponin assays (11).

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