Digital Imaging and Communications in Medicine (DICOM)

Supplement 169: Simplified Adult Echocardiography Report

DICOM Standards Committee

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Table of Contents

Scope and Field

This supplement to the DICOM Standard introduces a simplified SR template for Adult Echocardiography measurements.

It provides similar content to that of TID 5200 “Echocardiography Procedure Report” while addressing details that were the source of interoperability issues; in particular, varying degrees and patterns of pre- and post-coordination, multiple codes for the same concept and numerous optional descriptive modifiers.

The new template is driven significantly by ASE Guidelines (http://asecho.org/ase-guidelines-by-publication-date).

Changes to NEMA Standards Publication PS 3.2

Digital Imaging and Communications in Medicine (DICOM)

Part 2: Conformance

Add new SOP Class in Table A.1-2

Table A.1-2
UID VALUES

UID Value	UID NAME	Category
…		
1.2.840.10008.5.1.4.1.1.88.72	**Simplified Adult Echo SR Storage**	**Transfer**
…		

Changes to NEMA Standards Publication PS 3.3

Digital Imaging and Communications in Medicine (DICOM)

Part 3: Information Object Definitions

Add Section A.35.17 for new SOP Class:

A.35.17 Simplified Adult Echo SR Information Object Definition

A.35.17.1 Simplified Adult Echo SR Information Object Description

The Simplified Adult Echo SR IOD is used to convey measurements collected in association with an adult echocardiography procedure.

A.35.17.2 Simplified Adult Echo SR IOD Entity-Relationship Model

The E-R Model in Section A.1.2 of this Part applies to the Simplified Adult Echo SR IOD. Table A.35.17-1 specifies the Modules of the Simplified Adult Echo SR IOD.

A.35.17.3 Simplified Adult Echo SR IOD Module Table

Table A.35.17-1
SIMPLIFIED ADULT ECHO SR IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	SR Document Series	C.17.1	M
	Clinical Trial Series	C.7.3.2	U
Frame of Reference	Synchronization	C.7.4.2	C – shall be present if system time is synchronized to an external reference. May be present otherwise.
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Document	SR Document General	C.17.2	M
	SR Document Content	C.17.3	M
	Timezone	C.12.5	M
	SOP Common	C.12.1	M

A.35.17.3.1 Simplified Adult Echo SR IOD Content Constraints

A.35.17.3.1.1 Template

The document shall be constructed from TID 5300 “Simplified Echo Procedure Report” (defined in PS3.16) invoked at the root node.

A.35.17.3.1.2 Value Type

Value Type (0040,A040) in the Content Sequence (0040,A730) of the SR Document Content Module shall be constrained to the following Enumerated Values (see Table C.17-7 for Value Type definitions):

TEXT
CODE
NUM
DATETIME
UIDREF
PNAME
CONTAINER
IMAGE
SCOORD

WAVEFORM
TCOORD

A.35.17.3.1.3 Relationship Constraints

Relationships between Content Items in the content of this IOD shall be conveyed in the by-value mode. See Table C.17.3-8 for Relationship Type definitions.

Note. Relationships by-reference are forbidden. Therefore, Referenced Content Item Identifier (0040,DB73) is not present in any of the Content Items within the SR Document Content Module.

Table A.35.17-2 specifies the relationship constraints of this IOD.

Table A.35.17-2
RELATIONSHIP CONTENT CONSTRAINTS FOR SIMPLIFIED ADULT ECHO SR IOD

Source Value Type	Relationship Type (Enumerated Values)	Target Value Type
CONTAINER	CONTAINS	TEXT, CODE, NUM, DATETIME, UIDREF, PNAME, CONTAINER
TEXT, CODE, NUM	HAS OBS CONTEXT	TEXT, CODE, NUM, DATETIME, UIDREF, PNAME, COMPOSITE
CONTAINER	HAS ACQ CONTEXT	TEXT, CODE, NUM, DATETIME, UIDREF, PNAME, CONTAINER.
Any type	HAS CONCEPT MOD	TEXT, CODE
TEXT, CODE, NUM	HAS PROPERTIES	TEXT, CODE, NUM, DATETIME, UIDREF, PNAME, CONTAINER.
TEXT, CODE, NUM	INFERRED FROM	TEXT, CODE, NUM, DATETIME, UIDREF, CONTAINER, IMAGE, SCOORD, WAVEFORM, TCOORD.
SCOORD	SELECTED FROM	IMAGE
TCOORD	SELECTED FROM	WAVEFORM

Modify Section C.12.1 as shown:

C.12.1 SOP Common Module

Table C.12-1 defines the Attributes that are required for proper functioning and identification of the associated SOP Instances. They do not specify any semantics about the Real-World Object represented by the IOD.

Table C.12-1. SOP Common Module Attributes

Attribute Name	Tag	Type	Attribute Description
…			
>Coding Scheme Responsible Organization	(0008,0116)	3	Name of the organization responsible for the Coding Scheme. May include organizational contact information.

Attribute Name	Tag	Type	Attribute Description
Timezone Offset From UTC	(0008,0201)	3	Contains the offset from UTC to the timezone for all DA and TM Attributes present in this SOP Instance, and for all DT Attributes present in this SOP Instance that do not contain an explicitly encoded timezone offset. **See Section C.12.1.1.8.** ~~**Encoded as an ASCII string in the format "&ZZXX". The components of this string, from left to right, are & = "+" or "-", and ZZ = Hours and XX = Minutes of offset. Leading space characters shall not be present.**~~ ~~**The offset for UTC shall be +0000; -0000 shall not be used.**~~ ~~**Note**~~ ~~**1. This encoding is the same as described in PS3.5 for the offset component of the DT Value Representation.**~~ ~~**2. This Attribute does not apply to values with a DT Value Representation, that contains an explicitly encoded timezone offset.**~~ ~~**3. The corrected time may cross a 24 hour boundary. For example, if Local Time = 1.00 a.m. and Offset = +0200, then UTC = 11.00 p.m. (23.00) the day before.**~~ ~~**4. The "+" sign may not be omitted.**~~ ~~**Time earlier than UTC is expressed as a negative offset.**~~ ~~**Note**~~ ~~**For example:**~~ ~~**UTC = 5.00 a.m.**~~ ~~**Local Time = 3.00 a.m.**~~ ~~**Offset = -0200**~~ The local timezone offset is undefined if this Attribute is absent.
…			

…

C.12.1.1.8 Timezone Offset From UTC

Encoded as an ASCII string in the format "&ZZXX". The components of this string, from left to right, are & = "+" or "-", and ZZ = Hours and XX = Minutes of offset. Leading space characters shall not be present.

A zero offset from UTC shall be expressed as +0000; -0000 shall not be used.

Notes:

1. **This encoding is the same as described in PS3.5 for the offset component of the DT Value Representation.**
2. **This Attribute does not apply to values with a DT Value Representation, that contains an explicitly encoded timezone offset.**
3. **The corrected time may cross a 24 hour boundary. For example, if Local Time = 1.00 a.m. and Offset = +0200, then UTC = 11.00 p.m. (23.00) the day before.**
4. **The "+" sign may not be omitted.**

Time earlier than UTC is expressed as a negative offset.

For example:

UTC = 5.00 a.m.
Local Time = 3.00 a.m.
Offset = -0200

Add Section C.12.5 for new Timezone module:

C.12.5 Timezone Module

Table C.12.5-1 defines the Attributes that are required for proper functioning and identification of the timezone within which an Instance was created.

Note

1. This table contains a subset of the attributes of SOP Common Module (Table C.12-1) but the Type Designation is changed into Type 1. Including this module in an IOD overwrites the Type Designation of the SOP Common Module.

Table C.12.5-1. Timezone Module Attributes

Attribute Name	Tag	Type	Attribute Description
Timezone Offset From UTC	(0008,0201)	1	Contains the offset from UTC to the timezone for all DA and TM Attributes present in this SOP Instance, and for all DT Attributes present in this SOP Instance that do not contain an explicitly encoded timezone offset. See Section C.12.1.1.8.

Changes to NEMA Standards Publication PS 3.4

Digital Imaging and Communications in Medicine (DICOM)

Part 4: Service Class Specifications

Add new SOP Class to PS 3.4 Annex B.3.1.4 Related General SOP Classes:

B.3.1.4 Related General SOP Classes (A-ASSOCIATE-RQ)

...

Table B.3-3
STANDARD AND RELATED GENERAL SOP CLASSES

SOP Class Name	Related General SOP Class Name
…	…
Procedure Log	Enhanced SR
	Comprehensive SR
	Comprehensive 3D SR
	Extensible SR
Simplified Adult Echo SR	**Enhanced SR**
	Comprehensive SR
	Comprehensive 3D SR
	Extensible SR
X-Ray Radiation Dose SR	Enhanced SR
	Comprehensive SR
	Comprehensive 3D SR
	Extensible SR

Add new SOP Class to PS 3.4 Annex B and I tables:

B.5 STANDARD SOP CLASSES

The SOP Classes in the Storage Service Class identify the Composite IODs to be stored. Table B.5-1 identifies Standard SOP Classes.

Table B.5-1
STANDARD SOP CLASSES

SOP Class Name	SOP Class UID	IOD Specification (defined in PS 3.3)
…	…	…
Simplified Adult Echo SR	**1.2.840.10008.5.1.4.1.1.88.72**	**Simplified Adult Echo**

Storage		**SR IOD**
…	…	…

…

B.5.1.5 Structured Reporting Storage SOP Classes

…

- Mammography CAD SR
- Chest CAD SR
- Procedure Log
- **Simplified Adult Echo SR**
- X-Ray Radiation Dose SR

…

I.4 MEDIA STORAGE STANDARD SOP CLASSES

…

I.4.1.2 Structured Reporting Storage SOP Classes

The requirements of Annex O apply to the following SOP Classes:

- **…**
- Mammography CAD SR
- Chest CAD SR
- **Simplified Adult Echo SR**
- Procedure Log
- X-Ray Radiation Dose SR

Add a new Conformance sub-section to PS 3.4 Annex O.4.1:

O.4.1.2 Ultrasound SR SOP Classes

The following shall be documented in the Conformance Statement of any SR creator implementation claiming conformance to the Simplified Adult Echo SR SOP Class as an SCU:

- A list of all the measurement codes from CID 12300 "Core Echo Measurements" supported by the device for use in TID 5301 "Pre-coordinated Echo Measurement"
- A list of initial measurement codes supported by the device for use in Row 1 or 2 of TID 5302 "Post-coordinated Echo Measurement"

    - Optionally, a table of the TID 5302 post-coordinated modifer values associated with each measurement code.
- A list of any extension codes added to CID 12301 "Measurement Selection Reasons", CID 12304 "Echo Measured Properties", CID 12305 "Basic Echo Anatomic Sites", CID 12307 "Cardiac Phases and Time Points" or CID 12227 "Echocardiography Measurement Method"

Changes to NEMA Standards Publication PS 3.6

Digital Imaging and Communications in Medicine (DICOM)

Part 6: Data Dictionary

Add the following UID Value to Part 6 Annex A Table A-1:

Annex A Registry of DICOM unique identifiers (UID) (Normative)

Table A-1
UID VALUES

UID Value	UID NAME	UID TYPE	Part
...	...	…	…
1.2.840.10008.5.1.4.1.1.88.72	**Simplified Adult Echo SR Storage**	**SOP Class**	**PS 3.4**

Add the following UID Value to Part 6 Annex A Table A-3:

Table A-3
CONTEXT GROUP UID VALUES

Context UID	Context Identifier	Context Group Name
...	...	…
1.2.840.10008.6.1.1142	**12301**	**Measurement Selection Reasons**
1.2.840.10008.6.1.1143	**12302**	**Echo Finding Observation Types**
1.2.840.10008.6.1.1144	**12303**	**Echo Measurement Types**
1.2.840.10008.6.1.1145	**12304**	**Echo Measured Properties**
1.2.840.10008.6.1.1146	**12305**	**Basic Echo Anatomic Sites**
1.2.840.10008.6.1.1147	**12306**	**Echo Flow Directions**
1.2.840.10008.6.1.1148	**12307**	**Cardiac Phases and Time Points**
1.2.840.10008.6.1.1149	**12300**	**Core Echo Measurements**

Changes to NEMA Standards Publication PS 3.16

Digital Imaging and Communications in Medicine (DICOM)

Part 16: Content Mapping Resource

Add new Section to Annex A following Echocardiography Procedure Report Templates

SIMPLIFIED ADULT ECHOCARDIOGRAPHY TEMPLATES

The templates that comprise the Simplified Adult Echocardiography Report are interconnected as in Figure A-10b.

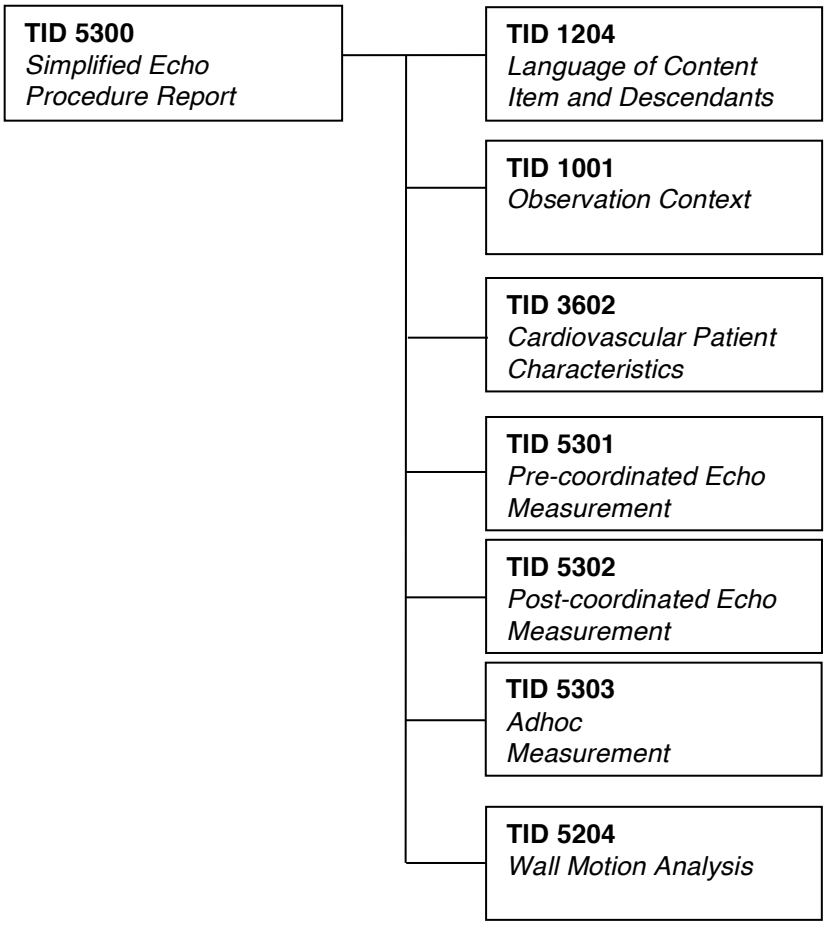

Figure A-10b: Echocardiography Procedure Report Template Structure

TID 5300 Simplified Echo Procedure Report

This template forms the top of a content tree that allows an ultrasound device to describe the results of an adult echocardiography imaging procedure.

The template is instantiated at the root node. It can also be included in other templates that need to incorporate echocardiography findings into another report as quoted evidence.

This template does not include an Image Library. Image Content Items in the Echo Measurement templates (for example to indicate Source of Measurement) shall be included with by-value relationships, not with by-reference relationships.

Measurements in this template (except for the Wall Motion Analysis) are collected into one of three containers, each with a specific sub-template and constraints appropriate to the purpose of the container.

- **Pre-coordinated Measurements**
  - Are fully standardized measurements (many taken from the ASE practice guidelines).
  - Each has a single pre-coordinated standard code that fully captures the semantics of the measurement.
  - The only modifiers permitted are to indicate coordinates where the measurement was taken, provide a brief display label, and indicate which of a set of repeated measurements is the preferred value. Other modifiers are not permitted.
- **Post-coordinated Measurements**
  - Are non-standardized measurements that are performed with enough regularity to merit the control and configuration to capture the full semantics of the measurement. For example these measurements may include those configured on the cart by the vendor or user site. Some of these may be variants of the Pre-coordinated Measurements.
  - A set of mandatory and conditional modifiers with controlled vocabularies capture the essential semantics in a uniform way.
  - A single pre-coordinated code is also provided so that when the same type of measurement is encountered in the future, it is not necessary to parse and evaluate the full constellation of modifer values. Since this measurement has not been fully standardized, the pre-coordinated code may use a private coding scheme (e.g. from the vendor or user site).
- **Adhoc Measurements**
  - Are non-standardized measurements that do not merit the effort to track or configure all the details necessary to populate the set of modifiers required for a post-coordinated measurement.
  - The measurement code describes the elementary property measured.
  - Modifiers provide a brief display label and indicate coordinates where the measurement was taken. Other modifiers are not permitted.

For an example of this encoding and a discussion of the benefits and use cases, see PS3.17 Annex CCCC.

TID 5300 – Simplified Echo Procedure Report
Type: Non-Extensible Order: Significant

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (125200, DCM, “Adult Echocardiography Procedure Report”)	1	M		
2	>	HAS CONCEPT MOD	INCLUDE	DTID (1204) Language of Content Item and Descendants	1	U		
3	>	HAS OBS CONTEXT	INCLUDE	DTID (1001) Observation Context	1	M		
4	>	CONTAINS	CONTAINER	DT (55111-9, LN, “Current Procedure Descriptions”)	1	U		

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
5	>>	CONTAINS	CODE	DT (125203, DCM, “Acquisition Protocol”)	1-n	M		BCID (12001) Ultrasound Protocol Types
6	>	CONTAINS	CONTAINER	EV (18785-6, LN, “Indications for Procedure”)	1	U		
7	>>	CONTAINS	CODE	EV (121071, DCM, “Finding”)	1-n	U		DCID (12246) Cardiac Ultrasound Indication for Study
8	>>	CONTAINS	TEXT	EV (121071, DCM, “Finding”)	1	U		
9	>	CONTAINS	INCLUDE	DTID (3602) Cardiovascular Patient Characteristics	1	U		
10	>	CONTAINS	CONTAINER	EV (125301, DCM, ”Pre-coordinated Measurements”)	1	M		
11	>>	CONTAINS	INCLUDE	DTID (5301) Pre-coordinated Echo Measurement	1-n	M		$Measurement = DCID (12300) Core Echo Measurements $Preferred = DCID (12301) Measurement Selection Reasons
12	>	CONTAINS	CONTAINER	EV (125302, DCM, ”Post-coordinated Measurements”)	1	M		
13	>>	CONTAINS	INCLUDE	DTID (5302) Post-coordinated Echo Measurement	1-n	U		$Preferred = DCID (12301) Measurement Selection Reasons
14	>	CONTAINS	CONTAINER	EV (125303, DCM, ”Adhoc Measurements”)	1	M		
15	>>	CONTAINS	INCLUDE	DTID (5303) Adhoc Measurement	1-n	U		$Property = DCID (12304) Echo Measured Properties
16	>	CONTAINS	INCLUDE	DTID (5204) Wall Motion Analysis	1-n	U		$Procedure = DT (P5-B3121, SRT, “Echocardiography for Determining Ventricular Contraction”)
17	>	CONTAINS	CONTAINER	EV (125310, DCM, ”Staged Measurements”)	1	U		
18	>>	HAS ACQ CONTEXT	CODE	EV (18139-6, LN, "Stage")	1	M		BCID 3207 “Stress Test Procedure Phases”
19	>>	CONTAINS	CONTAINER	EV (125301, DCM, “Pre-coordinated Measurements”)	1	M		
20	>>>	CONTAINS	INCLUDE	DTID (5301) Pre-coordinated Echo Measurement	1-n	U		$Measurement = DCID (12300) Core Echo Measurements $Preferred = DCID (12301) Measurement Selection Reasons
21	>>	CONTAINS	CONTAINER	EV (125302, DCM, “Post-coordinated Measurements”)	1	M		
22	>>>	CONTAINS	INCLUDE	DTID (5302) Post-coordinated Echo Measurement	1-n	U		$Preferred = DCID (12301) Measurement Selection Reasons
23	>>	CONTAINS	CONTAINER	EV (125303, DCM, “Adhoc Measurements”)	1	M		
24	>>>	CONTAINS	INCLUDE	DTID (5303) Adhoc Measurement	1-n	U		$Property = DCID (12304) Echo Measured Properties

Content Item Descriptions

Row 8	A text string containing one or more sentences describing one or more indications, possibly with additional comments from the physician or tech.
Row 11	These are measurements from a standardized list of pre-coordinated codes. See CID 12300 "Core Echo Measurements". Measurements which do not correspond to the full semantics of one of the pre-coordinated codes in CID 12300 can likely be encoded in Row 13 instead.

	Multiple instances of the same measurement code may be present in the container. Each instance represents a different sample or derivation. This template makes no requirement that any or all samples be sent. For example, a mean value of all the samples of a given measurement could be sent without sending all or any of the samples from which the mean was calculated. Device configuration and/or operator interactions determine what measurements are sent.
Row 13	These are measurements that can be encoded using a standardized structure of post-coordinated codes. Measurements which correspond to the full semantics of one of the pre-coordinated codes in CID 12300 "Core Echo Measurements" should be encoded in Row 11 instead. $Measurement shall be provided, but is not constrained to a CID. Multiple instances of the same measurement code may be present in the container. Each instance represents a different sample or derivation. This template makes no requirement that any or all samples be sent. For example, a mean value of all the samples of a given measurement could be sent without sending all or any of the samples from which the mean was calculated. Device configuration and/or operator interactions determine what measurements are sent.
Row 15	These are adhoc measurements encoded with minimal semantics. Row 13 can be used to encode measurements with more complete semantics. $Units shall be provided, but is not constrained to a CID. Device configuration and/or operator interactions determine what measurements are sent.
Row 17-24	When present, these rows contain measurements and associate them with a specific stage of a staged procedure.

TID 5301 Pre-coordinated Echo Measurement

This template codes numeric echo measurements where most of the details about the nature of the measurement have been pre-coordinated in the measurement code. In contrast, see TID 5302 Post-coordinated Echo Measurement.

The pre-coordinated measurement code is provided when this Template is included from a parent Template.

TID 5301 Parameters

Parameter Name	Parameter Usage
$Measurement	Coded term or Context Group for Concept Name of measurement
$Preferred	Flag the preferred value by indicating the reason it was selected as preferred.

TID 5301
Pre-coordinated Echo Measurement
Type: Non-Extensible Order: Significant

	NL	Relation with Parent	Value Type	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			NUM	$Measurement	1	M		
2	>	HAS	CODE	EV (121404, DCM,	1	MC	IFF this measurement has been selected as	$Preferred = MemberOf {DCID

	NL	Relation with Parent	Value Type	Concept Name	VM	Req Type	Condition	Value Set Constraint
		PROPERTIES		"Selection Status")			the single preferred value for the measured concept.	(12301) Measurement Selection Reasons}
3	>	HAS CONCEPT MOD	CODE	EV (121401, DCM, "Derivation")	1	MC	IFF this measurement is not a sample.	EV (R-0031,SRT, "Mean")
4	>		INCLUDE	DTID (320) Image or Spatial Coordinates	1-n	U		$Purpose = EV (121112, DCM, "Source of measurement")
5	>		INCLUDE	DTID (321) Waveform or Temporal Coordinates	1-n	U		$Purpose = EV (121112, DCM, "Source of measurement")
6	>	HAS PROPERTIES	TEXT	(125309,DCM,"Short Label")	1	U		

Content Item Descriptions

Row 2	The reason that this value was selected as the preferred value for the measured concept. The parent template may allow TID 5301 "Pre-coordinated Echo Measurement" to be included multiple times with the same Measurement Concept Name, for example to allow multiple samples of the measurement. A given Measurement Concept Name might appear only once in the instance, in which case this this row may or may not be present. A given Measurement Concept Name may appear multiple times, however this row shall not be present for more than one value of the given Measurement Concept Name. E.g. multiple measurements of (11706-9,LN,"Aortic Valve Peak Systolic Flow") may be present, but only one may be selected as preferred.
Row 3	The method used to derive this measurement value from multiple samples of the Measurement Concept Name. If Row 3 is not present, then this measurement value is simply a single sample of the Measurement Concept Name. Notes: A measurement value that is a mean value of other measurements and was also selected as the preferred value because it is the mean will have both Row 2 and Row 3 present.
Row 6	This may be used to label the measurement value when space is limited on the screen or report page. E.g. a Short Label of "LVIDD" might be provided for a measurement of the left ventricle internal diameter at end diastole. Note: Short Labels are not standardized and may omit details of the measurement, thus it is not recommended to use them for purposes such as matching.

TID 5302 Post-coordinated Echo Measurement

This template codes numeric echo measurements where most of the details about the nature of the measurement have been post-coordinated in modifiers and acquisition context. In contrast, see TID 5301 "Pre-coordinated Echo Measurement".

This template is intended to be used for User-defined and Vendor-defined Echo Measurements.

Several modifier rows are conditional and are omitted when the modifier concept is not significant for the measurement encoded in the item. When these modifiers are included by the sender, it indicates that the modifier concept is significant and receivers will generally treat the measurements differently than similar measurements sent that omit that modifier.

Note: The codes in the CIDs referenced below were sufficient to accurately encode all the best practice echo measurements recommended by the ASE. If, however, a new code is needed to record a specific User-defined or Vendor-defined measurement, most of the CIDs are extensible. It is not unreasonable to

expect that measurements might be made at other Finding Sites than those listed in CID (12305) "Basic Echo Anatomic Sites", or using Measurement Methods beyond those listed in CID (12227) "Echocardiography Measurement Method".

The concept modifiers in the template below were sufficient to accurately encode all the best practice echo measurements recommended by the ASE. Although TID 5302 "Post-coordinated Echo Measurement" is extensible and adding new modifiers is not prohibited, the meaning and significance of such new modifiers will generally not be understood by receiving systems, delaying or preventing import of such measurements. Further, adding modifiers that replicate the meaning of an existing modifier is prohibited.

If such measurements cannot be encoded with the following structure, an implementation may choose to code the measurement in TID 5303 "Adhoc Measurement", or to use TID 5200 “Echocardiography Procedure Report” instead of TID 5300 “Simplified Echo Procedure Report”.

TID 5302 Parameters

Parameter Name	Parameter Usage
$Measurement	Coded term or Context Group for Concept Name of measurement
$Preferred	Flag the preferred value by indicating the reason it was selected as preferred.

TID 5302
Post-coordinated Echo Measurement
Type: Extensible Order: Significant

	NL	Relation with Parent	Value Type	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			NUM	$Measurement	1	M		
2	>	HAS PROPERTIES	CODE	EV (121050,DCM,”Equivalent Meaning of Concept Name”)	1-n	U		
3	>	HAS PROPERTIES	CODE	EV (121404, DCM, “Selection Status”)	1	MC	IFF this measurement has been selected as the single preferred value for the measured concept.	$Preferred =MemberOf {DCID (12301) Measurement Selection Reasons}
4	>	HAS CONCEPT MOD	CODE	EV (121401, DCM, “Derivation”)	1	MC	IFF this measurement is not a sample.	EV (R-0031,SRT, ”Mean”)
5	>		INCLUDE	DTID (320) Image or Spatial Coordinates	1-n	U		$Purpose = EV (121112, DCM, “Source of measurement”)
6	>		INCLUDE	DTID (321) Waveform or Temporal Coordinates	1-n	U		$Purpose = EV (121112, DCM, “Source of measurement”)
7	>	HAS CONCEPT MOD	CODE	EV (125306, DCM, “Measurement Type”)	1	M		DCID (12303) Echo Measurement Types
8	>	HAS CONCEPT MOD	CODE	EV (G-C0E3, SRT, “Finding Site”)	1	M		DCID (12305) Basic Echo Anatomic Sites
9	>	HAS CONCEPT MOD	CODE	EV (125305, DCM, “Finding Observation Type”)	1	M		DCID (12302) Echo Finding Observation Types
10	>	HAS CONCEPT MOD	CODE	EV (125307, DCM, “Measured Property”)	1	M		DCID (12304) Echo Measured Properties
11	>	HAS CONCEPT MOD	CODE	EV (G-C048, SRT, “Flow Direction”)	1	MC	IFF Row 9 is (PA-50030,SRT, ”Hemodynamic	DCID (12306) Echo Flow Directions

	NL	Relation with Parent	Value Type	Concept Name	VM	Req Type	Condition	Value Set Constraint
							Measurements") and the Flow Direction is significant for this measurement.	
12	>	HAS CONCEPT MOD	CODE	EV (G-C036, SRT, "Measurement Method")	1	MC	IFF the Measurement Method is significant for this measurement.	DCID (12227) Echocardiography Measurement Methods
13	>	HAS ACQ CONTEXT	CODE	EV (G-0373, SRT, "Image Mode")	1	MC	IFF the Image Mode is significant for this measurement.	DCID (12224) Ultrasound Image Modes
14	>	HAS ACQ CONTEXT	CODE	EV (111031, DCM, "Image View")	1	MC	IFF the Image View is significant for this measurement.	DCID (12226) Echocardiography Image View
15	>	HAS CONCEPT MOD	CODE	EV (R-4089A, SRT, "Cardiac Cycle Point")	1	MC	IFF the Cardiac Cycle Point is significant for this measurement.	DCID (12307) Cardiac Phases and Time Points
16	>	HAS CONCEPT MOD	CODE	EV (R-40899, SRT, "Respiratory Cycle Point")	1	MC	IFF the Respiratory Cycle Point is significant for this measurement.	DCID (12234) Respiration State
17	>	HAS CONCEPT MOD	CODE	EV (125308, DCM, "Measurement Divisor")	1	MC	IFF the value of Row 7 is (125313,DCM, "Indexed") or (G-D750, SRT, "Ratio") or (125314,DCM, "Fractional Change")	
18	>	HAS PROPERTIES	TEXT	(125309,DCM,"Short Label")	1	U		

350 **Content Item Descriptions**

Row 1	A fully pre-coordinated code that incorporates all the semantics of Rows 7-17 for this measurement. The code is intended to allow parsers to recognize post-coordinated measurements that have been previously encountered, thus facilitating incorporation of the measurement into databases, report templates, registries, etc. Typically these codes will be from a vendor or site specific coding scheme, e.g. 99ACME. Sending the same code consistently in different reports will depend on the recording system maintaining a stable list of these pre-coordinated codes. Such a list might be configured or internally generated and managed. This shall be populated by the recording system. If the recording system does not have a method to ensure that all occurrences of the same post-coordinated measurement use the same code, it shall use the code (125304,DCM,"Untrackable Measurement"). Notes: 1. Two measurements with the same pre-coordinated code have, by definition, the same semantics (except for "Untrackable Measurements") 2. Two measurements with the same constellation of modifier values have the same semantics but may have different pre-coordinated codes because they - come from carts of different vendors who don't share the same code table - come from carts of the same vendor, but the carts don't share the same code table - come from the same cart, but it's code table has been modified - come from the same cart, but it does not maintain a code table 3. Two measurements with the same constellation of modifier values and different pre-coordinated codes have the same semantics and the receiver is entitled to treat them as the same (with respect

	to the scope of those modifiers) 4. Recommended units for various Measured Properties (Row 10) can be found in the Units column of CID (12304) "Echo Measured Properties". 5. When the Measurement Type (Row 7) is (125313,DCM, "Indexed"), (G-D750, SRT, "Ratio") or (125314,DCM, "Fractional Change"), the Units for Row 1 corresponds to the fully calculated $Measurement, incorporating both the numerator (Row 10) and the denominator (Row 17). E.g. a measure of Left Ventricular Outflow Tract Diameter / BSA would have units of (cm/m2, UCUM, "cm/m2") in Row 1, (125313,DCM, "Indexed") in Row 7, (M-02550,SRT,"Diameter") in Row 10, and (LN, 8277-6,"Body Surface Area") in Row 17.
Row 2	One or more additional fully pre-coordinated codes which are semantically equivalent to the code in Row 1. This may be used to communicate known mappings, such as to national registry codes or other vendors' codes.
Row 3	The reason that this value was selected as the preferred value for the measured concept. The parent template may allow TID 5301 "Pre-coordinated Echo Measurement" to be included multiple times with the same Measurement Concept Name, for example to allow multiple samples of the measurement. A given Measurement Concept Name might appear only once in the instance, in which case this this row may or may not be present. A given Measurement Concept Name may appear multiple times, however this row shall not be present for more than one value of a given measured concept. E.g. multiple measurements of (11706-9,LN,"Aortic Valve Peak Systolic Flow") may be present, but only one may be selected as preferred.
Row 4	The method used to derive this measurement value from multiple samples of the Measurement Concept Name. If Row 3 is not present, then this measurement value is simply a single sample of the Measurement Concept Name. Notes: 1. A measurement value that is a mean value of other samples and was also selected as the preferred value because it is the mean will have both Row 2 and Row 3 present. 2. This row is not used to record whether the measurement value is a direct measurement vs a measurement calculated from an equation. Such information is recorded in Row 7.
Row 8	The finding site reflects the anatomical location where the measurement is taken. CID (12305) "Basic Echo Anatomic Sites" contains the codes which proved to be sufficient for mapping the full set of ASE standard measurements. It is recommended to use these locations unless a more detailed location is truly necessary.
Row 9	The finding observation type indicates the type of observation made at the finding site to produce the measurement. In many cases, for example Aortic Root Diameter, the structure of the finding site is being observed. In other cases, for example Mitral Valve Regurgitant Flow Peak Velocity, the finding site is the mitral valve, the hemodynamic flow (not the valve structure) is being observed, the measured property is the peak velocity, and the flow direction is retrograde.
Row 17	The pre-coordinated code for the measurement that has been used as the denominator of this measurement. Only applies to measurements of type Indexed, Ratio or Fractional Change. The measurement referenced as the Measurement Divisor shall be present in the instance in which it is used. When Row 17 is present, any values in Rows 5-6, 8-16 shall reflect the numerator of the measurement rather than the Index, Ratio or Fractional Change as a whole. The rest of the rows, including the pre-coordinated measurement value, the pre-coordinated measurement code, the units and the short label, reflect the Index, Ratio or Fractional Change as a whole. E.g. in the case of an Indexed measurement, the value recorded in Row 1 has already been divided by the Index referenced in Row 17, and the Units in Row 1 match the indexed value, not the numerator Property described in Row 10. For a measurement of type Indexed, the numerator is divided by the Measurement Divisor. For a measurement of type Ratio, the numerator is divided by the Measurement Divisor and is unitless. For a measurement of type Fractional Change, the numerator is first subtracted from the Measurement Divisor and the result divided by the Measurement Divisor (i.e. (Divisor-Numerator)/Divisor).
Row 18	This may be used to label the measurement value when space is limited on the screen or report page. E.g. a Short Label of "LVIDD" might be provided for a measurement of the left ventricle internal diameter at end diastole. Note: Short Labels are not standardized and may omit details of the measurement, thus it is not

	recommended to use them for purposes such as matching.

TID 5303 Adhoc Measurement

This Template codes numeric echo measurements where most of the details about the nature of the measurement are not communicated. The measurement is identified in terms of the property measured, such as Length, Diameter, Area, Velocity etc. and some measurement context may established by reference to spatial coordinates on an image or a waveform. A displayable label is included but there is no managed code identifying the measurement.

The template is intended to be used to include adhoc, one-time measurements whose need is determined during imaging exam or reviewing session.

Measurements that are taken in an adhoc fashion but are selected from the set of pre-coordinated or post-coordinated measurements that are configured on the Ultrasound System should be coded using TID 5301 "Pre-coordinated Echo Measurement" or TID 5302 "Post-coordinated Echo Measurement".

TID 5303 Parameters

Parameter Name	Parameter Usage
$Property	Property being measured

TID 5303
Adhoc Measurement
Type: Non-Extensible Order: Significant

	NL	Relation with Parent	Value Type	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			NUM	$Property	1	M		
2	>		INCLUDE	DTID (320) Image or Spatial Coordinates	1-n	U		$Purpose = EV (121112, DCM, “Source of measurement”)
3	>		INCLUDE	DTID (321) Waveform or Temporal Coordinates	1-n	U		$Purpose = EV (121112, DCM, “Source of measurement”)
4	>	HAS PROPERTIES	TEXT	(125309,DCM,”Short Label”)	1	M		

Content Item Descriptions

Row 4	This may be used to label the measurement value when space is limited on the screen or report page. E.g. a Short Label of “LVIDD” might be provided for a measurement of the left ventricle internal diameter at end diastole. Note: Short Labels are not standardized and may omit details of the measurement, thus it is not recommended to use them for purposes such as matching.

Add the following CID’s to Part 16 Annex B:

CID 12301 Measurement Selection Reasons

The codes in this Context Group describe the reason that a value was selected as the preferred value. E.g. (121411,DCM,"Most Recent Value Chosen") means that the value was selected as preferred because the value was the most recent value.

Context ID 12301
Measurement Selection Reasons
Type: Extensible Version: 20161109

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT	G-A437	Maximum
SRT	R-404FB	Minimum
DCM	121410	User chosen value
DCM	121411	Most recent value chosen
DCM	121412	Mean value chosen

CID 12302 Echo Finding Observation Types

Context ID 12302
Echo Finding Observation Types
Type: Non-Extensible Version: 20161109

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	125311	Structure of the Finding Site
DCM	125312	Behavior of the Finding Site
SRT	PA-50030	Hemodynamic Measurements

CID 12303 Echo Measurement Types

Context ID 12303
Echo Measurement Types
Type: Non-Extensible Version: 20161109

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	125313	Indexed
SRT	G-D750	Ratio
DCM	125314	Fractional Change
DCM	125315	Calculated
DCM	113857	Manual Entry

DCM	125316	Directly measured

CID 12304 Echo Measured Properties

The Units column contains the proper UCUM representation of the recommended units for the measured property.

Context ID 12304
Echo Measured Properties
Type: Extensible Version: 20161109

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	Units
LN	20168-1	Acceleration Time	(ms, UCUM, “ms”)
LN	59130-5	Alias Velocity	(m/s, UCUM, “m/s”)
SRT	G-A160	Angle	(deg, UCUM, "deg"
SRT	G-A166	Area	(cm2, UCUM, “cm2”)
SRT	F-31000	Blood Pressure	(mm[Hg], UCUM, “mmHg”)
SRT	F-32070	Cardiac Ejection Fraction	(%, UCUM, “%”)
LN	20217-6	Deceleration Time	(ms, UCUM, “ms”)
SRT	M-02550	Diameter	(cm, UCUM, “cm”)
LN	59120-6	dP/dt by US	(mm[Hg]/s, UCUM, “mmHg/s”)
SRT	G-D217	Interval	(ms, UCUM, “ms”)
DCM	125325	Dyssynchrony Index	(ms, UCUM, “ms”)
DCM	125326	Effective Orifice Area	(cm2, UCUM, “cm2”)
LN	59093-5	Epicardial Area	(cm2, UCUM, “cm2”)
DCM	125327	Excursion Distance	(cm, UCUM, “cm”)
LN	59132-1	Fractional Shortening	(%, UCUM, “%”)
SRT	G-D7FE	Length	(cm, UCUM, “cm”)
SRT	G-D701	Mass	(g, UCUM, “g”)
DCM	125328	Maximum Orifice Area	(cm2, UCUM, “cm2”)
SRT	F-31150	Mean Blood Pressure	(mm[Hg], UCUM, “mmHg”)
LN	20256-4	Mean Gradient [Pressure] by Doppler	(mm[Hg], UCUM, “mmHg”)
LN	20352-1	Mean Blood Velocity	(m/s, UCUM, “m/s”)
SRT	G-A194	Minor Axis	(cm, UCUM, “cm”)
LN	59099-2	Myocardial Performance Index (Tei)	(1, UCUM, “no units”)
LN	20247-3	Peak Gradient [Pressure]	(mm[Hg], UCUM, “mmHg”)

LN	34141-2	Peak Instantaneous Flow Rate	(ml/s, UCUM, “ml/s”)
DCM	125329	Peak Blood Pressure	(mm[Hg], UCUM, “mmHg”)
LN	11726-7	Peak Blood Velocity	(m/s, UCUM, “m/s”)
DCM	125330	Peak Tissue Velocity	(cm/s, UCUM, “cm/s”)
DCM	125331	PISA Radius	(cm, UCUM, “cm”)
LN	20280-4	Pressure Half Time	(ms, UCUM, “ms”)
SRT	G-0390	Regurgitant Fraction	(%, UCUM, “%”)
DCM	125332	Regurgitation Jet Area	(cm2, UCUM, “cm2”)
DCM	125333	Regurgitation Jet Width	(cm, UCUM, “cm”)
LN	59090-1	Internal Dimension	(cm, UCUM, “cm”)
LN	59089-3	Thickness	(cm, UCUM, “cm”)
SRT	F-32120	Stroke Volume	(ml, UCUM, “ml”)
SRT	F-02692	Vascular Resistance	(dyn.s/cm5, UCUM, “dynes.s/cm5”)
LN	20354-7	Velocity Time Integral	(cm, UCUM, “cm”)
DCM	125334	Vena Contracta Width	(cm, UCUM, “cm”)
SRT	G-D705	Volume	(ml, UCUM, “ml”)
LN	33878-0	Volume Flow Rate	(ml/s, UCUM, “ml/s”)

CID 12305 Basic Echo Anatomic Sites

Context ID 12305
Basic Echo Anatomic Sites
Type: Extensible Version: 20161109

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT	T-42110	Aortic Root
SRT	T-42102	Aortic Sinotubular Junction
SRT	T-35400	Aortic Valve
SRT	T-35410	Aortic Valve Ring
SRT	T-42100	Ascending Aorta
SRT	T-48710	Inferior vena cava
SRT	T-32410	Interventricular septum
SRT	G-0392	Lateral Mitral Annulus
SRT	T-32300	Left Atrium
SRT	T-44400	Left Pulmonary Artery
SRT	T-32600	Left Ventricle
SRT	T-32619	Left ventricle basal anterior segment

SRT	R-1007A	Left ventricle basal anterolateral segment
SRT	R-10075	Left ventricle basal anteroseptal segment
SRT	T-32615	Left ventricle basal inferior segment
SRT	R-10079	Left ventricle basal inferolateral segment
SRT	R-10076	Left ventricle basal inferoseptal segment
SRT	T-32617	Left ventricle mid anterior segment
SRT	R-1007C	Left ventricle mid anterolateral segment
SRT	R-10077	Left ventricle mid anteroseptal segment
SRT	T-32616	Left ventricle mid inferior segment
SRT	R-1007B	Left ventricle mid inferolateral segment
SRT	R-10078	Left ventricle mid inferoseptal segment
SRT	T-32620	Left Ventricle Myocardium
SRT	T-32650	Left Ventricle Outflow Tract
SRT	G-0391	Medial Mitral Annulus
SRT	T-35310	Mitral Annulus
SRT	T-35300	Mitral Valve
SRT	T-44000	Pulmonary Artery
SRT	T-4858F	Pulmonary Vein
SRT	T-35210	Pulmonic Ring
SRT	T-35200	Pulmonic Valve
SRT	T-32200	Right Atrium
SRT	T-44200	Right Pulmonary Artery
SRT	T-32500	Right Ventricle
DCM	125319	Right Ventricle Anterior Wall
SRT	T-32503	Right Ventricle Midventricular Segment
SRT	T-32550	Right Ventricle Outflow Tract
DCM	125317	Right Ventricle Outflow Tract, Distal
DCM	125318	Right Ventricle Outflow Tract, Proximal
SRT	T-32504	Right Ventricle Basal Segment
SRT	T-35110	Tricuspid Annulus
SRT	T-35100	Tricuspid Valve
SRT	T-44100	Trunk of pulmonary artery

CID 12306 Echo Flow Directions

Context ID 12306
Echo Flow Directions

Type : Non-Extensible **Version : 20161109**

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT	R-42047	Antegrade Direction
SRT	R-42E61	Retrograde Direction

CID 12307 Cardiac Phases and Time Points

The following codes are intended for use in a post-coordinated context. For example, the E-wave refers to the period of diastolic rapid inflow as experienced at the post-coordinated finding site, such as the mitral valve or the tricuspid valve.

The table is organized in time sequence based on the start of the coded period.

As indicated in Annex G, the e-prime period used for tissue velocity measurements is synonymous with the E-wave period used for blood velocity measurements.

Context ID 12307
Cardiac Phases and Time Points

Type: Extensible **Version: 20100317**

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	125320	Electromechanical Delay
DCM	125321	Pre-ejection Period
SRT	F-32020	Systole
SRT	R-40B12	Ventricular Isovolumic Contraction
SRT	R-40B11	Ventricular Ejection (S-wave)
SRT	R-FAB5B	End Systole
SRT	F-32010	Diastole
SRT	R-40B10	Ventricular Isovolumic Relaxation
DCM	125322	Atrial Diastolic Filling (D-wave)
SRT	R-40B1C	Diastolic Rapid Inflow (E-wave)
SRT	R-40B21	Diastasis
SRT	F-32030	Atrial Systole (A-wave)
DCM	125323	AR-wave
SRT	F-32011	End Diastole
DCM	125324	Full Cardiac Cycle

CID 12300 Core Echo Measurements

This codeset is populated mostly based on measurements identified in best practice articles published by the American Society of Echocardiography (ASE). The LOINC codes were introduced after fully modelling the underlying semantics of the measurement. The Units column contains the proper UCUM representation of the recommended units for the measured property.

NOTE: The Code Meaning shown here reflects the colloquial style by which the measurements were identified in the ASE articles and would likely be appropriate for displaying to users. However, implementers of clinical applications and databases will need to review the definitions of these measurements to correctly understand the full pre-coordinated semantics of the codes. Similarly, reuse of the codes based on the Code Meaning text without reviewing and confirming the applicability of the full semantics found in the code definitions is discouraged.

Context ID 12300
Core Echo Measurements
Type : Non-Extensible Version : 20161109

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	Units
LN	79940-3	Aortic annulus diameter	(cm, UCUM, “cm”)
LN	79941-1	Aortic regurgitant flow	(ml/s, UCUM, “ml/s”)
LN	79942-9	Aortic regurgitant fraction	(%, UCUM, “%”)
LN	79943-7	Aortic regurgitant jet area/LVOT area %	(%, UCUM, “%”)
LN	79944-5	Aortic regurgitant jet width/LVOT width %	(%, UCUM, “%”)
LN	79945-2	Aortic regurgitation PISA radius	(cm, UCUM, “cm”)
LN	79946-0	Aortic regurgitation PISA velocity	(cm/s, UCUM, “cm/s”)
LN	79947-8	Aortic regurgitation pressure half-time	(ms, UCUM, “ms”)
LN	79948-6	Aortic regurgitation vena contracta width	(cm, UCUM, “cm”)
LN	79949-4	Aortic regurgitation Vmax	(cm/s, UCUM, “cm/s”)
LN	79950-2	Aortic regurgitation volume (Continuity VTI)	(ml, UCUM, “ml”)
LN	79951-0	Aortic regurgitation volume (PISA)	(ml, UCUM, “ml”)
LN	79952-8	Aortic regurgitation VTI	(cm, UCUM, “cm”)
LN	79953-6	Aortic root diameter	(cm, UCUM, “cm”)
LN	79954-4	Aortic root diameter / BSA	(cm/m2, UCUM, “cm/m2”)
LN	79955-1	Aortic sinotubular junction dimension	(cm, UCUM, “cm”)
LN	79956-9	Aortic valve area (Continuity Vmax)	(cm2, UCUM, “cm2”)
LN	79957-7	Aortic valve area (Continuity Vmax) / BSA	(cm2/m2, UCUM, “cm2/m2”)
LN	79958-5	Aortic valve area (Continuity VTI)	(cm2, UCUM, “cm2”)

LN	79959-3	Aortic valve area (Continuity VTI) / BSA	(cm2/m2, UCUM, “cm2/m2”)
LN	79960-1	Aortic valve effective regurgitant orifice area	(cm2, UCUM, “cm2”)
LN	79961-9	Aortic valve mean blood velocity	(cm/s, UCUM, “cm/s”)
LN	79962-7	Aortic valve mean gradient	(mm[Hg], UCUM, “mmHg”)
LN	79963-5	Aortic valve peak instantaneous gradient	(mm[Hg], UCUM, “mmHg”)
LN	79964-3	Aortic valve Vmax	(cm/s, UCUM, “cm/s”)
LN	79965-0	Aortic valve VTI	(cm, UCUM, “cm”)
LN	79966-8	Ascending Aorta Dimension	(cm, UCUM, “cm”)
LN	79967-6	Inferior vena cava diameter	(cm, UCUM, “cm”)
LN	79968-4	Interventricular septum diastolic dimension MM	(cm, UCUM, “cm”)
LN	79969-2	Interventricular septum diastolic dimension 2D	(cm, UCUM, “cm”)
LN	79970-0	Interventricular septum systolic dimension MM	(cm, UCUM, “cm”)
LN	79971-8	Interventricular septum systolic dimension 2D	(cm, UCUM, “cm”)
LN	79972-6	Interventricular septum time to peak displacement	(ms, UCUM, “ms”)
LN	79973-4	Left atrial end systolic area 2C	(cm2, UCUM, “cm2”)
LN	79974-2	Left atrial end systolic area 4C	(cm2, UCUM, “cm2”)
LN	79975-9	Left atrial end systolic diameter (AP) 2D	(cm, UCUM, “cm”)
LN	79976-7	Left atrial end systolic diameter (AP) 2D / BSA	(cm/m2, UCUM, “cm/m2”)
LN	79977-5	Left atrial end systolic diameter (AP) MM	(cm, UCUM, “cm”)
LN	79978-3	Left atrial end systolic diameter (AP) MM / BSA	(cm/m2, UCUM, “cm/m2”)
LN	79979-1	Left atrial end systolic length 2C	(cm, UCUM, “cm”)
LN	79980-9	Left atrial end systolic length 4C	(cm, UCUM, “cm”)
LN	79981-7	Left atrial end systolic volume biplane (area-length)	(ml, UCUM, “ml”)
LN	79982-5	Left atrial end systolic volume biplane (area-length) / BSA	(ml/m2, UCUM, “ml/m2”)
LN	79983-3	Left atrial end systolic volume biplane (MOD)	(ml, UCUM, “ml”)

LN	79984-1	Left atrial end systolic volume biplane (MOD) / BSA	(ml/m2, UCUM, “ml/m2”)
LN	79985-8	Left atrial end systolic volume single plane 2C (MOD)	(ml, UCUM, “ml”)
LN	79986-6	Left atrial end systolic volume single plane 4C (MOD)	(ml, UCUM, “ml”)
LN	79987-4	Left pulmonary artery diameter	(cm, UCUM, “cm”)
LN	79988-2	Left venticular posterior wall time to peak displacement	(ms, UCUM, “ms”)
LN	79989-0	Left ventricular pre-ejection period	(ms, UCUM, “ms”)
LN	77891-0	Left ventricular ejection fraction (Teichholz) 2D	(%, UCUM, “%”)
LN	18049-7	Left ventricular ejection fraction (Teichholz) MM	(%, UCUM, “%”)
LN	79990-8	Left ventricular ejection fraction 3D	(%, UCUM, “%”)
LN	79991-6	Left ventricular ejection fraction biplane (MOD)	(%, UCUM, “%”)
LN	79992-4	Left ventricular ejection fraction single plane 2C (MOD)	(%, UCUM, “%”)
LN	79993-2	Left ventricular ejection fraction single plane 4C (MOD)	(%, UCUM, “%”)
LN	79994-0	Left ventricular end diastolic length 4C	(cm, UCUM, “cm”)
LN	79995-7	Left ventricular end diastolic volume (3D)	(ml, UCUM, “ml”)
LN	79996-5	Left ventricular end diastolic volume biplane (MOD)	(ml, UCUM, “ml”)
LN	79997-3	Left ventricular end diastolic volume biplane (MOD) / BSA	(ml/m2, UCUM, “ml/m2”)
LN	79998-1	Left ventricular end diastolic volume single plane 2C (MOD)	(ml, UCUM, “ml”)
LN	79999-9	Left ventricular end diastolic volume single plane 4C (MOD)	(ml, UCUM, “ml”)
LN	80000-3	Left ventricular end systolic volume (3D)	(ml, UCUM, “ml”)
LN	80001-1	Left ventricular end systolic volume biplane (MOD)	(ml, UCUM, “ml”)
LN	80002-9	Left ventricular end systolic volume biplane (MOD) / BSA	(ml/m2, UCUM, “ml/m2”)
LN	80003-7	Left ventricular end systolic volume single plane 2C (MOD)	(ml, UCUM, “ml”)
LN	80004-5	Left ventricular end systolic volume single plane 4C (MOD)	(ml, UCUM, “ml”)

LN	80005-2	Left ventricular endocardial area SAX PM level	(cm2, UCUM, “cm2”)
LN	80006-0	Left ventricular epicardial area SAX PM level	(cm2, UCUM, “cm2”)
LN	29434-8	Left ventricular fractional shortening (of minor axis) (2D)	(%, UCUM, “%”)
LN	29435-5	Left ventricular fractional shortening (of minor axis) (MM)	(%, UCUM, “%”)
LN	80007-8	Left ventricular internal diastolic dimension - 2D	(cm, UCUM, “cm”)
LN	80008-6	Left ventricular internal diastolic dimension - MM	(cm, UCUM, “cm”)
LN	80009-4	Left ventricular internal diastolic dimension / BSA	(cm/m2, UCUM, “cm/m2”)
LN	80010-2	Left ventricular internal diastolic dimension / BSA	(cm/m2, UCUM, “cm/m2”)
LN	80011-0	Left ventricular internal systolic dimension - 2D	(cm, UCUM, “cm”)
LN	80012-8	Left ventricular internal systolic dimension - MM	(cm, UCUM, “cm”)
LN	80013-6	Left ventricular internal systolic dimension / BSA	(cm/m2, UCUM, “cm/m2”)
LN	80014-4	Left ventricular internal systolic dimension / BSA	(cm/m2, UCUM, “cm/m2”)
LN	18071-1	Left ventricular isovolumic relaxation time by Doppler	(ms, UCUM, “ms”)
LN	80015-1	Left ventricular isovolumic relaxation time by TDI	(ms, UCUM, “ms”)
LN	80016-9	Left ventricular mass (area-length)	(g, UCUM, “g”)
LN	80017-7	Left ventricular mass (area-length) / BSA	(g/m2, UCUM, “g/m2”)
LN	80018-5	Left ventricular mass (area-length) / height^^2.7	(g/m2.7, UCUM, “g/m2.7”)
LN	80019-3	Left ventricular mass (dimension method) 2D	(g, UCUM, “g”)
LN	80020-1	Left ventricular mass (dimension method) 2D / BSA	(g/m2, UCUM, “g/m2”)
LN	80021-9	Left ventricular mass (dimension method) 2D / height^^2.7	(g/m2.7, UCUM, “g/m2.7”)
LN	80022-7	Left ventricular mass (dimension method) MM	(g, UCUM, “g”)
LN	80023-5	Left ventricular mass (dimension method) MM / BSA	(g/m2, UCUM, “g/m2”)

LN	80024-3	Left ventricular mass (dimension method) MM / height^^2.7	(g/m2.7, UCUM, “g/m2.7”)
LN	80025-0	Left ventricular mass (truncated ellipse)	(g, UCUM, “g”)
LN	80026-8	Left ventricular mass (truncated ellipse) / BSA	(g/m2, UCUM, “g/m2”)
LN	80027-6	Left ventricular mass (truncated ellipse) / height^^2.7	(g/m2.7, UCUM, “g/m2.7”)
LN	80028-4	Left ventricular outflow tract dimension (2D)	(cm, UCUM, “cm”)
LN	80029-2	Left ventricular outflow tract Vmax	(cm/s, UCUM, “cm/s”)
LN	80030-0	Left ventricular outflow tract VTI	(cm, UCUM, “cm”)
LN	80031-8	Left ventricular posterior wall diastolic thickness	(cm, UCUM, “cm”)
LN	80032-6	Left ventricular posterior wall diastolic thickness	(cm, UCUM, “cm”)
LN	80033-4	Left ventricular posterior wall systolic thickness	(cm, UCUM, “cm”)
LN	80034-2	Left ventricular posterior wall systolic thickness	(cm, UCUM, “cm”)
LN	80035-9	Left ventricular stroke volume 3D	(ml, UCUM, “ml”)
LN	80036-7	LV basal anterior time to S Vmax (Ts-basal anterior)	(ms, UCUM, “ms”)
LN	80037-5	LV basal anteroseptal time to S Vmax (TS-basal anteroseptal)	(ms, UCUM, “ms”)
LN	80038-3	LV basal inferior time to S Vmax (Ts-basal inferior)	(ms, UCUM, “ms”)
LN	80039-1	LV basal lateral time to S Vmax (Ts-basal lateral)	(ms, UCUM, “ms”)
LN	80040-9	LV basal posterior time to S Vmax (Ts-basal posterior)	(ms, UCUM, “ms”)
LN	80041-7	LV basal septal time to S Vmax (Ts-basal septal)	(ms, UCUM, “ms”)
LN	80042-5	LV mid anterior time to S Vmax (Ts-mid anterior)	(ms, UCUM, “ms”)
LN	80043-3	LV mid anteroseptal time to S Vmax (Ts-mid anteroseptal)	(ms, UCUM, “ms”)
LN	80044-1	LV mid inferior time to S Vmax (Ts-mid inferior)	(ms, UCUM, “ms”)
LN	80045-8	LV mid lateral time to S Vmax (Ts-mid lateral)	(ms, UCUM, “ms”)

LN	80046-6	LV mid posterior time to S Vmax (Ts-mid posterior)	(ms, UCUM, “ms”)
LN	80047-4	LV mid septal time to S Vmax (Ts-mid septal)	(ms, UCUM, “ms”)
LN	80048-2	LV Ts-SD (Dyssynchrony Index)	(ms, UCUM, “ms”)
LN	80049-0	Main pulmonary artery diameter	(cm, UCUM, “cm”)
LN		Main pulmonary artery Vmax	(cm/s, UCUM, “cm/s”)
LN	80050-8	Mitral annulus diastolic diameter - A2C	(cm, UCUM, “cm”)
LN	80051-6	Mitral annulus diastolic diameter - A4C	(cm, UCUM, “cm”)
LN	80052-4	Mitral annulus diastolic diameter - PLAX	(cm, UCUM, “cm”)
LN	80053-2	Mitral annulus VTI	(cm, UCUM, “cm”)
LN	80054-0	Mitral lateral e-prime Vmax	(cm/s, UCUM, “cm/s”)
LN	80057-3	Mitral regurgitant flow (PISA)	(ml/s, UCUM, “ml/s”)
LN	80055-7	Mitral regurgitant fraction (Continuity VTI)	(%, UCUM, “%”)
LN	80056-5	Mitral regurgitant fraction (PISA)	(%, UCUM, “%”)
LN	80058-1	Mitral regurgitation peak gradient	(mm[Hg], UCUM, “mmHg”)
LN	80059-9	Mitral regurgitation PISA radius	(cm, UCUM, “cm”)
LN	80060-7	Mitral regurgitation PISA velocity	(cm/s, UCUM, “cm/s”)
LN	80061-5	Mitral regurgitation vena contracta width	(cm, UCUM, “cm”)
LN	80062-3	Mitral regurgitation Vmax	(cm/s, UCUM, “cm/s”)
LN	80063-1	Mitral regurgitation volume (Continuity VTI)	(ml, UCUM, “ml”)
LN	80064-9	Mitral regurgitation volume (PISA)	(ml, UCUM, “ml”)
LN	79911-4	Mitral septal e-prime Vmax	(cm/s, UCUM, “cm/s”)
LN	80067-2	Mitral valve area (PISA)	(cm2, UCUM, “cm2”)
LN	80068-0	Mitral valve area (Planimetry)	(cm2, UCUM, “cm2”)
LN	80069-8	Mitral valve area (Pressure Half-Time)	(cm2, UCUM, “cm2”)
LN	80065-6	Mitral valve A-wave duration	(ms, UCUM, “ms”)
LN	80066-4	Mitral valve A-wave Vmax	(cm/s, UCUM, “cm/s”)
LN	78191-4	Mitral valve deceleration time	(ms, UCUM, “ms”)
LN	80071-4	Mitral valve effective regurgitant orifice area (PISA)	(cm2, UCUM, “cm2”)
LN	18038-0	Mitral valve E-to-A ratio	(1, UCUM, "no units")
LN	80070-6	Mitral valve E-wave Vmax	(cm/s, UCUM, “cm/s”)

LN	80072-2	Mitral valve flow propagation velocity (Vp)	(cm/s, UCUM, “cm/s”)
LN	80073-0	Mitral valve mean gradient	(mm[Hg], UCUM, “mmHg”)
LN	80074-8	Mitral valve peak instantaneous gradient	(mm[Hg], UCUM, “mmHg”)
LN	79912-2	Mitral valve pressure half-time	(ms, UCUM, “ms”)
LN	79913-0	Mitral valve Vmax	(cm/s, UCUM, “cm/s”)
LN	79914-8	Mitral valve VTI	(cm, UCUM, “cm”)
LN	78184-9	Pulmonary vein A-wave duration	(ms, UCUM, “ms”)
LN	79915-5	Pulmonary vein A-wave Vmax	(cm/s, UCUM, “cm/s”)
LN	79916-3	Pulmonary vein D-wave Vmax	(cm/s, UCUM, “cm/s”)
LN	79917-1	Pulmonary vein S-wave Vmax	(cm/s, UCUM, “cm/s”)
LN	79909-8	Pulmonic annulus diameter	(cm, UCUM, “cm”)
LN	79934-6	Pulmonic regurgitation end diastolic peak gradient	(mm[Hg], UCUM, “mmHg”)
LN	79918-9	Pulmonic regurgitation end diastolic velocity	(cm/s, UCUM, “cm/s”)
LN	79919-7	Pulmonic regurgitation Vmax	(cm/s, UCUM, “cm/s”)
LN	79928-8	Pulmonic valve acceleration time	(ms, UCUM, “ms”)
LN	18042-2	Pulmonic valve ejection time	(ms, UCUM, “ms”)
LN	79935-3	Pulmonic valve peak gradient	(mm[Hg], UCUM, “mmHg”)
LN	79920-5	Pulmonic valve Vmax	(cm/s, UCUM, “cm/s”)
LN	79910-6	Pulmonic valve VTI	(cm, UCUM, “cm”)
LN	80075-5	Right atrial end systolic area 4C	(cm2, UCUM, “cm2”)
LN	80076-3	Right atrial major axis dimension 4C	(cm, UCUM, “cm”)
LN	80077-1	Right atrial minor axis dimension 4C	(cm, UCUM, “cm”)
LN	80078-9	Right atrial minor axis dimension 4C / BSA	(cm/m2, UCUM, “cm/m2”)
LN	80079-7	Right pulmonary artery diameter	(cm, UCUM, “cm”)
LN	80080-5	Right ventricular basal dimension 4C	(cm, UCUM, “cm”)
LN	79929-6	Right ventricular ejection time	(ms, UCUM, “ms”)
LN	80081-3	Right ventricular end diastolic area 4C	(cm2, UCUM, “cm2”)
LN	80082-1	Right ventricular end systolic area 4C	(cm2, UCUM, “cm2”)
LN	79936-1	Right ventricular fractional area change	(%, UCUM, “%”)
LN	80083-9	Right ventricular free wall thickness 2D	(cm, UCUM, “cm”)
LN	80084-7	Right ventricular free wall thickness MM	(cm, UCUM, “cm”)

LN	80085-4	Right ventricular mid-cavity dimension 4C	(cm, UCUM, “cm”)
LN	80086-2	Right ventricular myocardial performance index	(1, UCUM, "no units")
LN	80087-0	Right ventricular outflow tract diameter at pulmonic valve (RVOT-Distal)	(cm, UCUM, “cm”)
LN	80088-8	Right ventricular outflow tract diameter at subvalvular level (RVOT-Proximal)	(cm, UCUM, “cm”)
LN	80089-6	Right ventricular outflow tract VTI	(cm, UCUM, “cm”)
LN	80090-4	Right ventricular pre-ejection period	(ms, UCUM, “ms”)
LN	77903-3	Tricuspid Annular Plane Systolic Excursion (TAPSE)	(cm, UCUM, “cm”)
LN	80091-2	Tricuspid annulus diameter	(cm, UCUM, “cm”)
LN	79937-9	Tricuspid regurgitation peak gradient	(mm[Hg], UCUM, “mmHg”)
LN	79932-0	Tricuspid regurgitation PISA radius	(cm, UCUM, “cm”)
LN	79933-8	Tricuspid regurgitation vena contracta width	(cm, UCUM, “cm”)
LN	79921-3	Tricuspid regurgitation Vmax	(cm/s, UCUM, “cm/s”)
LN	79922-1	Tricuspid valve a-prime Vmax	(cm/s, UCUM, “cm/s”)
LN	79923-9	Tricuspid valve A-wave Vmax	(cm/s, UCUM, “cm/s”)
LN	79930-4	Tricuspid valve closure to opening time	(ms, UCUM, “ms”)
LN	79931-2	Tricuspid valve deceleration time	(ms, UCUM, “ms”)
LN	18175-0	Tricuspid valve diastolic VTI	(cm, UCUM, “cm”)
LN	79924-7	Tricuspid valve e-prime Vmax	(cm/s, UCUM, “cm/s”)
LN	79925-4	Tricuspid valve E-wave Vmax	(cm/s, UCUM, “cm/s”)
LN	79938-7	Tricuspid valve mean gradient	(mm[Hg], UCUM, “mmHg”)
LN	79939-5	Tricuspid valve peak gradient	(mm[Hg], UCUM, “mmHg”)
LN	18032-3	Tricuspid valve pressure half-time	(ms, UCUM, “ms”)
LN	79926-2	Tricuspid valve s-prime Vmax	(cm/s, UCUM, “cm/s”)
LN	79927-0	Tricuspid valve Vmax	(cm/s, UCUM, “cm/s”)

Modify the following CID’s in Part 16 Annex B:

CID 12227 Echocardiography Measurement Method

Context ID 12227
Echocardiography Measurement Method
Type: Extensible Version: ~~20030918~~20161109

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
Include CID 12228 "Echocardiography Volume Methods"		
Include CID 12229 "Echocardiography Area Methods"		
Include CID 12230 "Gradient Methods"		
Include CID 12231 "Volume Flow Methods"		
Include CID 12232 "Myocardium Mass Methods"		
DCM	**125316**	**Directly measured**

Add the following Definitions to Annex D

DICOM Code Definitions (Coding Scheme Designator "DCM" Coding Scheme Version "01")

Code Value	Code Meaning	Definition
	…	
125301	Pre-coordinated Measurements	Measurements that are described by a single pre-coordinated code.
125302	Post-coordinated Measurements	Measurements that are described by a collection of (generally atomic) post-coordinated codes.
125303	Adhoc Measurements	Measurements taken in an ad hoc fashion without any coordinated semantics.
125304	Untrackable Measurement	The source system of the measurement does not maintain a persistent pre-coordinated code by which different instances of the measurement can be associated and tracked over multiple procedures.
125305	Finding Observation Type	The type of observation made at the finding site, e.g. whether it is an observation of the structure of the finding site, an observation of the behavior of the finding site, or an observation of the blood flow at the finding site.
125306	Measurement Type	The type of derivation used to obtain the measurement value. E.g. whether it is taken directly, formed as a ratio, normalized against an index, or calculated using a more elaborate equation.

125307	Measured Property	The property that is being measured. Examples include mass, diameter, peak blood velocity.
125308	Measurement Divisor	The measurement which is the denominator of a measurement that is divided. This applies to measurements such as ratios or indexed values.
125309	Short Label	A brief label, suitable for display on a screen or report. (Not suitable for matching).
125310	Staged Measurements	Measurements that need to be associated with a specific stage in a procedure or acquisition protocol.
125311	Structure of the Finding Site	The subject of a measurement is the physical structure of the Finding Site, such as the mass or diameter.
125312	Behavior of the Finding Site	The subject of a measurement is the behavior of the Finding Site, such as the velocity or duration of motion.
125313	Indexed	The measurement has been normalized by dividing it by an index value (such as Body Surface Area).
125314	Fractional Change	The measurement is a change value expressed as a fraction of its baseline value. E.g. cardiac ejection fraction or fractional shortening.
125315	Calculated	The measurement is calculated by incorporating one or more measured values into an equation other than a ratio, fractional change or indexed calculation.
125316	Directly measured	The measurement is a direct output of the measurement tool.
125317	Right Ventricle Outflow Tract, Distal	The distal portion (at the Pulmonic Valve) of the Right Ventricle Outflow Tract.
125318	Right Ventricle Outflow Tract, Proximal	The proximal portion (subvalvular) of the Right Ventricle Outflow Tract.
125319	Right Ventricle Anterior Wall	The anterior wall of the right ventricle of the heart.
125320	Electromechanical Delay	The period of time between the onset of muscle activation and the onset of force or motion.
125321	Pre-ejection Period	The period between onset of ventricular contraction and the beginning of antegrade blood flow out of the ventricle.
125322	Atrial Diastolic Filling (D-wave)	The period of atrial diastolic filling.
125323	AR-wave	The period of retrograde flow into the pulmonary vein during atrial contraction.

125324	Full Cardiac Cycle	The period of the entire cardiac cycle. E.g. from End Systole of one heartbeat to End Systole of the next heartbeat.
125325	Dyssynchrony Index	The standard deviation over 12 left ventricle myocardial segments of the time to peak myocardial sustained systolic velocity of each segment. See Yu, et al., Circulation, 2002; 105: 438-445
125326	Effective Orifice Area	The effective area of an orifice (such as the mitral valve orifice) during bloodflow through the orifice.
125327	Excursion Distance	The distance traversed by some tissue over a defined period.
125328	Maximum Orifice Area	The maximum area of an orifice opening over a defined period.
125329	Peak Blood Pressure	The peak pressure of blood over a defined period at a defined location.
125330	Peak Tissue Velocity	The peak velocity of some tissue over a defined period
125331	PISA Radius	The radius of the proximal isovelocity surface area (PISA) of fluid flow approaching an orifice. It is commonly used to evaluate cardiac valve regurgitation.
125332	Regurgitation Jet Area	A cross-sectional area of a regurgitation jet, taken perpendicular to the primary flow.
125333	Regurgitation Jet Width	A width of a regurgitation jet taken perpendicular to the primary flow.
125334	Vena Contracta Width	The width of the vena contracta of a fluid flow.

Add Synonyms to Annex G as shown:

Note: Annex G is for synonyms, Annex H is for abbreviating code meanings to the 64 character limit.

445 # Annex G English Code Meanings of Selected Codes (Normative)

Coding Scheme Designator	Code Value	Code Meaning
LN	20280-4	Pressure Half Time
		Pressure Half Time by US.calculated
LN	59089-3	Thickness

		ROI Thickness by US
LN	59090-1	Internal Dimension
		ROI Internal Dimension by US
LN	20247-3	Peak Gradient [Pressure]
		Peak Gradient [Pressure] by US.calculated
LN	20256-4	Mean Gradient [Pressure]
		Mean Gradient [Pressure] by Doppler
SRT	R-1007B	Left ventricle mid inferolateral segment
		Left Ventricle Posterior Wall
SRT	R-40B11	Ventricular Ejection
		S-wave
		s-prime
SRT	R-40B1C	Diastolic Rapid Inflow
		E-wave
		e-prime
SRT	F-32030	Atrial Systole
		A-wave
		a-prime

Changes to NEMA Standards Publication PS 3.17

Digital Imaging and Communications in Medicine (DICOM)

Part 17: Explanatory Information

Add Annex CCCC

ANNEX CCCC: Populating the Simplified Echo Procedure Report Template (Informative)

This Annex provides guidance to understand and populate the Simplified Echo Procedure Report (TID 5300) and its sub-templates. For implementers familiar with the Echocardiography Procedure Report (TID 5200), which is largely replaced by TID 5300, some relationships and differences are also explained.

CCCC.1 STRUCTURE OVERVIEW

Measurements in this template (except for the Wall Motion Analysis) are collected into one of three containers, each with a specific sub-template and constraints appropriate to the purpose of the container.

- **Pre-coordinated Measurements**
  - are fully standardized measurements (many taken from the ASE practice guidelines).
  - Each has a single pre-coordinated standard code that fully captures the semantics of the measurement.
  - The only modifiers permitted are to indicate coordinates where the measurement was taken, provide a brief display label, and indicate which of a set of repeated measurements is the preferred value. Other modifiers are not permitted.
- **Post-coordinated Measurements**
  - are measurements for which DICOM has not established pre-coordinated codes, but that are performed with enough regularity to merit configuration and capturing the full semantics of the measurement. For example these measurements may include those configured on the Ultrasound System by the vendor or user site. Some of these may be variants of the Pre-coordinated Measurements.
  - A set of mandatory and conditional modifiers with controlled vocabularies capture the essential semantics in a uniform way.
  - A single pre-coordinated code is also provided so that when the same type of measurement is encountered in the future, it is not necessary to parse and evaluate the full constellation of modifer values. Since this measurement has not been fully standardized, the pre-coordinated code may use a private coding scheme (e.g. from the vendor or user site)
- **Adhoc Measurements**
  - are non-standardized measurements that do not merit the effort to track or configure all the details necessary to populate the set of modifiers required for a post-coordinated measurement.
  - The measurement code describes the elementary property measured.

- Modifiers provide a brief display label and indicate coordinates where the measurement was taken. Other modifiers are not permitted.

CCCC.2 USE CASES

Use Case 1: Store and Extract Specific Measurement

The user wishes to perform measurements on the Ultrasound System, store them to the PACS and later have a specific measurement (say ABC) automatically displayed in the overlay or automatically inserted into a report page on the review system. This does not require the receiver to understand any of the semantics of the measurement.

Configuration:

The Ultrasound System is configured to encode a particular measurement using a specific pre-coordinated code (and code meaning).

In the case of measurements from the Core Set, it is a well-known pre-coordinated code (i.e. the code is in CID 12300 "Core Echo Measurements"), the full semantics are well-known and the measurement will be recorded in TID 5301 "Pre-coordinated Echo Measurement". Likely most, if not all, of the Core Set measurements come pre-configured on the Ultrasound System.

In the case of vendor-specific or site-specific measurements, it is a pre-coordinated code managed by the site or the vendor which is entered and persisted on the Ultrasound System. Since the code is not well-known, the measurement will be recorded in TID 5302 "Post-coordinated Echo Measurement" along with the modifiers describing its semantics.

The receiver (i.e. the PACS display package or the reporting package) is configured to associate the specific pre-coordinated code with a location on the overlay or a slot in the report.

The form of the user interface for these capabilities is up to the implementer.

Operation:

The user takes measurements on the Ultrasound System, including measurement ABC. All these measurements are recorded in the Simplified Adult Echo SR object. If multiple instances of measurement ABC are included, one of them may be flagged by the Ultrasound System by setting the Selection Status for that instance to the reason it was selected as the preferred value.

The Ultrasound System stores the SR object to the PACS.

The PACS or the reporting package retrieves the SR object and scans the contents looking for measurements with the pre-coordinated code for measurement ABC. If multiple instances are found, the receiver takes the one for which the Selection Status has been set.

The receiver renders the measurement value to the display or report, annotating it with the recorded Units, Code Meaning, and/or Short Label as appropriate.

Note that in this use case the receiver handles the measurement in a mechanical way. As long as the measurement can be unambiguously identified, the semantics do not need to be understood by the receiver.

Use Case 2: Store and Process Measurements

The user wishes to perform measurements on the Ultrasound System, store them to the PACS and later perform processing of some or all of the measurements on a CVIS (Cardiovascular Information System) or other system. Processing may include incorporating measurements into a database, performing trend analysis, plotting graphs, driving decision support, etc. One measurement taken at end systole may be compared to the “same” measurement that is taken at end diastole, etc. Measurements at the same Finding Site might be collected together.

Configuration:

As in Use Case 1, the Ultrasound System is configured to encode each measurement using a specific pre-coordinated code (and code meaning).

Again, measurements from the Core Set use a well-known pre-coordinated code and are recorded in TID 5301 "Pre-coordinated Echo Measurement" while vendor-specific or site-specific measurements use locally managed codes and are recorded in TID 5302 "Post-coordinated Echo Measurement" along with the modifiers describing their semantics.

Operation:

The user again takes measurements on the Ultrasound System which are recorded in the Simplified Adult Echo SR object and if multiple instances of a measurement are included, one of them may be flagged by the Ultrasound System by setting the Selection Status for that instance to the reason it was selected as the preferred value.

The Ultrasound System stores the SR object to the PACS.

The receiving database or processing system retrieves the SR object and parses the contents. The contents of TID 5301 "Pre-coordinated Echo Measurement" have known semantics and are processed accordingly.

On first encounter, measurements in TID 5302 "Post-coordinated Echo Measurement" will likely have unfamiliar pre-coordinated codes (since the pre-coordinated code in Row 1 of 5302 is not taken from CID 12300 "Core Echo Measurements", but rather was likely produced by the vendor of the Ultrasound System). Depending on the sophistication of the receiver, parsing the modifiers may provide sufficient information for the receiver to automatically handle the new measurement. If not, the measurement can be put in an exception queue for a human operator to review the values of the modifiers and decide how the measurement should be handled. In between those two possibilities, the receiver may be able to compare the modifier values of known measurements and provide the operator with a partially categorized measurement.

In any case, once the semantics of the measurement are understood by the receiver, the corresponding pre-coordinated code can be logged so that future encounters with that measurement can be handled in an automated fashion.

The receiver may also make use of the Selection Status values or may database all the provided measurement values or allow the human to select from the provided set.

Note that in this use case the receiver handles the measurements based on the semantics associated with the measurement.

CCCC.3 DIFFERENCES OF NOTE BETWEEN TID 5200 AND TID 5300

Report Sections: In TID 5200 “Echocardiography Procedure Report”, containers and headings were used to facilitate the layout of printed/displayed reports by collecting measurements into groups based on

concepts like anatomical region. Further, TID 5200 permitted Ultrasound Systems to add new sections freely, TID 5300 “Simplified Echo Procedure Report” does not. Section usage was a source of problematic variability for receivers of TID 5200. TID 5300 constrains this. When such groupings are useful, for example when printing reports, it makes more sense to configure it in one place (in the receiving database/reporting system) rather than configuring such groupings independently (and possibly inconsistently) on each ultrasound device in a department. Receivers may choose to group measurements based on Finding Site or some other logic as they see fit. This avoids the problem of trying to keep many Ultrasound Systems in sync. SR objects are considered acquisition data/evidence. If the findings are transcoded into CDA reports, sections will likely be introduced in the CDA as appropriate.

Finding Observation Type: The Finding Site is the location at which the measurement was taken. While some measurements will be an observation of the structure of the finding site itself, other measurements will be an observation of something like flow, in which case the Finding Site is simply the location, not the actual thing being observed/measured. To clarify this distinction, Finding Observation Type was introduced in TID 5302 "Post-coordinated Echo Measurement". For example, when the measurement is a peak velocity and the Finding Site is a valve, to distinguish between a measurement of the velocity of the blood through the valve, and a measurement of the velocity of the valve tissue, the Finding Observation Type would be set to “Hemodynamic Measurement” or “Behavior of Finding Site” respectively.

CCCC.4 USAGE GUIDANCE

Finding Site: Modifiers are not permitted on the Finding Site in TID 5302 "Post-coordinated Echo Measurement" since such modifiers resulted in different ways of encoding the same concept. TID 5302 requires the use of a single anatomical code that fully pre-coordinates the location details of the measurement. CID 12305 "Basic Echo Anatomic Sites" has proven to be sufficient to encode the ASE Core Set of measurements. Implementers are strongly recommended to using codes from that list. If there is a truly significant location detail that needs to be captured, e.g., to identify a specific segment of the atrial wall, or a specific leaf of a valve as the location of the measurement, then the implementer may introduce a new code (CID 12305 is extensible) or better yet, new codes can be added to CID 12305 through a DICOM Change Proposal.

Measured Property: The codes in CID 12304 "Echo Measured Properties" have also proven to be sufficient to encode the ASE Core Set of measurements. It is expected that the majority of vendor-specific or site-specific measurements can also be encoded using these properties, but it is understandable that some additional codes may be needed. When introducing new codes, implementers should be careful not to introduce elements of the other modifiers, such as Finding Site or Cardiac Cycle Point, into the Measured Property. For example, do not introduce a property for Diastolic Atrial Length to be used for the left and right atria, rather for such a measurement, use Property=Length, Cardiac Cycle Point=End Diastole and Finding Site=Left Atrium or Right Atrium respectively.

Image View: Implementers may use codes for image views beyond those listed in DCID 12226 "Echocardiography Image View" as needed, but note that Image View is only recorded if it is significant to the interpretation of the measurement. Inclusion of the Image View will likely isolate the measurement from other measurements of the same feature taken in different views.

Cardiac Cycle Point: Note that (SRT, F-32020, “Systole”) is used here to refer to the entire duration of ventricular systole, while (SRT, R-FAB5B, “End Systole”) is used to refer to the point in time where the aortic valve closes (or in the case of the right ventricle, the pulmonary valve). Therefore, a Vmax measurement for systole would mean the maximum velocity over the period of systole, and a Vmax measurement for end systole would mean the maximum velocity at the time point of end systole.

Measurement Method: This distinguishes between two measurements that convey the same concept, but are obtained or derived in a different way. As with the Image View, this is only recorded if it is significant to the interpretation of the measurement.

Selection Status: This is used to flag the preferred value when multiple instances of the same measurement are recorded in the SR object. Using this to communicate the value preferred by the operator or the Ultrasound System is very useful for receivers that lack the logic to make a selection themselves. In cases where there is no need or value in sending multiple instances of the same measurement, the issue can be avoided by only sending a single instance of any given measurement in the SR object.

Additional Modifiers: The concept modifiers in the template are sufficient to accurately encode all the best practice echo measurements recommended by the ASE. Although TID 5302 "Post-coordinated Echo Measurement" is extensible and adding new modifiers is not prohibited, the meaning and significance of such new modifiers will generally not be understood by receiving systems, delaying or preventing import of such measurements. Further, adding modifiers that replicate the meaning of an existing modifier is prohibited.

CCCC.5 EXAMPLE

```
:CONTAINER: (125200,DCM," Adult Echocardiography Procedure Report")

>CONTAINS: CONTAINER: (125301,DCM,"Pre-coordinated Measurements")

>>CONTAINS: NUM: (79969-2,LN,"Interventricular septum diastolic dimension") = 1.00 (cm,UCUM,"cm")
>>>HAS PROPERTIES: TEXT: (125309,DCM,"Short Label") = "IVSd (2D)"

>>CONTAINS: NUM: (79991-6,LN,"Left ventricular ejection fraction biplane (MOD)") = 70.3 (%,UCUM,"%")
>>>HAS PROPERTIES: TEXT: (125309,DCM,"Short Label") = "LV EF (MOD)"

>>CONTAINS: NUM: (79996-5,LN,"Left ventricular end diastolic volume biplane (MOD)") = 118 (ml,UCUM,"ml")
>>>HAS PROPERTIES: TEXT: (125309,DCM,"Short Label") = "LV EDV (MOD)"

>>CONTAINS: NUM: (80001-1,LN,"Left ventricular end systolic volume biplane (MOD)") = 35.0 (ml,UCUM,"ml")
>>>HAS PROPERTIES: TEXT: (125309,DCM,"Short Label") = "LV ESV (MOD)"

>>CONTAINS: NUM: (80007-8,LN,"Left ventricular internal diastolic dimension - 2D") = 5.00 (cm,UCUM,"cm")
>>>HAS PROPERTIES: CODE: (121404,DCM,"Selection Status") = (121410,DCM,"User chosen value")
>>>HAS PROPERTIES: TEXT: (125309,DCM,"Short Label") = "LVIDd (2D)"

>>CONTAINS: NUM: (80007-8,LN,"Left ventricular internal diastolic dimension - 2D") = 5.50 (cm,UCUM,"cm")
>>>HAS PROPERTIES: TEXT: (125309,DCM,"Short Label") = "LVIDd (2D)"

>>CONTAINS: NUM: (80007-8,LN,"Left ventricular internal diastolic dimension - 2D") = 6.00 (cm,UCUM,"cm")
>>>HAS PROPERTIES: TEXT: (125309,DCM,"Short Label") = "LVIDd (2D)"

>>CONTAINS: NUM: (80011-0,LN,"Left ventricular internal systolic dimension - 2D") = 3.00 (cm,UCUM,"cm")
>>>HAS PROPERTIES: TEXT: (125309,DCM,"Short Label") = "LVIDs (2D)"

>>CONTAINS: NUM: (80031-8,LN,"Left ventricular posterior wall diastolic thickness") = 1.00 (cm,UCUM,"cm")
>>>HAS PROPERTIES: TEXT: (125309,DCM,"Short Label") = "LVPWd (2D)"

>>CONTAINS: NUM: (80068-0,LN,"Mitral valve area (Planimetry)") = 4.82 (cm2,UCUM,"cm2")
>>>HAS PROPERTIES: TEXT: (125309,DCM,"Short Label") = "MV Area (Planim)"

>CONTAINS: CONTAINER: (125302,DCM,"Post-coordinated Measurements")

>>CONTAINS: NUM: (LVSIMOD,99CompanyName,"Left Ventricle Stroke Index (MOD)") = 39 (ml/m2,UCUM,"ml/m2")
>>>HAS CONCEPT MOD: CODE: (125306,DCM,"Measurement Type") = (125313,DCM,"Indexed")
>>>HAS CONCEPT MOD: CODE: (G-C0E3,SRT,"Finding Site") = (T-32600,SRT,"Left Ventricle")
>>>HAS CONCEPT MOD: CODE: (125305,DCM,"Finding Observation Type") = (PA-50030,SRT,"Hemodynamic Measurements")
>>>HAS CONCEPT MOD: CODE: (125307,DCM,"Measured Property") = (F-32120,SRT,"Stroke Volume")
>>>HAS CONCEPT MOD: CODE: (G-C036,SRT,"Measurement Method") = (125207,DCM,"Method of Disks Biplane")
```

```
>>>HAS CONCEPT MOD: CODE: (G-0373,SRT,"Image Mode") = (G-03A2,SRT,"2D Mode")
>>>HAS CONCEPT MOD: CODE: (125308,DCM,"Measurement Divisor") = (8277-6,LN,"Body Surface Area")
>>>HAS PROPERTIES: TEXT: (125309,DCM,"Short Label") = "LV SI (MOD)"

>>CONTAINS: NUM: (29469-4,LN,"Left Atrium Antero-posterior Systolic Dimension") = 3.0 (cm,UCUM,"cm")
>>>HAS CONCEPT MOD: CODE: (125306,DCM,"Measurement Type") = (125316,DCM,"Directly measured")
>>>HAS CONCEPT MOD: CODE: (G-C0E3,SRT,"Finding Site") = (T-32300,SRT,"Left Atrium")
>>>HAS CONCEPT MOD: CODE: (125305,DCM,"Finding Observation Type") = (125311,DCM,"Structure of the Finding Site")
>>>HAS CONCEPT MOD: CODE: (125307,DCM,"Measured Property") = (M-02550,SRT,"Diameter")
>>>HAS CONCEPT MOD: CODE: (G-C036,SRT,"Measurement Method") = (122675,DCM,"Anterior-Posterior")
>>>HAS CONCEPT MOD: CODE: (G-0373,SRT,"Image Mode") = (G-03A2,SRT,"2D Mode")
>>>HAS CONCEPT MOD: CODE: (R-4089A,SRT,"Cardiac Cycle Point") = (R-FAB5B,SRT,"End Systole")
>>>HAS PROPERTIES: TEXT: (125309,DCM,"Short Label") = "LA Dimen (2D)"

>CONTAINS: CONTAINER: (125303,DCM,"Adhoc Measurements")

>>CONTAINS: NUM: (G-D217,SRT,"Interval") = 15.0 (ms,UCUM,"ms")
>>>HAS PROPERTIES: TEXT: (125309,DCM,"Short Label") = "MV Jet Duration"

>>CONTAINS: NUM: (G-A160,SRT,"Angle") = 27.0 (deg,UCUM,"deg")
>>>HAS PROPERTIES: TEXT: (125309,DCM,"Short Label") = "MV Leaf Angle"
```

Add Annex DDDD

ANNEX DDDD: Types of Echocardiography Measurement Specifications (Informative)

DDDD.1 OVERVIEW

Real-world quantities of clinical interest are exchanged in DICOM Structured Reports. These real-world quantities are identified using concept codes of three different types:

- Standard measurements that are *defined* by professional organizations such as the American Society of Echocardiography (ASE), and *codified* by vocabulary standards such as the Logical Observation Identifiers Names and Codes (LOINC) or Systematized Nomenclature of Medicine – Clinical Terms (SNOMED-CT) standards.
- Non-Standard measurements that are defined by a medical equipment vendor or clinical institution and codified using a private or standard Coding Scheme.
- Adhoc measurements are those measurements that are generally acquired one time to quantify some atypical anatomy or pathology that may be observed during an exam. These measurements are not codified, but rather are described by the image itself and a label assigned at the time the measurement is taken.

This annex discusses the requirements for identifying measurements in such a manner that they are accurately acquired and correctly interpreted by medical practitioners.

DDDD.2 SPECIFICATION OF STANDARD MEASUREMENTS

Clinical organizations publish recommendations for standardized measurements that comprise a necessary and sufficient quantification of particular anatomy and physiology useful in obtaining a clinical diagnosis. For each measurement recommendation, the measurement definition is specific enough so that any trained medical practitioner would know exactly how to acquire the measurement and how to interpret the measurement. Thus, there would be a 1:1 correspondence between the intended measurement recommendation and the practitioner's understanding of the intended measurement and the technique

used to measure it (anatomy and physiology, image view, cardiac/respiratory phase, and position/orientation of measurement calipers). This is illustrated in Figure 1:

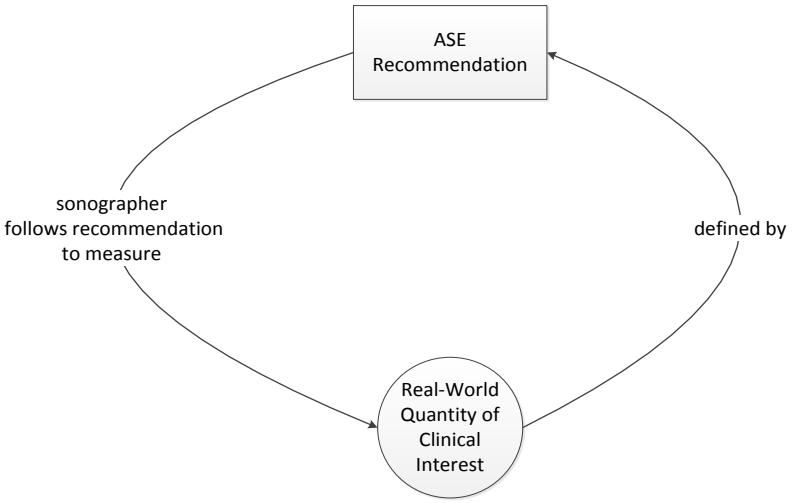

Figure 1: Matching Intended Quantity with Measurement Definition

The goal is for each recommended measurement to be fully specified such that every medical practitioner making the measurement on a given patient at a given time achieves the same result. However, if the recommendation were to be unclear or ambiguous, different qualified medical practitioners would achieve different results measuring the same quantity on the same patient, as illustrated in Figure 2:

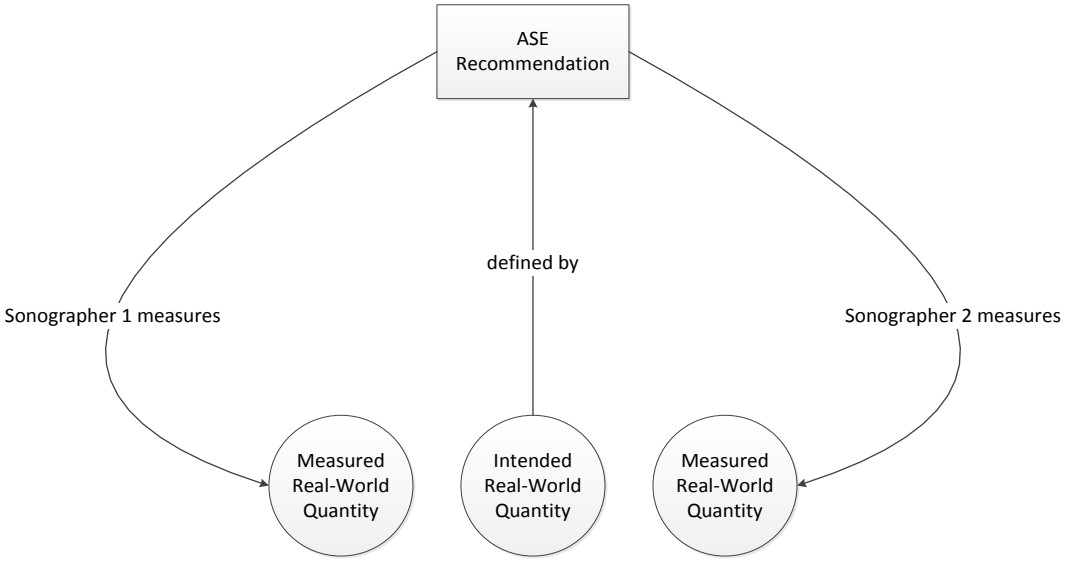

Figure 2: Result of Unclear or Ambiguous Measurement Definition

There are a number of characteristics that should be included in a measurement recommendation in order to ensure that all practitioners making that measurement achieve the same results in making the measurement. Some characteristics are

- Anatomy being measured, specified to appropriate level of detail

- Reference points (e.g., “OFD is measurement in the same plane as BPD from the outer table of the proximal skull with the cranial bones perpendicular to the US beam to the inner table of the distal skull”)
- Type of measurement (distance, area, volume, velocity, time, VTI, etc.)
- Sampling method (average of several samples, peak value of several samples, etc.)
- Image view in which the measurement is made
- Cardiac and/or respiratory phase

The measurement definition should specify these characteristics in order that the definition is clear and unambiguous. Since the characteristics are published by the professional society as part of the Standard measurement definition document are incorporated in the codes that are added to LOINC, a pre-coordinated measurement code is sufficient to specify the measurement in a structured report.

Because of the detail in the definition of each standard measurement, it is sufficient to represent such measurements with a pre-coordinated measurement code and a minimum of circumstantial modifiers. This approach is being followed by PS 3.16 TID 5301 "Pre-coordinated Echo Measurement", for example.

DDDD.3 SPECIFICATION OF NON-STANDARD MEASUREMENTS

Non-Standard Measurements are defined by a particular vendor or clinical institution, and are not necessarily understood by users of other vendors’ equipment or practitioners in other clinical institutions. A system producing such measurements cannot expect a consuming application to implicitly understand the measurement and its characteristics. Further, such measurements may not be fully understood by the medical practitioners who are acquiring the measurements, so there is some risk that the measurement acquired may not match the real-world quantity intended by the measurement definition, as illustrated by Figure 3:

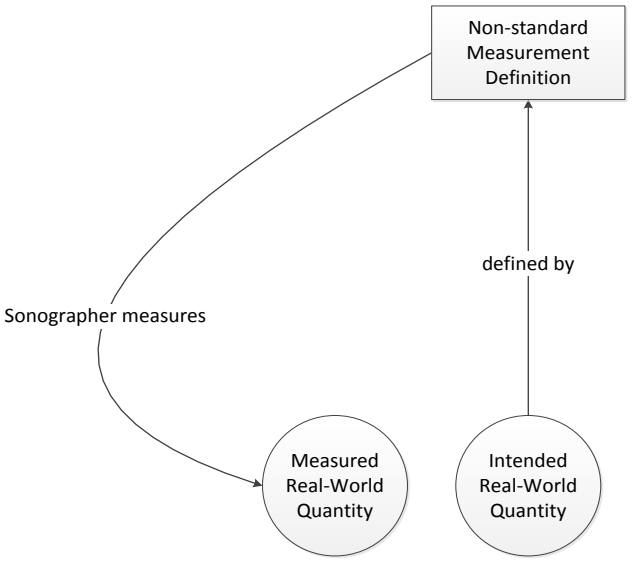

Figure 3: Inadequate Definition of Non-Standard Measurement

It is important for all non-standard measurement definitions to include all the characteristics of the measurement as would have been specified for Standard (baseline) measurement definitions, such as:

- Anatomy being measured, specified to appropriate level of detail
- Reference points (e.g., “OFD is measurement in the same plane as BPD from the outer table of the proximal skull with the cranial bones perpendicular to the US beam to the inner table of the distal skull”)

- Type of measurement (distance, area, volume, velocity, time, VTI, etc.)
- Sampling method (average of several samples, peak value of several samples, etc.)
- Image view in which the measurement is made
- Cardiac and/or respiratory phase

Fully specifying the characteristics of such measurements is important for several reasons:

1. Ensuring medical practitioners correctly measure the intended real-world quantity
2. Aiding receiving applications in correctly interpreting the non-standard measurement and mapping the non-standard measurement to the most appropriate internally-supported measurement.
3. Aid in determining whether non-standard measurements from different sources are in fact equivalent measurements and could thus be described by a common measurement definition.

Each of these reasons is elaborated upon in the sections to follow. This is the justification for representing such non-standard measurements using both post-coordinated concepts and a pre-coordinated concept code for the measurement, such as is done in PS 3.16 TID 5302 "Post-coordinated Echo Measurement".

DDDD.3.1 Acquiring the Intended Real-World Quantity

A medical practitioner can be expected to correctly acquire the real-world quantity intended by the non-standard measurement definition only if it is completely specified. This includes explicitly specifying all the essential clinical characteristics as are described for Standard measurements. While the resultant measurement value can be described by a pre-coordinated concept code, the characteristics of the intended real-world quantity must be defined and known.

DDDD.3.2 Interpreting the Non-Standard Measurement

The characteristics of the real-world measurement measured by the acquisition system and user are conveyed in the mandatory post-coordinated descriptors recorded alongside the measurement value.

The presence of such post-coordinated descriptors aids the consumer application in

1. Mapping the non-standard measurement to a corresponding internally-supported measurement. The full details provided by including the post-coordinated descriptors greatly simplifies the task of determining measurement equivalence.
2. Organizing the display of the non-standard measurement values in a report. It is clinically useful to structure written reports in a hierarchical manner by displaying all measurements that pertain to the same anatomical structure or physiological condition together.
3. Interpreting similar anatomical measurements differently depending on such characteristics as acquisition image mode (e.g., 2D vs. M-mode image). Since the clinical interpretation may depend on this information, it should be explicitly included along with the measurement concept code/code meaning.
4. Analyzing accumulated report data (trending, data mining, and big data analytics)

Note: Some of these benefits are reduced if the context groups specified for each post-coordinated descriptor are extended with custom codes. A user should take great care when considering the extension of the standard context groups to minimize the proliferation of modifier codes.

The first time that a consumer application encounters a new post-coordinated measurement, it will need to evaluate it based on the values of the post-coordinated descriptors. To help the consumer application with subsequent encounters with the same type of measurement, the acquisition system can consistently populate the Concept Name of the measurement with a code that corresponds to the collection of post-coordinated descriptor values; effectively a non-standard, but stable, pre-coordinated measurement code. (See PS3.16 TID 5302 Content Item Description, Row 1)

The presence of the pre-coordinated code in addition to the post-coordinated descriptors allows subsequent receipt of the same measurement to utilize the mapping that was performed as described above and treat the measurement as an effectively pre-coordinated measurement.

If the acquisition system is aware of other pre-coordinated codes (e.g. those used by other vendor carts) that are also equivalent to the collection of post-coordinated descriptor values for a given measurement, those pre-coordinated codes may be listed as (121050,DCM,"Equivalent Meaning of Concept Name"). These "known mappings" provided by the acquisition system can also be useful for consumer applications trying to recognize or map measurements.

DDDD.3.3 Determining Equivalence of Measurements from Different Sources

It is customary for individual vendors to provide tools to acquire measurements that aren't currently defined in a Standard measurement template. In the normal evolution of the Standard, standard measurement sets are periodically updated to reflect the state of medical practice. Often, individual vendors and/or clinical users are first to implement the acquisition of new measurements.

Some measurements may be defined and used within a particular clinical institution. For maximum interoperability, if there exists a Standard or vendor-defined measurement concept code for that measurement, the Standard or vendor-defined concept code should be used instead of creating a custom measurement code unique to that institution.

Determining whether two or more different measurement definitions pertain to the same real-world quantity is a non-trivial task. It requires clinical experts to carefully examine alternative measurement definitions to determine if two or more definitions are equivalent. This task is greatly simplified if the distinct characteristics of the non-standard measurement are explicitly stated and conveyed. If two measurements differ in one or more critical characteristics then it can be concluded that the two measurement definitions describe different real-world quantities. Only those measurements that share all the critical clinical characteristics need to be carefully examined by clinical experts to see if they are equivalent.

It may be determined that two measurements that share all specified clinical characteristics are actually distinct real-world quantities. If this occurs, it may be an indication that not all relevant clinical characteristics have been isolated and codified. In this case, the convention for defining the measurement should be extended to include the unspecified clinical characteristic.

DDDD.4 SPECIFICATION OF ADHOC (ONE-TIME) MEASUREMENTS

In the case of a measurement that is only being performed once, there is little value in incurring the overhead to specify all measurement characteristics and assign a code to the measurement as it will never be used again. Rather, the descriptive text associated with the measurement may provide sufficient clinical context. Association of the measurement with the source image (and/or particular points in the source image) can often provide additional relevant context so it is recommended to provide image coordinate references in the Structured Report (See TID 5303 "Adhoc Measurement").

If a user finds that the same quantity is being measured repeatedly as an adhoc measurement, a non-standard measurement definition should be created for the measurement as described in Section DDDD.3.