

DICOM Correction Item

Correction Number		CP-756
Log Summary: Add general area and volume calculation methods to SR templates		
Type of Modification	Name of Standard	
Addition	PS 3.16 2007	
Rationale for Correction		
Calculations of areas and volumes may require that the method of calculation from the supplied spatial coordinates be specified, since it may be necessary to reproduce the same value in a deterministic manner, such as when recalculating the value after editing the coordinates.		
Sections of documents affected		
PS 3.16		
Correction Wording:		

Add calculation method code to existing general area and volume measurement templates in Annex A Structured Reporting Templates:

TID 1401 Area Measurement Template

**TID 1401
 AREA MEASUREMENT
 Type: Extensible**

NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1		NUM	DCID(7471) "Area Measurements"	1	M		Value shall be > 0 UNITS = DCID(7461) "Units of Area Measurement"
2	>	INFERRED FROM	EV (121056,DCM, "Area Outline")	1	MC	Shall be present if concept name of Row 1 is (G-A16A,SRT, "Area of defined region"). May be present otherwise.	GRAPHIC TYPE = not {MULTIPOINT}
3	>>	R-SELECTED FROM		1	MC	XOR Row 4	
4	>>	SELECTED FROM		1	MC	XOR Row 3	
5	≥	<u>HAS PROPERTIES</u>	<u>EV (G-C036, SRT, "Measurement Method")</u>	1	<u>U</u>		<u>DCID (nnnn1) General Area Calculation Methods</u>

Content Item Descriptions

Row 2 "Area Outline" A Graphic Type of POINT implies that the object is a single pixel and the object's area is the area of the pixel. Otherwise the type shall be a closed POLYLINE (start and end point the same) or a CIRCLE or an ELLIPSE.

TID 1402 Volume Measurement Template

**TID 1402
 VOLUME MEASUREMENT
 Type: Extensible**

NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1		NUM	DCID(7472) "Volume Measurements"	1	M		Value shall be > 0 UNITS = DCID(7462) "Units of Volume Measurement"
2	>	INFERRED FROM	EV (121057,DCM, "Perimeter Outline")	1-n	U		GRAPHIC TYPE = not {MULTIPOINT}
3	>>	R-SELECTED FROM		1	MC	XOR Row 4	
4	>>	SELECTED FROM		1	MC	XOR Row 3	
5	≥	<u>HAS PROPERTIES</u>	<u>EV (G-C036, SRT, "Measurement Method")</u>	<u>1</u>	<u>U</u>		<u>DCID (nnnn2) General Volume Calculation Methods</u>

Content Item Descriptions

Row 2 "Perimeter Outline"

The two dimensional perimeter of the volume's intersection with or projection into the image. A Graphic Type of POINT implies that the volume's intersection or projection in a plane is a single pixel. A single pixel projection perimeter cannot cause a volume calculation to become 0.

Otherwise the type shall be a closed POLYLINE (start and end point the same) or a CIRCLE or an ELLIPSE.

Rename references to existing cardiac-specific context groups from cardiac templates in Annex A Structured Reporting Templates:

TID 3206 VA Main Results Template

The VA Main Results Template consists of a CONTAINER with a structure for reporting the main ventricular analysis measurements.

**TID 3206
 VA MAIN RESULTS
 Type: Extensible**

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (121070, DCM, "Findings")	1	M		
2	>	HAS CONCEPT MOD	CODE	EV (G-C0E3, SRT, "Finding Site")	1	M		DCID (3462) Chamber Identification
3	>	CONTAINS	CODE	EV (122429, DCM, "Volume Method")	1	M		DCID (3453) Cardiac Volume Methods
4	>	CONTAINS	NUM	EV (122435, DCM, "Regression Volume Exponent")	1	U		Unit = DT (1, UCUM, "no units")
5	>	CONTAINS	NUM	EV (122431, DCM, "Regression Slope ED")	1	U		Unit = DT (1, UCUM, "ratio")
6	>	CONTAINS	NUM	EV (122432, DCM, "Regression Offset ED")	1	U		Unit = DT (ml, UCUM, "ml")
7	>	CONTAINS	NUM	EV (122433, DCM, "Regression Slope ES")	1	U		Unit = DT (1, UCUM, "ratio")
8	>	CONTAINS	NUM	EV (122434, DCM, "Regression Offset ES")	1	U		Unit = DT (ml, UCUM, "ml")
9	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		\$Measurement = DCID (3467) Ejection Fraction \$Unit = DT (% , UCUM, "%")
10	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		\$Measurement = DCID (3468) ED Volume \$Unit = DT (ml, UCUM, "ml")
11	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		\$Measurement = DCID (3469) ES Volume \$Unit = DT (ml, UCUM, "ml")
12	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		\$Measurement = EV (20562-5, LN, "Stroke Volume") \$Unit = DT (ml, UCUM, "ml")
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TID 3207 AA Main Results Template

The AA Main Results Template consists of a CONTAINER with a structure for reporting the main atrial analysis measurements.

**TID 3207
 AA MAIN RESULTS
 Type: Extensible**

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (121070, DCM, "Findings")	1	M		
2	>	HAS CONCEPT MOD	CODE	EV (G-C0E3, SRT, "Finding Site")	1	M		DCID (3462) Chamber Identification
3	>	CONTAINS	CODE	EV (122429, DCM, "Volume Method")	1	M		DCID (3453) <u>Cardiac</u> Volume Methods
4	>	CONTAINS	NUM	EV (122435, DCM, "Regression Volume Exponent")	1	U		Unit = DT (1, UCUM, "no units")
5	>	CONTAINS	NUM	EV (122431, DCM, "Regression Slope ED")	1	U		Unit = DT (1, UCUM, "ratio")
6	>	CONTAINS	NUM	EV (122432, DCM, "Regression Offset ED")	1	U		Unit = DT (ml, UCUM, "ml")
7	>	CONTAINS	NUM	EV (122433, DCM, "Regression Slope ES")	1	U		Unit = DT (1, UCUM, "ratio")
8	>	CONTAINS	NUM	EV (122434, DCM, "Regression Offset ES")	1	U		Unit = DT (ml, UCUM, "ml")
9	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		\$Measurement = DCID (3468) ED Volume \$Unit = DT (ml, UCUM, "ml")
10	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		\$Measurement = DCID (3469) ES Volume \$Unit = DT (ml, UCUM, "ml")
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TID 3208 Frame-to-Frame Results Template

The Frame-to-Frame Result Template consists of a CONTAINER providing measurements derived from the angiographic images on frame-by-frame basis.

**TID 3208
 FRAME-TO-FRAME RESULT
 Type: Extensible**

NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1		CONTAINER	EV (121070, DCM, "Findings")	1	M		
2 >	HAS CONCEPT MOD	CODE	EV (111004, DCM, "Analysis Performed")	1	M		EV (122499, DCM, "Frame to Frame Analysis")
3 >	CONTAINS	IMAGE	EV (121112, DCM, "Source of Measurements")	1-2	M	VM = 1: Single plane analysis, VM = 2: Biplane analysis	
4 >	CONTAINS	CODE	EV (122429, DCM, "Volume Method")	1	M		DCID (3453) Cardiac Volume Methods
5 >	CONTAINS	INCLUDE	DTID (300) Measurement	n	M		\$Measurement = DCID (3471) Estimated Volumes \$TargetSite = DCID (3462) Chamber Identification \$Unit = DT (ml, UCUM, "ml")
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TID 5202 Echo Section

This is a generic section heading Template for any of the anatomical headings. Measurements within a section heading appear as groups (by image mode or acquisition protocol).

Parameter Name	Parameter Usage
\$SectionSubject	The subject modifier of the section heading container
\$MeasType	The concept name of the measurement

**TID 5202
 ECHO SECTION
 Type: Extensible**

NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1		CONTAINER	EV (121070, DCM, "Findings")	1	M		
2 >	HAS CONCEPT MOD	CODE	EV (G-C0E3, SRT, "Finding Site")	1	M		\$SectionSubject
3 >	CONTAINS	CONTAINER	DT (125007, DCM, "Measurement Group")	1-n	M		
4 >>	HAS CONCEPT MOD	CODE	EV (G-0373, SRT, "Image Mode")	1	U		BCID (12224) Ultrasound Image Modes
5 >>	HAS CONCEPT MOD	CODE	DT (125203, DCM, "Acquisition Protocol")	1	U		
6 >>	CONTAINS	INCLUDE	DTID (5203) Echo Measurement	1-n	M		\$Measurement = \$MeasType \$Method=CID (12227) Echocardiography

NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
							Measurement Method

Rename existing cardiac-specific context groups in Annex B DCMR Context Groups:

CID 3453 Cardiac Volume Methods

**Context ID 3453
Cardiac Volume Methods**

Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	122558	Area Length Kennedy
DCM	122559	Area Length Dodge
DCM	122560	Area Length Wynne
DCM	122562	Multiple Slices
DCM	122563	Boak
DCM	122564	TS Pyramid
DCM	122565	Two Chamber
DCM	122566	Parallelepiped

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CID 12227 Echocardiography Measurement Method

**Context ID_12227
 Echocardiography Measurement Method**

Type: Extensible Version: 20030918

Code Scheme	Code Value	Concept Name
INCLUDE CID 12228	<u>Echocardiography</u>	Volume Methods
INCLUDE CID 12229	<u>Echocardiography</u>	Area Methods
INCLUDE CID 12230		Gradient Methods
INCLUDE CID 12231		Volume Flow Methods
INCLUDE CID 12232		Myocardium Mass Methods

CID 12228 Echocardiography Volume Methods

Context ID_12228
Echocardiography Volume Methods
Type: Extensible Version: 20030918

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	125204	Area-Length Biplane
DCM	125205	Area-Length Single Plane
DCM	125211	Biplane Ellipse
DCM	125226	Single Plane Ellipse
DCM	125206	Cube Method
DCM	125207	Method of Disks, Biplane
DCM	125208	Method of Disks, Single Plane
DCM	125209	Teichholz

CID 12229 Echocardiography Area Methods

Context ID 12229
Echocardiography Area Methods
Type: Extensible Version: 20030918

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	125210	Area by Pressure Half-Time
DCM	125212	Continuity Equation
DCM	125213	Continuity Equation by Mean Velocity
DCM	125214	Continuity Equation by Peak Velocity
DCM	125215	Continuity Equation by Velocity Time Integral
DCM	125216	Proximal Isovelocity Surface Area
DCM	125220	Planimetry

Add new context groups to Annex B DCMR Context Groups:

CID nnn1 General Area Calculation Methods

**Context ID nnn1
 General Area Calculation Methods**

Type: Extensible Version: yyymmdd

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	nnnnn5	Area of closed irregular polygon
DCM	nnnnn6	Area of a closed NURBS

CID nnn2 General Volume Calculation Methods

**Context ID nnn2
 General Volume Methods**

Type: Extensible Version: yyymmdd

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	nnnnn7	Integration of sum of closed areas on contiguous slices

Types of Area and Volume measurements are reproduced unchanged for reference from Annex B DCMR Context Groups:

CID 7471 Area Measurements

**Context ID 7471
 Area Measurements**

Type: Extensible Version: 20020904

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SNM3	G-A166	Area
SRT	G-A16A	Area of defined region

CID 7472 Volume Measurements

**Context ID 7472
 Volume Measurements**

Type: Extensible Version: 20020904

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SNM3	G-D705	Volume
DCM	121216	Volume estimated from single 2D region
DCM	121218	Volume estimated from two non-coplanar 2D regions
DCM	121217	Volume estimated from three or more non-coplanar 2D regions
DCM	121222	Volume of sphere
DCM	121221	Volume of ellipsoid
DCM	121220	Volume of circumscribed sphere
DCM	121219	Volume of bounding three dimensional region

Add bold highlighted text to Annex D DICOM Controlled Terminology Definitions:

122428	Area Length Method	Method how long axis is positioned	
122429	Volume Method	Model for ventricular cardiac chamber volume calculation	<u>Used for both ventricular and atrial volume calculations</u>
...	
<u>nnnnn5</u>	<u>Area of closed irregular polygon</u>	<u>The area is derived by considering a set of coordinates as a closed irregular polygon, accounting for inner angles.</u>	<u>The exact method, such as by decomposition into triangles or quadrilaterals, is not specified, since it does not affect the numeric result, apart from the effect of numeric precision during computation of intermediate results.</u>
<u>nnnnn6</u>	<u>Area of a closed NURBS</u>	<u>The area is derived by considering a set of coordinates as a control points for a Non Uniform Rational B-Spline (NURBS).</u>	
<u>nnnnn7</u>	<u>Integration of sum of closed areas on</u>	<u>The volume derived by integrating the sum of the areas</u>	

	<u>contiguous slices</u>	<u>on adjacent slices across the slice interval; each area is defined by a regular planar shape or by considering a set of coordinates as a closed irregular polygon, accounting for inner angles.</u>	
125204	Area-length biplane	Method for calculating left ventricular volume from two orthogonal views containing the true long axis (usually the apical 4 and 2 chamber views). Volume = $[\pi L_1/6]*[(4A_1)\div(\pi L_1)]*[(4A_2)\div(\pi L_2)]$	
125205	Area-Length Single Plane	Method for calculating left ventricular volume from a view containing the true long axis (usually the apical 4-chamber view). Volume = $[8(A)^2]\div[3\pi L]$	
125206	Cube	Method (formula) for calculating left ventricle volumes and function derivatives (EF, SV, SI, etc.) that estimates the volume as the cube of diameter.	
125207	Method of Disks, Biplane	Method of calculating volume based on the summation of disk volumes. The disk axis is parallel to the left ventricular long axis and using a disk diameter averaged from the two chamber and four chamber views.	
125208	Method of Disks, Single Plane	Method of calculating volume based on the summation of disk volumes. The disk axis is parallel to the left ventricular long axis with disk diameter taken from the four-chamber view.	
125209	Teichholz	Method (formula) for calculating left ventricle volumes and function derivatives (EF, SV, SI, etc.) Volume = $[7.0/(2.4+D)]*D^3$	
125210	Area by Pressure Half-Time	Mitral valve area (cm ²) by Pressure Half-time = 220 (cm ² .ms) / PHT (ms)	
125211	Biplane Ellipse	Area = $\Pi/4 \times d1 \times d2$ d1 = anterior/posterior axis d2 = medial/lateral axis <i>Hagen-Ansert, Sandra L., Textbook of Diagnostic Ultrasound, ed. 3, The C.V.Mosby</i>	

		<i>Co., 1989, p. 73.</i>	
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122558	Area Length Kennedy	Area Length method defined by Kennedy [Kennedy, 1970]	
122559	Area Length Dodge	Area Length method defined by Dodge [Dodge, 1960]	
122560	Area Length Wynne	Area Length method defined by Wynne [Wynne]	
122562	Multiple Slices	Volume method based on multiple slice	
122563	Boak	Volume method defined by Boak [Boak]	
122564	TS Pyramid	Volume method defined by Ferlinz [Ferlinz]	
122565	Two Chamber	Volume method defined by Graham [Graham]	
122566	Parallelepiped	Volume method defined by Arcilla [Arcilla]	
...

Add bold highlighted text to Section 2 Normative References:

[Kennedy, 1970] Kennedy JW, Trenholme SE, Kasser IS (1970) Left ventricular volume and mass from single-plane cineangiogram. A comparison of anteroposterior and right anterior oblique methods. Am Heart J 80:343

[Dodge, 1960] Dodge HT, Sandler H, Ballew DW, Lord JD (1960) The use of biplane angiography for the measurement of left ventricular volume in man. Am Heart J 60:762

[Wynne] Wynne J, Green LH, Mann T, Levin D, Grossman W (1978) Estimation of left ventricular volumes in man from biplane cineangiograms filmed in oblique projections. Am J Cardiol 41: 726

[Boak] Boak, J. G., Bove, A. A., Kreulen, T. & Spann, J. F. A geometric basis for calculation of right ventricular volume in man. Cathet Cardiovasc Diagn 3, 217-30, 1977.

[Ferlinz] Ferlinz, J. Measurements of right ventricular volumes in man from single plane cineangiograms. A comparison to the biplane approach. Am Heart J 94, 87-90, 1977.

[Graham] Graham, T. P., Jr., Jarmakani, J. M., Atwood, G. F. & Canent, R. V., Jr. Right ventricular volume determinations in children. Normal values and observations with volume or pressure overload. Circulation 47, 144-53, 1973.

[Arcilla]

Arcilla RA, Tsai P, Thilenius O, Ranniger K (1971) Angiographic method for volume estimation of right and left ventricles. Chest 60:446

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