

1	Status	Final Text
2	Date of Last Update	2019/03/26
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5	Submitter Name	QIICR
6	Submission Date	2018/07/07

7	Correction Number CP-1845
8	Log Summary: Add description and example for ROI distance measurements with coordinates
9	Name of Standard
10	PS3.16, PS3.17 2019a
11	Rationale for Correction:
12	CP 1386 added planar and volumetric ROI measurement examples to PS3.17 and illustrated how to encode related linear distance
13	measurements such as for RECIST or WHO when there were no end points specified, but did not show how to encode linear distance
14	measurements for the same ROIs with explicit end point coordinates, nor how to encode the bi-dimensional measurements that are
15	commonly used in oncology response assessment.
16	Correction Wording:

Amend DICOM PS3.16 as follows (changes to existing text are bold and underlined for additions and ~~struckthrough~~ for removals):

TID 1500 Measurement Report

This Root Template encodes a list of Measurement Groups each containing lists of measurements, together with any derived measurements.

Each Measurement Group is identified by Tracking ID and UIDs.

An image library is available to describe characteristics of the images referenced by the measurements, if any.

Type: Extensible
Order: Non-Significant
Root: Yes

Table TID 1500. Measurement Report

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	DCID 7021 "Measurement Report Document Titles"	1	M		Root node
2	>	HAS CONCEPT MOD	INCLUDE	DTID 1204 "Language of Content Item and Descendants"	1	M		
3	>	HAS OBS CONTEXT	INCLUDE	DTID 1001 "Observation Context"	1	M		
4	>	HAS CONCEPT MOD	CODE	EV (121058, DCM, "Procedure reported")	1-n	M		BCID 100 "Quantitative Diagnostic Imaging Procedures"
5	>	CONTAINS	INCLUDE	DTID 1600 "Image Library"	1	M		
6	>	CONTAINS	CONTAINER	EV (126010, DCM, "Imaging Measurements")	1	C	IF row 10 and 12 are absent	
7	>>	CONTAINS	INCLUDE	DTID 1410 "Planar ROI Measurements"	1-n	U		\$Measurement = BCID 7469 "Generic Intensity and Size Measurements" \$Measurement = BCID 7468 "Texture Measurements" \$Units = BCID 7181 "Abstract Multi-dimensional Image Model Component Units" \$Derivation = BCID 7464 "General Region of Interest Measurement Modifiers" \$Method = BCID 6147 "Response Criteria"

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
8	>>	CONTAINS	INCLUDE	DTID 1411 "Volumetric ROI Measurements"	1-n	U		\$Measurement = BCID 7469 "Generic Intensity and Size Measurements" \$Measurement = BCID 7468 "Texture Measurements" \$Units = BCID 7181 "Abstract Multi-dimensional Image Model Component Units" \$Derivation = BCID 7464 "General Region of Interest Measurement Modifiers" \$Method = BCID 6147 "Response Criteria"
9	>>	CONTAINS	INCLUDE	DTID 1501 "Measurement Group"	1-n	U		\$Measurement = BCID 7469 "Generic Intensity and Size Measurements" \$Measurement = BCID 7468 "Texture Measurements" \$Units = BCID 7181 "Abstract Multi-dimensional Image Model Component Units" \$Derivation = BCID 7464 "General Region of Interest Measurement Modifiers" \$Method = BCID 6147 "Response Criteria" \$ImagePurpose = DT (121112, DCM, "Source of Measurement")
10	>	CONTAINS	CONTAINER	EV (126011, DCM, "Derived Imaging Measurements")	1	C	IF row 6 and 12 are absent	
11	>>	CONTAINS	INCLUDE	DTID 1420 "Measurements Derived From Multiple ROI Measurements"	1-n	U		
12	>	CONTAINS	CONTAINER	EV (C0034375, UMLS, "Qualitative Evaluations")	1	C	IF row 6 and 10 are absent	
13	>>	CONTAINS	CODE		1-n	U		
14	>>	CONTAINS	TEXT		1-n	U		

Content Item Descriptions

Rows 6, 10, 12	The conditions require that at least one of the "heading" containers be present, though any of them may be present but empty.
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1 2 3 4	Rows 7, 8, 9	The baseline context groups defined allow for generic intensity, size and texture measurements, regardless of the geometry of the ROI (e.g., linear distance can be measured on volumes, or volume can be estimated from a linear distance), and being baseline, do not constrain the invoker from using other appropriate concepts specific to the application. <u>Different measurements of the same real world lesion made using different types of measurements (different templates) can be correlated by a shared value of Tracking Unique Identifier. See also PS3.17 Section RRR.5 "Measurement Report SR Document Volumetric ROI with RECIST Linear Distance Specified by Coordinates on CT Example".</u>
5 6 7 8	<u>Row 7</u>	<u>Planar ROI measurements are those defined on a single plane by a segmentation reference or planar spatial coordinates.</u>
9 10 11 12	<u>Row 8</u>	<u>Volumetric ROI measurements are those defined on a volume by raster or surface segmentation references or a set of 2D or 3D spatial coordinates.</u>
13 14 15 16 17 18	Row 9	<u>Generic measurements include those specified on an image as a whole or by unconstrained graphic coordinates. These may be used for such things as whole image scores or quality measures, and for linear distance measurements, such as for RECIST or WHO tumor treatment response criteria evaluation.</u> A Measurement Group is used to contain one or more individual measurements that are invocations of TID 300, consistent with TIDs 1410 and 1411, which both already have Measurement Group containers as their roots.
19 20 21	Rows 12, 13, 14	These Content Items allow encoding a flat list of name-value pairs that are coded questions with coded or text answers, for example, to record categorical observations related to the entire subject of the report rather than specific measurement groups.

TID 1501 Measurement Group

...

Table TID 1501. Parameters

Parameter Name	Parameter Usage
...	...
\$ImagePurpose	Purpose of Reference for an image used as a source of the measurement
...	...

Table TID 1501. Measurement Group

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
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	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
10	>	CONTAINS	INCLUDE	DTID 300 "Measurement"	1-n	M		\$Measurement = \$Measurement \$Units = \$Units \$ModType = \$ModType \$ModValue = \$ModValue \$Method = \$Method \$Derivation = \$Derivation \$TargetSite = \$TargetSite \$TargetSiteMod = \$TargetSiteMod \$Equation = \$Equation <u>\$ImagePurpose = \$ImagePurpose</u> \$RefAuthority = \$RefAuthority \$RangeAuthority = \$RangeAuthority \$DerivationParameter = \$DerivationParameter \$DerivationParameterUnits = \$DerivationParameterUnits
...								

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Section headings unchanged (for hyperlinks):

1 **TID 300 Measurement**

2 **TID 320 Image or Spatial Coordinates**

3 **TID 1001 Observation Context**

4 **TID 1003 Person Observer Identifying Attributes**

5 **TID 1204 Language of Content Item and Descendants**

6 **TID 1410 Planar ROI Measurements**

7 **TID 1411 Volumetric ROI Measurements**

8 **TID 1419 ROI Measurements**

9 **TID 1420 Measurements Derived From Multiple ROI Measurements**

10 **TID 1600 Image Library**

11 **TID 4020 CAD Image Library Entry**

12 **TID 5016 LWH Volume Group**

13 **CID 100 Quantitative Diagnostic Imaging Procedures**

14 **CID 6147 Response Criteria**

15 **CID 7021 Measurement Report Document Titles**

16 **CID 7181 Abstract Multi-dimensional Image Model Component Units**

17 **CID 7464 General Region of Interest Measurement Modifiers**

18 **CID 7468 Texture Measurements**

19 **CID 7469 Generic Intensity and Size Measurements**

20 **CID 7470 Linear Measurements**

21 **CID 7474 General Volume Calculation Methods**

22 *Amend DICOM PS3.17 as follows (changes to existing text are bold and underlined for additions and ~~struckthrough~~ for removals):*

23 **RRR Measurement Report SR Document for Planar and Volumetric ROI (Inform-**
24 **ative)**

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RRR.2 Measurement Report SR Document Volumetric ROI on CT Example

This CT example describes a set of measurements (volume, long axis and mean attenuation coefficient) made from a single volumetric ROI encoded as a single segment that spans two source CT images, and includes a description of the measurement methods and the finding site, as well as an image library to describe characteristics of the images used, and categorical observations at the measurement group and entire subject level.

Note

1. For a different modality than CT, the choice of measurement for the mean intensity would not be (122713, DCM, "Attenuation Coefficient").
2. For MR one might use (110852, DCM, "MR signal intensity"), or (110804, DCM, "T1 Weighted MR Signal Intensity"), etc. See also ??? for various appropriate signal intensity types for MR and other modalities.
3. For PET one might use (110821, DCM, "Nuclear Medicine Tomographic Activity"), in which case the specific type of signal would be apparent from the units, e.g., (SUVbw)g/ml, UCUM, "Standardized Uptake Value body weight") or for activity-concentration, (Bq/ml, UCUM, "Becquerels/milliliter"). See also ???.
4. Care should be taken when selecting modifiers such as (G-C036, SRT, "Measurement Method") versus (121401, DCM, "Derivation").
5. The finding site and laterality within the measurement template (???) are factored out and shared by both measurements.
6. The pattern used for the image library uses ???, though commonality may be refactored.
7. **The length of the long axis of the volumetric ROI is encoded, but the end points of the line segment used to make that measurement are not recorded, since only the volumetric spatial description of TID 1411 is used. For an alternative encoding, see Section RRR.5.**

Table RRR.2-1. Volumetric ROI on CT Example

Node	Code Meaning of Concept Name	Code Meaning or Example Value	TID
1	Oncology Measurement Report		TID 1500
1.1	Language of Content Item and Descendants	English	TID 1204
1.2	Observation Context		TID 1001
1.2.1	Person Observer Name	Doe^Jane	TID 1003
1.3	Procedure Reported	Chest+Abd CT W+WO contr IV	TID 1500
1.4	Image Library		TID 1500
1.4.1		IMAGE - CT image #1	TID 4020
1.4.1.1	Study Date	20030417	TID 4020
1.4.1.2	Study Time	104607	TID 4020
1.4.1.3	Horizontal Pixel Spacing	0.810547 mm	TID 4020
1.4.1.j	TID 4020
1.4.1.n	Pixel Data Columns	512 pixels	TID 4020
1.4.2		IMAGE - CT image #2	TID 4020
1.4.2.j	TID 4020
1.5	Measurements		TID 1500
1.5.1	Measurement Group		TID 1411
1.5.1.1	Tracking Identifier	Object1	TID 1411
1.5.1.2	Tracking Unique Identifier	1.2.276.0.7230010...	TID 1411

Node	Code Meaning of Concept Name	Code Meaning or Example Value	TID
1.5.1.3	Referenced Segment	IMAGE - Segmentation, Segment #1	TID 1411
1.5.1.4	Source image for segmentation	IMAGE - CT image #1	TID 1411
1.5.1.5	Source image for segmentation	IMAGE - CT image #2	TID 1411
1.5.1.6	Finding Site	Adrenal Gland	TID 1419
1.5.1.6.1	Laterality	Right	TID 1419
1.5.1.7	Volume	3267.46 mm ³	TID 1419
1.5.1.7.1	Measurement Method	Sum of segmented voxel volumes	TID 1419 CID 7474
1.5.1.8	Long Axis	9.21 mm	TID 1419 CID 7470
1.5.1.8.1	Measurement Method	RECIST 1.1	TID 1419 CID 6147
1.5.1.9	Attenuation Coefficient	70.978 Hounsfield unit	TID 1419
1.5.1.9.1	Derivation	Mean	TID 1419 CID 7464
1.5.1.10	Necrosis	Present	TID 1419
1.5.1.11	Hemorrhage	Absent	TID 1419
1.6	Qualitative Evaluations		TID 1500
1.6.1	Renal Vein Involvement	Absent	TID 1500

Add new Section to DICOM PS3.17 as follows :

RRR.5 Measurement Report SR Document Volumetric ROI with RECIST Linear Distance Specified by Coordinates on CT Example

This CT example describes a set of measurements (volume, long axis (RECIST), short axis (WHO bi-dimensional) and mean attenuation coefficient) made from a single volumetric ROI encoded as a single segment, including specification of the end points of the line segment used to make the linear distance measurements.

Note

1. The lengths of the long axis and the short axis of the lesion are not encoded as characteristics of the volumetric ROI, but rather the long axis and the short axis are encoded explicitly as the end points of line segments used to make those measurements. The commonality of the Tracking Unique Identifier establishes that they are measurements of the same ROI. If multiple measurements were to be made of the same ROI over time or by different observers, other content items such as those related to Timepoint, Activity Session and Observer may be used. For an alternative encoding, see Section RRR.2.
2. The pattern of using multiple sibling linear distance measurements within TID 1419 "ROI Measurements" is similar to and not incompatible with the pattern used for length, width and height in the OB/GYN Ultrasound template TID 5016 "LWH Volume Group".
3. The Finding Site information is duplicated in the second measurement template invocation in this example, though it is not required to be.

Table RRR.5-1. Volumetric ROI on CT Example

Node	Code Meaning of Concept Name	Code Meaning or Example Value	TID
1	Oncology Measurement Report		TID 1500
...
1.5	Measurements		TID 1500
1.5.1	Measurement Group		TID 1411
1.5.1.1	Tracking Identifier	Object1 (same for both Measurement Groups)	TID 1411
1.5.1.2	Tracking Unique Identifier	1.2.276.0.7230010... (same for both Measurement Groups)	TID 1411
1.5.1.3	Referenced Segment	IMAGE - Segmentation, Segment #1	TID 1411
1.5.1.4	Source image for segmentation	IMAGE - CT image #1	TID 1411
1.5.1.5	Source image for segmentation	IMAGE - CT image #2	TID 1411
1.5.1.6	Finding Site	Adrenal Gland (same for both Measurement Groups)	TID 1419
1.5.1.6.1	Laterality	Right (same for both Measurement Groups)	TID 1419
1.5.1.7	Volume	3267.46 mm ³	TID 1419
1.5.1.7.1	Measurement Method	Sum of segmented voxel volumes	TID 1419 CID 7474
1.5.1.8	Attenuation Coefficient	70.978 Hounsfield unit	TID 1419
1.5.1.8.1	Derivation	Mean	TID 1419 CID 7464
1.6.1	Measurement Group		TID 1501
1.6.1.1	Tracking Identifier	Object1 (same for both Measurement Groups)	TID 1501
1.6.1.2	Tracking Unique Identifier	1.2.276.0.7230010... (same for both Measurement Groups)	TID 1501
1.6.1.3	Finding Site	Adrenal Gland (same for both Measurement Groups)	TID 1501
1.6.1.3.1	Laterality	Right (same for both Measurement Groups)	TID 1501
1.6.1.4	Long Axis	9.21 mm	TID 300 CID 7470
1.6.1.4.1	Measurement Method	RECIST 1.1	TID 300 CID 6147
1.6.1.4.2	Source of Measurement	SCoord GraphicType POLYLINE with two coordinates, the beginning and end of a line segment	TID 320 CID 7470
1.6.1.4.2.1	(none)	IMAGE - CT image #1	TID 320
1.6.1.5	Short Axis	6.8 mm	TID 300 CID 7470
1.6.1.5.1	Measurement Method	WHO	TID 300 CID 6147

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Node	Code Meaning of Concept Name	Code Meaning or Example Value	TID
1.6.1.5.2	Source of Measurement	SCoord GraphicType POLYLINE with two coordinates, the beginning and end of a line segment	TID 320 CID 7470
1.6.1.5.2.1	(none)	IMAGE - CT image #1	TID 320