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Status	Letter Ballot
Date of Last Update	2024/06/03
Person Assigned	David Clunie mailto:dclunie@dclunie.com
Submitter Name	IDC
Submission Date	2023/12/15
Correction Number CP-2382	
Log Summary: Add derived measures of similarity for ROIs	
Name of Standard	
PS3.16	
Rationale for Correction:	
Similarity measures like Dice, Jaccard are needed, for example for comparing different segmentations for ROIs.	
Note that the measurement values of each ROI that contributes to the derived measurement, are specified by reference; i.e., they actually need to exist elsewhere (with the ROI specification via coordinates, segmentations, etc.) elsewhere in a TID 1500 invocation.	
Also need to add concepts for number of pixels or voxels, since those need to be recorded for each ROI and used as the source for the reference.	
Correction Wording:	

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

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TID 1420 Measurements Derived From Multiple ROI Measurements

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This Template encodes measurements for some metric, e.g., density, flow, or concentration, which are acquired over some defined sampling (e.g., over successive time slots in a dynamic contrast enhanced acquisition), or of some comparison between different ROIs.

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Table TID 1420. Measurements Derived From Multiple ROI Measurements

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	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			NUM	DCID 7465 "Measurement Derived From Multiple ROI Measurements"	1-n	M		
1b	>	HAS CONCEPT MOD	INCLUDE	DTID 4019 "Algorithm Identification"	1	U		
2	>	R-INFERRED FROM	INCLUDE	DTID 1410 "Planar ROI Measurements and Qualitative Evaluations"	1-n	MC	XOR Row 3	\$Measurement = ...
3	>	R-INFERRED FROM	INCLUDE	DTID 1411 "Volumetric ROI Measurements and Qualitative Evaluations"	1-n	MC	XOR Row 2	\$Measurement = ...
4	>	HAS PROPERTIES	INCLUDE	DTID 310 "Measurement Properties"	1	U		\$RefAuthority = ...

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Content Item Descriptions

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Row 1	Specifies the type of derived measurement reported, e.g., the mean of the individual ROI mean density values, <u>or a similarity measure of the number of pixels or voxels in the ROIs.</u> Note that the units may be different from the units in the ROI measurements
Row 1b	Describes the algorithm used to produced the derived measurement, as opposed to the referenced measurements from which this measurement was derived.
Rows 2, 3	The measurement values of each ROI that contributes to the derived measurement, e.g., the mean density within an ROI, <u>the number of pixels or voxels in an ROI.</u> These are specified by reference, so as to not have to repeat the ROI information when it contributes to multiple derived measurements (e.g., if both mean and SD of ROI mean density values were specified).

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CID 7465 Measurement Derived From Multiple ROI Measurements

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Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML
Keyword: MeasurementDerivedFromMultipleROIMeasurements
FHIR Keyword: dicom-cid-7465-MeasurementDerivedFromMultipleROIMeasurements
Type: Extensible
Version: ~~20121101~~yyymmdd
UID: 1.2.840.10008.6.1.952

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Table CID 7465. Measurement Derived From Multiple ROI Measurements

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Coding Scheme Designator	Code Value	Code Meaning
Include CID 226 "Population Statistical Descriptor"		
Include CID 227 "Sample Statistical Descriptor"		
<u>Include CID ccc1 "Similarity Measure"</u>		

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CID 7469 Generic Intensity and Size Measurement

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Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML
Keyword: GenericIntensityAndSizeMeasurement
FHIR Keyword: dicom-cid-7469-GenericIntensityAndSizeMeasurement
Type: Extensible
Version: 20141110yyvymdd
UID: 1.2.840.10008.6.1.1003

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Table CID 7469. Generic Intensity and Size Measurement

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Coding Scheme Designator	Code Value	Code Meaning
Include ???		
Include ???		
Include ???		
Include ???		
DCM	ddd003	Number of pixels
DCM	ddd004	Number of voxels

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Add new context group to DICOM PS3.16

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CID ccc1 Similarity Measure

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Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML
Keyword: SimilarityMeasure
FHIR Keyword: dicom-cid-ccc1-SimilarityMeasure
Type: Extensible
Version: yyvymdd
UID: 1.2.840.10008.6.1.uuu1

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Table CID ccc1. Similarity Measure

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Coding Scheme Designator	Code Value	Code Meaning
DCM	ddd001	Dice Similarity Coefficient
DCM	ddd002	Jaccard Index

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Add new concepts to DICOM PS3.16

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D DICOM Controlled Terminology Definitions (Normative)

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Table D-1. DICOM Controlled Terminology Definitions (Coding Scheme Designator "DCM" Coding Scheme Version "01")

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Code Value	Code Meaning	Definition	Notes
ddd001	Dice Similarity Coefficient	A measure of the pair-wise overlap of two sets defined as two times the intersection of the two samples, divided by the sum of the two samples. Also known as the Sørensen–Dice coefficient. The samples may be points representing pixels or voxels in a geometric region.	1. Dice LR. Measures of the Amount of Ecologic Association Between Species. Ecol. 1945 Jul;26(3):297–302. doi:10.2307/1932409 2. Taha AA, Hanbury A. Metrics for evaluating 3D medical image segmentation: analysis, selection, and tool. BMC Med Imag. 2015 Dec;15(1):29. doi:10.1186/s12880-015-0068-x

Code Value	Code Meaning	Definition	Notes
ddd002	Jaccard Index	A measure of the pair-wise overlap of two samples defined as the intersection of the two regions, divided by the union of the two samples. Also known as the Intersection Over Union (IoU). The samples may be points representing pixels or voxels in a geometric region.	1. Jaccard P. The Distribution of the Flora of the Alpine Zone. New Phytol. 1912 Feb;11(2):37-50. doi:10.1111/j.1469-8137.1912.tb05611.x 2. Taha AA, Hanbury A. Metrics for evaluating 3D medical image segmentation: analysis, selection, and tool. BMC Med Imag. 2015 Dec;15(1):29. doi:10.1186/s12880-015-0068-x
ddd003	Number of pixels	A count of the number of pixels in an image or a region of an image.	
ddd004	Number of voxels	A count of the number of voxels in a volume or a region of a volume.	

For reference unchanged DICOM PS3.16

TID 1410 Planar ROI Measurements and Qualitative Evaluations

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Table TID 1410. Planar ROI Measurements and Qualitative Evaluations

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (125007, DCM, "Measurement Group")	1	M		
...								
5	>	CONTAINS	SCOORD	EV (111030, DCM, "Image Region")	1	MC	XOR Rows 7, 7b, 8b	GRAPHIC TYPE = not {MULTIPOINT}
6	>>	SELECTED FROM	IMAGE		1	M		
7	>	CONTAINS	IMAGE	EV (121214, DCM, "Referenced Segmentation Frame")	1	MC	XOR Rows 5, 7b	<p>Reference shall be to a Segmentation Image, with a single value specified in Referenced Segment Number (0062,000B).</p> <p>For references to tiled Segmentation Images, one or more values shall be specified in Referenced Frame Number (0008,1160), unless all frames in the referenced Segmentation Image are selected and there is only a single Segment, in which case Referenced Frame Number (0008,1160) will be absent. The referenced tiles shall all be in the same plane.</p> <p>For references to non-tiled Segmentation Images, a single value shall be specified in Referenced Frame Number (0008,1160), unless there is only one frame in the referenced Segmentation Image, in which case Referenced Frame Number (0008,1160) will be absent.</p>

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
7b	>	CONTAINS	SCOORD3D	EV (111030, DCM, "Image Region")	1	MC	XOR Rows 5, 7, 8b	GRAPHIC TYPE = not {MULTIPOINT, POLYLINE or ELLIPSOID}
8	>	CONTAINS	IMAGE	EV (121233, DCM, "Source image for segmentation")	1	MC	IFF Row 7	
8b	>	CONTAINS	COMPOSITE	EV (130488, DCM, "Region in Space")	1	MC	XOR Rows 5, 7, 7b	Reference shall be to an Instance of the RT Structure Set Storage SOP Class.
8c	>>	HAS PROPERTIES	TEXT	EV (130489, DCM, "Referenced Region of Interest Identifier")	1	M		Shall be the value of ROI Number (3006,0022) within the single referenced Item of Structure Set ROI Sequence (3006,0020) of the referenced Instance of the RT Structure Set Storage SOP Class.
...								
11	>	CONTAINS	INCLUDE	DTID 1419 "ROI Measurements"	1	U		\$Measurement = \$Measurement ...
...								

TID 1411 Volumetric ROI Measurements and Qualitative Evaluations

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Table TID 1411. Volumetric ROI Measurements and Qualitative Evaluations

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (125007, DCM, "Measurement Group")	1	M		
...								
5	>	CONTAINS	SCOORD	EV (111030, DCM, "Image Region")	1-n	MC	XOR Rows 7, 10, 12b	GRAPHIC TYPE = not {MULTIPOINT}
6	>>	SELECTED FROM	IMAGE		1	M		
7	>	CONTAINS	IMAGE	EV (121191, DCM, "Referenced Segment")	1	MC	XOR Rows 5, 10, 12b	Reference shall be to a Segmentation Image or Surface Segmentation object, with a single value specified in Referenced Segment Number
10	>	CONTAINS	SCOORD3D	EV (121231, DCM, "Volume Surface")	1-n	MC	XOR Rows 5, 7, 12b	If one item, GRAPHIC TYPE = {ELLIPSOID or POINT} If more than one item, GRAPHIC TYPE = {POLYGON or ELLIPSE}
11	>	CONTAINS	IMAGE	EV (121233, DCM, "Source image for segmentation")	1-n	MC	XOR Row 12 and IFF (Row 7 or Row 10)	

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
12	>	CONTAINS	UIDREF	EV (121232, DCM, "Source series for segmentation")	1	MC	XOR Row 11 and IFF (Row 7 or Row 10)	
12b	>	CONTAINS	COMPOSITE	EV (130488, DCM, "Region in Space")	1	MC	XOR Rows 5, 7, 10	Reference shall be to an Instance of the RT Structure Set Storage SOP Class.
12c	>>	HAS PROPERTIES	TEXT	EV (130489, DCM, "Referenced Region of Interest Identifier")	1	M		Shall be the value of ROI Number (3006,0022) within the single referenced Item of Structure Set ROI Sequence (3006,0020) of the referenced Instance of the RT Structure Set Storage SOP Class.
...								
15	>	CONTAINS	INCLUDE	DTID 1419 "ROI Measurements"	1	U		\$Measurement = \$Measurement ...
...					1			

TID 1419 ROI Measurements

Table TID 1419. ROI Measurements

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
...								
5			NUM	\$Measurement	1-n	M		UNITS = \$Units
...								

TID 1500 Measurement Report

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Table TID 1500. Measurement Report

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
...								
7	>>	CONTAINS	INCLUDE	DTID 1410 "Planar ROI Measurements and Qualitative Evaluations"	1-n	U		\$Measurement = BCID 218 "Quantitative Image Feature" ...
8	>>	CONTAINS	INCLUDE	DTID 1411 "Volumetric ROI Measurements and Qualitative Evaluations"	1-n	U		\$Measurement = BCID 218 "Quantitative Image Feature" ...

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	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
9	>>	CONTAINS	INCLUDE	D???	1-n	U		\$Measurement = BCID 218 "Quantitative Image Feature" ...
10	>	CONTAINS	CONTAINER	EV (126011, DCM, "Derived Imaging Measurements")	1	MC	IF Row 6 and 12 are absent	
...								

11 **TID 310 Measurement Properties**

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13 **TID 4019 Algorithm Identification**

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15 **CID 226 Population Statistical Descriptor**

16 **Table CID 226. Population Statistical Descriptor**

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-RT ID	UMLS Concept Unique ID
SCT	371889001	95th Percentile Value of population	R-00337	C1299358
...				

22 **CID 227 Sample Statistical Descriptor**

23 **Table CID 227. Sample Statistical Descriptor**

Coding Scheme Designator	Code Value	Code Meaning
DCM	121415	Percentile Ranking of measurement
DCM	121416	Z-Score of measurement

27 **CID 218 Quantitative Image Feature**

28 **Resources:** HTML | FHIR JSON | FHIR XML | IHE SVS XML
30 **Keyword:** QuantitativeImageFeature
32 **FHIR Keyword:** dicom-cid-218-QuantitativeImageFeature
33 **Type:** Extensible
34 **Version:** 20200920
35 **UID:** 1.2.840.10008.6.1.1269

40 **Table CID 218. Quantitative Image Feature**

Coding Scheme Designator	Code Value	Code Meaning
Include ???		
Include CID 7469 "Generic Intensity and Size Measurement"		
Include ???		

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Coding Scheme Designator	Code Value	Code Meaning
Include ???		