Digital Imaging and Communications in Medicine (DICOM)

Supplement 247: Eyecare Measurement Templates

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Document History

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Scope and Field of Application

This Supplement proposes to add templates, context groups, and coded vocabulary for key eyecare measurements to the Standard. These templates may be used in either Structured Reporting documents, or for structured content in an Encapsulated PDF object.

The focus of this Supplement is the set of “key” measurements clinically important for patient care. These are not intended to be a comprehensive set of ophthalmic measurements, although the extensible context groups and templates allow additional measurements beyond the specified key measurements to be included in SOP Instances.

The key measurements of this Supplement are primarily derived from analysis of images, in particular retinal optical coherence tomography (OCT) images. Note that there are several existing IODs that record measurements directly produced by various refractive devices that do not produce images (autorefraction, lensometry, keratometry, etc.), as well as more comprehensive visual field and macular thickness reports, which are not intended to be replaced by these more summary key measurement templates.

The IHE Eyecare domain defined within the Unified Eye Care Workflow Profile (as a draft for trial implementation) an option for Key Measurements in DICOM Encapsulated PDF [https://www.ihe.net/uploadedFiles/Documents/Eye_Care/IHE_EyeCare_Suppl_Key_Measurement_PDF.pdf]. That option specified templates, context groups, and coded vocabulary for various key measurements in ophthalmology to be encoded as structured content within Encapsulated PDF objects. WG-09 has determined that those should be formalized in the DICOM Standard, and that work informed the draft of this Supplement.

Some vocabulary may be submitted to LOINC for assignment of codes.

SR and Encapsulated PDF

There is tension in clinical documentation between the needs for structured discrete data and human-readable content. In DICOM, discrete data is generally sent using Structured Reporting, and ready for display rendered data may be sent in an Encapsulated PDF. A given set of measurements may be sent in objects in both formats, with cross-reference to the other object using the Referenced Instance Sequence (0008,114A); note that the cross-reference is to an instance as a whole, not to individual measurements. Alternatively, discrete measurements may be included in an Encapsulated PDF object in the SR-like Content Sequence (0040,A730). The Templates defined in this Supplement may be used in either object type.

The DICOM Standard does not recommend the use of any particular approach to meeting the clinical documentation needs of the users. Such recommendation may be made by a professional society or a standards profiling effort. For example, the American Academy of Ophthalmology and the IHE Eyecare domain, considering the need to integrate legacy PDF-based systems, have in the past recommended use of Encapsulated PDF with the included SR-like Content Sequence for basic interoperability (see https://www.aaojournal.org/article/S0161-6420(21)00164-0/fulltext), but those recommendations may not meet all use cases in the evolving interoperable healthcare IT environment.

Open Issues for Public Comment

1	TIDs 60x2 – 60x9	Should then invocations of the T60x1 measurement group section have VM 1-2 (limited to one each for L and R eye), or 1-n (e.g., to allow different sets of measurements with different grid positioning)?
2	TID 60x1	Are there implementation concerns with the specifications for mandatory Content Items? TID 60x1 makes mandatory a Content Item for each concept specified in the invoking Template, i.e., in the Context Groups invoked for parameters $Measurement and $QualType. This manner of specifying multiple mandatory items has not previously been used in the Standard, and may have implications for software libraries, toolkits, and validators. Additionally, receiving implementations may need to better handle an absent NUM value with an associated reason code.
3	TID 60x2	Is the use of Rational Numerator Value (0040,A162) and Rational Denominator Value (0040,A163) in a single NUM item as a supplement to a % value acceptable? A concern is that receiving implementations may ignore those type 3 attributes. Visual Field Fixation ratios in the IHE profile were represented as TEXT ('Text string in the form of "number of <x> responses/number of trials"'). This is bad form for SR. However, encoding the ratio components as separate NUM Content Items does not seem to fit the model of key measurements.
4	TID 60x6, CID 42x5, CID 42x6	Is the approach acceptable to post-coordinate Gangion Cell Layer measurement concepts with a topographical modifier specifying the layers included? The approach specified allows the same measurement concepts, but has the creator specify whether they were made solely on the GCL, on the Gangion Cell Layer + Inner Plexiform Layer (GCL-IPL), or on the entire Ganglion Cell Complex (GCL + IPL + RNFL).
5	TID 60x6, CID 42x7, CID 42x8	Is the approach acceptable for allowing application specific definitions of GCL sectors, but using common measurement concepts for sectors with the same name but different spans?
6	Annex D nnn411-nnn422	Are clockface position definitions clear? Positions go clockwise for the right eye, but counterclockwise for the left eye, when viewed from the anterior position (i.e., looking at the patient face on).
7	CID 42x1, CID 42x2, CID 42x3, CID 42x4, CID 42x6, CID 42x9, CID 42y0, Annex D	Are the identified key measurements necessary and sufficient for the purposes of patient care? Are there additional needed key measurements? Are there some identified measurements that are not useful and may be removed? Are all measurement definitions accurate? Do measurement definitions that include units of measure do so justifiably?
8		Should a new SOP Class be defined that makes SR content mandatory in an Encapsulated PDF SOP Instance?

		One intended use of these templates is for the SR-like content included in an EPDF. A separate SOP Class might better support conformance claims for systems that are providing such content, and would distinguish PDF display-only instances from those that also have processable discrete data.
9		Should a new Ophthalmology SR SOP Class be defined for these SR's? For integration into enterprise EHRs, these SR instances might be transcoded (e.g., into FHIR) under the single document type "Ophthalmology Note" defined in LOINC. Such a SOP Class might facilitate handling such instances as a class for enterprise integration, but would be yet another SOP Class to be added to PACS and other systems.
10		Is the concept of "key measurements" necessary in the current interoperability environment? The IHE profile presumed Encapsulated PDF SOP Instances would be the basic mechanism for interoperability, and that key measurements included in the object would support basic needs for discrete data (e.g., in EHR summaries). As the interoperability environment in general evolves to a more data-rich approach, perhaps standardization should focus on defining comprehensive sets of ophthalmology measurements from which applications can select based on their specific use case.
11		Do all root node templates require a Value Set Constraint specification of "Root Node"? PS3.16 section 6.1.9.2 has no provision for this use, and it is inconsistently used in Annex A root containers, and it is redundant with the root specification above the table.

Closed Issues

1	Structured as separate root templates to facilitate intra-department (PACS) management and search, rather than as a single master template with subsections for each class of measurements. [WG-9 consensus 12/2024]
2	Measurements should be post-coordinated with laterality, in contrast to current LOINC pre-coordinated RNFL measurements (LOINC Panel 86291-2). [WG-9 consensus 12/2024]

PS3.6

Add new Context Group UIDs to PS3.6 Annex A

Table A-3. Context Group UID Values

Context Group UID	Context Group Identifier	Context Group Name	Comment
1.2.840.10008.6.1.x1	CID 42x1	Visual Field Key Measurements	
1.2.840.10008.6.1.x2	CID 42x2	Optic Disc Key Measurements	
1.2.840.10008.6.1.x3	CID 42x3	RNFL Key Measurements	
1.2.840.10008.6.1.x4	CID 42x4	Macular Thickness Key Measurements	
1.2.840.10008.6.1.x5	CID 42x5	GCL Measurement Extent	
1.2.840.10008.6.1.x6	CID 42x6	GCL Key Measurements	
1.2.840.10008.6.1.x7	CID 42x7	GCL Sector Measurements	
1.2.840.10008.6.1.x8	CID 42x8	GCL Sector Grid Methods	
1.2.840.10008.6.1.x9	CID 42x9	Corneal Topography Key Measurements	
1.2.840.10008.6.1.y0	CID 42y0	Endothelial Cell Count Key Measurements	

PS3.16

Update TID 4019 PS3.16 Annex A with Item from TID 2102

TID 4019 Algorithm Identification

This Template details the algorithm unambiguously. Re-state the software identification from the General Equipment Module of the SR IOD if all algorithms are unambiguously defined by that Module.

Type: Non-Extensible
Order: Significant
Root: No

Table TID 4019. Algorithm Identification

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			TEXT	EV (111001, DCM, "Algorithm Name")	1	M		
1b			CODE	EV (111001, DCM, "Algorithm Name")	1	U		
2			TEXT	EV (111003, DCM, "Algorithm Version")	1	M		
2b			**TEXT**	**EV (122405, DCM, "Algorithm Manufacturer")**	**1**	**U**		
3			TEXT	EV (111002, DCM, "Algorithm Parameters")	1-n	U		
4			CODE	EV (111000, DCM, "Algorithm Family")	1	U		

Content Item Descriptions

Row 1	May be the same as the Manufacturer's Model Name (0008,1090) of the General Equipment Module, if the Algorithm is not distinguishable from the body of software that makes up the Equipment.
Row 2	May be the same as Software Versions (0018,1020) of the General Equipment Module, if the latter is a single Value, or its multiple Values are combined into a single TEXT Content Item Value.
Row 2b	**May be the same as the Manufacturer (0008,0070) of the General Equipment Module.**

New templates for PS3.16 Annex A

TID 60x1 Ophthalmology Measurements Group

This Template is a proper subset of TID 1501, with some optional extensions, and may be processed by a receiving application in the same way. The parameters used in this Template are identical to those parameters as used in TID 1501. However, this Template is specialized for ophthalmology (finding site "Eye"), and makes mandatory a Content Item for each measuement or finding concept specified in the invoking Template in the Context Groups invoked for parameters $Measurement and $QualType. (TID 1501 has no mandatory content.)

Type: Extensible
Order: Non-Significant
Root: No

Table TID 60x1.a. Parameters

Parameter Name	Parameter Usage
$TargetSiteMod	Value for Anatomic Location of measurement
$Method	Value for Measurement Method
$Measurement	Coded term or Context Group for Concept Name of mandatory measurements
$QualType	Coded term or Context Group for Concept Name of mandatory qualitative findings
$QualValue	Coded term or Context Group for value of qualitative finding
$OptMeasure	Coded term or Context Group for Concept Name of optional measurements

Table TID 60x1. Ophthalmology Measurements Group

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1		CONTAINS	CONTAINER	EV (125007, DCM, "Measurement Group")	1	M		
2	>	HAS CONCEPT MOD	CODE	EV (363698007, SCT, "Finding Site")	1	M		EV (81745001, SCT, “Eye”)
3	>>	HAS CONCEPT MOD	CODE	EV (272741003, SCT, "Laterality")	1	M		DCID 247 “Laterality Left-Right Only”
3	>>	HAS CONCEPT MOD	CODE	EV (106233006, SCT, "Topographical modifier")	1	MC	IFF Template is invoked with a non-empty $TargetSiteMod parameter	$TargetSiteMod
4	>	HAS CONCEPT MOD	CODE	EV (370129005, SCT, "Measurement Method")	1	MC	IFF Template is invoked with a non-empty $Method parameter	$Method

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
5	>	HAS OBS CONTEXT	CODE	EV (370129005, SCT, "Measurement Method")	1	MC	IFF measurements made with ROI or sector grid positioned differently from prior analyses	EV (nnn110, DCM, “Repositioned ROI or grid”)
6	>	HAS OBS CONTEXT	TEXT	EV (112039, DCM, "Tracking Identifier")	1	U		
7	>	HAS OBS CONTEXT	UIDREF	EV (112040, DCM, "Tracking Unique Identifier")	1	U		
8	>	CONTAINS	INCLUDE	DTID 300 “Measurement”	1-n	MC	IFF Template is invoked with a non-empty $Measurement parameter (see Content Item Description)	$Measurement = $Measurement
9	>	CONTAINS	CODE	$QualType	1-n	MC	IFF Template is invoked with a non-empty $QualType parameter (see Content Item Description)	$QualValue
10	>	CONTAINS	INCLUDE	DTID 300 “Measurement”	1-n	U		$Measurement = $OptMeasure
11	>	CONTAINS	IMAGE	EV (121112, DCM, “Source of Measurement”)	1-n	U		
12	>	CONTAINS	NUM	EV (111694, DCM, "Image Set Quality Rating")	1	UC	XOR Row 12	UNITS = EV ({0:100}, UCUM, "range:0:100") Value = 0 - 100
13	>	CONTAINS	CODE	EV (111101, DCM, “Image Quality”)	1	UC	XOR Row 11	BCID 3114 Study Quality
14	>	CONTAINS	IMAGE	EV (130401, DCM, "Visual explanation")	1	U		
15	>	CONTAINS	COMPOSITE	EV (130401, DCM, "Visual explanation")	1	U		
16	>	CONTAINS	TEXT	EV (121106, DCM, "Comment")	1	U		

Content Item Descriptions

Row 8	Mandatory numeric findings of the measurement group. Each Concept specified in the Value Set Constraints (i.e., as specified in the invoking Template $Measurement parameter) shall be encoded in a NUM Content Item. Note that the NUM Content Item allows an absent value with an associated reason code per CID 42, e.g., (114007, DCM, "Measurement not attempted"). TID 300 Measurement defines an optional capability to specify properties of a measurement via TID 310 Measurement Properties. TID 310 supports properties such as normality, statistical properties (through subsidiary TID 311), normal ranges (subsidiary TID 312), level of significance and more. Normality flags are highly useful and commonly provided by implementations.
Row 9	Mandatory qualitative findings of the measurement group. Each Concept specified in the Value Set Constraints (i.e., as specified in the invoking Template $QualType parameter) shall be encoded in a CODE Content Item.
Row 10	Optional numeric measurements of the measurement group.
Row 11	Reference to the original image(s), e.g., Ophthalmic Tomography, that provided the data analyzed to produce the measurements in this group.
Rows 12, 13	A numeric (row 12) or categorical (row 13) rating of the quality of the source images for the purpose of producing the measurements in this group.
Rows 14, 15	May be a reference to a Secondary Capture Image (row 14) or Encapsulated PDF (row 15) rendering of the set of measurements and findings encoded in this Measurement Group, and possibly additional data.

TID 60x2 Visual Field Key Measurements

Type: Extensible
Order: Non-Significant
Root: Yes

Table TID 60x2 Visual Field Key Measurements

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (nnn100, DCM, "Visual Field Key Measurements")	1	M		
2	>	HAS CONCEPT MOD	INCLUDE	DTID 1204 "Language of Content Item and Descendants"	1	U		
3	>	HAS OBS CONTEXT	INCLUDE	DTID 1002 "Observer Context"	1-n	U		

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
4	>	HAS OBS CONTEXT	INCLUDE	DTID 4019 Algorithm Identification	1	U		
5	>	CONTAINS	INCLUDE	DTID 60x1 "Ophthalmology Measurements Group"	1-2	M		$Method = DCID 4250. Visual Field Static Perimetry Test Pattern $Measurement = DCID 42x1 Visual Field Key Measurements $QualType = EV (111855, DCM, "Glaucoma Hemifield Test Analysis") $QualValue = DCID 4254. Visual Field Static Perimetry Test Analysis Result

Content Item Descriptions

Row 5	TID 60x1 may be invoked once per eye. Each invocation will instantiate a Content Item for each numeric measurement defined in CID 42x1 Visual Field Key Measurements and for the qualitative finding (111855, DCM, "Glaucoma Hemifield Test Analysis") CID 42x1 Visual Field Key Measurements includes fixation false positive, false negative, and losses ratios. While these are specified as being reported in %, the NUM Content Item (see PS3.3 Section C.18.1) allows the encoding of a Rational Numerator Value (0040,A162) and a Rational Denominator Value (0040,A163). Those attributes thus allow the supplemental specification of the ratio in the form of the number of false responses or losses (numerator) and the number of trials (denominator).

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TID 60x3 Optic Disc Key Measurements

Type: Extensible
Order: Non-Significant
Root: Yes

155

Table TID 60x3 Optic Disc Key Measurements

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (nnn101, DCM, "Optic Disc Key Measurements")	1			
2	>	HAS CONCEPT MOD	INCLUDE	DTID 1204 "Language of Content Item and Descendants"	1	U		

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
3	>	HAS OBS CONTEXT	INCLUDE	DTID 1002 "Observer Context"	1-n	U		
4	>	HAS OBS CONTEXT	INCLUDE	DTID 4019 Algorithm Identification	1	M		
5	>	CONTAINS	INCLUDE	DTID 60x1 "Ophthalmology Measurements Group"	1-2	M		$Measurement = DCID 42x2 Optic Disc Key Measurements

Content Item Descriptions

Row 5	TID 60x1 is invoked once per eye measured.

160

TID 60x4 Retinal Nerve Fiber Layer Key Measurements

Type: Extensible
Order: Non-Significant
Root: Yes

165

Table TID 60x4 Retinal Nerve Fiber Layer Key Measurements

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (nnn102, DCM, "RNFL Key Measurements")	1			
2	>	HAS CONCEPT MOD	INCLUDE	DTID 1204 "Language of Content Item and Descendants"	1	U		
3	>	HAS OBS CONTEXT	INCLUDE	DTID 1002 "Observer Context"	1-n	U		
4	>	HAS OBS CONTEXT	INCLUDE	DTID 4019 Algorithm Identification	1	M		
5	>	CONTAINS	INCLUDE	DTID 60x1 "Ophthalmology Measurements Group"	1-2	M		$Measurement = DCID 42x3 RNFL Key Measurements
6	>	CONTAINS	INCLUDE	DTID 300 "Measurement"	1	MC	IFF RNFL measurements made on both eyes	$Measurement = (nnn405, DCM, "Retinal nerve fiber layer symmetry") $Units = (%, UCUM, "%")

Content Item Descriptions

Row 5	TID 60x1 is invoked once per eye measured.

TID 60x5 Macular Thickness Key Measurements

The macular grid used for the measurements of this template is based upon the grid employed by the Early Treatment of Diabetic Retinopathy Study (ETDRS) to measure area and proximity of macular edema to the anatomic center (fovea) of the macula. See *ETDRS Report Number 10*.

Type: Extensible
Order: Non-Significant
Root: Yes

Table TID 60x5 Macular Thickness Key Measurements

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (nnn103, DCM, "Macular Thickness Key Measurements")	1			
2	>	HAS CONCEPT MOD	INCLUDE	DTID 1204 "Language of Content Item and Descendants"	1	U		
3	>	HAS OBS CONTEXT	INCLUDE	DTID 1002 "Observer Context"	1-n	U		
4	>	HAS OBS CONTEXT	INCLUDE	DTID 4019 Algorithm Identification	1	M		
5	>	CONTAINS	INCLUDE	DTID 60x1 "Ophthalmology Measurements Group"	1-2	M		$Measurement = DCID 42x4 Macular Thickness Key Measurements

Content Item Descriptions

Row 5	TID 60x1 is invoked once per eye measured.

TID 60x6 Ganglion Cell Layer Key Measurements

Type: Extensible
Order: Non-Significant
Root: Yes

Table TID 60x6 Ganglion Cell Layer Key Measurements

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (nnn104, DCM, "GCL Key Measurements")	1			

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
2	>	HAS CONCEPT MOD	INCLUDE	DTID 1204 "Language of Content Item and Descendants"	1	U		
3	>	HAS OBS CONTEXT	INCLUDE	DTID 1002 "Observer Context"	1-n	U		
4	>	HAS OBS CONTEXT	INCLUDE	DTID 4019 Algorithm Identification	1	M		
5	>	CONTAINS	INCLUDE	DTID 60x1 "Ophthalmology Measurements Group"	1-2	M		$TargetSiteMod = DCID 42x5 GCL Measurement Extent $Method = DCID 42x8 GCL Sector Grid Methods $Measurement = DCID 42x6 GCL Key Measurements $OptMeasure = DCID 42x7 GCL Sector Measurements

Content Item Descriptions

Row 5	TID 60x1 is invoked once per eye measured. Approaches to measure the Ganglion Cell Layer thickness vary widely. This template requires the SOP Instance creator application to specify which other cell layers, if any, are measured with the GCL proper (using a concept from CID 42x5 GCL Measurement Extent). Applications also use various approaches to identifying different sectors of the retina when measuring the GCL thickness. The sector definition used is specified by a concept from CID 42x8 GCL Sector Grid Methods. Measurements that match the sector names defined by the method may be selected from CID 42x7 GCL Sector Measurements to be included in the key measurements.

TID 60x7 Corneal Topography Key Measurements

Type: Extensible
Order: Non-Significant
Root: Yes

Table TID 60x7 Corneal Topography Key Measurements

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (nnn105, DCM, "Corneal Topography Key Measurements")	1			
2	>	HAS CONCEPT MOD	INCLUDE	DTID 1204 "Language of Content Item and Descendants"	1	U		
3	>	HAS OBS CONTEXT	INCLUDE	DTID 1002 "Observer Context"	1-n	U		

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
4	>	HAS OBS CONTEXT	INCLUDE	DTID 4019 Algorithm Identification	1	M		
5	>	CONTAINS	INCLUDE	DTID 60x1 "Ophthalmology Measurements Group"	1-2	M		$Measurement = DCID 42x9 Corneal Topography Key Measurements

Content Item Descriptions

Row 5	TID 60x1 is invoked once per eye measured.

TID 60x8 Endothelial Cell Count Key Measurements

Type: Extensible
Order: Non-Significant
Root: Yes

Table TID 60x8 Endothelial Cell Count Key Measurements

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (nnn106, DCM, "Endothelial Cell Count Key Measurements")	1			
2	>	HAS CONCEPT MOD	INCLUDE	DTID 1204 "Language of Content Item and Descendants"	1	U		
3	>	HAS OBS CONTEXT	INCLUDE	DTID 1002 "Observer Context"	1-n	U		
4	>	HAS OBS CONTEXT	INCLUDE	DTID 4019 Algorithm Identification	1	M		
5	>	CONTAINS	INCLUDE	DTID 60x1 "Ophthalmology Measurements Group"	1-2	M		$Measurement = DCID 42y0 Endothelial Cell Count Measurements

Content Item Descriptions

Row 5	TID 60x1 is invoked once per eye measured.

TID 60x9 Ophthalmic Image ROI Measurements

Type: Extensible
Order: Non-Significant
Root: Yes

Table TID 60x9 Ophthalmic Image ROI Measurements

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (nnn107, DCM, "Ophthalmic Image ROI Measurements")	1			
2	>	HAS CONCEPT MOD	INCLUDE	DTID 1204 "Language of Content Item and Descendants"	1	U		
3	>	HAS OBS CONTEXT	INCLUDE	DTID 1002 "Observer Context"	1-n	U		
4	>	HAS OBS CONTEXT	INCLUDE	DTID 4019 Algorithm Identification	1	U		
5	>	CONTAINS	INCLUDE	DTID 60x1 "Ophthalmology Measurements Group"	1-n	M		

Content Item Descriptions

Row 5	TID 60x1 is invoked once per eye measured. No mandatory key measurements are specified. Creating applications may include any measurements or findings.

New context groups for PS3.16 Annex B

CID 42x1 Visual Field Key Measurements

Keyword: VisualFieldKeyMeasurements
FHIR Keyword: dicom-cid-42x1-VisualFieldKeyMeasurements
Type: Extensible
Version: 2025mmdd
UID: 1.2.840.10008.6.1.x1

Table CID 42x1 Visual Field Key Measurements

Coding Scheme Designator	Code Value	Code Meaning	Units of Measure
DCM	nnn200	Global Deviation from Normal	(dB, UCUM, "dB")
DCM	nnn201	Localized Deviation From Normal	(dB, UCUM, "dB")
DCM	111852	Visual Field Index	(%, UCUM, "%")
DCM	nnn202	Fixation false positive ratio	(%, UCUM, "%")
DCM	nnn203	Fixation false negative ratio	(%, UCUM, "%")
DCM	nnn204	Fixation losses ratio	(%, UCUM, "%")

CID 42x2 Optic Disc Key Measurements

Keyword: OpticDiscKeyMeasurements
FHIR Keyword: dicom-cid-42x2-OpticDiscKeyMeasurements
Type: Extensible
Version: 2025mmdd
UID: 1.2.840.10008.6.1.x2

Table CID 42x2 Optic Disc Key Measurements

Coding Scheme Designator	Code Value	Code Meaning	Units of Measure
DCM	nnn300	Cup to disc area ratio	({ratio}, UCUM, "ratio")
DCM	nnn301	Cup to disk ratio vertical	({ratio}, UCUM, "ratio")
DCM	nnn302	Cup to disk ratio horizontal	({ratio}, UCUM, "ratio")
DCM	nnn303	Optic disc rim area	(mm2, UCUM, "mm2")
DCM	nnn304	Optic disc cup area	(mm2, UCUM, "mm2")
DCM	nnn305	Optic disc area	(mm2, UCUM, "mm2")
DCM	nnn306	Optic disc cup volume	(mm3, UCUM, "mm3")

CID 42x3 RNFL Key Measurements

In encoding of clockface position measurements, positions in the right eye proceed in the natural clockwise direction as viewed from the anterior position, while positions in the left eye proceed in the counter-clockwise direction.

Keyword: RNFLKeyMeasurements
FHIR Keyword: dicom-cid-42x3-RNFLKeyMeasurements
Type: Extensible
Version: 2025mmdd
UID: 1.2.840.10008.6.1.x3

Table CID 42x3 RNFL Key Measurements

Coding Scheme Designator	Code Value	Code Meaning	Units of Measure
DCM	nnn400	Retinal nerve fiber layer average thickness	(um, UCUM, "um")
DCM	nnn401	Retinal nerve fiber layer inferior thickness	(um, UCUM, "um")
DCM	nnn402	Retinal nerve fiber layer superior thickness	(um, UCUM, "um")
DCM	nnn403	Retinal nerve fiber layer temporal thickness	(um, UCUM, "um")
DCM	nnn404	Retinal nerve fiber layer nasal thickness	(um, UCUM, "um")
DCM	nnn411	RNFL clockface position 1 thickness	(um, UCUM, "um")
DCM	nnn412	RNFL clockface position 2 thickness	(um, UCUM, "um")
DCM	nnn413	RNFL clockface position 3 thickness	(um, UCUM, "um")
DCM	nnn414	RNFL clockface position 4 thickness	(um, UCUM, "um")
DCM	nnn415	RNFL clockface position 5 thickness	(um, UCUM, "um")
DCM	nnn416	RNFL clockface position 6 thickness	(um, UCUM, "um")
DCM	nnn417	RNFL clockface position 7 thickness	(um, UCUM, "um")
DCM	nnn418	RNFL clockface position 8 thickness	(um, UCUM, "um")
DCM	nnn419	RNFL clockface position 8 thickness	(um, UCUM, "um")
DCM	nnn420	RNFL clockface position 10 thickness	(um, UCUM, "um")
DCM	nnn421	RNFL clockface position 11 thickness	(um, UCUM, "um")
DCM	nnn422	RNFL clockface position 12 thickness	(um, UCUM, "um")
DCM	nnn406	Retinal ROI radius	(mm, UCUM, "mm")

CID 42x4 Macular Thickness Key Measurements

Keyword: MacularThicknessKeyMeasurements
FHIR Keyword: dicom-cid-42x4-MacularThicknessKeyMeasurements
Type: Extensible
Version: 2025mmdd
UID: 1.2.840.10008.6.1.x4

Table CID 42x4 Macular Thickness Key Measurements

Coding Scheme Designator	Code Value	Code Meaning	Units of Measure
LN	57108-3	Macular grid.center point thickness by OCT	(um, UCUM, "um")
LN	57109-1	Macular grid.center subfield thickness by OCT	(um, UCUM, "um")
LN	57110-9	Macular grid.inner superior subfield thickness by OCT	(um, UCUM, "um")
LN	57111-7	Macular grid.inner nasal subfield thickness by OCT	(um, UCUM, "um")
LN	57112-5	Macular grid.inner inferior subfield thickness by OCT	(um, UCUM, "um")
LN	57113-3	Macular grid.inner temporal subfield thickness by OCT	(um, UCUM, "um")
LN	57114-1	Macular grid.outer superior subfield thickness by OCT	(um, UCUM, "um")
LN	57115-8	Macular grid.outer nasal subfield thickness by OCT	(um, UCUM, "um")
LN	57116-6	Macular grid.outer inferior subfield thickness by OCT	(um, UCUM, "um")
LN	57117-4	Macular grid.outer temporal subfield thickness by OCT	(um, UCUM, "um")
LN	57118-2	Macular grid.total volume by OCT	(uL, UCUM, "uL")
DCM	nnn250	Average macular thickness	(um, UCUM, "um")

Note : The Macular grid measurement concepts, based on the ETDRS grid, are included in LOINC panel 57119-0 Optical coherence tomography panel.

CID 42x5 GCL Measurement Extent

This Context Group specifies the retinal layers included in the ganglion cell layer (GCL) measurements.

Keyword: GCLMeasurementExtent
FHIR Keyword: dicom-cid-42x5-GCLMeasurementExtent
Type: Extensible
Version: 2025mmdd
UID: 1.2.840.10008.6.1.x5

Table CID 42x5 GCL Measurement Extent

Coding Scheme Designator	Code Value	Code Meaning
SCT	39197003	Ganglion cell layer
DCM	nnn550	GCL-IPL
DCM	nnn551	Ganglion cell complex

CID 42x6 GCL Key Measurements

This Context Group includes key measurements of the ganglion cell layer (GCL) thickness, with or without adjacent layers as specified by the context of usage.

Keyword: GCLKeyMeasurements
FHIR Keyword: dicom-cid-42x6-GCLKeyMeasurements
Type: Extensible
Version: 2025mmdd
UID: 1.2.840.10008.6.1.x6

Table CID 42x6 GCL Key Measurements

Coding Scheme Designator	Code Value	Code Meaning	Units of Measure
DCM	nnn406	Retinal ROI radius	(mm, UCUM, "mm")
DCM	nnn500	Average GCL thickness	(um, UCUM, "um")
DCM	nnn502	Minimum GCL thickness	(um, UCUM, "um")

CID 42x7 GCL Sector Measurements

This Context Group includes measurements of the ganglion cell layer (GCL) thickness in each retinal sector, with or without adjacent layers as specified by the context of usage, and with the span of each sector also defined by the context of usage.

Keyword: GCLSectorMeasurements
FHIR Keyword: dicom-cid-42x7-GCLSectorMeasurements
Type: Extensible
Version: 2025mmdd
UID: 1.2.840.10008.6.1.x7

Table CID 42x7 GCL Sector Measurements

Coding Scheme Designator	Code Value	Code Meaning	Units of Measure
DCM	nnn511	Average GCL thickness superior sector	(um, UCUM, "um")
DCM	nnn512	Average GCL thickness nasal-superior sector	(um, UCUM, "um")
DCM	nnn513	Average GCL thickness nasal sector	(um, UCUM, "um")
DCM	nnn514	Average GCL thickness nasal-inferior sector	(um, UCUM, "um")
DCM	nnn515	Average GCL thickness inferior sector	(um, UCUM, "um")
DCM	nnn516	Average GCL thickness temporal-inferior sector	(um, UCUM, "um")
DCM	nnn517	Average GCL thickness temporal sector	(um, UCUM, "um")
DCM	nnn518	Average GCL thickness temporal-superior sector	(um, UCUM, "um")

CID 42x8 GCL Sector Grid Methods

Keyword: GCLSectorGridMethods
FHIR Keyword: dicom-cid-42x8-GCLSectorGridMethods
Type: Extensible
Version: 2025mmdd
UID: 1.2.840.10008.6.1.x8

Table CID 42x8 GCL Sector Grid Methods

Coding Scheme Designator	Code Value	Code Meaning
DCM	nnn560	Hemifield sector grid
DCM	nnn561	Elliptical annulus sector grid
DCM	nnn562	Garway-Heath sector grid
DCM	nnn563	Quadrant-octant sector grid

CID 42x9 Corneal Topography Key Measurements

Keyword: CornealTopographyKeyMeasurements
FHIR Keyword: dicom-cid-42x9-CornealTopographyKeyMeasurements
Type: Extensible
Version: 2025mmdd
UID: 1.2.840.10008.6.1.x9

Table CID 42x9 Corneal Topography Key Measurements

Coding Scheme Designator	Code Value	Code Meaning	Units of Measure
DCM	nnn600	Central keratometry minimum power	([diop], UCUM, "diopters")
DCM	nnn601	Central keratometry minimum radius of curvature	(mm, UCUM, "mm")
DCM	nnn602	Central keratometry minimum power axis	(deg, UCUM, "degrees")
DCM	nnn603	Central keratometry maximum power	([diop], UCUM, "diopters")
DCM	nnn604	Central keratometry maximum radius of curvature	(mm, UCUM, "mm")
DCM	nnn605	Central keratometry maximum power axis	(deg, UCUM, "degrees")
DCM	nnn606	Minimum corneal thickness	(um, UCUM, "um")

CID 42y0 Endothelial Cell Count Measurements

Keyword: EndothelialCellCountMeasurements
FHIR Keyword: dicom-cid-42y0-EndothelialCellCountMeasurements
Type: Extensible
Version: 2025mmdd
UID: 1.2.840.10008.6.1.y0

Table CID 42y0 Endothelial Cell Count Measurements

Coding Scheme Designator	Code Value	Code Meaning	Units of Measure
DCM	nnn700	Endothelial cell density	({cells}/mm2, UCUM, "cells/mm2")

Update CID 222 with additonal SNOMED normality codes

CID 222 Normality

Keyword: Normality
FHIR Keyword: dicom-cid-222-Normality
Type: Extensible
Version: ~~**20170914**~~ **2025mmdd**
UID: 1.2.840.10008.6.1.27

Table CID 222. Normality

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-RT ID	UMLS Concept Unique ID
SCT	17621005	Normal	G-A460	C0205307
SCT	263654008	Abnormal	R-42037	C0205161
SCT	371879000	Abnormally High	R-002C4	C1299351
SCT	371880002	Abnormally Low	R-002C5	C1299352
SCT	371934000	Normality Undetermined	R-0039B	C1299401
SCT	**442777001**	**Borderline high**		
SCT	**442779003**	**Borderline low**		
SCT	**394844007**	**Outside reference range**		
SCT	**281302008**	**Above reference range**		
SCT	**281300000**	**Below reference range**		
SCT	**281301001**	**Within reference range**		

New codes and definitions for PS3.16 Annex D

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ANNEX D

Code Value	Code Meaning	Definition	Notes
nnn100	Visual Field Key Measurements	Clinically most significant measurements of patient Visual Field	
nnn101	Optic Disc Key Measurements	Clinically most significant measurements of Optic Disc	
nnn102	RNFL Key Measurements	Clinically most significant measurements of Retinal Nerve Fiber Layer	
nnn103	Macular Thickness Key Measurements	Clinically most significant measurements of Macular Thickness	
nnn104	GCL Key Measurements	Clinically most significant measurements of Gangion Cell Layer	
nnn105	Corneal Topography Key Measurements	Clinically most significant measurements of Corneal Topography	
nnn106	Endothelial Cell Count Key Measurements	Clinically most significant measurements of Endothelial Cell Count	
nnn107	Ophthalmic Image ROI Measurements	Measurements of Ophthalmic Images based on a Region of Interest	
nnn110	Repositioned ROI or grid	Indicator that measurements were made with ROI or grid positioned differently than used for a prior measurement set	
nnn200	Global Deviation from Normal	Weighted average deviation from the age corrected normal visual field, as decibel. Corresponds to Global Deviation from Normal (0024,0066) in the Results Normals Sequence (0024,0064)	
nnn201	Localized Deviation From Normal	Weighted square root of loss variance, as decibel. Corresponds to Localized Deviation From Normal (0024,0068) in the Results Normals Sequence (0024,0064)	
nnn202	Fixation false positive ratio	Estimated percentage of all patient responses that occurred at a time when no visual stimulus was present (false positive responses), as percent. Corresponds to False Positives Estimate (0024,0054) in the Visual Field Catch Trial Sequence (0024,0034)	
nnn203	Fixation false negative ratio	Estimated percentage of all stimuli that were not seen by the patient but were previously seen at a lower luminance earlier in the visual field test (false negative responses), as percent. Corresponds to False Negatives Estimate (0024,0046) in the Visual Field Catch Trial Sequence (0024,0034)	
nnn204	Fixation losses ratio	The ratio between the number of times a patient loses visual fixation while maintaining a visual gaze on a single location and the number of trials presented. Corresponds to ratio of Patient Not Properly Fixated Quantity (0024,0036) to Fixation Checked Quantity (0024,0035) in Fixation Sequence (0024,0032)	

Code Value	Code Meaning	Definition	Notes
nnn250	Average macular thickness	Average macular thickness across all ETDRS subfields	
nnn300	Cup to disc area ratio	Ratio of the optic disc cup area to the disc area	
nnn301	Cup to disc ratio vertical	Ratio of the vertical diameter of the physiological cup to that of the vertical diameter of the optic disc	
nnn302	Cup to disc ratio horizontal	Ratio of the horizontal diameter of the physiological cup to that of the vertical diameter of the optic disc	
nnn303	Optic disc rim area	Area of the rim portion of the optic disc	
nnn304	Optic disc cup area	Area of the cup portion of the optic disc	
nnn305	Optic disc area	Area of the optic disc	
nnn306	Optic disc cup volume	Volume of the cup portion of the optic disc	
nnn400	Retinal nerve fiber layer average thickness	Average measured thickness of the retinal nerve fiber layer (RNFL), i.e., the distance between the internal limiting membrane (ILM) and the Gangion Cell Layer (GCL), in all regions	
nnn401	Retinal nerve fiber layer inferior thickness	Average measured thickness of the retinal nerve fiber layer (RNFL), i.e., the distance between the internal limiting membrane (ILM) and the Gangion Cell Layer (GCL), in the inferior quadrant.	
nnn402	Retinal nerve fiber layer superior thickness	Average measured thickness of the retinal nerve fiber layer (RNFL), i.e., the distance between the internal limiting membrane (ILM) and the Gangion Cell Layer (GCL), in the superior quadrant.	
nnn403	Retinal nerve fiber layer temporal thickness	Average measured thickness of the retinal nerve fiber layer (RNFL), i.e., the distance between the internal limiting membrane (ILM) and the Gangion Cell Layer (GCL), in the temporal quadrant.	
nnn404	Retinal nerve fiber layer nasal thickness	Average measured thickness of the retinal nerve fiber layer (RNFL), i.e., the distance between the internal limiting membrane (ILM) and the Gangion Cell Layer (GCL), in the nasal quadrant.	
nnn405	Retinal nerve fiber layer symmetry	Symmetry between the two eyes of the average retinal nerve fiber layer (RNFL) thickness, as smaller value divided by larger value, represented as percent.	
nnn406	Retinal ROI radius	Radius of circular area, or minor axis of eliptical area, used for measurement of retinal layer thicknesses	
nnn411	RNFL clockface position 1 thickness	Average measured retinal nerve fiber layer thickness at clockface position 1, in the clockwise direction for the right eye and the counter-clockwise direction for the left eye, as viewed from an anterior position	
nnn412	RNFL clockface position 2 thickness	Average measured retinal nerve fiber layer thickness at clockface position 2, in the clockwise direction for the right eye and the counter-clockwise direction for the left eye, as viewed from an anterior position	

Code Value	Code Meaning	Definition	Notes
nnn413	RNFL clockface position 3 thickness	Average measured retinal nerve fiber layer thickness at clockface position 3, in the clockwise direction for the right eye and the counter-clockwise direction for the left eye, as viewed from an anterior position. This is the nasal position.	
nnn414	RNFL clockface position 4 thickness	Average measured retinal nerve fiber layer thickness at clockface position 4, in the clockwise direction for the right eye and the counter-clockwise direction for the left eye, as viewed from an anterior position	
nnn415	RNFL clockface position 5 thickness	Average measured retinal nerve fiber layer thickness at clockface position 5, in the clockwise direction for the right eye and the counter-clockwise direction for the left eye, as viewed from an anterior position	
nnn416	RNFL clockface position 6 thickness	Average measured retinal nerve fiber layer thickness at clockface position 6. This is the inferior position.	
nnn417	RNFL clockface position 7 thickness	Average measured retinal nerve fiber layer thickness at clockface position 7, in the clockwise direction for the right eye and the counter-clockwise direction for the left eye, as viewed from an anterior position	
nnn418	RNFL clockface position 8 thickness	Average measured retinal nerve fiber layer thickness at clockface position 8, in the clockwise direction for the right eye and the counter-clockwise direction for the left eye, as viewed from an anterior position	
nnn419	RNFL clockface position 9 thickness	Average measured retinal nerve fiber layer thickness at clockface position 9, in the clockwise direction for the right eye and the counter-clockwise direction for the left eye, as viewed from an anterior position. This is the temporal position.	
nnn420	RNFL clockface position 10 thickness	Average measured retinal nerve fiber layer thickness at clockface position 10, in the clockwise direction for the right eye and the counter-clockwise direction for the left eye, as viewed from an anterior position	
nnn421	RNFL clockface position 11 thickness	Average measured retinal nerve fiber layer thickness at clockface position 11, in the clockwise direction for the right eye and the counter-clockwise direction for the left eye, as viewed from an anterior position	
nnn422	RNFL clockface position 12 thickness	Average measured retinal nerve fiber layer thickness at clockface position 12. This is the superior position.	
nnn500	Average GCL thickness	Average thickness of the ganglion cell layer	
nnn502	Minimum GCL thickness	Lowest thickness of the ganglion cell layer over a single meridian crossing the annulus	
nnn511	Average GCL thickness superior sector	Average ganglion cell layer thickness in the superior sector as defined by the measurement method	
nnn512	Average GCL thickness nasal-superior sector	Average ganglion cell layer thickness in the nasal-superior sector as defined by the measurement method	

Code Value	Code Meaning	Definition	Notes
nnn513	Average GCL thickness nasal sector	Average ganglion cell layer thickness in the nasal sector as defined by the measurement method	
nnn514	Average GCL thickness nasal-inferior sector	Average ganglion cell layer thickness in the nasal-inferior sector as defined by the measurement method	
nnn515	Average GCL thickness inferior sector	Average ganglion cell layer thickness in the inferior sector as defined by the measurement method	
nnn516	Average GCL thickness temporal-inferior sector	Average ganglion cell layer thickness in the temporal-inferior as defined by the measurement method sector	
nnn517	Average GCL thickness temporal sector	Average ganglion cell layer thickness in the temporal sector as defined by the measurement method	
nnn518	Average GCL thickness temporal-superior sector	Average ganglion cell layer thickness in the temporal-superior sector as defined by the measurement method	
nnn550	GCL-IPL	Ganglion cell layer (GCL) plus inner plexiform layer (IPL)	
nnn551	Ganglion cell complex	Ganglion cell layer (GCL) plus inner plexiform layer (IPL) plus retinal nerve fiber layer (RNFL)	
nnn560	Hemifield sector grid	Circular measurement area with measurements on 180° hemifield sectors centered on vertical and horizontal axes (superior, inferior, nasal, temporal).	
nnn561	Elliptical annulus sector grid	Measurement area of an elliptical annulus, inner minor axis radius of 0.5 mm, outer minor axis of 2.0 mm aligned vertically, inner major axis radius of 0.6 mm, outer major axis of 2.4 mm aligned horizontally, divided into six 60° sectors with boundaries beginning at 30° from vertical (superior, nasal-superior, nasal-inferior, inferior, temporal-inferior, temporal-superior).	
nnn562	Garway-Heath sector grid	Circular measurement area, divided into six sectors – a 110° nasal sector and a 90° temporal sector centered on the fovea-Bruch's membrane opening (BMO) axis, and four 40° sectors (temporal-superior, nasal-superior, nasal-inferior, temporal-inferior)	
nnn563	Quadrant-octant sector grid	Circular measurement area, divided into six sectors – 90° nasal and temporal quadrants centered on the horizontal axis, and four 45° octants (temporal-superior, nasal-superior, nasal-inferior, temporal-inferior)	
nnn600	Central keratometry minimum power	The lowest refractive power in the central zone (for example central 3mm), as diopters Note: This code is related to DICOM attribute Keratometric Power (0046,0076) within the attribute Flat Keratometric Axis Sequence (0046,0080).	

Code Value	Code Meaning	Definition	Notes
nnn601	Central keratometry minimum radius of curvature	The longest radius of curvature of the two most extreme orthogonal keratometry measurements in the central zone (for example central 3mm), as mm Note: This code is related to DICOM attribute Radius of Curvature (0046,0075) within the attribute Flat Keratometric Axis Sequence (0046,0080).	
nnn602	Central keratometry minimum power axis	The meridian of the lowest power radius of the two most extreme orthogonal keratometry measurements in the central zone (for example central 3mm), as degrees Note: This code is related to DICOM attribute Keratometric Axis (0046,0077) within the attribute Flat Keratometric Axis Sequence (0046,0080).	
nnn603	Central keratometry maximum power	The highest refractive power in the central zone (for example central 3mm), as diopters Note: This code is related to DICOM attribute Keratometric Power (0046,0076) within the attribute Steep Keratometric Axis Sequence (0046,0074).	
nnn604	Central keratometry maximum radius of curvature	The shortest radius of curvature of the two most extreme orthogonal keratometry measurements in the central zone (for example central 3mm), as mm Note: This code is related to DICOM attribute Radius of Curvature (0046,0075) within the attribute Steep Keratometric Axis Sequence (0046,0074).	
nnn605	Central keratometry maximum power axis	The meridian of the highest power radius of the two most extreme orthogonal keratometry measurements in the central zone (for example central 3mm), as degrees Note: This code is related to DICOM attribute Keratometric Axis (0046,0077) within the attribute Steep Keratometric Axis Sequence (0046,0074).	
nnn606	Minimum corneal thickness	The thickness of the cornea at the location representing the minimum measurable thickness, as microns	
nnn700	Endothelial cell density	The density of endothelial cells present on the innermost surface of the cornea, as cells/mm2	