Digital Imaging and Communications in Medicine (DICOM)

Supplement 239: Waveform Annotations SR

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DICOM Standards Committee, Working Group 6

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Document History

2023/05/17	Version 0		Initial version, fragmentary
2023/06/12	Version 1		Prepared for WG-32, before First Read
2023/06/17	Version 2		After discussion with WG-32; prepared for First Read
2023/08/24	Version 3		Prepared for WG-06, before Public Comment • Added Waveform Library • Added CID for SR Titles • Added CID for EEG Procedures • Added CID for Patient Consciousness
2023/08/29	Version 4		Added PS3.6 and PS3.4 changes
2023/08/31	Version 5		Changes resulting from discussion with WG-06
2023/10/12	Version 6		Minor adaptions due to discussion in wg-32
2023/11/03	Version 7		Feedback from WG-32 / J.Halford incorporated, added example, update for some CIDs
2023/11/13	Version 8		Result of review with WG-06 in Nov.2023, prepared for PC
2023/11/20	Version 9		Worked in some results from discussion with WG-32, prepared for PC

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Open Issues

1.	In neurophysiology, montages are used to review the recording. Q: How relevant is the relationship of the montage used to view the waveform when the annotation was added? It might be complicated to establish this relationship to the montage information, which is stored in another object (a waveform presentation state, see sup236).
2.	The attribute Observation UID (0040,A171) is optional. This attribute could be use to refer to single observations from other objects. One use case might be to refer from a report document to a specific measurement or annotation in this SR. Another use case might be to assign display properties to observations (display properties come from the Waveform Presentation State – sup239; currently in work, not yet finished). As an alternative the attributes Tracking ID (0062,0020) and Tracking UID (0062,0021) might be used instead but these track the same entity over time.

	Q: Shall there be a constraint for the optional attribute Observation UID (0040,A171) to be used for referencing single annotations in this SR? If the answer is yes, this attribute will be made mandatory in this sort of SR object.
3.	The attribute Observation DateTime (0040,A032) in the Document Relationship Macro (SR Document Content Module) represents the timepoint when the annotation was added, when the observation was made. It is not the absolute time, when the observed pattern occurred. This attribute is conditionally mandatory. The condition there seems adequate to meet the requirements for Waveform Annotations. Nevertheless, there could be further constraints for this attribute. Q: Can the required information be assumed to be available (e.g. in the recording system or review system database) if the SR is created at a later date, and what date and time should be used if not? Shall there be any additional constraints for the Observation DateTime (0040,A032) attribute for the Waveform Annotation SR IOD and, if yes, which one?

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Closed Issues

1.	Q: Should annotations also be included in the presentation state object or should annotations be saved separately - e.g. in a separate Structured Report document. If both is applicable: a clear distinction criterion is required: which annotations shall go to the display object, which go to the SR document. A: Annotations expressing clinical information (observations, measurements, …) should go to a separate object, a DICOM Structured Report object.
2.	Q: Procedure Log is a SR intended to store time stamped events during a procedure (e.g. catheterization lab). Would the Procedure Log IOD fit the requirements as well as the Presentation State IOD? In imaging Presentation State objects are (usually) created after image creation, the neurophysiology the recording use case requires the PR to be created during the recording. A: Use a separate object to store the annotations, but an SR.
3.	Sup222 Microscopy Bulk Simple Annotations Storage introduced the definition of Annotations as separate IEs in MORW and E-R model. Shall the new IODs make use of this IE or choose another wording (not using Annotation) in order to keep the distinction? A: The existing definition is very general and does not contradict its use for waveforms. In the new IODs introducing the Annotations for waveforms, the definition could be narrowed.
4.	There are generic SR IODs which allow for encoding observations and measurements in a generic way. What is the reason for defining a new IOD for this sort of observations and measurements? A: This SR is intended for very specific use cases, relevant mostly for modalities / devices producing and consuming time series data. Support of this kind of SR should be negotiable, such SRs should be selectable in queries and distinguishable in SOP Instance references.

5.	There are generic SR Templates which allow for encoding observations and measurements in a generic way. What is the reason for defining new Templates for this sort of observations and measurements? A: The proposed template narrows the generic template (TID 1500) for the specific use cases. It sticks to the principles provided by these templates but omits not relevant parts and includes others like time relationship to procedure. TID 1500, included TIDs and the used CIDs are imaging specific. This SR provides annotations to time series data like EEG recordings.
6.	Q: Shall the Template contain an analogy to the Image Library (TID 1600) describing the underlying study? A: Yes. An analogy to Image Library (TID 1600) shall be include, but optionally.
7.	Clarify the intention of (0040,A180) Annotation Group Number. Q: Shall this concept have a representation in the Annotation SR, too? A: Annotations stored in the recorded waveform objects use Annotation Group Number (0040,A180) to allow a logical associations of multiple annotations. The same possibility it defined for Annotations stored in an SR object by adding an optional content item.
8.	Q: Some Annotations may have additional properties (e.g. localization of spikes, frequency of recurring patterns, …). This could be expressed by specialized codes (e.g. spike -> focal spike, generalized spike) or by optional modifiers for a code. A: Allowing coded modifiers is preferred due to being more flexible.
9.	Q: How can the patient's condition be documented? In general, and in particular with regard to his vigilance? A: The patient’s condition is documented using coded annotations.
10.	Q: Not all Annotations are assigned to a specific point in time, but provide general information. How could this be expressed? A: Assigning time coordinates to an Annotation is optional, a reference to the waveform object itself is sufficient to fulfill the template.
11.	There could be quite a lot of neurophysiology annotations in a short period of time (e.g. 1000 in a 30 min recording). Storing them as individual annotations in an SR object seems to produce a lot of redundancy. Q: Is it worth defining an SR despite of this concern? A: Having structured, interoperable annotations is important for many use cases. There are mechanisms that might help reduce redundancy like using MULTIPOINT time coordinates for identical annotations occurring at many timepoints.

Scope and Field of Application

This supplement introduces SOP Classes for storage and exchange of waveform annotations. It applies to all modalities in which waveform objects are created and applications used to review them.

Waveform Annotations can be stored in the waveform object itself expressing physical or environmental circumstances noted by the recording device at recording time.

The new IOD can be used to store additional clinical information added at recording time or later provided either by a human reviewer (for example a neurologist or a technologist) or by an automated analysis software.

This supplement

- adds a SOP Class to store observations and measurements in a Waveform Annotation SR
- defines a new Root Template derived from TID 1500, a waveform analogy to TID 1600 Image Library, and some included templates to store Annotations as codes or free text and measurements.
- Defines the Context Groups used in these Templates

Changes to NEMA Standards Publications PS3.3
Digital Imaging and Communications in Medicine (DICOM)
Part 3: Information Object Definitions

Add new IODs to Overview Table PS3.3 Table A.1-7b:

Table A.1-7b. Composite Information Object Modules Overview – More Structured Reports

IODs Modules	RD SR	…	Perf IA Admin SR	Waveform Annotation SR
Patient	M		M	**M**
Clinical Trial Subject	U		U	**U**
General Study	M		M	**M**
Patient Study	U		U	**U**
Clinical Trial Study	U		U	**U**
Clinical Trial Series	U		U	**U**
SR Document Series	M		M	**M**
Key Object Document Series				
Sync.	C		M	**C**
General Equip.	M		M	**M**
Enhanced General Equip.	M		M	**M**
SR Document General	M		M	**M**
SR Document Content	M		M	**M**
Key Object Document				
Timezone				
SOP Common	M		M	**M**

Add the following new content to PS3.3 Section A.35.xx …

A.35.xx Waveform Annotation SR IOD

A.35.xx.1 Waveform Annotation SR IOD Description

The Waveform Annotation SR Information Object Definition (IOD) conveys observations and measurements detected in waveform data by either a human reviewer or analysis software. The content may include both text and encoded information, numerical measurements, time coordinates or intervals, and references to waveform SOP instances and dedicated channels within them.

A.35.xx.2 Waveform Annotation SR IOD Entity-Relationship Model

This IOD uses the E-R Model in Section A.1-2, with only the SR Document IE below the Series IE.

A.35.xx.3 Waveform Annotation SR IOD Module Table

Table A.35.xx.1-1 specifies the Modules of the Waveform Annotation SR IOD.

Table A.35.xx-1 Waveform Annotation 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
SR Document	SR Document General	C.17.2	M
	SR Document Content	C.17.3	M
	SOP Common	C.12.1	M

A.35.xx.3.1 Waveform Annotation SR IOD Content Constraints

A.35.xx.3.1.1 Template

The document shall be constructed from TID XXXX “Waveform Annotations” invoked at the root node.

A.35.xx.3.1.2 Observation DateTime

[Any constraints for Observation DateTime – open issue #3. TBD.]

A.35.xx.3.1.3 Observation UID

[Any constraints for Observation UID – open issue #2. TBD.]

A.35.xx.3.1.4 Value Type

Value Type (0040,A040) in Content Sequence (0040,A730) of the SR Document Content Module is constrained to the following Enumerated Values (see Table C.17.3-7 for Value Type definitions):

Enumerated Values:

TEXT
CODE
NUM
TCOORD
WAVEFORM
CONTAINER
DATE
TIME
UIDREF
PNAME

A.35.xx.3.1.5 Relationship Constraints

The Waveform Annotations SR IOD allows for by-reference INFERRED FROM and by-reference SELECTED FROM relationships. Other relationships in the content of this IOD shall be conveyed by-value. Table A.35.xx-b specifies the relationship constraints of this IOD. See Table C.17.3-8 for Relationship Type definitions.

Table A.35.xx-1. Relationship Constraints for Waveform Annotation SR IOD

Source Value Type	Relationship Type (Enumerated Values)	Target Value Type
CONTAINER	CONTAINS	TEXT, CODE, NUM, TCOORD, WAVEFORM, CONTAINER
CONTAINER	HAS CONCEPT MOD	CODE, TEXT
CONTAINER	HAS OBS CONTEXT	CODE, PNAME, TEXT, UIDREF, CONTAINER
CODE, NUM, TEXT	HAS CONCEPT MOD	CODE, TEXT
CODE, NUM, TEXT	HAS OBS CONTEXT	CODE, PNAME, TEXT, UIDREF, CONTAINER
CODE, NUM, TEXT	HAS PROPERTIES	CODE, TEXT
CODE, NUM, TEXT	INFERRED FROM	WAVEFORM, TCOORD
CODE, NUM, TEXT	R-INFERRED FROM	WAVEFORM
TCOORD	SELECTED FROM	WAVEFORM
TCOORD	R-RESLECTED FROM	WAVEFORM

Changes to NEMA Standards Publications PS 3.4

Digital Imaging and Communications in Medicine (DICOM)
Part 4: Service Class Specifications

Add new Elements to PS3.4 B.5 Table B.5-1. Standard SOP Classes

SOP Class Name	SOP Class UID	IOD Specification (defined in PS3.3)	Specialization
…			
1.2.840.10008.1.XX	**Waveform Annotation SR Storage**	**Waveform Annotation SR IOD**	**B.5.1.5**

Amend B.5.1.5

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

- Basic Text SR
- …
- **Waveform Annotation SR**

Changes to NEMA Standards Publications PS 3.6

Digital Imaging and Communications in Medicine (DICOM)
Part 6: Data Dictionary

Add new SOP Classes to PS3.6 Annex A Table A-1:

UID Value	UID Name	UID Keyword	UID Type	Part
…				
1.2.840.10008.1.XX	**Waveform Annotation SR Storage**	**WaveformAnnotationSRStorage**	**SOP Class**	**PS3.4**
…				

Add new Context Group UID Values to Table A-3:

Context UID	Context Identifier	Context Group Name	Comment
…	…	…	
1.2.840.10008.6.1.ccc2	**CID ccc2**	**Waveform Annotation Classification**	
1.2.840.10008.6.1.ccc3	**CID ccc3**	**Waveform Annotation Document Title**	
1.2.840.10008.6.1.ccc4	**CID ccc4**	**EEG Procedure**	
1.2.840.10008.6.1.ccc5	**CID ccc5**	**Patient Consciousness**	
…			

Changes to NEMA Standards Publications PS3.15

Digital Imaging and Communications in Medicine (DICOM)
Part 15: Security and System Management Profiles

Add new Codes to PS3.15 Annex E:

Table E.3.4-1. Application Level Confidentiality Profile Clean Structured Content Option Content Item Concept Name Codes

Code Meaning	Code Value	Coding Scheme Designator	Value Type	Retd. (from PS3.16)	In Std. Tmpl. (from PS3.16)	Basic Prof.	Rtn. UIDs Opt.	Rtn. Dev. Id. Opt.	Rtn. Inst. Id. Opt.	Rtn. Pat. Chars. Opt.	Rtn. Long. Full Dates Opt.	Rtn. Long. Modif. Dates Opt.	Clean Desc. Opt.
…													
Acquisition DateTime	**xxxf**	**DCM**	**DATETIME**	**N**	**Y**	**X**					**K**	**C**	
Synchronization Frame Of Reference UID	**xxxg**	**DCM**	**UIDREF**	**N**	**Y**	**X**	**K**						
…													

Changes to NEMA Standards Publications PS3.16

Digital Imaging and Communications in Medicine (DICOM)
Part 16: Content Mapping Resource

Amend Annex A by adding a new Section and the following Template[s]

TID XXXX Waveform Annotations

This Root Template encodes a list of Annotations for waveform data consisting of measurements or observations added at recording time or later provided either by a human reviewer (a cardiologist, a neurologist, or a technologist) or by an automated analysis algorithm.

Type: **Extensible**

Order: **Non-Significant**
Root: **Yes**

Table TID XXXX. Waveform Annotations

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	BCID ccc3 “Waveform Annotations Document Title”	1	M		Root node
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	>	HAS CONCEPT MOD	CODE	EV (xxx2, DCM, “Procedure annotated”)	1-n	U		BCID 3670 “ECG Procedure Type” BCID ccc4 “EEG Procedure”
5	>	HAS OBS CONTEXT	CODE	EV (1185780006, SCT, “Relative Time”)	1	U		DCID 61 “Time Relative to Procedure”
6	>	CONTAINS	INCLUDE	DTID XXX5 “Waveform Library”	1	U		
7	>	CONTAINS	CONTAINER	EV (xxx1, DCM, “Waveform Annotations”)	1	M		
7b	>>	HAS CONCEPT MOD	INCLUDE	DTID 4019 “Algorithm Identification”	1	U		
8	>>	CONTAINS	CONTAINER	EV (xxx3, DCM, “Waveform Annotation Group”)	1-n	M		
8b	>>>	HAS OBS CONTEXT	NUM	EV (xxx4, DCM, “Waveform	1	U		UNITS = (1, UCUM, “no units”)

				Annotation Group Number")				
8c	>>>	HAS OBS CONTEXT	TEXT	EV (xxx5, DCM, Waveform Annotation Group Label")	1	U		
9a	>>>	CONTAINS	INCLUDE	DTID XXX2 "Waveform Pattern or Event"	1-n	U		$Annotation Classification = EV (ccc2-1, DCM, "Pattern Event") $Annotation Code = BCID 3038 "Pattern Events"
9b	>>>	CONTAINS	INCLUDE	DTID XXX2 "Waveform Pattern or Event"	1-n	U		$Annotation Classification = EV (ccc2-2, DCM, "EEG-Annotation") $Annotation Code = BCID 3035 "EEG Annotation – Neurophysiologic Enumeration"
9c	>>>	CONTAINS	INCLUDE	DTID XXX2 "Waveform Pattern or Event"	1-n	U		$Annotation Classification = EV (ccc2-3, DCM, "EMG-Annotation") $Annotation Code = BCID 3036 "EMG Annotation – Neurophysiologic Enumeration"
9d	>>>	CONTAINS	INCLUDE	DTID XXX2 "Waveform Pattern or Event"	1-n	U		$Annotation Classification = EV (ccc2-4, DCM,

								"EOG-Annotation") $Annotation Code = BCID 3037 "EOG Annotation – Neurophysiological Enumeration"
9e	>>>	CONTAINS	INCLUDE	DTID XXX2 "Waveform Pattern or Event"	1-n	U		$Annotation Classification = EV (ccc2-5, DCM, "Device-related and Environment-related Event") $Annotation Code = BCID 3039 "Device-related and Environment-related Event"
9f	>>>	CONTAINS	INCLUDE	DTID XXX2 "Waveform Pattern or Event"	1-n	U		$Annotation Classification = EV (ccc2-6, DCM, "Patient Consciousness") $Annotation Code = BCID ccc5 "Patient Consciousness"
9g	>>>	CONTAINS	INCLUDE	DTID XXX2 "Waveform Pattern or Event"	1-n	U		$Annotation Classification = EV (ccc2-7, DCM, "ECG Annotation") $Annotation Code = BCID

								3335 “ECG Annotation”
10	>>>	CONTAINS	INCLUDE	DTID XXX3 “Waveform Measurement”	1-n	U		$Measurement = BCID 3040 EEG Annotation – Neurological Monitoring Measurement
11	>>>	CONTAINS	INCLUDE	DTID XXX4 “Annotation Note”	1-n	U		

Content Item Description

Row 4	A coded descriptor of the sort of procedure the annotations apply to.
Row 5	Indicates the point in time when the Annotations have been made relative to the waveform recording procedure.
Row 6	The Waveform Library provides potentially relevant characteristics of the waveform objects associated with the annotations. There is no requirement to include all, or any, of the waveform objects referenced in the annotations and measurements elsewhere in this template. The template may also include waveform objects that are associated with, but not directly referenced in, the annotations and measurements. The Waveform Library is not replicating the content of the SOP Instance Reference Macro.
Row 8b	Defines an identifier for a group of annotations analogously to Annotation Group Number (0040,A180) see C.10.10.1.4, which may be used for example for display purposes. The number itself is not semantically significant, no ordering is required.
Row 8c	A descriptive label for a group of annotations, e.g. to be used for display purpose.

TID XXX2 Waveform Pattern or Event

This Template encodes a Waveform Annotation represented by a coded concept.

Table TID XXX2. Parameters

Parameter Name	Parameter Usage
$AnnotationClassification	A coded term or Context Group for Concept Name of annotation type that determines the value set constraint.
$AnnotationCode	A code or a context group with codes representing the observation.

Type: Non-Extensible

Order: **Significant**
Root: **No**

Table TID XXX2. Waveform Pattern or Event

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CODE	$AnnotationClassification	1	M		$AnnotationCode
1a	>	HAS PROPERTIES	CODE	EV (xxx6, DCM, “Waveform Annotation Modifier”	1-n	U		
2	>	HAS OBS CONTEXT	INCLUDE	DTID 1001 “Observation Context”	1	U		
3	>	HAS CONCEPT MOD	INCLUDE	DTID 4019 “Algorithm Identification”	1	U		
4	>		INCLUDE	DTID 321 “Waveform or Temporal Coordinates”	1-n	M		$Purpose = EV (260753009, SCT, “Source”)
5	>	HAS PROPERTIES	TEXT	EV (125309, DCM, “Short Label”	1	U		

Content Item Description

Row 1a	Contains additional qualifiers, if the value in Row 1 does not fully define the annotation. For example, this might be information about the location of an observation or the frequentness of a pattern.
Row 5	This may be used to label the coded annotation when space is limited on the screen or report page. Note Short Labels are not standardized and may omit details of the annotation; thus, it is not recommended to use them for purposes such as matching.

TID XXX3 Waveform Measurement

This Template encodes a Waveform Annotation expressing a measurement.

Table TID XXX3. Parameters

Parameter Name	Parameter Usage
$Measurement	Coded term or Context Group for Concept Name of measurement.

Type: **Non-Extensible**
Order: **Significant**

222 **Root: No**

223

224 **Table TID XXX3. Waveform Measurement**

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			NUM	§Measurement	1	M		
1a	>	HAS PROPERTIES	CODE	EV (xxx6, DCM, “Waveform Annotation Modifier”	1-n	U		
2	>	HAS OBS CONTEXT	INCLUDE	DTID 1001 “Observation Context”	1	U		
3	>	HAS CONCEPT MOD	INCLUDE	DTID 4019 “Algorithm Identification”	1	U		
4	>		INCLUDE	DTID 321 “Waveform or Temporal Coordinates”	1-n	M		$Purpose = EV (121112, DCM, “Source of Measurement”)
5	>	HAS PROPERTIES	TEXT	EV (125309, DCM, “Short Label”	1	U		

225

226 **Content Item Description**

Row 5	This may be used to label the measurement value when space is limited on the screen or report page. 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.

227

228 **TID XXX4 Annotation Note**

229 This Template defines a Waveform Annotation in the form of a text note.

230

231 **Type: Non-Extensible**

232 **Order: Significant**

233 **Root: No**

234

235 **Table TID XXX4. Annotation Note**

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

1			TEXT	EV (xxx7, DCM, “Annotation Note”	1	M		
2	>	HAS OBS CONTEXT	INCLUDE	DTID 1001 “Observation Context”	1	U		
3	>	HAS CONCEPT MOD	INCLUDE	DTID 4019 “Algorithm Identification”	1	U		
4	>		INCLUDE	DTID 321 “Waveform or Temporal Coordinates”	1-n	M		$Purpose = EV (260753009, SCT, “Source”)
5	>	HAS PROPERTIES	TEXT	EV (125309, DCM, “Short Label”	1	U		

Content Item Description

Row 5	This may be used to label the text value when space is limited on the screen or report page. Note Short Labels are not standardized and may omit details of the Annotation Note text; thus, it is not recommended to use them for purposes such as matching.

TID XXX5 Waveform Library

The Waveform Library contains references to waveform objects and selected attributes describing them that facilitate analysis without having to retrieve the entire set of referenced objects.

Type: **Extensible**
Order: **Non-Significant**
Root: **No**

Table TID XXX5. Waveform Library

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (xxx8, DCM, “Waveform Library”	1	M		
2	>	CONTAINS	CONTAINER	EV (xxx9, DCM, “Waveform Library Group”)	1-n	U		
3	>>	HAS ACQ CONTEXT	INCLUDE	DTID XXX7 “Waveform Library Entry Descriptors”	1	U		

4	>>	CONTAINS	INCLUDE	DTID XXX6 “Waveform Library Entry”	1-n	U		

Row 3	These Waveform Library Entry Descriptors apply to all Waveform Library Entries in this Waveform Library Group.

TID XXX6 Waveform Library Entry

Each instance of the Waveform Library Entry Template contains the SOP Class and Instance UIDs, and selected attributes for a waveform that facilitate analysis without having to retrieve the entire set of referenced waveforms.

Type: **Extensible**
Order: **Non-Significant**
Root: **No**

Table TID XXX6. Waveform Library Entry

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			WAVEFORM		1	M		
2	>	HAS ACQ CONTEXT	INCLUDE	DTID XXX7 “Waveform Library Entry Descriptors”	1	U		

Row 2	These Waveform Library Entry Descriptors apply to the WAVEFORM in Row 1 and override descriptors in Row 3 of Section TID XXX5 in case of conflict.

TID XXX7 Waveform Library Entry Descriptors

This Template contains selected attributes for a waveform or a group of waveforms. The descriptive information may be copied from the waveforms or derived.

Type: **Extensible**
Order: **Non-Significant**
Root: **No**

Table TID XXX7. Waveform Library Entry Descriptors

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1		HAS ACQ CONTEXT	CODE	EV (121139, DCM, “Modality”)	1	U		DCID 29 „Acquisition Modality“

2		HAS ACQ CONTEXT	DATE	EV (111060, DCM, “Study Date”)	1	U		
3		HAS ACQ CONTEXT	TIME	EV (111061, DCM, “Study Time”)	1	U		
4		HAS ACQ CONTEXT	DATE	EV (111018, DCM, “Content Date”)	1	U		
5		HAS ACQ CONTEXT	TIME	EV (111019, DCM, “Content Time”)	1	U		
6		HAS ACQ CONTEXT	DATETIME	EV (xxxf, DCM, “Acquisition DateTime”)	1	U		
7		HAS ACQ CONTEXT	UIDREF	EV (xxxg, DCM, “Synchronization Frame of Reference UID”)	1	U		
9		CONTAINS	INCLUDE	DTID XXX8 “Waveform Library Entry Multiplex Group Descriptors”	1-n	U		

TID XXX8 Waveform Library Entry Multiplex Group Descriptors

This Template contains selected attributes for a waveform multiplex group within a waveform object or a group of waveform objects. The descriptive information may be copied from the waveform objects or derived.

Type: **Extensible**
Order: **Non-Significant**
Root: **No**

Table TID XXX8. Waveform Library Entry Multiplex Group Descriptors

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (xxxa, DCM, “Waveform Library Entry Multiplex Group Descriptors”)	1-n			

2	>	HAS ACQ CONTEXT	NUM	EV (xxxb, DCM, “Multiplex Group Number”)	1	U		UNITS = (1, UCUM, “no units“)
3	>	HAS ACQ CONTEXT	UIDREF	EV (xxxc, DCM, “Multiplex Group UID”)	1	U		
4	>	HAS ACQ CONTEXT	NUM	EV (xxxd, DCM, “Sampling Frequency”)	1	U		UNITS = (Hz, UCUM, “Hz”)
5	>	HAS ACQ CONTEXT	NUM	EV (xxxe, DCM, “Number of Channels”)	1	U		UNITS = EV ({channels}, UCUM, “channels”)

Add new context groups to annex C

CID ccc3 Waveform Annotations Document Title

Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML
Keyword: WaveformAnnotationsDocumentTitle
FHIR Keyword: dicom-cid-ccc3-WaveformAnnotationsDocumentTitle
Type: Extensible
Version: yyyymmdd
UID: 1.2.840.10008.6.1.ccc3

Table CID ccc3 Waveform Annotations Document Title

Coding Scheme Designator	Code Value	Code Meaning
DCM	ccc3-1	EEG Recording Annotations
DCM	ccc3-2	EEG Post-hoc Review Annotations
DCM	ccc3-3	EEG Automated Analysis Annotations

CID ccc4 EEG Procedure

Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML
Keyword: EEGProcedure
FHIR Keyword: dicom-cid-ccc4-EEGProcedure
Type: Extensible
Version: yyyymmdd
UID: 1.2.840.10008.6.1.ccc4

Table CID ccc4 EEG Procedure

Coding Scheme Designator	Code Value	Code Meaning
SCT	54550000	EEG
SCT	252735006	Ambulatory EEG
SCT	252721009	Scalp EEG
SCT	18648009	Sleep EEG
SCT	252738008	Video EEG
…		

CID ccc5 Patient Consciousness

Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML
Keyword: PatientConsciousness
FHIR Keyword: dicom-cid-ccc5-PatientConsciousness
Type: Extensible
Version: yyyymmdd
UID: 1.2.840.10008.6.1.ccc5

Table CID ccc5 Patient Consciousness

Coding Scheme Designator	Code Value	Code Meaning
SCT	248220008	Asleep
SCT	248218005	Awake
SCT	271782001	Drowsy
…		

Amend existing context groups

CID 3035 EEG Annotation – Neurophysiologic Enumeration

This Context Group comprises codes for Neurophysiologic Enumerations related to electroencephalography. MDC codes come from the corresponding table of ISO/IEEE 11073-10101. MDC terms included in the table below may not constitute the complete list; see the ISO/IEEE Standard.

Note

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Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML
Keyword: EEGAnnotationNeurophysiologicEnumeration
FHIR Keyword: dicom-cid-3035-EEGAnnotationNeurophysiologicEnumeration

Type: **Extensible**
Version: **20200623**
UID: **1.2.840.10008.6.1.1333**

Table CID 3035. EEG Annotation – Neurophysiologic Enumeration

Coding Scheme Designator	Code Value	Code Meaning	ISO/IEE 11073 MDC Equivalent Reference ID (Informative)
DCM	cid3035-c1	Line noise artifact	

CID 3039 Device-related and Environment-related Event

This Context Group comprises the nomenclature and codes for device-related and environment-related events of ISO/IEEE 11073-10101. The terms included in the table below may not constitute the complete list; see the ISO/IEEE Standard.

Note

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Resources: **HTML | FHIR JSON | FHIR XML | IHE SVS XML**
Keyword: **DeviceRelatedAndEnvironmentRelatedEvent**
FHIR Keyword: **dicom-cid-3039-DeviceRelatedAndEnvironmentRelatedEvent**
Type: **Extensible**
Version: **20200623**
UID: **1.2.840.10008.6.1.1337**

Table CID 3039. Device-related and Environment-related Event

Coding Scheme Designator	Code Value	Code Meaning	ISO/IEE 11073 MDC Equivalent Reference ID (Informative)
DCM	**cid3039-c1**	**Video recording on**	
DCM	**cid3039-c2**	**Video recording off**	
DCM	**cid3039-c3**	**Preamplifier connected**	
DCM	**cid3039-c4**	**Preamplifier disconnected**	
DCM	**cid3039-c5**	**Breakout box connected**	
DCM	**cid3039-c6**	**Breakout box disconnected**	
DCM	**cid3039-c7**	**Event Button pressed**	
DCM	**cid3039-c8**	**Event Button test**	
DCM	**cid3039-c9**	**Tap test begin**	
DCM	**cid3039-c10**	**Tap test end**	

Amend Annex D Table D-1. with new Enumerated Values

370 **D DICOM Controlled Terminology Definitions**

371 **Table D-1. DICOM Controlled Terminology Definitions (….)**

Code Value	Code Meaning	Definition	Notes
…			
ccc2-1	**Pattern Event**	**Classification of a Waveform annotation as a pattern.**	
ccc2-2	**EEG Annotation**	**Classification of a Waveform annotation as belonging to EEG.**	
ccc2-3	**EMG Annotation**	**Classification of a Waveform annotation as belonging to ECG.**	
ccc2-4	**EOG Annotation**	**Classification of a Waveform annotation as belonging to EOG.**	
ccc2-5	**Device-related and Environment-related Event**	**Classification of a Waveform annotation as an event, which occurred in the recording device or in the environment (e.g. the room)**	
ccc2-6	**Patient Consciousness**	**Classification of a Waveform annotation as a description of the patient's consciousness.**	
ccc2-7	**ECG Annotation**	**Classification of a Waveform annotation as belonging to ECG.**	
xxx1	**Waveform Annotations**	**A container that groups waveform annotations.**	
xxx2	**Procedure annotated**	**The neurophysiology or cardiology procedure to which annotations apply.**	
xxx3	**Waveform Annotation Group**	**A container that groups a set of associated waveform annotations.**	
xxx4	**Waveform Annotation Group Number**	**A number identifying a set of associated annotations.**	
xxx5	**Waveform Annotation Group Label**	**A text describing a set of associated annotations.**	
xxx6	**Waveform Annotation Modifier**	**Coded modifier for a coded waveform annotation.**	
xxx7	**Annotation Note**	**A free text information.**	
xxx8	**Waveform Library**	**A container that references properties of involved waveforms**	
xxx9	**Waveform Library Group**	**A container that groups common information about a set of involved waveforms**	
xxxa	**Waveform Library Entry Multiplex Group Descriptors**	**A container that groups common information about a waveform multiplex group comprising a set of recording channel**	

xxxb	Multiplex Group Number	Identifying number of a waveform multiplex group	
xxxc	Multiplex Group UID	Unique identifier of a waveform multiplex group	
xxxd	Sampling Frequency	Frequency of waveform digitalization	
xxxe	Number of Channels	Number of channels in a waveform multiplex group	
xxxf	Acquisition DateTime	Date and Time of an Acquisition	
xxxg	Synchronization Frame of Reference UID	UID of common synchronization environment.	
...			
cid3035-c1	Line noise artefact	50 Hz or 60 Hz line noise artifact from a power supply	
cid3039-c1	Video recording on	Video recording turned on automatically or by the operator	
cid3039-c2	Video recording off	Video recording turned off automatically or by the operator	
cid3039-c3	Preamplifier connected	Machine code for when the preamplifier (the headbox in case of EEG recordings) is connected to the recording device.	
cid3039-c4	Preamplifier disconnected	Machine code for when preamplifier (the headbox in case of EEG recordings) is disconnected.	
cid3039-c5	Breakout box connected	A breakout box was connected or reconnected.	A breakout box is a box into which electrode cables are plugged, but the analog electrical signal of those cables is passed from the breakout box to the preamplifier (the headbox in case of EEG recordings) through another cable, so there is no preamp or A/D conversion in the box.

cid3039-c6	**Breakout box disconnected**	**A breakout box was disconnected.**	**A breakout box is a box into which electrode cables are plugged, but the analog electrical signal of those cables is passed from the breakout box to the preamplifier (the headbox in case of EEG recordings) through another cable, so there is no preamp or A/D conversion in the box.**
cid3039-c7	**Event button pressed**	**The event button was pressed.**	**The event button is a button that a medical staff member, patient, or family/friend of patient can press when the patient (who is getting the recording) has an event (such as an abnormal movement or seizure).**
cid3039-c8	**Event button test**	**The event button was pressed for the purpose of testing.**	**Testing the event button usually occurs at the beginning of a neurophysiology recording to make sure the mechanism is working.**
cid3039-c9	**Tap test begin**	**The tap test is started.**	**A tap test is when the operator taps each electrode in sequence to verify that each electrode is plugged into the correct channel of the preamplifier (the headbox in case of EEG recordings).**

cid3039-c10	**Tap test end**	**The tap test has finished.**	**A tap test is when the operator taps each electrode in sequence to verify that each electrode is plugged into the correct channel of the preamplifier (the headbox in case of EEG recordings).**

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Changes to NEMA Standards Publications PS3.17

Digital Imaging and Communications in Medicine (DICOM)
Part 17: Explanatory Information

Add a new chapter to Annex SSSS Neurophysiology Waveforms

SSSS.2 Example Waveform Annotations SR for an EEG recording

The following example lists a Waveform Annotations SR containing coded annotations as well as measurements and also some Annotations notes.

```
Patient             : TEst123^TEst123 (1970-01-01, #TEst123)
Study               : EEG Aufnahme
Manufacturer        : Austrian Institute of Technology
Completion Flag     : PARTIAL
Verification Flag   : UNVERIFIED
Content Date/Time   : 2023-11-04 16:03:27

1  <CONTAINER:(,,"EEG automated analysis result")=SEPARATE>
1.1  <has concept mod CODE:(,,"Language of Content Item and Descendants")=(en,RFC5646,"English")>
1.2  <has obs context CODE:(,,"Observer Type")=(121007,DCM,"Device")>
1.3  <has obs context UIDREF:(,,"Device Observer UID")="1.2.3.4">
1.4  <has obs context TEXT:(,,"Device Observer Name")="encevis">
1.5  <has obs context TEXT:(,,"Device Observer Manufacturer")="Austrian Institute of Techn...">
1.6  <has obs context TEXT:(,,"Device Observer Model Name")="encevis">
1.7  <has obs context TEXT:(,,"Device Observer Serial Number")="encevis 2.0.3-Build:60986">
1.8  <contains CONTAINER:(,,"Unique Device Identifiers")=SEPARATE>
1.8.1  <contains TEXT:(,,"Unique Device Identifier")="09120109830092">
1.9  <has concept mod CODE:(,,"Procedure Annotated")=(54061003,SCT,"Portable
electroencephalogram")>
1.10  <has concept mod CODE:(,,"Relative Time")=(303110006,SCT,"After Procedure")>
1.11  <contains CONTAINER:(,,"Waveform Annotations")=SEPARATE>
1.11.1  <has concept mod TEXT:(,,"Algorithm Name")="EpiSpike">
1.11.2  <has concept mod TEXT:(,,"Algorithm Version")="2.0.3">
1.11.3  <contains CONTAINER:(,,"Waveform Annotation Group")=SEPARATE>
1.11.3.1  <has obs context NUM:(,,"Waveform Annotation Group Number")="1" (1,UCUM,"no units")>
1.11.3.2  <has obs context TEXT:(,,"Waveform Annotation Group Label")="Annotation Group #1">
1.11.3.3  <contains CODE:(,,"EEG-Annotation")=(2:23920,MDC,"Spike and wave complex")>
1.11.3.3.1  <has properties CODE:(,,"Waveform Annotation Modifier")=(87017008,SCT,"focal")>
1.11.3.3.2  <inferred from TCOORD:(,,"Source")=(SEGMENT,39300,...)>
1.11.3.3.2.1  <selected from
WAVEFORM:(,,"Source")=(RoutineScalpElectroencephalogramWaveformStorage,,1/1,...)>
1.11.3.4  <contains CODE:(,,"EEG-Annotation")=(2:23840,MDC,"Small sharp spike")>
1.11.3.4.1  <inferred from TCOORD:(,,"Source")=(SEGMENT,23023,...)>
1.11.3.4.1.1  <selected from
WAVEFORM:(,,"Source")=(RoutineScalpElectroencephalogramWaveformStorage,,1/1,...)>
1.11.3.5  <contains CODE:(,,"EEG-Annotation")=(2:23904,MDC,"Epileptic or potentially
epileptogenic spike")>
1.11.3.5.1  <inferred from TCOORD:(,,"Source")=(SEGMENT,28611,...)>
1.11.3.5.1.1  <selected from
WAVEFORM:(,,"Source")=(RoutineScalpElectroencephalogramWaveformStorage,,1/1,...)>
1.11.3.6  <contains NUM:(,,"Heart Rate")="65" ({H.B.}/min,UCUM,"BPM")>
1.11.3.6.1  <inferred from TCOORD:(,,"Source of Measurement")=(MULTIPOINT,35611,...)>
1.11.3.6.1.1  <selected from WAVEFORM:(,,"Source of
Measurement")=(RoutineScalpElectroencephalogramWaveformStorage,)>
1.11.3.7  <contains NUM:(,,"Mean blood pressure")="120" (mm[Hg],UCUM,"mmHg")>
1.11.3.7.1  <inferred from TCOORD:(,,"Source of Measurement")=(MULTIPOINT,28611,...)>
1.11.3.7.1.1  <selected from WAVEFORM:(,,"Source of
Measurement")=(RoutineScalpElectroencephalogramWaveformStorage,)>
1.11.3.8  <contains TEXT:(,,"Annotation Note")="This is a free text annotation"> {2023-06-13
11:59:59}
1.11.3.8.1  <inferred from TCOORD:(,,"Source")=(POINT,12000)>
1.11.3.8.1.1  <selected from
WAVEFORM:(,,"Source")=(RoutineScalpElectroencephalogramWaveformStorage,)>
```

```
1.11.4  <contains CONTAINER:(,,"Waveform Annotation Group")=SEPARATE>
1.11.4.1  <has obs context NUM:(,,"Waveform Annotation Group Number")="2" (1,UCUM,"no units")>
1.11.4.2  <has obs context TEXT:(,,"Waveform Annotation Group Label")="Annotation Group #2">
1.11.4.3  <contains CODE:(,,"EEG-Annotation")=(2:23920,MDC,"Spike and wave complex")>
1.11.4.3.1  <inferred from TCOORD:(,,"Source")=(SEGMENT,19300,...)>
1.11.4.3.1.1  <selected from
WAVEFORM:(,,"Source")=(RoutineScalpElectroencephalogramWaveformStorage,,1/1,...)>
1.11.4.4  <contains CODE:(,,"EEG-Annotation")=(2:23840,MDC,"Small sharp spike")>
1.11.4.4.1  <inferred from TCOORD:(,,"Source")=(SEGMENT,33023,...)>
1.11.4.4.1.1  <selected from
WAVEFORM:(,,"Source")=(RoutineScalpElectroencephalogramWaveformStorage,,1/1,...)>
1.11.4.5  <contains CODE:(,,"EEG-Annotation")=(2:23904,MDC,"Epileptic or potentially
epileptogenic spike")>
1.11.4.5.1  <inferred from TCOORD:(,,"Source")=(SEGMENT,38611,...)>
1.11.4.5.1.1  <selected from
WAVEFORM:(,,"Source")=(RoutineScalpElectroencephalogramWaveformStorage,,1/1,...)>
1.11.4.6  <contains NUM:(,,"Heart Rate")="65" ({H.B.}/min,UCUM,"BPM")>
1.11.4.6.1  <inferred from TCOORD:(,,"Source of Measurement")=(MULTIPOINT,15611,...)>
1.11.4.6.1.1  <selected from WAVEFORM:(,,"Source of
Measurement")=(RoutineScalpElectroencephalogramWaveformStorage,)>
1.11.4.7  <contains NUM:(,,"Mean blood pressure")="120" (mm[Hg],UCUM,"mmHg")>
1.11.4.7.1  <inferred from TCOORD:(,,"Source of Measurement")=(MULTIPOINT,38611,...)>
1.11.4.7.1.1  <selected from WAVEFORM:(,,"Source of
Measurement")=(RoutineScalpElectroencephalogramWaveformStorage,)>
1.11.4.8  <contains TEXT:(,,"Annotation Note")="This is a free text annotation"> {2023-06-13
11:59:59}
1.11.4.8.1  <inferred from TCOORD:(,,"Source")=(POINT,22000)>
1.11.4.8.1.1  <selected from
WAVEFORM:(,,"Source")=(RoutineScalpElectroencephalogramWaveformStorage,)>
```