Supplement 217

NEUROPHYSIOLOGY WAVEFORMS
DICOM WORKING GROUP 32
PRE - PUBLIC COMMENT
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Introducing Working Group 32

ORGANIZATION AND PURPOSE
Introducing Working Group 32

Chaired by:
- Jonathan Halford
  Medical University of South Carolina (MUSC)
- Shiv Sabesan
  Philips Neuro

Secretary:
- The International Federation of Clinical Neurophysiology (IFCN)
  Catherine Lamoureux
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Ultimate goal is

- a comprehensive, standard-based digital platform for neurophysiology in the patient care setting

New specification should

- Leverage the existing and growing ecosystem of DICOM-capable systems in use in healthcare institutions
- Leverage standards already in use in the neurophysiology industry
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Short-term objectives:

- New IOD(s) for storing neurophysiology data in PACS or VNA
  - Direct association with the patient
  - Together with related objects such as video or ECG
  - Keeping data synchronized
- Gap analysis of existing DICOM Standard with respect to potential neurophysiology requirements (e.g. waveform compression)
- Identify and establish relationship to other DICOM Working Groups currently responsible for related features
- Priorities for the identified gaps
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How this happened:

- IFCN Task Force in 2018
  - “Common Standard Format for Neurophysiology Data Exchange”
- In Vienna some research projects were initiated:
  - Using DICOM Waveforms for EEG and Sleep Studies
  - Proofed EHR integration, EEG analysis algorithms running on DICOM Waveforms
- Clear vote of the IFCN Task Force for DICOM
- Kickoff for Working Group 32 in Dec. 2018
- First Read of Sup217 Jun, 3rd 2019
Neurophysiology Waveforms

EXTENDING DICOM WAVEFORMS TO NEW DOMAINS
DICOM Waveforms

DICOM Support since 2000

- Audio: 2 SOP Classes
- ECG: 3 SOP Classes
  - 12-lead, General ECG, Ambulatory
- Arterial Pulse Waveform
- Respiratory Waveform
- Basic Cardiac Electrophysiology
- Hemodynamic

DICOM PS3.17 Fig. C.4-1.
DICOM Waveforms

- Waveform Attributes
  - Acquisition Time
  - Acquisition Context
  - Annotations
- Channel Multiplexing
- Channel Attributes
  - Channel Source
  - Scaling
  - Callibration
  - Filter
- Sample Values

DICOM Waveform Information Model PS3.17 Fig. C.5-1
<table>
<thead>
<tr>
<th>Scenario</th>
<th>Recording</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine EEG</td>
<td>Scalp EEG</td>
<td>Encephalography, epilepsy</td>
</tr>
<tr>
<td>EEG-Video-Monitoring</td>
<td>Scalp EEG</td>
<td>Seizure characterization, presurgical epilepsy evaluation</td>
</tr>
<tr>
<td>EEG-Video Monitoring – intracranial</td>
<td>Implanted electrodes</td>
<td>presurgical epilepsy evaluation</td>
</tr>
<tr>
<td>Longterm EEG Monitoring</td>
<td>Scalp EEG</td>
<td>Encephalographyh, epilepsy, ICU</td>
</tr>
<tr>
<td>Polysomnography</td>
<td>Scalp EEG, EMG, EOG + additional</td>
<td>Sleep disorders</td>
</tr>
<tr>
<td>High-density EEG</td>
<td>More Electrodes, req. 3D localization</td>
<td></td>
</tr>
<tr>
<td>EEG-fMRI</td>
<td>Sync. Acquisition of EEG and MRI</td>
<td></td>
</tr>
</tbody>
</table>
Routine Scalp EEG

Properties
- Electrode positions according the international 10/20 or 10/10 system
- Maybe alternative setting using a cap instead of single electrodes
- Up to 64 channels, sampling frequency up to 1024 Hz
- Additionally recorded: single ECG channel

Nomenclature: ISO IEEE 11073 10101
- Leads
  A.8.4 Sites for EEG-electrode placement on the head
- Annotations

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Polysomnography

Multimodal recording:

- Additionally required:
  - EMG (activity of skeletal muscles)
  - EOG (eye activity)
- Reuse of existing objects:
  - Video
  - arterial pulse waveform (pulse oximetry)
  - sound recordings

Nomenclature: ISO 11073 10101
Why this makes sense ….

- Compatible to / reuse of existing objects
  - ECG, pulse oximetry, respiratory, video and synchronization
  - Probably methods to spatially align with imaging in case of intracranial recording
- No silos: data will be semantically interoperable in terms of
  - Locations, annotations, and acquisition context
- Integration to clinical infrastructure
  - PACS, VNA, EHR, …
Sup 217 now contains a shortened list of SOP Classes
- Focussing on main clinical routine scenarios
- Deferred to later (shall become an additional supplement)
  - Long running recordings (like Epilepsy monitoring)
  - Recording with many electrodes and/or high sampling frequency
  These huge data sets require compression algorithms for time series.
- Work on Context Groups (not finished yet)