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Meeting Minutes

DICOM WORKING GROUP SEVEN (RADIOTHERAPY)

Meeting Location	Online Meeting	
Dates and Times	October 4-5 and 11-12, 2021	
	Mon – Tues, Mon – Tues	9:00 – 13:00 EDT
Presiding Officers	Christof Schadt, Co-Chair Jim Percy, Co-Chair	
Secretary	Shayna Knazik, MITA	

Participants

Name	Affiliation	Oct 4	Oct 5	Oct 11	Oct 12
Jim Percy	Elekta	X	X	X	X
Walter Bosch	AAPM	X	X	X	X
Yulong Yan	AAPM	X	X		X
Bruce Curran	AAPM	X	X	X	X
Bruce Rakes	Mevion	X	X		
Bob Pekarek	Accuray	X	X	X	X
Kari Jyrkkälä	Varian	X	X	X	X
Ulrich Busch	Varian	X	X	X	X
David Wikler	IBA	X	X	X	
Christof Schadt	Brainlab	X	X	X	X
Harold Beunk	ICT				
Stefan Pall Boman	RaySearch	X		X	X
Marcus Bergman	RaySearch	X	X	X	X
Chris Pauer	Sun Nuclear				
Thomas Schwere	Varian				
Rollo Moore	Royal Marsden NHS	X	X		
Jon Treffert	RaySearch	X	X		
Steve Weston	Leeds Teaching Hosp. NHS	X		X	X
Shayna Knazik	MITA	X	X	X	X
Robert Ward	Rhode Island Medical Imaging		X		

Actual Week Schedule

	Monday	Tuesday	Monday	Tuesday
Session 1 09:00-09:55	Setup, Administrative, Opening Group Status	Adaptive RT Presentation	CPs	CID 9535 Commissioning Keys (WG-06) Hybrid Discussions Approval
Session 2 10:00-10:50	New CP	CPs in Work	CPs	Hybrid Discussions
Session 3 11:10-12:00	Assigned CPs	CPs in Work	RT Segment Annotation and Roles	Hybrid Discussions
Session 4 12:05-13:00	Other Topics	Segmentation Creation Template	CID 9535	Hybrid Discussions Future Meetings

Topics

- Meeting called to order at 9:05am EDT on October 4, 2021.
- Shayna reminded the group of NEMA anti-trust and patent policies.
- Minutes from Aug 2021 meeting were reviewed and approved by the group without objection or abstention.

Subgroup Reports

Brachy subgroup

- Subgroup is working toward a Connectathon to test TPPC-Brachy Profile.

Ion subgroup

- Working on TDRC to set the content of RT Ion Beam Treatment Record. David reported progress. No DICOM CPs to report at present.

Motion Management subgroup

- Definition of motion management categories is underway. The group is organizing those concepts.

IHE-RO

- A DICOM CP to add 4D CT annotation has been discussed. Suggest to forward to the CT Working Group
- High-resolution contouring approach has been discussed. Proposal to retire attached contours.

WG-28

- The group is drafting an RDSR Informative Annex
- Working on radiofluoroscopy.
- Group met recently, plans to meet next Dec 15

NOTE: Email aliases for DICOM WGs listervs have changed. Shayna can provide updated aliases if needed.

DICOM Standard Reference

- Several WG members use the online HTML version. It was noted that the latest edition loads much more slowly than earlier ones.
- Difficulty noted in searching the PDF version.
- It was noted that Google has indexed an early version of the Standard. Recent additions are not found in Google search results.
- **Action:** Christof to summarize access/search issues for WG-29.

Correction Proposals

CpRT190 – Linking facility from 2nd Gen to 1st Gen

- Annotates the source of information for 2nd Gen objects that have been transcoded from 1st Gen. Links
 - RT Radiation Set IOD to RT Plan or RT Ion Plan
 - RT Radiation IOD to RT Beam, RT Brachy Application (?) or RT Ion Beam item in RT Plan IOD
 - RT Radiation Record to Treatment Session Beam, Treatment Session Application Setup, or Treatment Session Ion Beam
- Introduces Definition Source Sequence (0008,1156) in RT Radiation Common
- It was discussed to introduce a section that explains the two intended use cases:
 - Transcribing from 1st to 2nd Gen (and vice versa)
 - Putting out 1st and 2nd Gen Instances in parallel
- The need for Brachy application setups was discussed, whether these should be removed from the CP.
- The reference from the RT Record Set will be removed.
- Mr. Busch will continue to work on the CP and include the direction from 1st to 2nd Gen as well cover Dose References.
- As a result, CP RT155 will be cancelled.

CP RT191, RT192 - Approval enhancements

- Discussion of CP RT191 Add Approval Module to Spatial Registration IOD and Deformable Spatial Registration IOD and CP RT192 Enhanced Approval to support multiple approvals and approval to a portion of an object, e.g., an ROI in an RT Structure Set.
 - Concern was expressed about proliferation of instances when meta-information is changed.
 - DICOM Assertion mechanism or RT Course could address these issues.
 - This topic will be discussed again in the context of 1st/2nd Gen Hybrid issues.

CP RT185 Add Patient to Equipment Matrix Examples

- Work continues to check calculation of matrices.

CP RT187 Multi-layer MLC

- This CP was discussed in the context of a potential hybrid solution.

CP RT152 RT Physician Intent Reference from RT Plan

- This CP was set aside earlier, but may be reconsidered in the context of other hybrid discussions.

- It would be helpful to maintain a list of CPs relevant to hybridization.

cp2151 Add Baseline CIDs To RT Structure Set

- Now as the structure is done, review the text and prepare it for Voting Packet.
 - The CP provides detailed guidance for use of RT Segmentation Property Category Codes and RT ROI Identification Codes to RT ROI Observation Module in RT Structure Set. The same CIDs are used for both Segmentation Annotation Type Code and RT ROI Identification Code. It also adds Therapeutic Role Category and Type codes.
 - Retirement of ORGAN as a Defined Term for RT ROI Interpreted Type to be considered as part of CP 2150 (adds OAR to Defined Terms).
 - Suggestion to retire RT ROI Observation Label and RT ROI Description attributes
 - Action:** Kari to draft CP.
 - **Action:** Christof will finish clean-up of CP-2151 and present to WG-06.

cp_RT185 Add Patient to Equipment Matrix Examples

- Homework by U. Busch. Tabled, awaiting further work.

cp_RT187 Multi-layer MLC

- Tabled, waiting for new proposal by U. Busch

cp_RT189 Add Referenced Beam Number to CT

- This CP has been rejected by WG-07. D. Wikler is providing a new CP RT196.

cp_RT166 Differentiate Geometric Types of CT Imaging Sources

- Draft reviewed by Yulong Yan.
- Discussion of Beam Geometry and Beam Collimation concepts. Acceptance in the broader CT Standard is challenging.
- Proposal to add a flag indicating that reconstruction is based on signals from a planar detector. Planar Projection Acquisition (,) Type 3 Flag indicating that CT is a reconstructed from a planar projection, Enumerated Values: YES, NO
- **Action:** Yulong Yan to continue editing of the CP.

cp_RT175 Retire Beam Dose Depth parameters

- No news on this CP.

Cp_RT193 Simplification of RT Observations Module

- CP retires RT Observation Label and RT Observation Description attributes in RT Observations Module of the RT Structure Set
- Consensus to forward to WG-06 for review. **Action:** Christof will present to WG-06.

Cp RT 194 Add Used ROI Sequence to Registration

- CP supports use of ROIs to define spatial registration (analogous to used fiducials)
- References Talairach Brain Atlas well-known Frame of Reference
- Consensus to forward to WG-06 for review. **Action:** Christof will present to WG-06.

CP 2151 Brachy Accessory RT ROI Interpreted Type Code Mapping

- Removes baseline CID for BRACHY ACCESSORY in RT ROI Interpreted Type Code Mapping table
- Discussion of Radiotherapy Role Category Codes. Distinguishing entities and roles is helpful. **Action:** Christof to revise for further discussion Oct 12.

CP RT197 Change references to “Planning Organ at Risk Volume” in CID 9535 to “Planning Risk Volume”

- CP to change “Planning Organ at Risk Volume” to align with ICRU terminology was prepared for review by WG-06.

CP_RT195 Conceptual Volume in RT Structure Set

- Adding the Conceptual Volume Macro to the RT Structure Set was discussed.
- Managing the history of CV UIDs was discussed. The Originating SOP Instance Reference Sequence (3010,0007) is Type 1C. It needs to be changed to Type 3.
 - The origin of CV UIDs was considered to be of limited value, but managing this information can be burdensome.
 - Segmentation may occur before prescription.
 - Equivalency of CVs and reconciliation of UIDs must be addressed.
- Conceptually, the CV serves a similar purpose as the Dose Reference UID.
- The Conceptual Volume Macro was considered to be sufficient for use in the RT Structure Set, since the use of the Conceptual Volume Reference and Combination Macro would require instantiating an RT Segmentation Annotation.
 - Add Conceptual Volume Identification Sequence (Type 3) with a single item (the Conceptual Volume Macro).
- **Action:** Jim will edit offline to prepare for presentation to WG-06.

CP RT196 Add Treatment Session UID to CT Images and RT Objects

- David W. presented a draft CP that would add Treatment Session UID to all CT images and RT objects created during an RT Treatment Session
- Should this apply to all images (e.g., MR, US, etc.)?
- Treatment Session UID uniquely identifies a treatment session. Options for where to include this attribute.
 - Add to specific image and RT IODs
 - RT Series Module

- General Reference Module (covers all RT Objects except RT Dose)
- **Action:** David will edit offline and post to Teams.

Supplements

Sup 213 (DLB3) - Enhanced RT Image

- RT Patient Position Scope Macro defined in Sup 160 to reference RT Radiations or an entire RT Radiation Set is used in Sup 213. Two approaches to extending this macro to reference 1st Gen RT Plans and Beams were discussed.
 - One approach would add Referenced RT Plan Sequence (mutually exclusive with Reference RT Radiation Sequence and Referenced RT Radiation Set Sequence) with an included Beam Sequence to specify a subset of beams, if not all are referenced.
 - An alternative approach would generalize semantics of the Referenced RT Radiation Sequence to allow references to beams in RT Plans and generalize the Referenced RT Radiation Set to permit referencing RT Plans.
 - The first approach was selected. **Action:** Uli Busch will incorporate the changes into the Supplement for further discussion later this meeting and for presentation to WG-06 in November.

Sup 196 - Segmentation Creation Template

Walter B. reviewed Supplement 196 rev. 9 with the group. Work is in progress to align the content with the current edition of the DICOM Standard.

- CT autosegmentation values are to be removed
- Therapeutic Role Category and Type codes are to be added
- Concern was expressed regarding difficulty in vendor implementation of non-patient object import. General consensus that XML would be much easier to implement. Content is nearly complete, but how to specify and publish as a standard remains challenging.
- **Action:** Jim P. will investigate AdvaMed support for development of an XML-based segmentation template standard.

General Discussions

Presentation on Adaptive Radiotherapy Workflow (Justin Park, UTSW)

1. Introduction – goal of ART is to deliver therapeutic dose to the target at each fraction
 - a. Two approaches:
 - i. On-demand changes in response to anatomical changes
 - ii. Daily (every fraction) adapt to variations in position of OARs and TVs
 - b. Current products:
 - i. Varian Ethos – CBCT based, ring gantry 6MV FFF VMAT dual-MLC

- ii. Elekta Unity - MRgRT 1.5T MRI, 7MV FFF, single MLC
 - iii. Viewray MRIdian – MRgRT 0.3T MRI, 6MV FFF, Step&shoot IMRT
- c. Features (of all systems): High-quality volumetric images, ED information propagation, autocontouring, fast dose calc/re-optimization, independent plan and dose verification tools
- 2. Adaptive Workflow
 - a. Workflow steps: Pre-treatment CT, Online MRI, deformable reg to CT, Contour adaptation, Bulk density, Online re-planning, Position verification/independent dose calc, Treatment
 - b. Manual editing of contours
 - c. Electron density transfer from primary density map (pre-plan CT) to image of the day
 - d. Dose prediction on current electron density map, DVH evaluation on new contours, check dose constraints, choose preplan or adapted plan, normalize
 - e. Approve final plan.
 - f. Independent plan evaluation (with patient on the table) - using in-house Monte Carlo (3D) or vendor-based tool
- 3. Clinical Challenges
 - a. Scheduling – requires coordination of nursing, therapy, physics, physician
 - b. Communication – cross-coverage requires specific guidelines
 - c. Treatment time – added time required (15min – 1h)
 - d. Contouring on demand – parallel re-contouring used by some
 - e. Imaging – image quality has improved, but artifacts are still an issue for accurate contouring, required breath hold for MRI may not be achievable
 - f. Robust pre-planning – proximity of OARs to TV may vary from day to day, ideal setup issues
 - g. Data exchangeability – integrated Treatment Planning Systems, unique treatment technology (e.g., dual-stack MLC)
- 4. ART promises gains in patient survival
 - a. Goal is 10-20min per Tx
- 5. Discussion
 - a. Data exchangeability remains challenging
 - i. Difficulty in exchange of plans may limit acceptance of linked information (RT Dose, RT Image).
 - ii. In general, the goal is not to re-plan in another system
 - iii. DICOM CP to improve dose portability is expected to help in compositing with prior doses.
 - iv. IHE-RO Profile are helpful, but require vendor implementation to be effective.

Commissioning Key Discussion

- Christof presented a draft CP to include a baseline TID with vendor-specific machine commissioning key codes for the Radiation Device Configuration and Commissioning Key Sequence. The TID includes multiple, user-optional UIDREF values for a Content Item Macro.
- **Action:** Christof to continue work on the CP for presentation to WG-06.

Discussion of ISO CBEM Draft Technical Report ISO/TC/215

DTR 24290 Datasets and format for clinical and biological metrics in radiation therapy

- The group reviewed the DTR Clinical and Biological Evaluation Metrics
- The document is not sufficiently mature to approve as a Technical Report.
- It does not distinguish physical vs effective dose.
- Suggestion to remove DICOM references
- Does not specify a dataset or format, rather structured content.
- **Action:** Christof and Jim to reply as WG-07 chairs.

Plan Approval Discussion

- Adding approvals to RT Structure Set or RT Plan is not practical as it results in proliferation of instances.
- Detailed approval IOD (like RT Course) is not likely to be a near-term solution.
- A light-weight item state solution (add Approval Module to KOS) was rejected by WG-06.
- Proposal to develop new IOD to represent item state at top (collection), instance (e.g., plan, structure set) and sub-instance (e.g., ROI) level.
- Use cases include clinical workflow approval (image registration, image segmentation, plan evaluation), data QA assessment, treatment history export manifest.
- **Action:** Christof to lead a subgroup. Marcus, Yulong, Walter, Bob, Uli have volunteered to participate.

Hybrid 1st Gen 2nd Gen Discussions

- Proposed enhancement to RT Plan adds a new Enumerated Value (EXTENDED) to the RT Beam Limiting Device Type (300A,00B8)
 - (Existing) Beam Limiting Device Position Sequence is present only if BLD Type is not EXTENDED
 - Enhanced RT Beam Limiting Device Sequence present only if BLD Type is EXTENDED.
 - Enhanced RT Beam Limiting Opening Sequence is present only if BLD Type is EXTENDED
- Re-using the 2nd Gen RT Beam Limiting Device Opening Macro in the context of enhanced 1st Gen RT Plan was discussed. Concern was expressed about confusion between 1st and 2nd Gen conventions for Control Point data.
- Support for binary MLCs is a related issue
- TODOs from the discussion:
 - Clarity is needed on handling of Control Point conventions when a BLD spec is used in both 1st and 2nd Gen contexts
 - Tolerance Module in 1st Gen needs to reflect the device index approach in 2nd Gen, rather than enumerated device types.

- The 2nd Gen beam modifier coordinate system is the IEC BLD coordinate system in 1st Gen.
- Extended BLD
 - Extended Beam Limiting Device Definition Flag (Type 3)
 - Beam Limiting Device Sequence (and Beam Limiting Device Position Sequence) is required if Extended Beam Limiting Device Definition Flag is absent or has the value NO.
 - Extended RT Beam Limiting Device Sequence (and Extended RT Beam Limiting Opening Sequence) is required if Extended Beam Limiting Device Definition Flag has the value YES.
- Extended BLD Coordinate system
 - Beam Modifier Definition Coordinate System is IEC6217 GANTRY
 - RT Device Distance Reference Location is machine isocenter
 - RT Beam Modifier Definition Distance is SAD
 - Angles are expressed as continuous angles
- Wording for 1st Gen control point attributes. Must be present at all CPs if they change.
- Support for tomotherapeutic binary MLC was discussed. Extensions for other treatment technologies can be accommodated.
- Decision to encode multi-layer MLC parameters using the 2nd Gen BLD model.
- CP for Multi-layer MLCs, MLCs with X-Y offset, and (eventually) binary MLCs. Draft to be based on Ul's 1st Gen – 2nd Gen Hybrid RT Plan document (in 1st Gen Hybrid Extension in Teams).
 - Add Treatment Technique Code and Manufacturers' Model Class Device Code

Future Meetings

Future WG-07 meetings

- Dec 7-8, 2021 (virtual)
- March 7-8 and 14-15, 2022 (virtual)
- June 13-17, 2022 (tentatively, at Brainlab in Chicago)
- Aug 29-30 and Sep 6-7, 2022. (Aug dates tentative)
- Oct 31, Nov 2 and Nov 7-8, 2022

Meeting adjourned at 1:00pm ET on October

Prepared by Walter Bosch
 Submitted by Shayna Knazik
 Reviewed by Counsel 10/25/21