

**IHE-RO Technical Committee
Multi-Day Teleconference
October 5-9, 2020 at 9:30-1:30 EDT**

**Technical Committee Chairs:
Scott Hadley, PhD
Chris Pauer
Jon Treffert, Incoming Chair**

**IHERO Working Group Co-Chairs
Bruce Curran, MS, ME, FAAPM, FACMP, FACR, AAPM / VCU Health
Bridget Koontz, MD, Medical Director, RO Services, Duke Regional**

Mission Statement: *The American Association of Physicists in Medicine (AAPM) sponsors a multi-society Task Force to undertake an initiative to promote the Integration of the Healthcare Enterprise (IHE) – Radiation Oncology (RO). Originally formed by the American Society for Radiation Oncology (ASTRO), it fosters seamless connectivity and integration of radiotherapy equipment and the patient health information systems. The Technical Committee of IHE-RO will undertake use cases defined by members from ASTRO, RSNA, American Association of Physicists in Medicine (AAPM), the American College of Radiology (ACR) and the Medical Imaging and Technology Alliance (MITA). In addition, members of the International community have also been invited to participate in IHE-RO. The IHE-RO Task Force, in close collaboration with radiotherapy product manufacturers, will develop appropriate integration profiles for radiation therapy and setup a demonstration of seamless communication among the full array of radiotherapy products.*

Attendees:

Name	Affiliation	Email	10/5	10/6	10/7	10/8	10/9
Chris Pauer	Sun Nuclear	chrispauer@sunnuclear.com	X	X	X	X	X
Scott Hadley	U. Mich.	swhadley@umich.edu	X	X	X	X	X
Jon Treffert	Raysearch Labs	Jon.treffert@raysearchlabs.com	X	X	X	X	X
Jill Moton	AAPM	Jill@aaapm.org	X	X	X	X	X
Walter Bosch	Wash. Univ.	wbosch@wustl.edu	X	X	X	X	X
Bruce Curran	AAPM / VCU	bhcurran@gmail.com	X	X	X	X	X
Jim Percy	Elekta	Jim.percy@elekta.com	X	X	X	X	X
Bruce Rakes	Mevion	rbrakes@mevion.com	X	X	X	X	
David Wikler	IBA	David.Wikler@iba-group.com	X	X	X	X	X
Harold Beunk	ICT	Harold.Beunk@ict.nl	X	X	X	X	X
Thomas Schwere	Varian	Thomas.Schwere@varian.com	X	X	X	X	X
Bob Pekarek	Accuray	bpekarek@accuray.com	X	X	X	X	X
Richard Voegele	Brainlab	richard.voegele@brainlab.com	X	X	X	X	X
Stefan Pall Boman	Raysearch Labs	Stefan.p.boman@raysearchlabs.com	X	X	X	X	X
Rickard Holmberg	Raysearch Labs	Rickard.Holmberg@raysearchlabs.com	X	X			
Marcus Bergman	Raysearch Labs	Marcus.bergman@rayserachlabs.com	X	X	X	X	X
Sanjay Bari	Elekta	Sanjay.Bari@elekta.com	X	X	X	X	X
John Stamm	EPIC	jstamm@epic.com	X	X		X	
Rishabh Kapoor	VCU/VHA	Rishabh.kapoor@va.gov		X		X	
Tucker Meyers	EPIC	tucker@epic.com		X			
Stina Svensson	Raysearch Labs	Stina.svensson@raysearchlabs.com			X	X	
Yury Niatsetski	Elekta	yury.niatsetski@elekta.com				X	
Martin von Siebenthal	Varian	martin.vonsiebenthal@varian.com		X		X	
Antonio Correia	Varian	Intoni.correia@varian.com		X			
Rok Stefanic	Cosylab	rok.stefanic@cosylab.com		X			
Elias Lundqvist	Raysearch Labs	elilun1@raysearchlabs.com			X		
Andreas Lindstrom	Raysearch Labs	andreas.lindstrom@raysearchlabs.com			X		
Lawrence Tarbox	UAMS	LTarbox@uams.edu			X		

Minutes:

- 30 I. Meeting was called to order at 9:34am EDT, October 5, 2020. A quorum was present.
- 35 II. Level Set
- A. Review Agenda – Order and timing for Topics was reviewed to facilitate discussion with key stakeholders.
 - B. Minutes for the Sept. 17, 2020 TC Teleconference were reviewed and approved without objection.
 - C. Updates
 - 35 1. IHE-RO Activities
 - a. PC would like update on progress on Profile development.
 - b. Email to Mary Jungers regarding a rider Profile to add C-GET for retrievals.
 - c. Update to IHE-RO Profiles in product directory.
 - 40 2. AAPM – supporting preparations for virtual Connectathon
 - 40 3. DICOM (Jim Percy)
 - a. DICOM edition 2020(d) has been released
 - b. Work in progress on Sup 177 (Dose), Sup 215 (Ion), Sup 216 (Brachy)
 - c. IEC 61217 ed. 3 – concern regarding lack of backward compatibility and interoperability problems in patient positioning
 - 45 4. Other groups
- III. Development Status of Profiles
- A. Indication of progress in authoring for each volume in the TF for Profiles in Development.
 - 50 1. Vol1State, Vol2State, Vol3State variables (%) have been added to the database for the Profiles table
 - B. Profile state variable values:
 - 55 1. Concept
 - 2. Development
 - 3. Public Comment
 - 4. Trial Implementation
 - 55 5. Final Text
 - 6. Technical Framework
 - 7. Superseded
 - 8. Retired
 - C. Profile use in the field (number of successful tests of Profile Actors) – This is a related (linked) database.
 - 60 D. **ACTION 201001**: Chris to update the Profile table database on the ihe-ro.org wiki with profile state, remove TF entry – completed.
 - E. **ACTION 201002**: Editors of Profiles in Development to assess progress (%) on content for each volume of their Profile.
- 65 IV. FDII
- A. The source of 4D image data is CT equipment. Requires engagement of IHE-RAD Domain.
 - B. The tags needed to represent respiratory phase do not exist in the legacy CT Image IOD.
 - C. The Enhanced CT IOD already contains the needed attributes, but limited implementation of Enhanced CT is a barrier.
 - 70 D. Review of Respiratory Synchronization information in the Enhanced CT Image IOD.
 - 1. DICOM Functional Group Macro: PS3.3 Section C.7.6.16-18 Respiratory Synchronization Macro Attributes
 - E. Options for encoding respiratory phase
 - 75 1. Enhanced CT Image – high cost of implementation
 - 2. CT Image Extended SOP Class – requires re-instantiating multiple CT Series
 - 3. Companion Object – options discussed include RT Structure Set and KOS.
 - 4. Phase annotation in Series Description – need consistent format that can be parsed
 - a. There are currently multiple, vendor-specific formats for encoding of Series Description
 - F. Discussion was tabled until 10/6.
- 80

V. Test Tool Plans

- A. An RFP for continued support of IHE-RO Test Tools has been distributed. Anticipated effort (40-50 hours/month) is largely for maintenance.
- B. Less than 200 hours remain on the current year budget.
- C. Possible additional work
 - 1. DICOM Secure Transport – Configuration of Test Tools to use secure DICOM was suggested. This is already supported in DVTk. This is likely too much to complete in the current contract.
 - 2. TDRC – need test data. What aspects of Treatment Record content should be checked with the referenced RT Plan: Beam references (but not Control Point Sequence).
 - a. **ACTION 201003**: Thomas (and other treatment delivery vendors) to send Treatment Records and Plan examples to Walter to forward to Binay Tamrakar.

VI. DPDW Topics

- A. Manufacturers of TSM and novel imaging devices have expressed interest in using the DPDW model.
- B. The TC discussed use of the DPDW model versus use of TDW-II with expanded instructions for imaging.
- C. DPDW provides an integration model for imaging/positioning/session management devices. Imaging, positioning and monitoring tasks are specified by protocol or parameters.
- D. Concurrent execution of multiple UPSs may present problems if the state of one task must be known by another.
- E. Development of DPDW is not currently a high priority.
- F. Consensus to invite new vendor(s) with interest in using DPDW for task management to meet with the TC to review the DPDW Profile, perhaps at the December 17, 2020 TC teleconference.

*[Adjourned for the day 10/5/20 at 1:30pm ET]
[Meeting resumed 10/6/20 at 9:32am ET]*

VII. XRTS Profile

- A. John Stamm reviewed the XRTS-mCODEDataDictionary with the TC. Comparison of XRTS HL7 data elements with FHIR elements from MITRE mCODE / 21st Century Cures Act.
- B. Concern expressed by IHE-RO PC that the scope of this Profile is very large. Recommendation to narrow the scope.
- C. Some clarification of terminology, e.g., “phase”, is needed. (Usage differs in DICOM, Profile.)
- D. Choice of standards discussion.
 - 1. The first version of the Profile is based on HL7. However, the Cures Act has created pressure to use FHIR instead of HL7.
 - 2. FHIR allows domain-specific extensions.
 - 3. Discussion of whether to (a) set aside the HL7 version of this Profile or (b) proceed with two mappings of the data model for HL7 and FHIR.
- E. Profile Scope / Use Case Discussion - Results Use Cases
 - 1. End of treatment summary (EOTS)
 - a. Notes from 10
 - b. Anticipated areas that are not expected to be available from the OIS:
 - i Follow up plan
 - ii Survivorship care plan
 - iii Patient Experience (side-effects, management)
 - c. Timing: at end of treatment course
 - d. Implementation should be able to query for missing EOTS if some treatment information is outstanding
 - 2. On treatment visit (OTV)
 - a. Expected that the data model for EOTS and OTV Use Cases would be largely the same.
 - b. Includes dose delivered to date (cumulative dose to tracking point)
 - c. Pain index (anticipated that this would be entered at the EHR).
 - d. Other items (not captured in the RO workflow):
 - i Vital signs

- ii Labs
- iii General patient management notes

F. Summary

1. FHIR version of XRTS was reviewed
2. Consensus that the FHIR approach is attractive to implementers.
3. Don't want to abandon HL7 version, but it is unclear at present what value it will have.
4. Effort to move forward with FHIR will not be wasted.
5. How will use cases differ between v1 HL7 and v2 FHIR?
6. Examination of End of Treatment Summary Use Case

G. Notes from discussion were added (highlighted) to the *XRTS use cases 2020-06-23.docx* document. Uploaded to Other Documents page on the ihe-ro.org wiki: <http://ihe-ro.org/doku.php?id=doc:otherdocuments>

H. Revisit discussion on 10/8/20 at 11:30am ET.

I. **ACTION 201004**: Chris to email XRTX Use Case notes document to interested members of the TC.

VIII. FDII (continued)

A. Thomas showed formats for 4-D image specifications in Series Description supported by Varian in the Varian DICOM Conformance Statement. Formats are largely reverse-engineered from other vendors' products. This approach does not always work.

B. Respiratory Phase format specification

1. Definition of phase %: What is end inspiration? End expiration?
2. DICOM Respiratory synchronization specification: Nominal Percentage of Respiratory Phase (0020,9245) (see PS3.3, Section C.7.6.16.2.17.1)
 - a. 0% Phase at max inhale
 - b. 50% Phase at max exhale
3. Series Description is 64 characters.
4. Human-readable and parseable format

C. **ACTION 201005**: Jon Treffert to research use of respiratory phase in (Siemens) CT scanners, to work with Scott Hadley (clinical practice) and DICOM WG-28.

IX. Connectathon

A. Walter to schedule a Setup Session with each vendor to check VPN and Zoom configuration.

B. Zoom to be used for sharing desktop of Systems under Test (SUT). Vendors can use Remote Desktop Protocol internally and share the view of the SUT.

C. Need to know number of systems to connect for each vendor

D. Brainlab DICOM Proxy software to be installed on Test Server after VPN goes to production on Oct 26.

E. Scheduling of tests

1. Shared spreadsheet
 - a. Judges commit to test slots
 - b. Vendors bid on slots, first-come-first-served.
2. Preliminary test times: 9:00am – 1:00pm ET
3. Judges will send Zoom meeting invitations to producer and consumer vendors.

F. Communications during connectathon

1. Profiles to be tested in Nov 2020: BRTO-II, TDW-II
2. Group meeting to be scheduled before Connectathon
3. Daily scrum to update and coordinate schedule.
4. Chat for each Profile (AAPM Slack account)– requires users to be connected
5. Questionnaire to be sent out to confirm Actors to be tested.

[Adjourned for the day 10/6/20 at 1:30pm ET]

[Meeting resumed 10/7/20 at 9:36am ET]

X. DRRO Plenary Review

A. Stina reported changes to the Profile (Revision 0.9)

1. Codes for deformable registration have been added to the DICOM standard.

- 190 2. The Deformable Contourer Actor has been renamed: Contour Deformer to reflect that it does not create new contours but deforms existing contours.
- B. Review of DRRO Draft Profile
- 195 1. Add Spatial Registration Retrieval Option to Deformable Registrator.
2. Displayer Actors in Process Flow diagrams in section X.4 – display of deformed images/structures/dose is not a required step of the process (may be removed from diagrams).
- C. DICOM Content requirements sections to be added to TF Volume 3:
- 200 1. Deformable Spatial Registration IOD
2. Deformable Spatial Registration Module
3. General Reference Module in Deformed Image
4. General Image Module in Deformed Image
5. RT Dose Module in Deformed Dose
- D. **ACTION 201006**: Chris to upload the revised ihe-ro_content_definitions document (with DRRO additions).
- E. Review of DICOM content requirements for Modules used in DRRO.
- 205 F. Open Issue: Verify treatment of Patient Position in PET Image.
G. Stefan will continue work on the Profile for further discussion 10/8 at 12:00pm ET.

XI. General Dose Profile – Abbreviated Dose Reference (DOSE)

- A. Plan-free dose reporting Profile has been proposed for scenarios in which no RT Plan exists.
- B. Examples include theragnostic / radiopharmaceutical applications.
- 210 C. Profile adds requirement to reference RT Structure Set in the Common Instance Reference Module.
1. The RT Dose IOD does *not* include the General Reference Module.
2. Referenced Series Sequence shall include exactly one reference to an RT Structure Set.
3. Dose Summation Type (3004,000A) Defined Term value that allows Referenced RT Plan Sequence to be absent.
- 215 D. Chris to continue development of this Profile.

XII. Secure DICOM Transport (Lawrence Tarbox)

- A. Transport Security Issues
- 220 1. On what basis are certificates assigned?
2. Certificates are usually linked to user, but could be linked to Application Entity
- B. ATNA (Audit Trail Node Authentication) Profile is lynchpin of IHE Security
- 225 1. Dictates that all communication channels be secured with TLS – sets up a secure pipe between partners.
2. DICOM Part 15 describes how to set up DICOMweb or DIMSE Services over TLS, ATNA goes beyond that to check whether certificate can be trusted.
3. RAD Domain has add-on Profile that says to use ATNA with mutual authentication.
4. Once the TLS pipe is setup, it is used like any other channel.
5. Encryption and integrity checks on the channel are Options in ATNA, but are trivial to add.
6. The IETF BCP195 document – recommendations for secure use of TLS.
7. Three current DICOM transport profiles
- 230 a. BCB195 downgradable (least secure)
b. BCP195 non-downgrading
c. Cryptrec (most secure)
8. Approaches to enterprise network security
- 235 a. Lock down (Firewall)
b. Audit trails to verify compliance to access policy
9. Both node authentication and audit trail are important.
- C. Popular open-source tool: openssl
1. DICOM Toolkits typically call openssl.
- D. Secure Certificates
- 240 1. Certificates can be tied to users or machine (node or application).
2. ATNA and DICOM are silent about how certificates are created and managed (software specific).
3. Certificate Validity
- 245 a. Expired certificates: IETF has ACME protocol (Automated Certificate Management Environment) - LetsEncrypt (server certificates)
b. Certificate validity can be checked with data that is available locally.

- c. Checking revocation status requires access to Certificate Authority.
- E. Vigilance is importance, even inside secure environments – zero trust.
- F. Radiology – ATNA Radiology Option.
- G. **ACTION 201007**: Lawrence Tarbox to send ATNA Profile (ITI TF?) and Radiology Option documents to Chris.

[Adjourned for the day 10/7/20 at 1:30pm ET]

[Meeting resumed 10/8/20 at 9:36am ET]

XIII. Brachytherapy Update

- A. Jim Percy reviewed v2.8 of the TPPC-Brachy Profile (IHE-RO_TPPC_Brachy_v2.8.docx). Current issues include the following:
 - 1. Use of RT Structure set for applicators
 - 2. Use of Ultrasound Imaging
- B. Volume 3 content sections for RT Plan for Brachytherapy were reviewed briefly and updated. The updated Profile draft was saved as v2.9
 - 1. Prescription information largely overlaps that for external beam.
 - 2. Sections added for LDR Temporary, LDR Permanent, HDR, PDR plan content
 - 3. 7.4.6.3 US Image Module
 - 4. 7.4.8.3.3 RT Structure Set Module in Brachy – RT ROI Observations Module
- C. DICOM CP RT161 to insert an Applicator Shape Referenced ROI attribute in RT Plan is in preparation.
- D. Some changes will be needed in the TDRC Profile for consistency with TPPC-Brachy.
- E. Next brachy sub-group meeting is scheduled for Nov 5.
- F. **ACTION 201008**: Jim to distribute DICOM CP for Applicator Shape Reference to the group - completed
- G. **ACTION 201009**: Chris to post link to IHE-RO TF Vol. 3 on ihe-ro.org wiki – completed

XIV. Treatment Delivery Offline Recording (TDOR)

- A. Thomas reviewed version 0.1 of this Profile with the TC.
- B. The Profile standardizes offline recording process.
 - 1. Deferred Recording Use Case (a) after TDD crash or (b) after treatment record(s) are rejected by the OST.
 - a. Offline recording is initiated by TDD.
 - b. Adds Treatment Session UID
 - c. Treatment Delivery Progress / Final Update is performed, but some or all Treatment Delivery Results are lost.
 - d. TDD uses N-CREATE (“implicit” subscription model) with Treatment Session UID to update the TMS.
- C. Explicit check that the TMS has correctly received and processed the Treatment Record.
 - 1. Discussion of whether such an indication of correct processing of treatment records should be added to the TDW-II Profile. Using the Treatment UPS does not work because the TDD owns task and the task has been completed. A second UPS would be needed for processing of the treatment record by the TMS.
 - 2. The TDOR subgroup to explore use of N-EVENT-REPORT (on the completed UPS) to notify the TDD of successful or unsuccessful processing of treatment records by the TMS.

XV. XRTS Update

- A. John Stamm to reach out to FHIR Infrastructure group.
- B. Potential overlap with MITRE/CODEX mCODE effort to push RT on FHIR.
- C. Review of Mary Feng’s comments on XRTS use cases.
- D. Next meeting of HIS group is Nov 10, 2020.

XVI. Profile Status Review

- A. Status codes assigned to existing Profiles were reviewed by the TC.
- B. Status changes discussed
 - 1. CPRO – Concept, started 2013 – little work has been done on this Profile. It appears to be (largely) redundant with RAD Scheduled Workflow Profile; currently low priority for development
 - 2. ROIT – In development, started 2013 – Status changed to “9 - Blocked”, awaiting standards development

3. MMRO-II – Status changed to “7 – Superseded”
4. ARTI – Status: “7 – Superseded”

XVII. ROTH Profile

- 305 A. Scott reviewed Clinical Impact Statement with the group.
- B. Use Cases
 1. Outside hospital/Previous Treatment/Continuity of Care
 2. Clinical Trial/Registry: Pre- and Post-Treatment Review; alternative plans or modalities
 3. Archive Complete History
- 310 C. Payload
 1. DICOM Instances
 2. Other documents
 3. Manifest/catalog
 - a. convey relationship among information objects
 - 315 b. format: XML/JSON, DICOM RT-KOS, other?
- D. Transport
 1. Secure network (TLS)
 2. Media (detached mode)
- E. Data Model maps to RT Course
 - 320 1. Start with Real-World Model?

[Adjourned for the day 10/8/20 at 1:35pm ET]

[Meeting resumed 10/9/20 at 9:33 am ET]

XVIII. ROTH Profile (continued)

- A. Scott updated the ROTH Clinical Impact Statement with comments from 10/8 discussion.
- B. Review of Diagrams of Possible Planning and Treatment Situations.
 - 330 1. This model should be checked for consistency with the RT Course data model.
 2. Some objects may be optional. E.g., RT Plan (for treatment modalities not supported by 1st Gen RT), and PDF documents
 3. The relationship between objects is to be represented in the manifest.
- C. Next step
 - 335 1. Mapping of entities to DICOM objects
 2. Identify what is not represented directly in the DICOM objects
 3. Identify what is optional
- D. Issues
 1. Can the same manifest work with both 1st and 2nd Gen RT?

XIX. DRRO (revisited)

- 340 A. Review of updated version (rev. 0.10) of DRRO Profile.
 1. Open Issue (#8) regarding Patient Position in PET Images. This is represented differently than in CT and MR Images.
 - 345 2. Added an Open Issue (#9) regarding re-orientation to gravity in DSRO and deformed images. Is there an indicator that an image has been deformed to match one with a different orientation to gravity?
 3. The Deformable Registration Comparison Use Case was removed from the text (retained as Open Issue #10)
 4. Requirements for Code Meaning for Registration Type Code: Code Meaning must correspond to the value of Code Value as specified in CID 7100.
 - 350 5. Add reference to Deformable Spatial Registration Instance in the General Reference Module of RT Structure Set for deformed structures stored by the Contour Deformer.
 6. Update Volume 3 Sections
 - a. Move Deformable Spatial Registration Modules in Planning to 7.4.15
 - 355 b. Add Section 7.3.4.2.2 RT Structure Set for Deformable Registration
 - c. Add Section 7.4.1.9.1 General Reference Module in Deformed Image

d. Add Section 7.4.1.9.2 General Reference Module in Deformed RT Structure Set

- B. Publication of DRRO Profile for Public Comment: Motion (Thomas), Second (Bob) to approve DRRO Profile v0.10 for Public Comment.
- C. **DECISION:** DRRO Profile v0.10 was approved for Public Comment without objection or abstention.
- D. **ACTION 201010:** Chris to request publication of the DRRO Profile for Public Comment.

XX. TDIC

- A. David presented a review of RT Image IOD attributes specifying source and receptor geometry.
- B. Want to verify that the DICOM specification is sufficient to represent the actual geometry for all imaging use cases.
- C. **ACTION 201011:** David to share his presentation with the TC – completed (see <http://ihe-ro.org/doku.php?id=doc:whitepapers>)
- D. **ACTION 201012:** David to add CP to TDIC Profile (currently in Public Comment).

XXI. BQAW Update

- A. Chris reviewed version 0.11 of the Profile
- B. Manifest for QA dataset is encoded as a KOS Instance.
 1. Series Description of KOS Instance identifies the type of QA analysis to be performed.
 2. Instances (artifacts) to be analyzed are referenced in the KOS and are (a) stored to QA Provider *prior* to KOS or (b) retrieved by QA Provider based on AE specified in KOS.
 3. Requested Procedure ID (0040,1001) – can this be used to specify a QA analysis task?
- C. Raw Data IOD can be used to encapsulate log files.

XXII. Administrative Issues

- A. Next Meetings - dates have been set for 2021.
- B. IHE-RO Connectathon Slack group has been created – invitations will be sent to TC members.

XXIII. Wrap up / Review

XXIV. Adjournment – Meeting was adjourned at 1:35 pm ET