IHE-RO Technical Committee
Face-to-Face
April 2, 2019 2:00-5:30 PM EST
April 3-4, 2019 8:30 – 5:30 EST
April 5, 2019 8:30-12:00 EST
Gaylord Palms Resort, Orlando FL

Technical Committee Chairs:
Scott Hadley, PhD, University of Michigan
Chris Pauer, Sun Nuclear

IHERO Task Force 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	4/2	4/3	4/4	4/5
Chris Pauer	Sun Nuclear	chrispauer@sunnuclear.com	X	X	X	X
Walter Bosch	Wash. Univ.	wbosch@wustl.edu	X	X	X	X
Jill Moton	AAPM	Jill@aapm.org	X	X	X	X
Thomas Schwere	Varian	Thomas.Schwere@varian.com	X	X	X	X
Bob Pekarek	Accuray	bpekarek@accuray.com	X	X	X	X
Jim Percy	Elekta	Jim.percy@elekta.com	X	X	X	X
Jon Treffert	Raysearch Labs/ ProNova	Jon.treffert@raysearchlabs.com	X	X	X	X
Christof Schadt	Brainlab	christof.schadt@brainlab.com	X	X	X	X
Richard Voegele	Brainlab	richard.voegele@brainlab.com	X	X	X	X
Bruce Rakes	Mevion	rbrakes@mevion.com	X	X	X	X
Bruce Curran	AAPM / VCU	bhcurran@gmail.com	X	X	X	X
Stina Svensson	Raysearch Labs	Stina.svensson@raysearchlabscom			T	
Stefan Pall Boman	Raysearch Labs	Stefan.p.boman@raysearchlabs.com		T	T	
Rishabh Kapoor	VCU/VHA	Rishabh.kapoor@va.gov	X	X	X	
Tucker Meyers	EPIC	tucker@epic.com			X	X
Chelsea Wezensky	EPIC	cwezensk@epic.com			X	X

Harold Beunk	ICT	Harold.Beunk@ict.nl		T	T	T
Kratika Bandi	Accuray	kbandi@accuray.com		T		
Sanjay Bari	Elekta	Sanjay.Bari@elekta.com		T		
David Wikler	IBA	David.Wikler@iba-group.com	T	T	T	T
Howie Richmond	MIM	hrichmond@mimsoftware.com				
Koua Yang	Philips	Koua.yang@philips.com				
Rickard Holmberg	Raysearch Labs	Rickard.Holmberg@raysearchlabs.com				
Scott Hadley	U. Mich.	swhadley@umich.edu				
Michael Owens	Reflexion	mowens@reflexion.com				

X = In person, T = Via teleconference

Minutes:

I. Call to Order at 2:05 pm EDT, Tues. Apr. 2, 2019.
   a. A quorum was declared.

II. Review Agenda
   a. Agenda for the week was reviewed. Topics were arranged to permit remote participation by off-site members. CDEB moved later. Topics 5, 8, 9, 12 moved to morning slots.

III. Minutes from last meetings
   a. IHE-RO TC teleconference 3/21/19 minutes were reviewed by the TC and approved without objection.

IV. Updates
   a. AAPM
      i. IHE-RO Oversite Committee consisting of Bruce Curran, Bridget Koonts and the PC and TC co-chairs is officially the AAPM "IHE-RO Working Group"
         1. Bridget Koontz presented the last RO Domain report to the IHE Domain Coordination Committee. Bruce with present to the IHE Board on 4/11/19.
      ii. AAPM is establishing the Medical Physics Institute to provide an impartial, expert evaluations of products and QA recommendations for their use. AAPM could hire experts or contract with academic sites. Goal is to begin operation in the next year. Legal challenges (NDAs) remain.
   b. DICOM WG-7 Update – Christof Schadt (co-chair) reported.
      i. Succession of leadership in WG-07. Uli Busch has retired as chair. Jim Percy is new co-chair.
      ii. Work has focused on Supplement 177 (RT Dose) using the Parametric Map IOD.
      iii. Review of Supplements 175 and 176 is underway with WG-06.
   c. AdvaMed and Standards Efforts
      i. RT3 (XML Profile specifying Treatment Device configuration and calibration) is expected to be voted for final approval in May 2019.
      ii. In-room imager configuration has been deferred to future work.

V. Topic 1: Goals for Week
   a. Advance Profiles:

i. Prescription in RO (RXRO)?
ii. Quality Assurance Workflow (BQAW)
iii. HIS
iv. Treatment Delivery – Record Content (TDRC) for Trial Implementation
v. CDEB solidified
vi. Couch Offsets advanced.
vii. DCOM – Location of file (v1.5 is the latest) – update needed on wiki
viii. MMRO-III – What Modalities must be supported by an Actor?
    1. Profile requires support for registration of "axial" images (within 30 degrees)
    2. The Profile places no constraint on the modalities supported. Test data include CT, MR, PT.
    3. MMRO-III does not allow re-registration of image Series that share the same Frame of Reference.
ix. BRTO-II

VI. Topic 11: ICT / Test Tools Topics

a. The TC created a sub-group to direct ICT efforts at its January 2019 meeting. Group members include Bob Pekarek, Stefan Boman, Sanjay Bari, Chris Pauer, Walter Bosch, Bruce Curran. The purpose of the group is to define priorities and direct efforts of the ICT support contract.
    i. Evaluation of Test Tools: does the software meet the needs of vendors and testers?
    ii. Consolidated "score card" proposed.
    iii. Prioritize ICT effort
        1. **Ease of data selection: dataset parser/selector, API-driven validator**
        2. **Process to validate tools and documentation for ISO, FDA, etc.**
        3. **Licensing support (per Profile), time-limited?**
        4. DICOM conformance testing – updated editions of the standard
        5. User-specified rules
        6. Expanded support for workflow Profiles
        7. Improved usability and documentation
        8. New Use Cases beyond (1) production, (2) pre-connectathon, (3) connectathon
        9. Automation
    iv. Other issues
        1. Need timely feedback from users
        2. Public access to legacy versions (one- or two-year embargo). Is this a good idea?
        3. Less-capable version for public distribution?
        4. Access to source code?
        5. How to strike balance between fairness to paying participants and improving interoperability in the community at-large.
        6. Tiered access to (a) tools alone versus (b) tools and testing? Other licensing schemes?
    v. Publicize IHE-RO benefits
        1. Survey: What's not working?
        2. What is the benefit to vendors of reducing cost of interoperable connectivity?
        3. Anecdotes, testimonials of new participants?
    vi. ACTION 190401: Chris to contact Harold to arrange meeting time to discuss ICT priorities.

[Adjourned for the day 4/2/19 at 5:25pm]
[Resume meeting 4/3/19 at 8:30am]

VII. 2019 Connectathon Preparation
    a. Schedule for next Connectathon: Milestones
        i. Judges selected: April 2019
        ii. ICT Test tool updates: June 2019
            1. TDW-II test tool (per Profile as of 4/2019)
            2. Detailed documentation for Validator
            3. Validation reports
        iii. Contracts distributed to vendors: June 2019
        iv. Questionnaire to vendors: July 2019
        v. Test Procedure for content validator: July 2019
        vi. Distribute pre-test datasets: July 19
        vii. Judges work session at AAPM Annual Meeting: July 16-19
        viii. Questionnaire returned: Aug 2019
        ix. Test results due: Aug 16
        x. Hotel reservation deadline: early Sept
        xi. Connectathon datasets to vendors: Sept 20
        xii. Connectathon: Oct 7-12, 2019
    b. Connectathon Planning and Approval Request has been reviewed by the IHE Testing and Tools Committee and forwarded to the IHE Board as of 4/3/19. Bruce Curran will present the Connectathon request with the IHE-RO Domain Report on 4/17/19.

VIII. Topic 6: Treatment Delivery – Record Content
    a. Trial Implementation review
        i. Is a reference back to plan origins, or reliance to plan content required?
            1. Found that material in content refers back to content modules in BRTO, so references to correct study and origins of data are clear.
        ii. Changes were made to the referenced beam number to rely on the original DICOM language.
        iii. Future tense of introduction was moved to open issues.
        iv. DECISION: Version will be saved as 0.12, voted to Trial Implementation, no objections or abstentions.

IX. Topic 8: IPDW and DPDW
X. Topic 9: Recording for offline delivery
XI. Topic 12: Couch Offsets / Shift

XII. Topic 12.5: TDW-II Discussion
    a. The TC reviewed TDW-II Profile document (ihe_ro_supp_tdw-ii_rev16.doc). Editorial changes include the following:
        i. Clarification of transactions.
        ii. Update transactions identifiers.
        iii. Type requirements for BDI attributes were “1” and “1C”. These have been changed to IHE requirements of “-“ (no change from DICOM) and “D” (must be displayed).
        iv. Delivery Verification Image Sequence note changed to “There shall be zero items in this sequence.”
        v. Requirements for Study Instance UID inheritance were discussed. The practice of using the Study Instance UID from the image Series was required in first-generation RT. However, the practice of using image Study Instance UIDs in derivative objects, e.g., RT Structure Set, RT Plan, etc., causes problems for billing, since the Study

remains unclosed. Removing requirements for Study Instance UID inheritance (copy from image) in the TF was considered. Note: This issue has not yet been resolved.

vi. Scheduled Workitem Code Sequence – displayed value shall clearly indicate the intent of the workitem (need not match exact wording of code value or meaning).

XIII. Topic 3: Consistent Dose for External Beam discussion

a. The TC reviewed version 0.1.1, which was released for Public Comment.
b. Beam Dose (300A,0084) is no longer tied to the Beam Dose Specification Point (300A,0082) (now retired in the DICOM Standard).
c. Target Multiplicity Option – supported by some TPS.
d. Separate the planning objectives from the recording objectives.
    i. There is a need to represent (a) Primary Target Dose Tracking, (b) zero or more Secondary Target Dose Tracking values, and (c) one or more QA dose references.
        1. CDEB currently allows only one item with Dose Reference Type = TARGET in the Dose Reference Sequence (300A,0020).
        2. The combination of values for Dose Reference Type and Dose Reference Structure Type can be used to distinguish among multiple dose reference use cases.
        3. Alternatively, the Defined Terms for Dose Reference Type (300A,0020) could be extended to cover both tracking and QA dose references, and to indicate Primary vs. Secondary dose tracking.
        4. The Referenced Dose Reference UID can be used to identify a "primary" tracking dose.
    ii. ACTION 190402: Christof to modify the CDEB Profile with concrete details to identify primary tracking dose, secondary tracking dose, and QA dose values for discussion by the group.
e. Referenced Calculated Dose Reference Sequence vs. Calculated Dose Reference Sequence
    i. Use Referenced Calculated Dose Reference Sequence (at the beam level in the RT Beams Session Record Module) rather than the (optional) Calculated Dose Reference Module.
    ii. ACTION 190403: Christof to update the CDEB Profile to use the Referenced Calculated Dose Reference Sequence in the RT Beams Session Record Module.

XIV. Topic 4: RXRO

a. Jim Percy reviewed version 0.11b of the RXRO Profile draft with the group.
b. The Dosimetric Objective Parameter Sequence (3010,0070) has been restructured – need to update the content requirements section of the Profile draft.
c. RT Treatment Phase UID (3010,001B) (Type 2) is a new tag – are there any specific requirements for this attribute?
d. ACTION 190404: Jim to incorporate changes from discussion and upload to the ihe-ro.org wiki.

XV. Topic 5.5: RO History – no update at this time

XVI. Topic 5.7: 4D Image Import – no update at this time

XVII. Topic 12: Couch Offsets / Shift

a. This Use Case appears to address communication of shifts between virtual simulation isocenter and treatment isocenter. Two parts were discussed:

i. Structure Set encoding of CT Simulation Position (offset from CT-sim markers to Isocenter).
ii. Patient Setup Module Couch Offsets (in IEC coordinates from planning)

b. This may be a new profile (would need a Clinical Impact Statement) or a modification to an existing profile.
c. It is not clear that clinical workflow is sufficiently uniform to pursue a standard solution.
d. ACTION 190405: Chris to request that Mark Pepelea draft Clinical Impact Statement(s) for the Patient Offsets Use Cases.

[Adjourned for the day 4/3/19 at 5:25pm]
[Resume meeting 4/4/19 at 8:30am]

XVIII. Topic 6: Deformable Registration update – DRRO

a. Stina Svensson reported on the status of the DRRO Profile draft (version 0.3). Work is in progress on Chapter 7 content material. The priority of the sub-group has been consistent use of the Deformable Spatial Registration IOD. Several open issues remain.
b. Key terminology issue – align to usage in DICOM: "Source" and "Registered" image Series.
c. Reference to "Registered" images can be included in a second, empty item in the Deformable Registration Sequence. This is the approach used for rigid registration in MMRO-III.
d. Deformation algorithm code – the DRRO group will put together a list of current usage and forward to WG-07 to update the DICOM Standard.
e. None of the vendors currently makes use of Fiducials in the DSRO.
f. For Deformed Doses, the source of dose information (Dose Summation Type) need not be further constrained.
g. For Deformed Images, what should be used for Derivation Code Sequence? One possibility is to use "Spatial Resampling" and to annotate the Source images used.

XIX. Topic 8: IPDW and DPDW

a. Thomas reported on the status of IPDW (rev. 2.1) and DPDW
b. It has been decided to use a protocol-based approach for IPDW. This approach will be applied to DPDW, as well.
c. Patient positioning is specified per Treatment Position (isocenter location and orientation of the tabletop system). A BDI contains only the subset of beams to be delivered for a single Patient Position.
d. Treatment Session UID is assigned at treatment time (may be specified by TMS in the UPS) and links artifacts to the Treatment Session Record.
e. UPSs {imaging, registration, correction, treatment} are grouped by Radiation Task.
f. The semantics of the Beam Task Type (0074,1022) enumerated values of VERIFY and VERIFY_AND_TREAT are not clear. From the descriptive text, it appears these task types involve imaging. A DICOM CP clarifying the descriptions of these values was suggested.
g. If a patient must be re-positioned (beam interrupted when patient moves), can we re-use the original positioning UPS (before resuming resuming delivery)? Do we need to create a new UPS?

XX. Topic 7: HIS Profile

a. Tucker Meyers reviewed an updated data model outline for OIS to HIS messages.
b. The data model for a Session Results Message was discussed. A Session Results Message contains one or more "Site Delivery Results", each referencing a prescription. For each Site, the Session Results Message reports the following:
i. Site UID
ii. Source prescription UID

iii. Plan UID (from TMS)
iv. Site (free text label)
v. fraction number
vi. planned fraction count (includes all phases of current course)
vii. nominal fraction dose delivered (this session)
viii. nominal fraction dose planned (this session)
ix. cumulative nominal dose delivered (to date, for the current course)
x. nominal total dose planned (for current course)
xi. delivery completion status (this session)

c. Final treatment status is reported per prescription in End-of-Therapy note.
d. Intent
   i. Include Patient ID, Provider ID, Patient consent, Date of order, Date of update & updating user
   ii. Site (preliminary)
   iii. Diagnosis (code, e.g., ICD-10)
   iv. Stage (preliminary, may be blank)
e. Prescription
   i. Prescription is specified (a) per site and (b) per treatment phase.
   ii. One or more Prescriptions are related to one Intent.
   iii. Staging is required (free text, may be preliminary)
   iv. More than one treatment phase may be active at any point in time.
f. The source of updates (OIS, HIS) was discussed.
   i. Both OIS and HIS – messages can be created/approved on either system (configurable), must be approved on the same system as created.
      1. Intent to Treat
      2. Consent – can also be communicated using ADT
   ii. OIS only – created and approved in OIS, updates triggered in OIS
      1. Prescription
      2. Session Results
      3. Phase Completion (End of Treatment)
g. ACTION 190406: Tucker Meyers to update data model outline document with changes captured in TC discussion and draft the Integration Profile.

XXI. Topic 12.7: Study and other data copying in Technical Framework
a. The IHE-RO TF currently specifies that an RT Structure Set may use the Study Instance UID of the CT image Series from which it is derived *or* create a new Study. Downstream RT Plan, RT Dose, and RT Treatment Record copy the Study of the RT Structure Set.
b. Some concern has been expressed by individuals in diagnostic radiology that creating new RT instances delays the closure of image Studies and causes problems in billing.
c. The TC discussed this rule and proposed the following changes to the TF (to be reviewed 4/5/19):
   i. Replace the table in Section 7.2.3 with the following inheritance rules for Study Instance UIDs and all Study level attributes.
      1. It recommended to create a new Study for the RT Structure Set.
      2. RT Structure Set may copy the Study IE of the treatment planning image Series.
      3. It is recommended that downstream RT instances copy the Study IE of their predecessors.
      4. If changes to Study-level attributes are required in the RT workflow, a new Study IE shall be created.
   ii. Create Frame of Reference Handling Section 7.2.4.

XXII. Topic 13: BQAW – no update at this time

XXIII. Topic 13.5: Image Content Profiles
- a. TDIC and TPIC are currently in Public Comment.
- b. TDIC needs work for registration – Thomas is continuing to work on this Profile:
  - i. A new Transaction and procedures for calculation of resulting couch shifts are needed.
  - ii. A new Use Case for in-room imaging in non-treatment positions is to be added.
  - iii. Should we record the actual couch shifts from the PDS in a dedicated object, e.g., a Structured Report, rather than having the TMS to the calculation?
- c. TPIC is complete.
  - i. Work is need on test procedures and selection of test data.
  - ii. Test tool updates are needed to check DICOM content.

XXIV. Topic 13.6: TDW-II Profile Review
- a. Chris reviewed an updated version (rev. 17) of TDW-II with changes from discussion 4/3/19.
  - i. Number on transactions in the diagram in Section 9.1 have been corrected.
  - ii. Edits for the description of TMS and OST roles have been updated.
  - iii. Treatment Delivery Final Update
  - iv. Reference to Table 3.65.2 (Final State Conditions) in Transaction RO-65 has been updated.
  - v. Security Considerations: To test hazard mitigation, a means (version of Test Tools) is needed to allows independent modification of RT Plan instances to demonstrate disagreement between the UPS and referenced RT Plan.
- b. Updated copy to be copied to ihe-ro.org wiki.

XXV. Topic 13.4: Offline treatment update
- a. Real-world problem: What happens with OIS goes offline due to a communication problem? How to copy records back to TMS for recovery?

[Adjourned for the day 4/4/19 at 5:00pm]
[Resume meeting 4/5/19 at 8:30am]

XXVI. Topic 13.6: TDW-II Profile Review (continued)
- a. Input Readiness State (0040,4041)
  - i. This attribute must be supplied as one of the Query keys in the SCU request.
  - ii. Input Readiness State (0040,4041) must be set "READY" to allow execution of the UPS to start. (N_ACTION set IN_PROGRESS.) Static objects may be queried and retrieved before this value is "READY".
  - iii. This condition has been added to the Trigger Events for both Transaction RO-59 and Transaction RO-61.
- b. Chris will update the Profile document with these changes and upload to the wiki.

XXVII. Topic 13.8: Test Tools priorities were discussed with Harold Beunk.
- **a. Top priorities**
  - **i. Support for Profile to be tested in 2019 Connectathon**
    - **1. TDW-II Test Tool**
  - **ii. Ease of data selection: dataset parser/selector – display relevant attributes of Series to be selected within a directory.**
    - **1. Does not use DICOMDIR**

2. **Like Q/R for directory.**

iii. **Process to validate tools and documentation for ISO, FDA, etc.**

1. **Unit test report of Content Validator**
2. **Report on tool validation process. – Why this is good enough for a software development tool and Connectathon test tool.**

iv. **Licensing support (per Profile), time-limited?**

1. **Administrative support for maintaining licenses: service? Admin tool?**

b. Other requests (to be considered further by the sub-group)

i. Revision of DICOM used for conformance testing

1. Definition files (locally maintained by ICT, based on most recent edition of the DICOM standard). – Display edition used.
2. IHE-RO Profile version tested

ii. Expanded support for workflow Profiles

iii. Improved usability and documentation

iv. New Use Cases beyond (1) production, (2) pre-connectathon, (3) connectathon

v. Automation

vi. Other issues

vii. User-specified rules – extensibility by users?

c. ACTION 190407: Harold to coordinate with Jill regarding ICT/TC teleconferences.

XXVIII. Topic 10: TPPC ION

a. Bruce Rakes reviewed the TPPC-ION Profile draft (v 0.12) with the group.

b. The profile draft currently includes scanned beams for protons and heavy ions (Carbon).

i. Modulated Scanning Beam

ii. Modulated Scanning Beam with MLC

iii. Fixed Beamline Modulated Scanning Beam

c. Suggestion to re-name Carbon Ion beams more generically for Heavy Ion (with Carbon as an option).

d. Suggestion to add Cloud in Process Flow diagram.

e. All scanning ion beams have a Beam Type value of STATIC.

f. Suggestion to define a "Multi-Aperture MLC" Option. Baseline behavior specifies BLD on first Control Point only. Option allows BLD to be specified on subsequent Control Points.

g. Using the *absolute Meterset* values as the Meterset Weight in the Control Point Sequence was discussed. This approach was suggested as a step toward 2nd Gen RT usage.

h. "Dynamic MLC Beam Modifier" changed to "Variable Aperture MLC".

i. Bruce will update Profile draft for further work at the DICOM WG-07 Ion Sub-group meeting at PTCOG.

XXIX. Topic 14: QRRO Update – no update at this meeting

XXX. Topic 20: BRTO-II Study Handling

a. All DICOM objects based on a planning image set shall copy the Frame of Reference Module values from that image set.

b. ACTION 190408: Chris to add BRTO-II Study Instance handling (Specifically, TF section 7.4.1.2.1 vs. 7.2)

c. ACTION 19409: Chris to include discussion of how/where to specify the edition of the DICOM Standard referenced by IHE-RO Profiles.

XXXI. Topic 15: RAD Profile Review

a. Usage of "R" requirements in IHE-RAD Profiles (includes additional constraints on attribute *values*) has been removed from the IHE-RO Profiles Template and Technical Framework.

XXXII. Topic 16: IHE Website Edits
XXXIII. Topic 17: Review Minutes
XXXIV. Topic 18: Review Action Items

XXXV. Future Meetings / Next Agenda

a. IHE-RO TC Meetings
   i. Post-AAPM – July 17-20, 2019, San Antonio, TX
      1. Wed July 17 2:00pm-5:30pm drop-in session
      2. Sat July 20 8:30am – 12:00pm
   ii. Fall Connectathon – Oct 7-12, 2019, Stockholm (confirmed)
   iii. Dec 9-13, 2019, Alexandria, VA

b. IHE-RO TC Tcons
   i. Time is third Thursdays 10:30am-12:00pm ET.
   ii. No teleconferences scheduled in Apr, Jul, Oct, Dec 2019.

c. Other meetings of interest
   i. DICOM WG-07
      1. July 29 – Aug 2, 2019 Brainlab, Chicago
      2. Sept 17 - 21, 2019 Washington University, St. Louis
      3. November 18-22, 2019 (tentative) - Melbourne, FL (or MITA, Washington)

   ii. PTCOG June 10, 2019
   iii. AAPM Jul 14-18, 2019, San Antonio, TX
   iv. ASTRO Sept. 15-18, 2019, Chicago, IL
   v. RSNA Dec 1-6, 2019, Chicago, IL

XXXVI. Adjournment – the meeting was adjourned 4/5/19 at 12:05pm.

For more information specific to the IHE-RO Technical Committee, visit www.ihe-ro.org.