Integrating the Healthcare Enterprise International

Free Educational Webinar Series 2017

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Radiation Oncology Domain

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IHE Radiation Oncology Agenda

- Domain & Committee Overview
- Domain Profiles & Technical Frameworks
  - Overview of Profiles
- How to Participate?
  - IHE International Membership
  - Planning & Technical Committees

What is IHE?

Integrating the Healthcare Enterprise (IHE)

IHE is an initiative by healthcare professionals and industry to improve the way computer systems in healthcare share information. IHE promotes the coordinated use of established standards such as DICOM and HL7 to address specific clinical needs in support of optimal patient care. Systems developed in accordance with IHE communicate with one another better, are easier to implement, and enable care providers to use information more effectively.

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What is IHE-RO?

IHE-RO

With technology at the core of delivering care in radiation oncology, it is imperative that patient safety is not compromised. Integrating Healthcare Enterprise - Radiation Oncology (IHE-RO) is an initiative that helps to ensure a safe, efficient radiation oncology practice by improving system to system connections.

Created in 2004, it is composed of members of the radiation oncology team, administrators and industry representatives that work together to ensure a safe and efficient radiation oncology clinic. The IHE-RO task force develops IHE Integration Profiles, which specify how industry standards are to be used to address specific clinical problems and ambiguities. These integration profiles are then tested at ASTRO's annual Connectathon, where vendors meet to test the connectivity of their products.

An important part of helping to ensure patient safety, IHE-RO is part of ASTRO's Target Safely initiative.

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Why is IHE-RO Important?

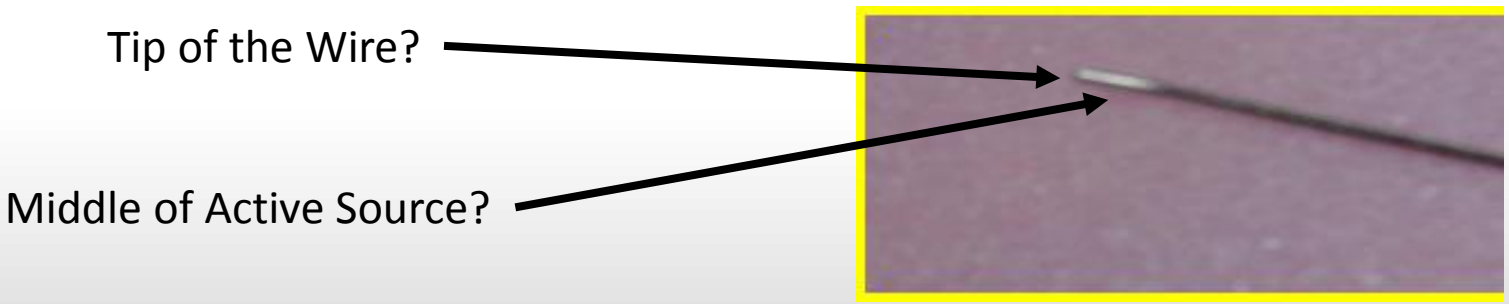
- Part of ASTRO's 6-point patient protection plan
  - Further developing our Integrating the Healthcare Enterprise – Radiation Oncology (IHE-RO) connectivity compliance program to ensure that medical technologies from different manufacturers can safely transfer information to reduce the chance of a medical error.

- Promotes discussion and correction of protocols / standards for data communication to improve the reliability and safety of data exchange in radiation oncology

- Provides a mechanism for inter-manufacturer testing of radiation oncology products prior to delivery
  - Connectathon

Real TC Example

- HDR source position refers to which of the following?



Clinical Impact of IHE-RO

- Clinical Impact Statements
- Integrating Healthcare Enterprise - Radiation Oncology profiles provide solutions to clinical challenges in the integration of technologies utilized within radiation oncology. The Clinical Impact Statement for each profile explains the issue, the rationale behind the creation of the profile and the anticipated clinical impact.

Advanced Radiation Therapy Interoperability [ARTI]

Date Created:	2013-10-03	**Last Revised:**	2014-01-30
Profile Completion Date:	2013-02-25	**Profile Implementation Date:**	2011-09-xx
Author(s):	Jim Percy, Stephanie Terezakis, MD		

Description:

Defines the data required to be transferred, accepted and displayed for 14 kinds of C-arm linear accelerator treatment plans- from open beam to VMAT.

Rationale for Profile Creation:

Differences in describing key treatment parameters have caused incompatibilities or inconsistencies in plan interpretation from one system to another. Given the critical nature of the data being sent to the treatment management system (TMS), these inconsistencies needed to be removed by explicitly defining one method of describing plan content for all current types of C-arm linear accelerator treatment modes.

Clinical Impact:

This profile describes the accepted way to export external beam plans delivered on a linac. Where there has been ambiguity in defining plan data at each point in the delivery, this profile defines one way to report it – for example, motorized wedge monitor units, electron field sizes and dynamically arc beams. The goal of this profile is to be able to intercommunicate. An individual reading this profile should be able to identify the required elements of such an export for a specific type of plan.

The profile also demands that the user can display the original plan content on the receiving system and thus allow the user to compare the original data to the receiving system's internal, working version of the plan. This can serve as an auditing tool if information doesn't match up after a data transfer. This profile facilitates this by specifying the mandatory, minimally available data for comparison of plans. This allows the user to see the original plan content so that it is readable not just in DICOM format.

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What are the Standards?

- DICOM (Digital Imaging and Communications in Medicine)
  - DICOM is a standard for handling, storing, printing, and transmitting information in medical imaging.
  - DICOM enables the integration of scanners, servers, workstations, printers, and network hardware from multiple manufacturers
  - http://medical.nema.org

- HL7 (Health Level 7)
  - HL7 is an international community of healthcare subject matter experts and information scientists collaborating to create standards for the exchange, management and integration of electronic healthcare information.
  - HL7 promotes the use of such standards within and among healthcare organizations to increase the effectiveness and efficiency of healthcare delivery for the benefit of all.
  - http://www.HL7.org

Parts from http://www.wikipedia.org

IHE-RO Overview

- Scope: Patient Care and Safety, Streamlining the Workflow and Interoperability in Radiation Oncology
- Sponsor: Originally, American Society for Radiation Oncology (ASTRO). In 2017, American Association of Physicists in Medicine (AAPM), ASTRO significantly involved.
- Established in 2004
- 17 Countries involved in committees including: Belgium, Canada, France, Germany, Japan, Netherlands, New Zealand, Spain, Sweden, Switzerland, United Kingdom, and USA

IHE-RO Committee Responsibilities

Steering Committee

- Provide leadership to Planning and Technical committees
- Coordinate
- Liaise with AAPM leadership

Contact Information

- Secretary: Jill Moton, jill@aapm.org
- Co-Chair: Bruce Curran
- Co-Chair: John Buatti

IHE-RO Committee Responsibilities

Planning Committee

- Recruit vendors of relevant clinical systems, and users with clinical and operational experience
- Prioritize & coordinate domain activities
- Identify, gather, review and prioritize inter-operability problems (Use Cases)
- Develop educational materials for the domain and profiles e.g. webinar, presentations

Contact Information

- Secretary: Jill Moton, jill@aapm.org
- Co-Chair: Bridget Koontz, bridget.koontz@duke.edu
- Co-Chair: R. Alfredo Siochi, rasiochi@hsc.wvu.edu
- Co-chair: Mark Pepelea, mark.pepelea@Philips.com
- http://**www.ihe.net**/Radiation_Oncology/
- http://**wiki.ihe.net**/index.php?title=Radiation_Oncology_Planning_Committee

IHE-RO Committee Responsibilities

Technical Committee

- Recruit vendors of relevant clinical systems, and users with technical experience
- Assess the feasibility and estimated effort for PC selected Use Cases
- Build consensus on the appropriate standards-based solutions
- Develop Integration Profiles for Use Case solutions
- Maintain Technical Framework for domain Integration Profiles

Contact Information

- Secretary: Jill Moton, jill@aapm.org
- Co-Chair: Chris Pauer, chrispauer@sunnuclear.com
- Co-Chair: Scott Hadley, swhadley@med.umich.edu
- http://**www.ihe.net**/Radiation_Oncology/
- http://**wiki.ihe.net**/index.php?title=Radiation_Oncology_Technical_Committee

IHE Profiles Drafted & Revised

IHE Technical Framework Developed

Published For Public Comment

Trial Implementation Posted

months 6-13

Test at IHE Connectathons

months 14-18

Publish in IHE's Product Registry

Demonstrate at AAPM and ASTRO

Profile Selection by Committees

IHE Call for Proposals Opens

months 1-5

IHE Improves, Safety, Quality and Efficiency in Clinical Settings

Install Interoperable products in Clinical Settings worldwide

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Profile Life Cycle

- Idea submission from
  - IHE RO members PC, SC, TC
  - Radiation Oncology Community
  - Draft Clinical use cases & Impact Statements
  - Ranked in terms of importance and prioritized

- TC investigates and determines
  - Available standard for implementation
  - Possible technical issues with profile

Profile Life Cycle

- TC Drafting Phase
  - Profile has champion from vendor to do major drafting
  - Drafting happens off line as well as at Face to Face meetings of TC
  - Possible to send “CP”s Change Proposals back to DICOM
- TC Final Draft
  - Sent to IHE for Public Comment phase
- Trial Implementation
- Final, Available for Connectathon Testing
- Deprecation when replaced

Realities of Profile Priorities

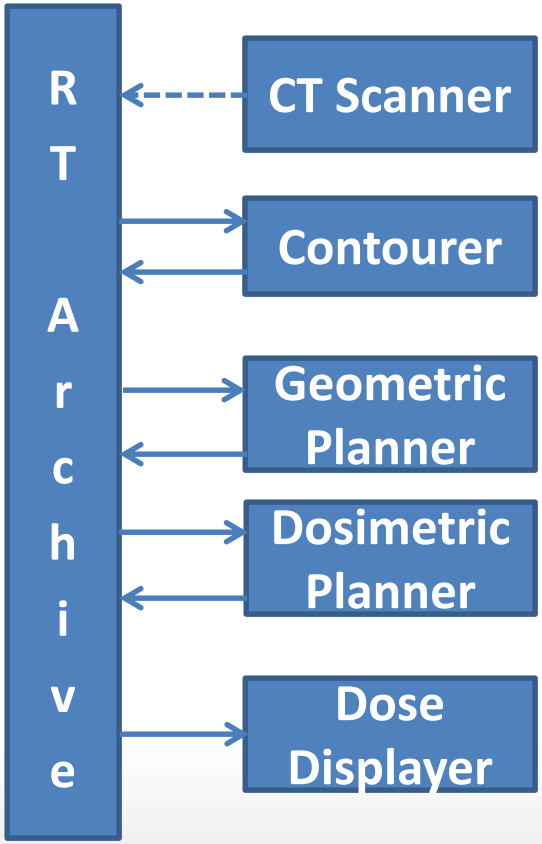
- Profiles ARE based on clinical use cases
- There is a priority and weighting process
  - What is most critical to the clinical flow
  - What can realistically be addressed by technical solutions
    - How does it affect treatment critical functioning of device?
    - Are there standards to support the data and transactions?
    - Is it an interoperability problem?
  - Weighting on difficulty of implementation / profile creation
  - How will it sell?
- Some profiles are not strictly driven by clinical use cases, but the behavior or data is technically needed to support basic correct operation.
- In the end, it is perceived demand for a given behavior that is key to it being developed into a profile, and then being included in product**. The clinical user is key to driving profile development!**

Content and Workflow – RO Planning and Treatment Delivery

- There are…
  - Content profiles – dictate specific relationships of data in existing standards
  - Workflow profiles – describe what is the order and content, from the content profiles, that transactions and signaling should be in place to claim that an actor's behavior is "correct".

Tested

Basic RT Planning (2007)



- Initial demonstration of interoperability using DICOM-RT objects (structure, plan, dose, image) for simple RT planning
- Systems impacted: RT-PACS, RTPS

Retired

Multi-Modality Registration (2008)

- Rigid registration of CT, MR, and PET images for RT treatment planning and review using the DICOM Spatial Registration object
- Actors:
  - **Registrator** (creates spatial registrations)
  - **Registered Contourer** (segmentation of registered image series)
  - **Registered Display** (displays registered image series)
  - **Registered Dose Display** (displays spatially registered images contours, doses)
  - **Archive** (RT-PACS)
- Systems impacted: RT_PACS, RTPS, Visualization systems

Tested

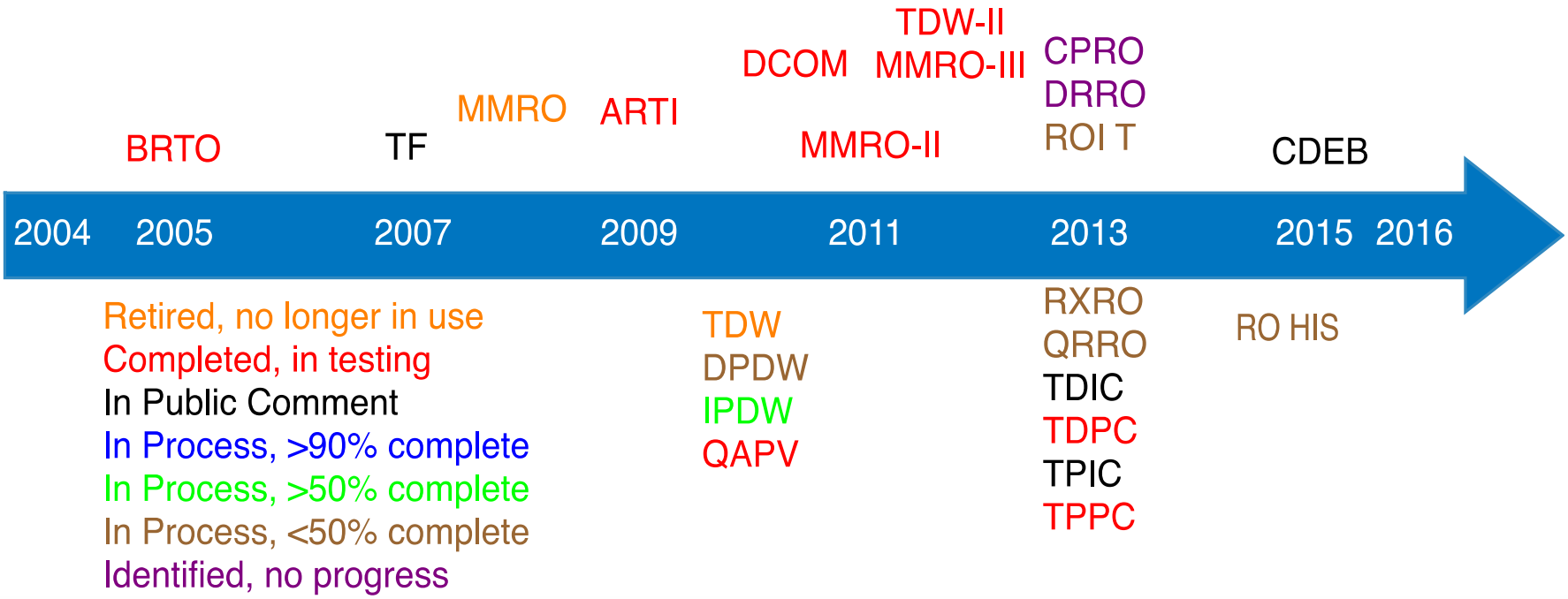
Advanced RT Objects (2009)

- Extends the Basic RT Planning Profile (2007) to include 14 external beam types:
  - Static, Static MLC, Arc, MLC Arc, Conformal Arc, Hard Wedge, Motorized Wedge, Virtual Wedge, Static Electron, Step & Shoot, Sliding Window, IMAT/VMAT, Stereo, Stereo Arc
- Defines two actors for each beam type
  - **Producer** (treatment planning system)
  - **Consumer** (treatment planning system, treatment management system)
- Systems impacted: RTPS, TMS, RT-PACS

IHE-RO Profiles - Current

- 9 Active Profiles
- 6 Profiles in development
- Other Use Cases
  - http://wiki.ihe.net/index.php?title=Radiation_Oncology#Use_Case_Selection

IHE-RO Profile Status



Retired IHE-RO Profiles

MMRO – MultiModality image registration for Radiation Oncology

TDW – Treatment Delivery Workflow

Completed IHE-RO Profiles

BRTO – Basic RadioTherapy Object

TF – Technical Framework – in public comment

ARTI – Advanced RT Integration

CDEB – Consistent Dose for External Beam – in public comment

DCOM – Dose Compositing

TDW-II – Treatment Delivery Workflow

MMRO-II – MultiModality image registration for Radiation Oncology

MMRO-III – MultiModality image registration for Radiation Oncology

QAPV – Quality Assurance with Plan Veto

TDIC – Treatment Delivery, Image Content– in public comment

TDPC – Treatment Delivery, Plan Content

TPIC – Treatment Planning, Image Content– in public comment

TPPC – Treatment Planning, Plan content

In Development IHE-RO Profiles

DPDW – Discrete Positioning and Delivery Workflow

IPDW – Integrated Positioning and Delivery Workflow

ROI T – ROI Template

RXRO – Prescription in Radiation Oncology

QRRO – Query and Retrieve in Radiation Oncology

RO HIS – Radiation Oncology, Hospital Information System

Identified IHE-RO Profiles

CPRO – Consistent Patient Identification in Radiation Oncology

DRRO – Deformable Registration objects

What is a Connectathon?

Cross-vendor, live, supervised, structured test event

- All participating vendors' products tested together in the same place/time.
- Experts from each vendor available for immediate problem resolution… fixes are often done in minutes, not months!!
- Each vendor tests with multiple trading partners (actual product to product).
- Testing of real-world clinical scenarios with IHE Integration Profiles.
- Supervised by test monitors, i.e. "judges".

IHE-RO Connectathon

- Annual, week-long event
  - ½ day setup
  - ½ day cleanup
- Hosted at ASTRO HQ, vendor facilities, and academic centers
- Supervised, informal test events ("Domain Pre-Testing") have also been held occasionally between connectathons.

Advanced RT Interoperability Profile Test Instructions

IHE Radiation Oncology - ARTI Profile Testing

The Advanced RT Integration (ARTI) Profile is tested by importing CT image and Structure Set test data in a Producer Actor, creating a treatment plan (and dose) for a supported beam type, and exporting the plan (and dose) to an Archive for retrieval by a test partner (Consumer Actor). Side-by-side comparison of plan displays on the Producer and Consumer Actors is used to verify interoperable exchange of plan information.

General Instructions

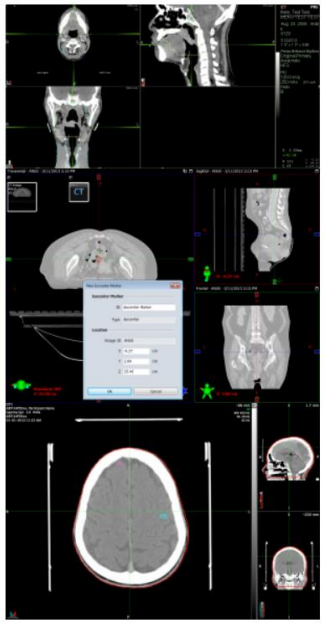
- Import and save CT images and RT structure set for both supine and prone patients. Import the multiple brain mets patient if you are testing stereotactic beams.
- For each producer, create two plans, one with all supported options and one without options (if you support multiple options e.g.: beam limiting devices, bolus etc.)
- Place isocenter as follows:
  - **Supine patient:** x = -3.2mm, y = 69.2mm, z = 239 mm (DICOM)
  - **Prone patient**: x = -2.7mm, y = 28.4mm, z = 254 mm (DICOM)
  - **Brain mets patient**: isocenter 1: x = 42.4mm, y = -194.3mm, z = -65.0mm; isocenter 2: x = -10.2mm, y = -256.8mm, z = -66.0mm (DICOM)
- Specify a total dose of 54 Gy (27 x 2 Gy fractions) to ptv54, unless otherwise specified.
- Label the plan appropriately: e.g., plan_static_mlc
- If possible, store each plan and dose in its own DICOM Series and use the Series Description to identify the ARTI Actor, i.e. beam type, that produced it.
- If possible, do not include setup beams in the plan.

Test Datasets

Three patient datasets are available for testing ARTI Actors:

- **ARTI15A01**xx - **Supine** (head/neck) patient
- **ARTI15A02**xx - **Prone** (anal-canal) patient
- **ARTI15A03**xx - Multiple brain mets patient (for stereotactic beams)

Note: xx is a vendor code for the Producer Actor.



Plans

Note: the numbering below is different from the numbering used in the Supplement ftp://ftp.ihe.net/RadiationOncology/Supplements/ARTI/IHE-RO_ARTI_Supplement_V1-6_2014-02-25.docx

1. **Basic Static Beam**: Generate a plan with two opposing lateral beams
2. **Basic Static MLC Beam**: Generate a plan with two opposing lateral beams
3. **Motorized Wedge Beam**: Generate a plan with AP and right lateral beams
4. **Hard Wedge Beam**: Generate a plan with AP and right lateral beams
5. **Virtual Wedge Beam**: Generate a plan with AP and right lateral beams
6. **Arc Beam**: Generate a plan with two lateral arcs (0 -270, 0 – 90)
7. **Conformal Arc**: Generate a plan with two lateral arcs (0 -270, 0 – 90)
8. **MLC Arc Beam**: Generate a plan with two lateral arcs (0 -270, 0 – 90)
9. **Step & Shoot Beam**: Generate 5 beams, use structure *ptv18* as target
10. **Sliding window Beam**: Generate 5 beams, use structure *ptv18* as target
11. **Static Electron Beam**: Generate a plan with a 10 x 10 applicator, 110 SSD, 9 MeV energy. Note: the isocenter is different than in other plans
12. **IMAT/VMAT Beam**: Generate a VMAT/IMAT plan, use structure *ptv18* as target
13. **Stereotactic Beam**: Generate a stereotactic plan
14. **Stereotactic Arc Beam**: Generate a stereotactic arc plan

- Instructions for testing ARTI Plan Producer Actors
- Also includes a table of detailed plan parameters to be used.

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Advanced RT Integration Profile Constraints

PES & NOTES - BY BEAM TECHNIQUE ARTI ACTOR								
ARTI-Odd # Storage/Even # Retrieval			ARTI-19/20		ARTI-21/22		ARTI-23/24	
			Step & Shoot		Sliding Window		IMAT/VMAT	
Attribute	Tag	DICOM Type	Type	Attribute Note	Type	Attribute Note	Type	Attribute Note
Beam Sequence	(300A, 00B0)	1	R+*		R+*		R+*	
>Beam Number	(300A, 00C0)	1	R+*	Shall be >=1	R+*	Shall be >=1	R+*	Shall be >=1
>Beam Name	(300A, 00C2)	3	R+		R+		R+	
>Beam Type	(300A, 00C4)	1	R+*	Shall be STATIC	R+*	Shall be DYNAMIC	R+*	Shall be DYNAMIC
>Radiation Type	(300A, 00C6)	2	R+*	Shall be PHOTON	R+*	Shall be PHOTON	R+*	Shall be PHOTON
>High-Dose Technique Type	(300A, 00C7)	1C	O+*	If present, shall be NORMAL	O+*	If present, shall be NORMAL	O+*	If present, shall be NORMAL or HDR If present, may not be ignored
>Treatment Machine Name	(300A, 00B2)	2	R+*		R+*		R+*	
>Primary Dosimeter Unit	(300A, 00B3)	3	R+	Shall be MU	R+	Shall be MU	R+	Shall be MU
>Source-Axis Distance	(300A, 00B4)	3	R+*		R+*		R+*	
>Beam Limiting Device Sequence	(300A, 00B6)	1	R+*		R+*		R+*	
>>RT Beam Limiting Device Type	(300A, 00B8)	1	R+*	At least 1 MLC shall be present	R+*	At least 1 MLC shall be present	R+*	Shall have at least 1 MLC
>>Leaf Position Boundaries	(300A, 00BE)	2C	R+*	Shall be present for MLCs May or may not be present for jaws, may be ignored for jaws	R+*	Shall be present for MLCs May or may not be present for jaws, may be ignored for jaws	R+*	Shall be present for MLCs May or may not be present for jaws, may be ignored for jaws
>Referenced Patient Setup Number	(300C, 006A)	3	R+*	Shall be >= 1	R+*	Shall be >= 1	R+*	Shall be >= 1
>Treatment Delivery Type	(300A, 00CE)	3	R+*		R+*		R+*	
>Number of Wedges	(300A, 00D0)	1	R+*	Shall be 0 or 1 If 1, see Hard Wedge Modifier	R+*	Shall be 0 or 1 If 1, see Hard Wedge Modifier	R+*	Shall be 0
>Wedge Sequence	(300A,00D1)	1C	R+*	Required if Number of Wedges is non-zero	R+*	Required if Number of Wedges is non-zero		NA (no Wedge)

R+ The Requirement is an IHE extension of the DICOM requirements

R* The attribute is not required to be displayed

R+* The Requirement is an IHE extension of the DICOM requirements, but it is NOT required to be displayed

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Connectathon Scoring

- ARTI checklist of plan parameters used for side-by-side comparison of Producer and Consumer

MLC ARC BEAM Result: ____Pass ____Fail

	Producer	Consumer	Discrepancy/Comments
Plan Name			
Gantry Start Angle(s)			
Gantry Stop Angle			
Energy			
Couch			
Collimator			
Field Size			
SSD			
MU			
Wedge ID/ Applicator			
Wedge orientation			
MLC shape review			
# control points			
Control pt meterset			
Orientation			
Isocenter			
Structure display			
Dose display			
Ref point dose			

What happens after the Connectathon?

- Successful results (specific by IHE profile/actor) are published by the sponsors (www.ihe.net/connectahons)

- Vendors self-certify, by publishing *IHE Integration Statements*: Precise and explicit public interoperability commitment for a specific commercial product.
  - Found on vendor website or ask for copy with RFP

Learn More about IHE Connectathons

- IHE-RO Connectathon: October 17 - 21, 2016, Philips, Madison, WI
- 2017 IHE-RO Connectathon to be in Veenendaal, NL. Hosted by Elekta, October 9 – 14.
- IHE Connectathons: www.iheusa.org/connectathon.aspx
- IHE N.A. Connectathon was January 23 - 27, 2017
  - Read more: http://www.iheusa.org/ihe-connectathon-overview
- Attend information webinars on the Connectathon during the IHE Webinar Series. View the full IHE agenda online at www.ihe.net

Learn More about IHE International

Important Links and Information

- IHE Webinar Series runs June-September Visit www.ihe.net for the full list of webinars
  - Registration is free!
- All webinar recordings and slide decks will be posted online. Link is: www.ihe.net/Webinars
- Sign up for the IHE News
  - Link is: www.ihe.net/Monthly-Newsletters/

How does IHE-RO affect me?

- If you ever said

  "Why can't those two boxes talk to each other – they are supposed to be DICOM compliant?"…

  IHE-RO might be the answer.

Again, the whole point of IHE is safe and effective interoperability.

What can IHE-RO do for me?

- In IHE-RO we try to address real world problems and attempt to work on what is most important. In order to do that we need help. We need to know what the real world needs are.

How to Participate in IHE?

- Apply for IHE International Organizational Membership
  - Visit: www.ihe.net/Join_IHE_Application
  - More than 175 member organizations
    www.ihe.net/Member_Organizations
- Participate in IHE Domains & Committees
  - *IHE Organizational Members only*
  - *12 Clinical and Operational Domains*
  - Each Domain has one planning and one technical committee
- Non-members participate in comment periods and implement IHE Technical Frameworks
  - Public comment www.ihe.net/Public_Comment

How to Participate in IHE-RO ?

- Committee work follows the IHE Profile Cycle
  - Annual 18-24 month cycle
  - Each IHE domain has its' own independent schedule
  - Opportunities for IHE members and non-members to participate in cycle

How to Participate in IHE-RO ?

- Let vendors know that you need compliance
  - Ask vendors what profiles they support
  - Put language requesting IHE-RO Profile support in your Request for Purchase

Profiles & Technical Frameworks

Overview

- IHE-RO's Technical Frameworks on IHE.net are:
  - http://www.ihe.net/Technical_Framework/index.cfm#rad_onc
- IHE-RO Profiles on IHE-RO's Wiki page are:
  - http://wiki.ihe.net/index.php?title=Profiles#IHE_Radiation_Oncology_Profiles
- Learn More
  - IHE wiki: http://wiki.ihe.net
  - General IHE information https://www.ihe.net

Thank you for your attention

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