Integrating the Healthcare Enterprise

IHE Radiation Oncology
Technical Framework Supplement

Consistent Dose Content for External Beam Radiation
(CDEB)

For review and comment only.

DO NOT implement this public comment version.

Rev. 1.0 – Draft for Public Comment

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Foreword

This is a supplement to the IHE Radiation Oncology Technical Framework V3.0. Each supplement undergoes a process of public comment and trial implementation before being incorporated into the volumes of the Technical Frameworks.

This supplement is published on May 20, 2025 for Public Comment. Comments are invited and can be submitted at http://www.ihe.net/Radiation_Oncology_Public_Comments/. In order to be considered in development of the Trial Implementation version of the supplement, comments must be received by July 19, 2025.

This supplement describes changes to the existing technical framework documents.

"Boxed" instructions like the sample below indicate to the Volume Editor how to integrate the relevant section(s) into the relevant Technical Framework volume.

Amend Section X.X by the following:

Where the amendment adds text, make the added text **bold underline**. Where the amendment removes text, make the removed text ~~**bold strikethrough**~~. When entire new sections are added, introduce with editor's instructions to "add new text" or similar, which for readability are not bolded or underlined.

General information about IHE can be found at IHE.net.

Information about the IHE Radiation Oncology domain can be found at IHE Domains.

Information about the organization of IHE Technical Frameworks and Supplements and the process used to create them can be found at Profiles and IHE Process

The current version of the Radiation Oncology Technical Framework can be found at Radiation Oncology Technical Framework.

CONTENTS

Introduction to This Supplement

The intent of this supplement is to describe the specific ways to describe planned and delivered nominal and concrete dose values in RT workflows for tracking, billing, or QA purposes. This supplement relies on the content objects DICOM RT Plan, RT Ion Plan, RT Beams Treatment Record and RT Ion Beams Treatment Record.

Revision History

Date	Rev	Author	Change Summary
May 2025	1.0	IHE Radiation Oncology Technical Committee	Initial IHE Public Comment publication

155 # Open Issues and Questions

#	Intr. in	Resp.	Description
6	Prepub 1.8	Schadt	In 7.4.11.5.1.2: Currently Referenced Dose Reference Number (3008,0051) AND Calculated Dose Reference Number (3008,0076) are present (like in the DICOM Standard) as they are mutually exclusive. How should this profile require this in the treatment record? a) Always refer to the Dose References in the Plan. This would then mean that the Calculated Dose Reference Record Module is not present. b) Always refer to the Calculated Dose Reference Record Module. c) Both references are possible.
7	Prepub 1.8	Schadt	Section X.3 ties together CDEB with the TPPC beam actors. Is this the intended/desired behavior? OR should this be rather “considerations” in X.6?
8	Prepub 1.8	Schadt	Section X.6 considers grouping of the Beam Dose QA Plan Producer with the TPPC beam actors. Or should both, the Beam Dose Tracking Plan Producer and the Beam Dose QA Plan Producer be combined with TPPC to be agnostic of the actual Content Consumer?
9	Prepub 1.10	Schadt	Are the RT Plan IOD tables in 7.3.2.2 actually needed? The actors in this profile directly refer to modules and therefore, the IOD sections in 7.3.2 are not referenced from within this profile.

Closed Issues

#	Intr. in	Resp.	Description
1	Prepub 1.0	Schadt	Single Target use case currently limits the definition of additional QA use cases. Why is the Single Target case there in the first place? Is it necessary to separate the options along this requirement? Proposal: - remove the Single Target use case as is. - Define the “Dose Tracking” case as standard with one primary target item representing a nominal dose. - Define a “Multiple Dose Tracking” Option with multiple non-primary items representing nominal doses in addition (!) to the single primary one. - Add a “QA” Option with multiple non-primary items of type COORDINATE representing actual doses in addition (!) to the single primary one. After discussion during San Diego meeting, see last statement in Meeting minutes: Handling of multiple targets was called out as an open issue in Oct 2014. It is not clear that this needs to be handled via separate Actors. All Consumers must be able to discriminate doses for multiple targets. Christof will re-work the CDEB Profile with Actors that handle multiple targets for discussion at the next TC Tcon. Reworked accordingly, now single/multiple targets differentiation is gone.

#	Intr. in	Resp.	Description
			Detailed the use cases in X.4.2 for Dose Tracking Dose References and Quality Assurance Dose References. For TC: should these details get folded in the tables in 7.4 to make it clearer? Or is this table sufficient.
2	Prepub 1.6	Schadt	For the use cases in X.4.2 it was mentioned that it should also be possible to annotate a COORDINATE. As the existing approach with distinguishing Dose Tracking Dose References from Quality Assurance Dose References by the Dose Reference Structure Type is weak at most, WG-07 is to be contacted whether it would be possible to introduce the 2nd Gen attribute Dose Value Type (with the two enumerated values TRACKING and QA) by a CP. DICOM CP 2297 was incorporated which allows to include this information.
3	Prepub 1.6	Schadt	Along with Issue #2, the question comes up whether an identifier is needed what the cumulated dose is. Although the Beam Dose can be expressed as nominal (Beam Dose Meaning FRACTION_LEVEL) or actual (BEAM_LEVEL), this is not possible for the Dose References. E.g., a "Tracking Dose Reference" would typically carry only a nominal dose (even for a coordinate), whereas a "QA Dose Reference" for a coordinate would typically carry an actual dose value. This important differentiation should be possible for a Dose Reference. DICOM CP 2297 was incorporated which allows to include this information.
4	Prepub 1.6	Schadt	The question was raised, whether the Beam Dose value shall always be 1.0Gy. This would indicate that this is for sure a nominal value only. A side-effect would be that the Cumulative Dose Reference Coefficients can be considered the absolute contributions (when multiplied by 1.0 Gy to include the unit). This issue will be discussed with DICOM WG-07. DICOM WG-07 did not like this approach, as the Beam Dose is still heavily used in some systems and requires to have an "actual" value.
5	Prepub 1.6	Schadt	RT Ion Record B. Rakes asked to introduce this Module along the Treatment Session Beam Record. Still though, as this was requested before, the group decided not to include it in this profile, but rather deal with interest in an Ion profile. That is also the reason why the RT Ion Plan is not included in this profile. The TC should review the current decision and decide whether the consistent dose aspects for ion should also be handled within this profile. Revised in March 2024 by TC: include RT Ion Record.

IHE Technical Frameworks General Introduction

The IHE Technical Frameworks General Introduction is shared by all of the IHE domain technical frameworks. Each technical framework volume contains links to this document where appropriate.

9 Copyright Licenses

IHE technical documents refer to, and make use of, a number of standards developed and published by several standards development organizations. Please refer to the IHE Technical Frameworks General Introduction, Section 9 - Copyright Licenses for copyright license information for frequently referenced base standards. Information pertaining to the use of IHE International copyrighted materials is also available there.

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IHE Technical Frameworks General Introduction Appendices

The IHE Technical Framework General Introduction Appendices are components shared by all of the IHE domain technical frameworks. Each technical framework volume contains links to these documents where appropriate.

*Update the following appendices to the General Introduction as indicated below. Note that these are **not** appendices to this domain's Technical Framework (TF-1, TF-2, TF-3 or TF-4) but rather, they are appendices to the IHE Technical Frameworks General Introduction located here.*

*Add the following **new or modified** actors to the IHE Technical Frameworks General Introduction Appendix A:*

Actor	Definition
Consistent External Beam Dose Plan Producer	Produces an RT Plan that contains dose values to allow consistent dose representation and tracking
Consistent External Beam Dose Record Producer	Produces an RT Beams Treatment Record that contains dose values to allow consistent dose representation and tracking
Consistent External Beam Dose Plan Consumer	Consumes and checks for consistency an RT Plan that contains dose values to allow consistent dose representation and tracking
Consistent External Beam Dose Record Consumer	Consumes and checks for consistency an RT Beams Treatment Record that contains dose values to allow consistent dose representation and tracking

Appendix B – Transactions

*Add the following **new or modified** transactions to the IHE Technical Frameworks General Introduction Appendix B:*

New (or modified) Transaction Name and Number	Definition
No new transactions	

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Add the following glossary terms to the IHE Technical Frameworks General Introduction Glossary:

New (or modified) Glossary Term	Definition	Synonyms	Acronym/ Abbreviation
No new terms			

Volume 1 – Profiles

Domain-specific additions

None.

Add Section X

X Consistent Dose for External Beam (CDEB) Profile

This profile specifies the content of DICOM RT Plan/RT Ion Plan instances for tracking dose information during radiotherapeutic beam delivery.

CDEB is a Content Module profile.

X.1 CDEB Actors, Transactions, and Content Modules

This section defines the actors, transactions, and/or content modules in this profile. General definitions of actors are given in the Technical Frameworks General Introduction Appendix A. IHE Transactions can be found in the Technical Frameworks General Introduction Appendix B. Both appendices are located at https://profiles.ihe.net/GeneralIntro/index.html.

Figure X.1-1 shows the actors directly involved in the CDEB Profile between actors that are identified as Content Creators and actors that are identified as Content Consumers.

The DICOM RT Plans, RT Ion Plans, RT Beam Session Records and RT Ion Beam Session Records exchanged between Content Creators and Content Consumers have to implement the requirements listed in this profile in order to be IHE compliant.

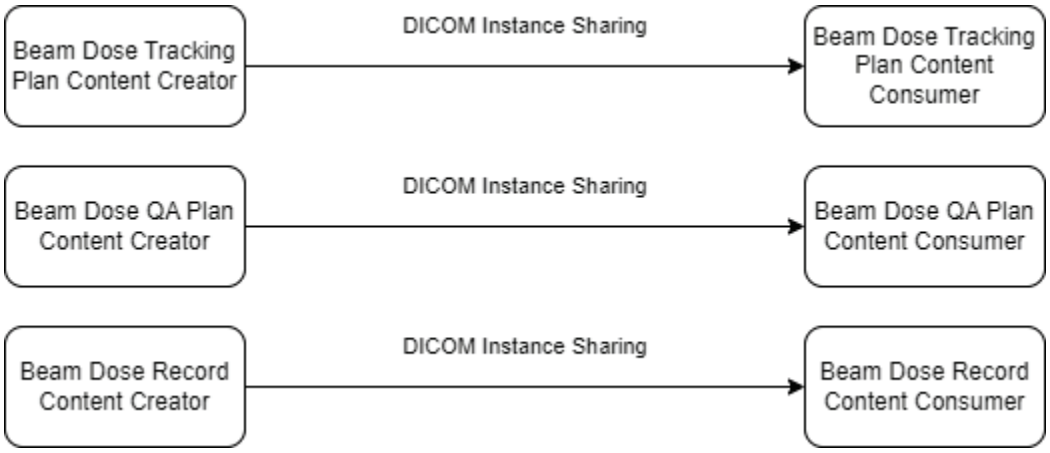

Figure X.1-1: CDEB Actor Diagram

Table X.1-1 lists the content module defined in the CDEB Profile. To claim support with this profile, an actor shall support all required content modules (labeled "R") but must adhere to at least one of the options described in Section X.2 Actor Options.

Table X.1-1: CDEB Profile - Actors and Content Modules

Actors	Content Definition	Optionality	Reference
Beam Dose Tracking Plan Content Creator	RT Prescription Module for Consistent Dose Tracking	R	See RO TF-3: 7.4.3.2.2
	RT Fraction Scheme Module for Consistent Dose Tracking	R	See RO TF-3: 7.4.3.3.1
	Control Point Attributes for Consistent Dose Tracking	R	See RO TF-3: 7.4.4.2.2
Beam Dose QA Plan Content Creator	RT Prescription Module for Consistent Dose Quality Assurance	R	See RO TF-3: 7.4.3.2.3
	RT Fraction Scheme Module for Consistent Dose Tracking	R	See RO TF-3: 7.4.3.3.1
	Control Point Attributes for Consistent Dose Tracking	R	See RO TF-3: 7.4.4.2.2
Beam Dose Record Content Creator	Calculated Dose Reference Record Module for Consistent Dose	R	See RO TF-3: 7.4.11.5.1
	Beam Fixed Attribute List for Consistent Dose	R	See RO TF-3: 7.4.11.2.2
Beam Dose Tracking Plan Content Consumer	RT Prescription Module for Consistent Dose Tracking	R	See RO TF-3: 7.4.3.2.2
	RT Fraction Scheme Module for Consistent Dose Tracking	R	See RO TF-3: 7.4.3.3.1
	Control Point Attributes for Consistent Dose Tracking	R	See RO TF-3: 7.4.4.2.2
Beam Dose QA Plan Content Consumer	RT Prescription Module for Consistent Dose Quality Assurance	R	See RO TF-3: 7.4.3.2.3
	RT Fraction Scheme Module for Consistent Dose Tracking	R	See RO TF-3: 7.4.3.3.1
	Control Point Attributes for Consistent Dose Tracking	R	See RO TF-3: 7.4.4.2.2
Beam Dose Record Content Consumer	Calculated Dose Reference Record Module for Consistent Dose	R	See RO TF-3: 7.4.11.5
	Beam Fixed Attribute List for Consistent Dose	R	See RO TF-3: 7.4.11.2.2

X.1.1 Actor Descriptions and Actor Profile Requirements

Most requirements are documented in RO TF-3 Content Modules. This section documents any additional requirements on profile actors.

X.1.1.1 Beam Dose Tracking Plan Content Creator

A Beam Dose Tracking Plan Content Creator sends an RT Plan or RT Ion Plan containing attributes that enable dose tracking during beam delivery.

X.1.1.2 Beam Dose QA Plan Content Creator

A Beam Dose QA Plan Content Creator sends an RT Plan or RT Ion Plan containing attributes that enable quality assurance of beam doses.

X.1.1.3 Beam Dose Record Content Creator

A Beam Dose Record Content Creator sends an RT Treatment Beams Session Record or RT Ion Treatment Beams Session Record containing attributes that represent tracked dose.

X.1.1.4 Beam Dose Tracking Plan Content Consumer

A Beam Dose Tracking Plan Content Consumer receives an RT Plan or RT Ion Plan containing attributes that enable dose tracking during beam delivery.

X.1.1.5 Beam Dose QA Plan Content Consumer

A Beam Dose QA Plan Content Consumer receives an RT Plan or RT Ion Plan containing attributes that enable quality assurance of beam doses.

X.1.1.6 Beam Dose Record Consumer

A Consistent External Beam Dose Record Consumer sends an RT Treatment Beams Session Record or RT Ion Treatment Beams Session Record containing attributes that represent tracked dose.

X.2 CDEB Actor Options

Options that may be selected for each actor in this profile, if any, are listed in Table X.2-1. Dependencies between options, when applicable, are specified in notes.

Table X.2-1: CDEB - Actors and Options

Actor	Option Name	Reference
Beam Dose Tracking Plan Content Creator	No options defined	-
Beam Dose QA Plan Content Creator	No options defined	-
Beam Dose Record Content Creator	No options defined	-
Beam Dose Tracking Plan Content Consumer	No options defined	-
Beam Dose QA Plan Content Consumer	No options defined	-
Beam Dose Record Consumer	No options defined	-

X.3 Consistent Dose Required Actor Groupings

An actor from this profile (Column "CDEB Actor") shall implement all of the required transactions and/or content modules in this profile ***in addition to all*** of the requirements for the grouped actor (Column "Actor(s) to be grouped with").

If this is a content profile, and actors from this profile are grouped with actors from a workflow or transport profile, the Reference column references any specifications for mapping data from the content module into data elements from the workflow or transport transactions.

In some cases, required groupings are defined as at least one of an enumerated set of possible actors; this is designated by merging column one into a single cell spanning multiple potential grouped actors. Notes are used to highlight this situation.

Section X.5 describes some optional groupings that may be of interest for security considerations and Section X.6 describes some optional groupings in other related profiles.

Table X.3-1: Consistent Dose for External Beam - Required Actor Groupings

CDEB Actor	Actor(s) to be grouped with	Reference	Content Bindings Reference
Beam Dose Tracking Plan Content Creator	Basic Static Beam Producer	RO TF-1: 5.1	See Note 1
	Basic Static MLC Beam Producer	RO TF-1: 5.1	See Note 1
	Arc Beam Producer	RO TF-1: 5.1	See Note 1
	MLC Fixed Aperture Arc Beam Producer	RO TF-1: 5.1	See Note 1
	MLC Variable Aperture Arc Beam Producer	RO TF-1: 5.1	See Note 1
	Hard Wedge Beam Producer	RO TF-1: 5.1	See Note 1
	Virtual Wedge Beam Producer	RO TF-1: 5.1	See Note 1
	Motorized Wedge Beam Producer	RO TF-1: 5.1	See Note 1
	Static Electron Beam Producer	RO TF-1: 5.1	See Note 1
	Step & Shoot Beam Producer	RO TF-1: 5.1	See Note 1
	Sliding Window Beam Producer	RO TF-1: 5.1	See Note 1
	IMAT/VMAT Beam Producer	RO TF-1: 5.1	See Note 1
	Photon Applicator Beam Producer	RO TF-1: 5.1	See Note 1
	Photon Applicator Arc Beam Producer	RO TF-1: 5.1	See Note 1
Beam Dose Record Content Creator	Treatment Delivery Record Producer	TDRC-1: X.1 TDRC-Ion-1: X.1	See Note 1
Beam Dose Tracking Plan Content Consumer	Treatment Management System (TMS)	RO TF-1: 5.1	See Note 1
Beam Dose Record Content Consumer	Treatment Management System (TMS)	RO TF-1: 5.1	See Note 1

Note 1: CDEB actor shall be grouped with at least one of the actors specified in the list.

X.4 Consistent Dose Content Overview

X.4.1 Concepts

Consistent specification of how dose should be described in the original RT DICOM objects can be tested with an agreed upon description of dose components as defined here. This content profile aims to define specific required attributes needed to determine planned dose to dose references, and then how to consistently report on those dose references for Dose Tracking or Quality Assurance.

An application may be both, a Beam Dose Tracking Plan Content Creator and a Beam Dose QA Plan Content Creator. This will result in twice the items in the Dose Reference Sequence in the RT (Ion) Plan for the same target: one with the parameters as defined in 7.4.3.2.2 “RT Prescription Module for Consistent Dose Tracking” and one as defined in 7.4.3.2.3 “RT Prescription Module for Consistent Dose Quality Assurance”.

X.4.2 Use Cases

In order to represent different use cases, the formatting of the Dose References is according to the following layout:

Use Case	Dose Reference Type (300A,0020)	Dose Reference Structure Type (300A,0014)	Dose Value Purpose (300A,061D)	Dose Value Interpretation (300A,068B)
Dose Tracking for specific target(s)	TARGET	VOLUME, SITE, COORDINATE	TRACKING	NOMINAL, ACTUAL
Dose Tracking for organs-at-risk	OAR	VOLUME, SITE, COORDINATE	TRACKING	NOMINAL, ACTUAL
Quality Assurance for specific point(s)	TARGET	COORDINATE	QA	ACTUAL
Quality Assurance for organs-at-risk	OAR	COORDINATE	QA	ACTUAL

X.4.2.1 Dose Tracking Dose References

Dose Tracking Dose References are utilized to evaluate dose that is accumulated by the delivery of one or more treatment plans. A typical clinical expectation is that after finishing the delivery of the entire treatment plan, the accumulated dose represents the nominal dose. This is typically a

single dose value that originates from a prescription template and nominally represents the prescription but does not fully describe it. The accumulated nominal dose value can be compared against such a prescribed dose value and can also be utilized for activity capture.

X.4.2.2 Quality Assurance Dose References

Quality Assurance Dose References are utilized to allow Quality Assurance software to re-calculate dose at specific points. Therefore, the accumulated dose value represents an actual dose at a specific spatial location identified by a 3D coordinate, as indicated by the Dose Value Interpretation (300A,068B) value ACTUAL.

Note: Independent of the fact that the accumulated dose value represents an actual dose value at the given coordinate, the Beam Dose values for each beam are still nominal, as declared by the Beam Dose Meaning (300A,008B) of which the value is defined as FRACTION_LEVEL, see 7.4.3.3.1.

X.4.3 Examples

X.4.3.1 Dose Tracking and Quality Assurance for one Target

For one target (30Gy/3fx) with dose contributions by three beams, a “Dose Tracking” Dose Reference (Item 1) as well as a “Quality Assurance” Dose Reference (Item 2) is produced:

Dose Reference Sequence	(300A,0010)	SQ	3	<Sequence>
>Item 1				
>Dose Reference Number	(300A,0012)	IS	1	1
>Dose Reference UID	(300A,0013)	UI	1	1.2.3.4.1
>Dose Reference Structure Type	(300A,0014)	CS	1	SITE
>Dose Reference Description	(300A,0016)	LO	1	Tumor
>Dose Reference Type	(300A,0020)	CS	1	TARGET
>Dose Value Purpose	(300A,061D)	CS	1	TRACKING
>Dose Value Interpretation	(300A,068B)	CS	1	NOMINAL
>Item 2				
>Dose Reference Number	(300A,0012)	IS	1	2
>Dose Reference UID	(300A,0013)	UI	1	1.2.3.4.2
>Dose Reference Structure Type	(300A,0014)	CS	1	COORDINATES
>Dose Reference Description	(300A,0016)	LO	1	Tumor
>Dose Reference Point Coordinates	(300A,0018)	DS	3	3.1\4.2\5.3
>Dose Reference Type	(300A,0020)	CS	1	TARGET
>Dose Value Purpose	(300A,061D)	CS	1	QA
>Dose Value Interpretation	(300A,068B)	CS	1	ACTUAL

The corresponding Fraction Group will contain the three referenced beams:

Fraction Group Sequence	(300A,0070)	SQ	1	<Sequence>
>Item 1				
>Fraction Group Number	(300A,0071)	IS	1	1
>Number of Fractions Planned	(300A,0078)	IS	1	3
>Number of Beams	(300A,0080)	IS	1	3
>Beam Dose Meaning	(300A,008b)	CS	1	FRACTION_LEVEL
>Number of Brachy Application Setups	(300A,00a0)	IS	1	0
>Referenced Beam Sequence	(300C,0004)	SQ	8	<Sequence>
>>Item 1				
>>Referenced Dose Reference UID	(300A,0083)	UI	1	1.2.3.4.1
>>Beam Dose	(300A,0084)	DS	1	3.0
>>Beam Meterset	(300A,0086)	DS	1	700
>>Beam Dose Type	(300A,0090)	CS	1	PHYSICAL
>>Referenced Beam Number	(300C,0006)	IS	1	1
>>Item 2				


```
>>Referenced Dose Reference UID                (300A,0083)    UI    1    1.2.3.4.1
>>Beam Dose                                    (300A,0084)    DS    1    3.0
>>Beam Meterset                                (300A,0086)    DS    1    700
>>Beam Dose Type                               (300A,0090)    CS    1    PHYSICAL
>>Referenced Beam Number                       (300C,0006)    IS    1    2
>>Item 3
>>Referenced Dose Reference UID                (300A,0083)    UI    1    1.2.3.4.1
>>Beam Dose                                    (300A,0084)    DS    1    4.0
>>Beam Meterset                                (300A,0086)    DS    1    800
>>Beam Dose Type                               (300A,0090)    CS    1    PHYSICAL
>>Referenced Beam Number                       (300C,0006)    IS    1    3
```

Note, that each beam declares its dose contribution to the first Dose Reference by referring to the Dose Reference UID (300A0013) of the first item in the Dose Reference Sequence.

For each beam, all Control Points will have two Referenced Dose Reference Sequence (300C,0050) Items and the corresponding last Control Points will indicate the final Cumulative Dose Reference Coefficient (300A,010C) declaring the dose contribution of this beam to the referenced Dose Reference.

Referenced Dose Reference Sequence Item of last Control for

- Beam 1:

```
>>Referenced Dose Reference Sequence      (300C,0050)    SQ    3    <Sequence>
>>>Item 1
>>>Cumulative Dose Reference Coefficient  (300A,010C)    DS    1    1.0
>>>Referenced Dose Reference Number       (300C,0051)    IS    1    1
>>>Item 2
>>>Cumulative Dose Reference Coefficient  (300A,010C)    DS    1    1.093
>>>Referenced Dose Reference Number       (300C,0051)    IS    1    2
```

- Beam 2:

```
>>Referenced Dose Reference Sequence      (300C,0050)    SQ    3    <Sequence>
>>>Item 1
>>>Cumulative Dose Reference Coefficient  (300A,010C)    DS    1    1.0
>>>Referenced Dose Reference Number       (300C,0051)    IS    1    1
>>>Item 2
>>>Cumulative Dose Reference Coefficient  (300A,010C)    DS    1    1.013
>>>Referenced Dose Reference Number       (300C,0051)    IS    1    2
```

- Beam 3:

```
>>Referenced Dose Reference Sequence      (300C,0050)    SQ    3    <Sequence>
>>>Item 1
>>>Cumulative Dose Reference Coefficient  (300A,010C)    DS    1    1.0
>>>Referenced Dose Reference Number       (300C,0051)    IS    1    1
>>>Item 2
>>>Cumulative Dose Reference Coefficient  (300A,010C)    DS    1    0.993
>>>Referenced Dose Reference Number       (300C,0051)    IS    1    2
```

This results in the following calculations for the dose contributions of the beams to the Dose References:

	Beam Dose	Dose Reference 1 Coefficient	Dose Reference 2 Coefficient
Beam 1	3.0Gy	1.0 ≙ 3.0Gy	1.093 ≙ 3.279Gy
Beam 2	3.0Gy	1.0 ≙ 3.0Gy	1.013 ≙ 3.039Gy
Beam 3	4.0Gy	1.0 ≙ 4.0Gy	0.993 ≙ 3,972Gy
Sum	10.0Gy	10.0Gy	10,29Gy

	Beam Dose	Dose Reference 1 Coefficient	Dose Reference 2 Coefficient
Sum*Num Fx	30.0Gy	30.0Gy	30,87Gy

X.4.3.2 Dose Tracking for Three Targets

For three targets (Metastasis 1: 20Gy/3fx, Metastasis 2: 30Gy/3fx, Metastasis 3: 10Gy/3fx) with each receiving a dose contribution by five beams, a “Dose Tracking” Dose Reference is produced for each target:

```
Dose Reference Sequence                          (300A,0010)      SQ      3       <Sequence>
>Item 1
>Dose Reference Number                           (300A,0012)      IS      1       1
>Dose Reference UID                              (300A,0013)      UI      1       1.2.3.4.1
>Dose Reference Structure Type                   (300A,0014)      CS      1       SITE
>Dose Reference Description                      (300A,0016)      LO      1       Metastasis 1
>Dose Reference Type                             (300A,0020)      CS      1       TARGET
>Dose Value Purpose                              (300A,061D)      CS      1       TRACKING
>Dose Value Interpretation                       (300A,068B)      CS      1       NOMINAL
>Item 2
>Dose Reference Number                           (300A,0012)      IS      1       2
>Dose Reference UID                              (300A,0013)      UI      1       1.2.3.4.2
>Dose Reference Structure Type                   (300A,0014)      CS      1       SITE
>Dose Reference Description                      (300A,0016)      LO      1       Metastasis 2
>Dose Reference Type                             (300A,0020)      CS      1       TARGET
>Dose Value Purpose                              (300A,061D)      CS      1       TRACKING
>Dose Value Interpretation                       (300A,068B)      CS      1       NOMINAL
>Item 3
>Dose Reference Number                           (300A,0012)      IS      1       3
>Dose Reference UID                              (300A,0013)      UI      1       1.2.3.4.3
>Dose Reference Structure Type                   (300A,0014)      CS      1       SITE
>Dose Reference Description                      (300A,0016)      LO      1       Metastasis 3
>Dose Reference Type                             (300A,0020)      CS      1       TARGET
>Dose Value Purpose                              (300A,061D)      CS      1       TRACKING
>Dose Value Interpretation                       (300A,068B)      CS      1       NOMINAL
```

The corresponding Fraction Group will contain the five referenced beams:

```
Fraction Group Sequence                          (300A,0070)      SQ      1       <Sequence>
>Item 1
>Fraction Group Number                           (300A,0071)      IS      1       1
>Number of Fractions Planned                     (300A,0078)      IS      1       3
>Number of Beams                                 (300A,0080)      IS      1       5
>Beam Dose Meaning                               (300A,008b)      CS      1       FRACTION_LEVEL
>Number of Brachy Application Setups            (300A,00a0)      IS      1       0
>Referenced Beam Sequence                        (300C,0004)      SQ      8       <Sequence>
>>Item 1
>>Referenced Dose Reference UID                  (300A,0083)      UI      1       1.2.3.4.2
>>Beam Dose                                      (300A,0084)      DS      1       2.5
>>Beam Meterset                                  (300A,0086)      DS      1       500
>>Beam Dose Type                                 (300A,0090)      CS      1       PHYSICAL
>>Referenced Beam Number                         (300C,0006)      IS      1       1
>>Item 2
>>Referenced Dose Reference UID                  (300A,0083)      UI      1       1.2.3.4.2
>>Beam Dose                                      (300A,0084)      DS      1       1.5
>>Beam Meterset                                  (300A,0086)      DS      1       500
>>Beam Dose Type                                 (300A,0090)      CS      1       PHYSICAL
>>Referenced Beam Number                         (300C,0006)      IS      1       2
>>Item 3
>>Referenced Dose Reference UID                  (300A,0083)      UI      1       1.2.3.4.2
>>Beam Dose                                      (300A,0084)      DS      1       3.0
>>Beam Meterset                                  (300A,0086)      DS      1       500
>>Beam Dose Type                                 (300A,0090)      CS      1       PHYSICAL
>>Referenced Beam Number                         (300C,0006)      IS      1       3
>>Item 4
```



```
>>Referenced Dose Reference UID                (300A,0083)      UI       1        1.2.3.4.2
>>Beam Dose                                    (300A,0084)      DS       1        2.5
>>Beam Meterset                                (300A,0086)      DS       1        500
>>Beam Dose Type                               (300A,0090)      CS       1        PHYSICAL
>>Referenced Beam Number                       (300C,0006)      IS       1        3
>>Item 5
>>Referenced Dose Reference UID                (300A,0083)      UI       1        1.2.3.4.2
>>Beam Dose                                    (300A,0084)      DS       1        0.5
>>Beam Meterset                                (300A,0086)      DS       1        300
>>Beam Dose Type                               (300A,0090)      CS       1        PHYSICAL
>>Referenced Beam Number                       (300C,0006)      IS       1        3
```

Although all beams contribute to all Dose References, the Beam Doses reflect the overall nominal dose to the Dose Reference with Dose Reference Number (300A,0012) of value 2, indicated by the corresponding Referenced Dose Reference UID (300A,0083).

The final Cumulative Dose Reference Coefficient (300A,010C) values for all beams referring to Dose Reference 2 will all equal 1.0, resulting in the nominal dose of 30Gy for all fractions. The final coefficients of the other Dose References will show values yielding the nominal doses of each corresponding target (20Gy and 10Gy).

X.5 CDEB Security Considerations

The security considerations for a content module are dependent upon the security provisions defined by the grouped actor(s).

X.6 CDEB Cross Profile Considerations

TPPC – Treatment Planning – Plan Content

The various Beam Producers in TPPC might be grouped with a Beam Dose QA Plan Producer to allow for dose tracking.

Appendices to Volume 1

None

Volume 2 – Transactions

No transactions.

Appendices to Volume 2

None

Volume 3 – Content Modules

11 7. Radiation Oncology DICOM Content Definition

DICOM Content Definitions constrain the use of instances of specific DICOM IODs (also referred to as DICOM objects). This typically means placing requirements on the creators of those instances, although requirements may also be placed on the receivers and users.

The most common such requirements are to:

- Make a module that is optional (U) in a DICOM IOD be required or conditional,
- Make an attribute that is optional (Type 3) in a DICOM Module be required or conditional,
- Require that an attribute that is optional (Type 3) in a DICOM Module be absent
- Constrain the content of an attribute to be empty
- Constrain the content of an attribute to be populated in a certain way, such as:
  - Constraining the value to be taken from a specific table
  - Constraining the value to be copied from a specific source
  - Constraining the value to encode certain information
- Require that an attribute be displayed/accessible to the operator

Reiterating DICOM requirements is kept to a minimum sufficient to provide context for the IHE requirements. Implementers are still required to be familiar with, and conform to, the underlying DICOM specification.

Content Definitions may be referenced from a Profile independent of transactions to constrain content without specifying the transport. Content Definitions may also be referenced from within a Transaction specification to constrain the content without duplicating the same constraint text across multiple related transactions.

For attributes that are optional, the creator is permitted but not required to include them, and the receiver is permitted but not required to ignore them.

7.1 Conventions

DICOM Conventions are defined in Appendix E to the *IHE Technical Frameworks General Introduction*.

Table 7.1.2-1: Usage of DICOM Modules in IHE

M / C / U	As defined in DICOM PS 3.3
R	The Module is defined as Conditional (C) or User Option (U) in DICOM. The Requirement is an IHE extension of the DICOM requirements, and the module shall be present.

RC	The Module is defined as Conditional (C) or User Option (U) in DICOM. The Requirement is an IHE extension of the DICOM requirements, and the module shall be present when the specified conditions apply.

Table 7.1.2-2: Usage of DICOM Attributes in IHE

O	The attribute or its value is optional, i.e., in DICOM it is Type 2 or 3.
O+*	The attribute is optional, but additional constraints have been added. Note: The specification approach does not force a Type 2 or Type 3 value to become a Type 1 by stating O+.
R	The attribute is required, and is not an IHE extension of the DICOM requirements; i.e., it is already Type 1 in DICOM, but additional constraints are placed by IHE, for example on the value set that may be used for the attribute.
R+	The Requirement is an IHE extension of the DICOM requirements, and the attribute shall be present, i.e., is Type 1, whereas the DICOM requirement may be Type 2 or 3.
RC+	The Requirement is an IHE extension of the DICOM requirements, and the attribute shall be present when the condition is satisfied, i.e., is Type 1C, whereas the DICOM requirement may be Type 2 or 3. If the condition is not fulfilled, the DICOM definitions apply. Note, that this means that the attribute may be present / have a value also in case the condition does not apply.
D	The requirements of DICOM apply unchanged, but the attribute needs to be displayed.
-	No IHE extension of the DICOM requirements is defined. The attribute is listed for better readability or similar purpose.
X+	The attribute information is required to be absent. DICOM Type 2 attributes shall be present with no value. DICOM Type 3 attributes shall be absent.

7.1.1 DICOM Structured Report

Conventions for constraining instances of DICOM Structured Reports as IHE Content Definitions are not yet worked out. In many cases, requiring the use of a specific DICOM SR Template may be sufficient.

7.1.2 Display Requirements

If a requirement lists *, then that attribute is not required to be displayed.

7.2 General Definitions

See TF-3: 7.2

7.3 IOD Definitions

This section contains DICOM IOD specifications referenced in profiles of the IHE Radiation Oncology domain, specifying the parts of the DICOM Standard used and the extended IHE requirements.

7.3.2 Plan IODs

7.3.2.2 RT Plan IOD for General Use

7.3.2.2.1 RT Plan IOD from Dosimetric Planning

7.3.2.2.2 RT Plan IOD for Dose Composition

7.3.2.2.3 RT Plan IOD for Consistent Dose Tracking and Quality Assurance

7.3.2.2.3.1 Referenced Standards

DICOM PS 3.3

7.3.2.2.3.2 IOD Definition

The RT Prescription Module for Consistent Dose Tracking or the RT Prescription Module for Consistent Dose Quality Assurance is used, depending on the Use Case.

IE	Module	Reference	Usage	IHE RO Usage
Patient	Patient	C.7.1.1	M	M See 7.4.1.1.1
	Clinical Trial Subject	C.7.1.3	U	U
Study	General Study	C.7.2.1	M	M See 7.4.1.2.1
	Patient Study	C.7.2.2	U	U
	Clinical Trial Study	C.7.2.3	U	U
Series	RT Series	C.8.8.1	M	M See 7.4.1.4.1
	Clinical Trial Series	C.7.3.2	U	U
Frame of Reference	Frame of Reference	C.7.4.1	U	-
Equipment	General Equipment	C.7.5.1	M	M See 7.4.1.5.1
Plan	RT General Plan	C.8.8.9	M	-

	RT Prescription	C.8.8.10	U	R See 7.4.3.2.2 RT Prescription Module for Consistent Dose Tracking and/or 7.4.3.2.3. RT Prescription Module for Consistent Dose Quality Assurance
	RT Tolerance Tables	C.8.8.11	U	-
	RT Patient Setup	C.8.8.12	U	-
	RT Fraction Scheme	C.8.8.13	U	R See 7.4.3.3.1 RT Fraction Scheme Module for Consistent Dose Tracking
	RT Beams	C.8.8.14	C - Required if RT Fraction Scheme Module exists and Number of Beams (300A,0080) is greater than zero for one or more fraction groups	R Use RT Beams Module and include 7.4.4.2.2 Control Point Attributes for Consistent Dose
	RT Brachy Application Setups	C.8.8.15	C - Required if RT Fraction Scheme Module exists and Number of Brachy Application Setups (300A,00A0) is greater than zero for one or more fraction groups	Absent
	Approval	C.8.8.16	U	-
	SOP Common	C.12.1	M	M See 7.4.1.6.1

7.3.2.2.5 RT Ion Plan IOD for Consistent Dose Tracking and Quality Assurance

7.3.2.2.5.1 Referenced Standards

530 DICOM PS 3.3

7.3.2.2.5.2 IOD Definition

The RT Prescription Module for Consistent Dose Tracking or the RT Prescription Module for Consistent Dose Quality Assurance is used, depending on the Use Case.

IE	Module	Reference	Usage	IHE RO Usage
Patient	Patient	C.7.1.1	M	M See RO TF-3: 7.4.1.1.1
	Clinical Trial Subject	C.7.1.3	U	U
Study	General Study	C.7.2.1	M	M See RO TF-3: 7.4.1.2.1
	Patient Study	C.7.2.2	U	U
	Clinical Trial Study	C.7.2.3	U	U
Series	RT Series	C.8.8.1	M	M See RO TF-3: 7.4.1.4.1
	Clinical Trial Series	C.7.3.2	U	U
Frame of Reference	Frame of Reference	C.7.4.1	U	-
Equipment	General Equipment	C.7.5.1	M	M See RO TF-3: 7.4.1.5.1
Plan	RT General Plan	C.8.8.9	M	-

	RT Prescription	C.8.8.10	U	R See 7.4.3.2.2 RT Prescription Module for Consistent Dose Tracking or 7.4.3.2.3. RT Prescription Module for Consistent Dose Quality Assurance
	RT Ion Tolerance Tables	C.8.8.24	U	-
	RT Patient Setup	C.8.8.12	U	-
	RT Fraction Scheme	C.8.8.13	U	R See RO TF-3: 7.4.3.3.1 RT Fraction Scheme Module for Consistent Dose Tracking
	RT Ion Beams	C.8.8.25	C - Required if RT Fraction Scheme Module exists and Number of Beams (300A,0080) is greater than zero for one or more fraction groups	R Use RT Ion Beams Module and include 7.4.4.2.2 Control Point Attributes for Consistent Dose
	RT Brachy Application Setups	C.8.8.15	C - Required if RT Fraction Scheme Module exists and Number of Brachy Application Setups (300A,00A0) is greater than zero for one or more fraction groups	Absent
	Approval	C.8.8.16	U	-
	SOP Common	C.12.1	M	M See RO TF-3: 7.4.1.6.1

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7.3.6 Treatment Record IODs

7.3.6.1 Technique Specific RT Treatment Record

7.3.6.2 RT Treatment Record

7.3.6.2.1 RT Beams Treatment Record IOD for Consistent Dose Tracking

7.3.6.2.1.1 Referenced Standards

DICOM PS 3.3

7.3.6.2.1.2 IOD Definition

IE	Module	Reference	Usage	IHE RO Usage
Patient	Patient	C.7.1.1	M	M See RO TF-3: 7.4.1.1.1
	Clinical Trial Subject	C.7.1.3	U	U
Study	General Study	C.7.2.1	M	M See RO TF-3: 7.4.1.2.1
	Patient Study	C.7.2.2	U	U
	Clinical Trial Study	C.7.2.3	U	U
Series	RT Series	C.8.8.1	M	M See RO TF-3: 7.4.1.4.1
	Clinical Trial Series	C.7.3.2	U	U
Equipment	General Equipment	C.7.5.1	M	M See RO TF-3: 7.4.1.5.1
Treatment Record	RT General Treatment Record	C.8.8.17	M	-
	RT Patient Setup	C.8.8.12	U	-
	RT Treatment Machine Record	C.8.8,18	M	-
	Measured Dose Reference Record	C.8.8.19	U	-
	Calculated Dose Reference Record	C.8.8.20	U	R See RO TF-3: 7.4.11.5 Calculated Dose Reference Record Module for Consistent Dose
	RT Beams Session Record	C.8.8.21	M	Use RT Beams Session Record Module and include 7.4.11.2.2 Beam Fixed Attribute List for Consistent Dose Tracking
	RT Treatment Summary Record	C.8.8.23	U	-
	SOP Common	C.12.1	M	M See RO TF-3: 7.4.1.6.1
	Common Instance Reference	C.12.2	U	-

545 #### 7.3.6.2.2 RT Ion Beams Treatment Record IOD for Consistent Dose Tracking

7.3.6.2.2.1 Referenced Standards

DICOM PS 3.3

7.3.6.2.2.2 IOD Definition

IE	Module	Reference	Usage	IHE RO Usage
Patient	Patient	C.7.1.1	M	M See 7.4.1.1.1
	Clinical Trial Subject	C.7.1.3	U	U
Study	General Study	C.7.2.1	M	M See 7.4.1.2.1
	Patient Study	C.7.2.2	U	U
	Clinical Trial Study	C.7.2.3	U	U
Series	RT Series	C.8.8.1	M	M See 7.4.1.4.1
	Clinical Trial Series	C.7.3.2	U	U
Equipment	General Equipment	C.7.5.1	M	M See 7.4.1.5.1
Treatment Record	RT General Treatment Record	C.8.8.17	M	-
	RT Patient Setup	C.8.8.12	U	-
	RT Treatment Machine Record	C.8.8,18	M	-
	Measured Dose Reference Record	C.8.8.19	U	-
	Calculated Dose Reference Record	C.8.8.20	U	R See 7.4.11.5 Calculated Dose Reference Record Module for Consistent Dose
	RT Ion Beams Session Record	C.8.8.21	M	Use RT Ion Beams Session Record Module and include 7.4.11.2.2 Beam Fixed Attribute List for Consistent Dose Tracking
	RT Treatment Summary Record	C.8.8.23	U	-
	SOP Common	C.12.1	M	M

IE	Module	Reference	Usage	IHE RO Usage
				See 7.4.1.6.1
	Common Instance Reference	C.12.2	U	-

7.4DICOM Content Modules

7.4.3 General Plan-Related Modules

7.4.3.2 RT Prescription Module

7.4.3.2.1 RT Prescription Module Base Content

7.4.3.2.2 RT Prescription Module for Consistent Dose Tracking

Table 7.4.3.2.2-1: Required Attributes for RT Prescription Module

Attribute	Tag	Presence	Specific Rules
Dose Reference Sequence	(300A, 0020)	R+	One or more Items with Dose Reference Type TARGET shall be supported.
>Dose Reference Number	(300A,0012)	-	
>Dose Reference UID	(300A,0013)	R+*	Shall unique to this Dose Reference.
>Dose Reference Structure Type	(300A,0014)	-*	VOLUME, SITE or COORDINATE
>Dose Reference Description	(300A,0016)	R+	
>Dose Reference Type	(300A,0020)	-	TARGET or OAR
>Dose Value Purpose	(300A,061D)	R+	TRACKING
>Dose Value Interpretation	(300A,068B)	R+	NOMINAL or ACTUAL

7.4.3.2.3 RT Prescription Module for Consistent Dose Quality Assurance

Table 7.4.3.2.3-1: Required Attributes for RT Prescription Module

Attribute	Tag	Presence	Specific Rules
Dose Reference Sequence	(300A, 0020)	R+	One or more Items with Dose Reference Type TARGET shall be supported.
>Dose Reference Number	(300A,0012)	-	
>Dose Reference UID	(300A,0013)	R+	Shall unique to this Dose Reference.
>Dose Reference Structure Type	(300A,0014)	-	COORDINATE only
>Dose Reference Description	(300A,0016)	R+	
>Dose Reference Type	(300A,0020)	-	TARGET or OAR
>Dose Value Purpose	(300A,061D)	R+	QA

Attribute	Tag	Presence	Specific Rules
>Dose Value Interpretation	(300A,068B)	R+	ACTUAL

7.4.3.3.1 RT Fraction Scheme Module for Consistent Dose Tracking

Table 7.4.3.3.1-1: Required Attributes for RT Fraction Scheme Module in RT Plan

Attribute	Tag	Presence	Specific Rules
Fraction Group Sequence	(300A,0070)	-	
>Number of Fractions Planned	(300A,0078)	R+	Shall have a number and shall be greater than 0.
>Number of Beams	(300A,0080)	-	Shall be greater than 0.
>Referenced Beam Sequence	(300C,0004)	-	Shall contain the same number of items as the Number of Beams (300A,0080).
>>Referenced Dose Reference UID	(300A,0083)	R+*	Shall refer to the Dose Reference UID (300A,0013) of the Dose Reference in the Dose Reference Sequence (300A,0020) that identifies the primary target for the current beam.
>>Beam Dose	(300A,0084)	R+	A scalar value used to indicate the planned dose to the Dose Reference. This value shall indicate the beam dose per fraction, not for the entire plan.
>Beam Dose Meaning	(300A,008B)	R+	Shall have the value FRACTION_LEVEL to indicate that the Beam Dose carries a nominally distributed dose only.

7.4.4 Plan-related Modules in Planning

7.4.4.2 General Beam Attribute Specifications

7.4.4.2.1 Control Point Fixed Attribute List Base Content

7.4.4.2.2 Control Point Fixed Attribute List for Consistent Dose Tracking

7.4.4.2.2.1 Referenced Standards

DICOM PS3.3

7.4.4.2.2.2 Required Attributes

The following Table 7.4.4.2.2.2-1 lists the attribute requirements for Consistent Dose Tracking in the Control Point Sequence (300A,0111) of the RT Beams Module in the RT Plan IOD and the Ion Control Point Sequence (300A,03A8) of the RT Ion Beams Module in the RT Ion Plan IOD.

Table 7.4.4.2.2.2-1: Required Attributes for RT Beams/RT Ion Beams Module

Attribute	Tag	Presence	Specific Rules
>>Control Point Index	(300A,0112)	-	
>>Referenced Dose Reference Sequence	(300C,0050)	R+*	Shall be present for all dose references in the RT Prescription Module of Dose Reference Type = TARGET. Other Referenced Dose References may be present.
>>>Referenced Dose Reference Number	(300C,0051)	-	
>>>Cumulative Dose Reference Coefficient	(300CA010C)	-	Shall have a value.

7.4.11 Treatment Record Modules

7.4.11.2 General Beam Attribute Specifications

7.4.11.2.1 Beam Fixed Attribute List Base Content

[This section is empty to mirror the chapter structure in 7.4.2.]

7.4.11.2.2 Beam Fixed Attribute List for Consistent Dose Tracking

7.4.11.2.2.1 Referenced Standards

DICOM PS3.3

7.4.11.2.2.2 Required Attributes

The following Table 7.4.11.2.2.2-1 lists the attribute requirements for Consistent Dose Tracking in the Treatment Session Beam Sequence (3008,0020) of the RT Beams Session Record Module in the RT Beams Treatment Record IOD and the Treatment Session Ion Beam Sequence (300A,0021) of the RT Ion Beams Session Record Module in the RT Ion Beams Treatment Record IOD.

Table 7.4.4.2.2.2-1: Required Attributes for RT Beams/RT Ion Beams Session Record Module

Attribute	Tag	Presence	Specific Rules
>Referenced Calculated Dose Reference Sequence	(3008,0090)	R+*	Shall be present for all Dose References in the RT Plan RT Prescription Module of Dose Reference Type with value TARGET. Other Referenced Dose References may be present.
>>Referenced Dose Reference Number	(300C,0051)	-	
>>Referenced Calculated Dose Reference Number	(300C,0092)	-	
>>Calculated Dose Reference Dose Value	(3008,0076)	-	

7.4.11.5 Calculated Dose Reference Record

7.4.11.5.1 Calculated Dose Reference Record for Consistent Dose

7.4.11.5.1.1 Referenced Standards

DICOM PS3.3

7.4.11.5.1.2 Required Attributes

Table 7.4.11.5.1.2-1: Required Attributes for Calculated Dose Referenced Record Module

Attribute	Tag	Presence	Specific Rules
Calculated Dose Reference Sequence	(3008,0070)	-*	
>Referenced Dose Reference Number	(3008,0051)	-	
>Calculated Dose Reference Number	(3008,0072)	-	
>Calculated Dose Reference Dose Value	(3008,0076)	R	Shall have a value.

Appendices to Volume 3

None

Volume 3 Namespace Additions

600 *Add the following terms to the IHE Namespace:*

None

Volume 4 – National Extensions

Add appropriate Country section

3 National Extensions for <Country Name or IHE Organization>

None