Digital Imaging and Communications in Medicine (DICOM)

Supplement 147: Second Generation Radiotherapy

- Prescription and Segment Annotation

Prepared by:

DICOM Standards Committee, Working Group 07, Radiation Therapy

1300 N. 17th Street, Suite 900

Rosslyn, Virginia 22209 USA

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Suggestions for revision should be directed to DICOM@medicalimaging.org

27 **Table of Contents**

Foreword

This Supplement specifies the additional IODs representing prescription and segment annotation information as a base model to support the new Radiotherapy (RT) Second Generation IODs and operations.

This document is an extension to the following parts of the published DICOM Standard:

PS 3.2	Conformance
PS 3.3	Information Object Definitions
PS 3.4	Service Class Specifications
PS 3.6	Data Dictionary
PS 3.16	Content Mapping Resource

Scope and Field of Application

INTRODUCTION

Existing radiotherapy IODs were designed to provide a set of containers for use in communicating radiotherapy data of all types, in a generic and flexible way.

Since the development of the initial IODs, both radiotherapy practice and the DICOM Standard itself have evolved considerably. This supplement addresses the need for a new generation of IODs and processes required for use in radiotherapy. The general principles under which these IODs and processes have been developed are documented below.

The IODs defined in here represent a base for further definition of radiotherapy-specific IODs that will be part of future Supplements that are already defined. At the time of this publication further supplements of the RT Second Generation objects include Supplement 175 "Second Generation Radiotherapy – C-Arm RT Treatment Modalities", Supplement 176 "Second Generation Radiotherapy – Additional RT Treatment Modalities", Supplement 177 "Second Generation Radiotherapy – RT Dose Objects" and Supplement 178 "Second Generation Radiotherapy – RT Course".

In order to provide an overview of the RT Second Generation concepts the general approach is described in this document going beyond the scope of the IODs defined in here.

GENERAL ARCHITECTURAL PRINCIPLES

The DICOM “STRATEGIC DOCUMENT Version 10.4, October 25, 2010” outlines a number of principles applicable across the entire DICOM standard. The key relevant points, and how this supplement addresses those concerns, are as follows:

- Different representations of data are encoded in different IODs. This is in contrast to first-generation objects, where multiple different types of data are encoded in a single IOD, such as RT Structure Set.
- Where applicable the development follows the “enhanced multi-frame” paradigm, rather than stacks of 2D SOP Instances. E.g. the new RT Dose Image included in Supplement 177 uses the multi-frame approach.

These new IODs do not define an architecture for the entire system, or functional requirements beyond behavior required for specific services. This is because the mode of manual exchange of objects (see PS3.17) supports an arbitrary system architecture. The worklist mode of operation does place some constraints on the architecture – for example, it implies the existence of one or more workflow servers that have knowledge of department-wide scheduling. The Radiation Oncology domain of the IHE initiative may adapt workflows that will utilize RT Second Generation objects and define their usage in a clinical workflow, as it was done with Supplement 74 and the IHE-RO Technical Profile "Treatment and Delivery Workflow".

RT ARCHITECTURAL PRINCIPLES

In addition to the general principles outlined above, additional principles specific to radiotherapy have been used in the development of this supplement:

- Support for available technologies: The new IODs are designed to support legacy and full-featured, modern equipment.
- Compatibility with First-Generation IODs: In general, where the technologies continue to be supported, it will be possible for the content of first-generation IODs to be re-encoded into the RT Second Generation IODs described in the supplement. However, such a translation will not be a basic re-encoding and will require additional information supplied by the translating device.
- New data representation approaches in DICOM: Where possible, use has been made of new and powerful approaches, such as 3D segmentation, mesh representation, rigid and deformable registrations.
- IODs specific to use cases: Explicit separate IODs have been developed for specific treatment modalities with the concept of RT Radiation IOD – for example, Tomotherapeutic, C-Arm, and Robotic beams are modeled separately. This allows more stringent conditions to be applied to the presence or absence of Attributes within those IODs, and thereby increases the potential for interoperability.
- Expandability of concept: New treatment modalities currently not considered by this standard can be modeled along the existing RT Radiation IODs and be introduced later on, fitting into the existing concept.
- New techniques in oncology: The existence of new treatment techniques (such as robotic therapy and tomotherapy) have been taken into account, along with new treatment strategies (such as image-guided therapy and adaptive therapy).

Part 2 Addendum

Add new SOP Classes to PS3.2 Table A.1-2 UID Values:

UID Value	UID Name	Category
1.2.840.10008.5.1.4.1.1.X.1.1	RT Physician Intent Storage	Transfer
1.2.840.10008.5.1.4.1.1.X.1.2	RT Segment Annotation Storage	Transfer

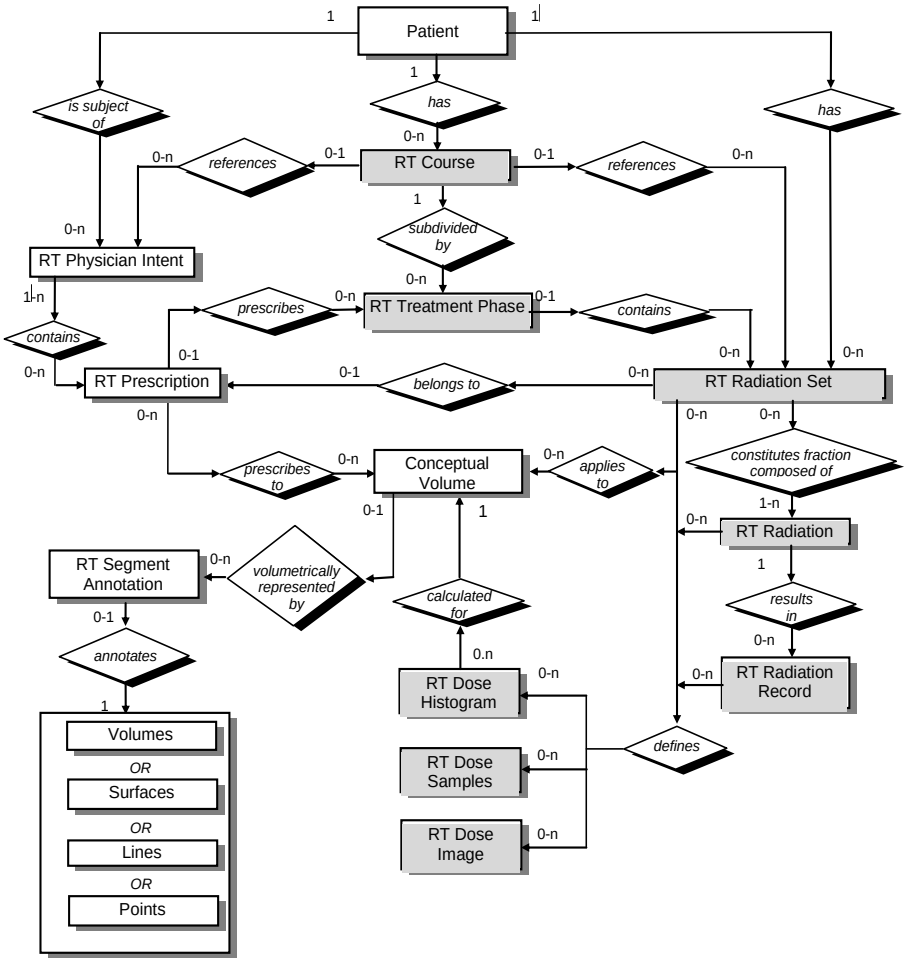
Part 3 Addendum

Add the following in PS3.3 Chapter 7 DICOM model of the real-world

7.12 EXTENSION OF THE DICOM MODEL OF THE REAL-WORLD FOR RADIOTHERAPY SECOND GENERATION INFORMATION OBJECTS

For the purpose of RT Second Generation SOP Classes the DICOM Model of the Real-World is described in this section. This subset of the real-world model covers the requirements for transferring information about planned and performed radiotherapeutic treatments and associated data.

Figure 7.12-1 describes the most important elements involved in the radiotherapy domain in DICOM.



Note 1: IODs which contain a representation of Volumes, Surfaces, Lines, Points can be annotated by an RT Segment Annotation.

Note 2: For better readability the diagram only contains the most important relationships, e.g. all objects have a relation to the Patient, but not all of these relationships are part of this diagram.

Figure 7.12-1 — DICOM MODEL OF THE REAL WORLD – RADIOTHERAPY

7.12.1 RT Course

The RT Course is a top-level entity that represents a radiotherapy treatment course, usually specified in one or more RT Prescriptions, generally for a defined tumor or group of tumors. A patient undergoing treatments of radiotherapy has one treatment course at a time. The RT Course may consist of several RT Treatment Phases (possibly with breaks of treatment in between them). Each treatment phase may consist of one or more RT

Treatment Sessions. An RT Treatment Session is delivered in one patient visit to a venue with a treatment machine and will typically deliver a fraction of one or more RT Radiation Sets. A new RT Course is administered, when the patient is treated for a re-occurrence or a new tumor site – typically after a period of a year or more after the previous RT Course has been finished.

The RT Course can be thought of as a container collecting all major objects which are relevant to this course. The RT Physician Intent and RT Radiation Sets reference other companion objects necessary to prepare, conduct and review the treatment. Timing information (start dates and phasing of treatment, breaks etc.) are also part of the RT Course information. Additionally it contains information of the ongoing status in treatment planning and delivery. The RT Course is a dynamic object that represents the current status of the patient's treatment.

The RT Course may also include information about previously conducted treatments by referencing previous RT Course objects or by directly recording the information in Attributes.

7.12.2 RT Physician Intent

The RT Physician Intent describes how the physician wishes to achieve curative or palliative therapy. This information includes, but is not limited to the use of external radiation therapy or brachytherapy, total and fractional doses and fractionation schemes, treatment sites, Dosimetric Objectives, envisioned treatment technique, beam energy or isotopes, and patient setup notes.

7.12.3 Conceptual Volume

The Conceptual Volume is a reference to a certain anatomical region or point. Conceptual Volumes may or may not have a representation in segmented images. In most cases they will be related to one or more volumetric representations in various image sets taken at different times.

For example, during a radiotherapy course at the time of prescription, physicians specify regions to which dose is prescribed. Subsequently these regions are referenced in other objects in order to track calculated and delivered dose in the course of treatment. This referencing capability is provided by the Conceptual Volume.

7.12.4 RT Segment Annotation

The RT Segment Annotation annotates segmented regions defined in other SOP Instances with radiotherapy-specific information about the role and RT-specific types of the regions (e.g. clinical target volume, organ at risk, bolus), and other information such as density definitions. An RT Segment Annotation SOP instance may reference any geometric general-purpose representation entity defined by DICOM.

7.12.5 RT Radiation Set

An RT Radiation Set is a collection of RT Radiations. An RT Radiation Set defines a Radiotherapy treatment fraction, which will be applied one or more times. The RT Radiation Set is delivered by delivering the radiation of all referenced RT Radiations.

Parallel and intermittent fractionation schemes, e.g. treatment of several target sites with different timing schemes, are represented by multiple RT Radiation Sets.

7.12.6 RT Radiation

An RT Radiation is a contiguous set of Control Points, describing machine and positioning parameters to be applied during treatment delivery. An RT Radiation describes one portion of an RT Radiation Set and represents an single-fraction delivery of therapeutic radiation intended to be delivered in an indivisible manner. An RT Radiation is typically referred to in end-user terminology as a beam (in external beam treatment) or a catheter (in brachytherapy).

7.12.7 RT Radiation Record

The RT Radiation Record records actual treatment parameters that have been applied during the delivery of an RT Radiation in the context of a specific fraction. Typically, those parameters are the same as those described within an RT Radiation, but may differ due to therapist decisions and/or circumstances of the delivery technology and/or for various other reasons.

7.12.8 RT Treatment Phase

An RT Course may be divided into multiple RT Treatment Phases. Each RT Treatment Phase represents a period of time during which a defined number of RT Treatment Fractions are delivered by RT Radiation Sets in order to

reach a specific treatment goal (see section 7.12.9 RT Fractionation, RT Fractionation Scheme and 7.12.10 RT Treatment Session, RT Treatment Fraction).

An RT Treatment Phase also defines the chronological relationship between RT Radiation Sets that are concurrently and/or subsequently treated.

7.12.9 RT Fractionation, RT Fractionation Scheme

Fractionation describes the splitting of a course of therapeutic radiation delivery into multiple sessions. Each session may consist of the delivery of one or more RT Radiation Sets. The temporal pattern of session is called a fractionation scheme.

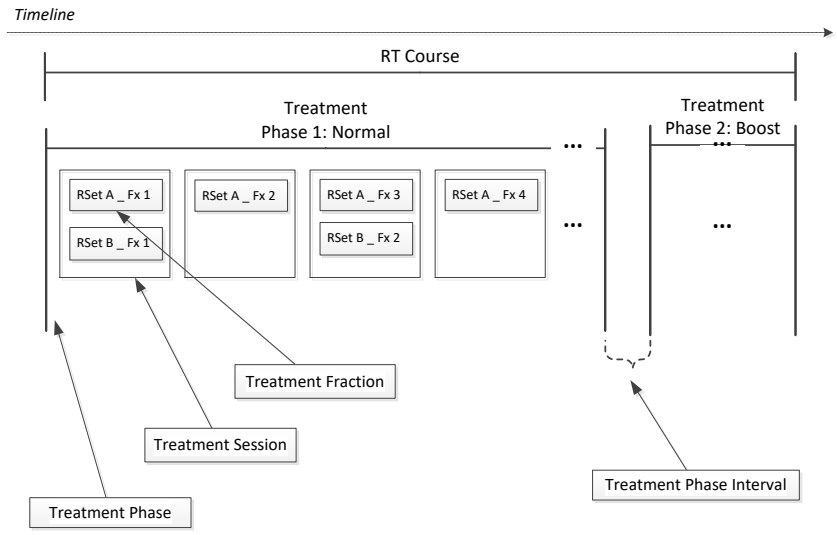
Further descriptions and examples of this such schemes can seen in section 7.12.10 RT Treatment Session, RT Treatment Fraction.

7.12.10 RT Treatment Session, RT Treatment Fraction

An RT Treatment Session is a collection of RT treatment events which are performed in a contiguous manner without any break in-between (other than time needed for required preparations) during a single Visit. It denotes the time period between the patient entering the treatment room and leaving the treatment room. In a treatment session one or more RT Radiation Sets (RSet in diagram below) may be treated. A RT Treatment Session may also include imaging. A group of radiation deliveries that are separated by an intentional delay to accommodate radiobiological recovery effects are considered separate Treatment Sessions.

Each treatment of an RT Radiation Set is labeled as an RT Treatment Fraction (often abbreviated as Fx) with a fraction number starting with 1 at the first RT Treatment Session in which the RT Radiation Set is delivered, incremented by 1 at each subsequent treatment session.

An RT Treatment Fraction is the delivery of a portion of the total dose (whose delivery is defined by a RT Radiation Set) which has been divided equally into smaller doses to be delivered over a period of time (e.g. daily for 4-6 weeks). In radiotherapy, this division of dose over a period of time is known as dose fractionation.



RSet = RT Radiation Set

Figure 7.12-2 — RT Treatment Phase, RT Treatment Session, RT Treatment Fraction

Partial treatments annotate RT Treatment Fractions, that are not completely performed for any reason (e.g. patient sickness, delivery device breakdown). The remainder of the RT Treatment Session is usually delivered at a later time.This remaining portion has the same fraction number as the one of the Partial Treatment Session. Further treatments will start a new RT Treatment Fraction with an incremented fraction number.

In Figure 7.12-3 below, the shaded areas of each Radiation Set represent the portion where dose is actually delivered. Partially shaded Radation Sets therefore represents a partial treatment.

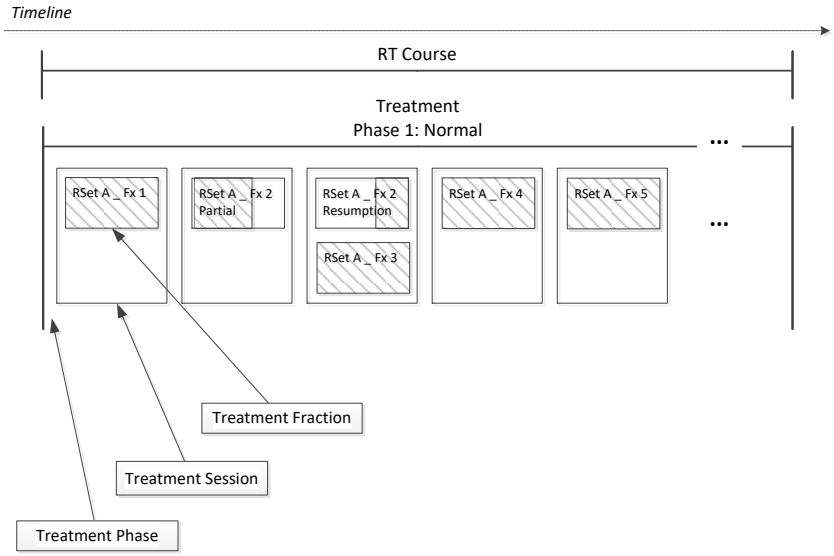


Figure 7.12-3 —Partial RT Treatment Fraction and Resumption

7.12.11 Dosimetric Objective

The Dosimetric Objective Macro specifies an intended goal to be used in the definition of the dosimetric plan for plan optimization etc. Dosimetric Objectives may define limits which affect the dose, such as dose volume constraints, minimum or maximum dose, treatment time or MU limits, and radiobiologic effects.

Add the following in PS3.3 Chapter 10 Miscellaneous Macros

10.A1 ENHANCED CONTENT IDENTIFICATION MACRO

The Enhanced Content Identification Macro identifies content using a label supporting lower case characters and specified character sets. If a Code String is required, see Content Identification Macro (Section 10.9).

Table 10.A1-1
Enhanced Content Identification Macro Attributes

Attribute Name	Tag	Type	Description
User Content Label	(gggg,51E0)	1	User-defined label for this SOP Instance. See 10.A1.1.1.
Content Description	(0070,0081)	2	User-defined description for the content of this SOP Instance. See 10.A1.1.1.
Content Creator's Name	(0070,0084)	2	Name of operator (such as a technologist or physician) creating the content of the SOP Instance.
Content Creator's Identification Code Sequence	(0070,0086)	3	Identification of the person who created the content. Only a single Item is permitted in this Sequence.
>Include Table 10-1 "Person Identification Macro Attributes"			

10.A1.1 Enhanced Content Identification Macro Attribute Description

10.A1.1.1 User Content Label and Content Description

User Content Label (gggg,51E0) shall represent a user-defined short free text providing the primary identification of this entity to other users. Content Description (0070,0081) allows a longer string containing additional descriptive identifying text.

This information is intended for display to human readers. Shall not be used for structured processing.

10.A2 EXTENDED CONTENT IDENTIFICATION MACRO

The Extended Content Identification Macro identifies content using a label supporting lower case characters and specified character sets. If a Code String is required, see Content Identification Macro (Section 10.9).

Table 10.A2-1
Extended Content Identification Macro Attributes

Attribute Name	Tag	Type	Description
User Content Long Label	(gggg,51E1)	1	User-defined label for the content of this SOP Instance. See 10.A2.1.1.
Content Description	(0070,0081)	2	User-defined description for the content of this SOP Instance. See 10.A2.1.1.
Content Creator's Name	(0070,0084)	2	Name of operator (such as a technologist or physician) creating the content of the SOP Instance.
Content Creator's Identification Code Sequence	(0070,0086)	3	Identification of the person who created the content. Only a single Item is permitted in this Sequence.
>Include Table 10-1 "Person Identification Macro Attributes"			

10.A2.1 Extended Content Identification Macro Attribute Description

10.A2.1.1 User Content Long Label and Content Description

User Content Long Label (gggg,51E1) shall represent a user-defined free text providing the primary identification of this entity to other users. Content Description (0070,0081) allows a longer string containing additional descriptive identifying text.

This information is intended for display to human readers. Shall not be used for structured processing.

10.A3 ENTITY LABELING MACRO

The Entity Labeling Macro provides identification of an entity to a user.

This information is intended for display to human readers. Shall not be used for structured processing.

Table 10.A3-1
Entity Labeling Macro Attributes

Attribute Name	Tag	Type	Description
Entity Label	(gggg,51E2)	1	User-defined label for this entity. See 10.A3.1.1.
Entity Name	(gggg,51E3)	3	User-defined name for this entity. See 10.A3.1.2.
Entity Description	(gggg,51E4)	3	User-defined description for this entity. See 10.A3.1.2.

10.A3.1 Entity Labeling Macro Attribute Description

10.A3.1.1 Entity Label

The Entity Label (gggg,51E2) Attribute represents a user-defined short free text providing the primary identification of this entity to other users.

10.A3.1.2 Entity Name and Entity Description

The optional Attribute Entity Name (gggg,51E3) allows a longer string containing additional descriptive identifying text. The optional Attribute Entity Description (gggg,51E4) provides additional information when needed.

10.A4 ENTITY LONG LABELING MACRO

The Entity Long Labeling Macro provides identification of an entity to a user.

This information is intended for display to human readers. Shall not be used for structured processing.

Table 10.A4-1
Entity Long Labeling Macro Attributes

Attribute Name	Tag	Type	Description
Entity Long Label	(gggg,51E5)	1	User-defined label for this entity. See 10.A3.2.1
Entity Description	(gggg,51E4)	3	User-defined description for this entity. See 10.A3.1.2.

10.A4.2 Entity Long Labeling Macro Attribute Description

10.A4.2.1 Entity Long Label

The Entity Long Label (gggg,51E5) Attribute represents a user-defined free text providing the primary identification of this entity to other users.

10.A5 CONCEPTUAL VOLUME MACRO

A Conceptual Volume is an abstract entity used to identify an anatomic region (such as a planning target volume or a combination of multiple anatomic segments) or non-anatomic volumes such as a bolus or a marker. A Conceptual Volume can be established without necessarily defining its spatial extent (for example a Conceptual Volume for a tumor can be established prior to segmenting it). The spatial extent of a Conceptual Volume may change over time (for example as treatment proceeds the tumor volume corresponding to the Conceptual Volume will change).

The spatial extent of a Conceptual Volume may be defined by any general-purpose entity that represents geometric information (such as Segmentation, Surface Segmentation, RT Structure Set SOP Instance and alike) or a combination thereof, although the Conceptual Volume does exist independently of a specific definition of its spatial extent.

A Conceptual Volume may also be defined as a combination of other Conceptual Volumes.

Examples for Conceptual Volumes:

1. A Conceptual Volume (with a Conceptual Volume UID (gggg,1301) can be used to represent the treatment target in an RT Physician Intent SOP Instance based upon a diagnostic image set, although the actual delineation of a specific target volume has not yet taken place. Later, the target volume is contoured. The RT Segment Annotation SOP Instance references the volume contours and associates it with the Conceptual Volume via the Conceptual Volume UID (gggg,1301).

2. In an adaptive workflow, the anatomic volume may change over time. The Conceptual Volume on the other hand does not change. Multiple RT Segment Annotation SOP Instances, each referencing different Segmentation instances, can be associated with the same Conceptual Volume via the Conceptual Volume UID (gggg,1301), making it possible to track the volume over time.

3. A Conceptual Volume may represent targets and/or anatomic regions for which manually calculated doses are tracked (for example, in emergency treatments). In this case, Conceptual Volumes may be instantiated first in an RT Physician Intent SOP instance and subsequently used in RT Radiation SOP instances, or may be first instantiated in the Radiation SOP instances. After treatment, these Conceptual Volumes will be used in RT Radiation Records to track the delivered dose. Such Conceptual Volumes may never reference a segmentation, but serve as a key for referencing the Conceptual Volume across these different SOP instances.

Table 10.A5-1
Conceptual Volume Macro Attributes

Attribute Name	Tag	Type	Attribute Description
Conceptual Volume UID	(gggg,1301)	1	A UID identifying the Conceptual Volume.
Originating SOP Instance Reference Sequence	(gggg,1302)	1C	Reference to the SOP Instance that contains the original definition of this Conceptual Volume identified by Conceptual Volume UID (gggg,1301). Required when Conceptual Volume UID (gggg,1301) was not issued in the current SOP Instance, but read from another SOP instance.. Only a single Item shall be included in this Sequence.
>Include Table 10-11 "SOP Instance Reference Macro Attributes"			

Equivalent Conceptual Volumes Sequence	(gggg,1305)	3	References one or more existing Conceptual Volumes that represent the same concept as the current Conceptual Volume. This Sequence might be used when Conceptual Volume references of existing SOP instances are retrospectively identified as representing the same entity. One or more Items are permitted in this Sequence. See 10.A5.1.1.
>Referenced Conceptual Volume UID	(gggg,1306)	1	A UID identifying the Conceptual Volume.
>Equivalent Conceptual Volume Instance Reference Sequence	(gggg,1304)	1	Reference to a SOP Instance that contains the Referenced Conceptual Volume UID (gggg,1306) of the Equivalent Conceptual Volume. Only a single Item shall be included in this Sequence.
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
Derivation Conceptual Volume Sequence	(gggg,1316)	3	Description of a Conceptual Volume that was used to derive this Conceptual Volume. Only a single Item shall be included in this Sequence.
>Derivation Description	(0008,2111)	3	A user-readable text description of how this Conceptual Volume was derived.
>Source Conceptual Volume Sequence	(gggg,1320)	1	The set of Conceptual Volumes that were used to derive this Conceptual Volume. One or more Items are permitted in this Sequence.
>>Source Conceptual Volume UID	(gggg,1317)	1	UID identifying the Conceptual Volume that was used to derive this Conceptual Volume.
>>Conceptual Volume Constituent Index	(gggg,1308)	1	Index of the constituent in the Source Conceptual Volume Sequence. The value shall start at 1 and increase monotonically by 1.
>>Conceptual Volume Constituent Segmentation Reference Sequence	(gggg,1314)	2	Contains the reference to the constituents of the RT Segment Annotation Instance from which Conceptual Volume is derived. Zero or one Item shall be included in this Sequence.

>>>Referenced Direct Segment Instance Sequence	(gggg,9875)	1	Reference to the SOP Instance that contains the Direct Segment Reference Sequence (gggg,1343). Only a single Item shall be included in this Sequence. See 10.A6.1.3
>>>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>>>Referenced Segment Reference Index	(gggg,1340)	1	The Segment Reference Index (gggg,1342) in the Segment Reference Sequence (gggg,1341) corresponding to the segment representing this Conceptual Volume. Shall reference only segment Items that contain the Direct Segment Reference Sequence (gggg,1343).
>Conceptual Volume Derivation Algorithm Sequence	(gggg,1318)	3	Algorithm used to derive this Conceptual Volume. One or more Items are permitted in this Sequence.
>>Include Table 10-19 "Algorithm Identification Macro Attributes"			*No Baseline CID defined*

10.A5.1 Conceptual Volume Macro Attribute Description

10.A5.1.1 Equivalent Conceptual Volumes

Conceptual Volumes can be declared to be equivalent to other Conceptual Volumes. In such cases, the Equivalent Conceptual Volumes Sequence (gggg,1305) is used in derived SOP instances which are aware of other SOP instances defining a semantically equivalent volume, but using different Conceptual Volume UIDs (gggg,1301).

10.A5.1.2 Derivation Conceptual Volume Sequence

The Derivation Conceptual Volume Sequence (gggg,1316) may be used to describe how a Conceptual Volume is derived from one or more other Conceptual Volumes in cases where it may not be possible to describe the method of the derivation completely. Since the Conceptual Volume cannot be mathematically constructed from a derivation description, it will be defined explicitly by a segmentation.

The specification of derivation is different from combining Conceptual Volumes as defined in 10.A6 "Conceptual Volume Segmentation Reference and Combination Macro".

10.A6 CONCEPTUAL VOLUME SEGMENTATION REFERENCE AND COMBINATION MACRO

This macro allows the combination of Conceptual Volumes as constituents of a combined volume. A representative example is to have the Left Lung and the Right Lung segmented, and then to declare the Lungs as a combined Conceptual Volume, for which prescription constraints can be defined.

The macro also allows reference to RT Segment Annotation SOP instances, which contain a segmented representation of the Conceptual Volume. At the invocation of this macro it is declared, whether this segmented representation is required or not.

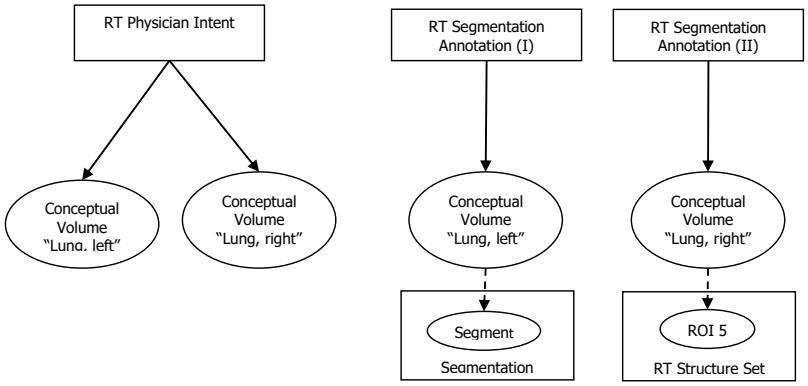


Figure 10.A6-1
Conceptual Volume References

Figure 10.A6-1 describes an RT Physician Intent Instance where Conceptual Volumes "Lung, left" and "Lung, right" are referenced, but not defined. In this example, the RT Segmentation Annotation Instances then define the volumetric information of the Conceptual Volumes by referencing a specific segment of a Segmentation Instance and a specific ROI in an RT Structure Set Instance.

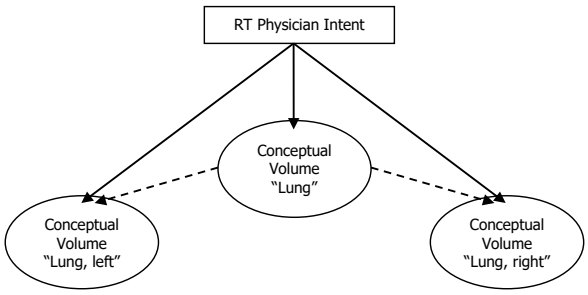


Figure 10.A6-2
Conceptual Volume Combination References

Figure 10.A6-2 describes an RT Physician Intent Instance defining Conceptual Volumes "Lung, left" and "Lung, right" and Conceptual Volume "Lung" as a combination of the first two without a direct reference to a volume definition.

Table 10.A6-1
Conceptual Volume Segmentation Reference And Combination Macro Attributes

Attribute Name	Tag	Type	Attribute Description

Include Table 10.A5-1 "Conceptual Volume Macro Attributes"			
Conceptual Volume Combination Flag	(gggg,1309)	1	Indication that this Conceptual Volume reference is a combination of other Conceptual Volumes. Enumerated Values: YES NO
Conceptual Volume Constituent Sequence	(gggg,1303)	1C	References to Conceptual Volumes which are constituents of this Conceptual Volume. See 10.A6.1.1. Required if Conceptual Volume Combination Flag (gggg,1309) equals YES. One or more Items shall be included in this Sequence. The combined Conceptual Volume UID shall not be included in the Sequence.
>Conceptual Volume Constituent Index	(gggg,1308)	1	An index referenced in the Conceptual Volume Combination Expression (gggg,1307) identifying the Conceptual Volume Constituent. The value shall start at 1 and increase monotonically by 1.
>Constituent Conceptual Volume UID	(gggg,1315)	1	UID identifying the Conceptual Volume that is a constituent of the combined Conceptual Volume.
>Originating SOP Instance Reference Sequence	(gggg,1302)	1	Reference to the SOP Instance that contains the original definition of the Conceptual Volume constituent identified by Constituent Conceptual Volume UID (gggg,1315) in this Sequence. If this Conceptual Volume orginated in the current SOP Instance, then the referenced SOP Instance UID is the current SOP Instance UID. Only a single Item shall be included in this Sequence.
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			

>Conceptual Volume Constituent Segmentation Reference Sequence	(gggg,1314)	1C	Contains the reference to the constituents of the RT Segment Annotation Instance defining this Conceptual Volume. Required if the Conceptual Volume Segmentation Defined Flag (gggg,1311) equals YES and the Conceptual Volume is not a Combination of other Conceptual Volumes. Only a single Item shall be included in this Sequence. See 10.A6.1.2.
>>Referenced Direct Segment Instance Sequence	(gggg,9875)	1	Reference to the SOP Instance that contains the Direct Segment Reference Sequence (gggg,1343). Only a single Item shall be included in this Sequence. See 10.A6.1.3
>>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>>Referenced Segment Reference Index	(gggg,1340)	1	The Segment Reference Index (gggg,1342) in the Segment Reference Sequence (gggg,1341) corresponding to the segment representing this Conceptual Volume. Shall reference only segment Items that contain the Direct Segment Reference Sequence (gggg,1343).
Conceptual Volume Combination Expression	(gggg,1307)	1C	Symbolic expression specifying the combination of Conceptual Volumes as a text string consisting of Conceptual Volume Constituent Index (gggg,1308) values, combination operators and parentheses. Required if Conceptual Volume Combination Flag (gggg,1309) equals YES. See 10.A6.1.1.
Conceptual Volume Combination Description	(gggg,1310)	2C	Human-readable description of the combination of Conceptual Volumes. This information is intended for displayand shall not be used for structured processing. Required if Conceptual Volume Combination Flag (gggg,1309) equals YES.

Conceptual Volume Segmentation Defined Flag	(gggg,1311)	1	States whether the Conceptual Volumes present in this Item have segmentations referenced at the lowest level of the tree of references, i.e. the Conceptual Volume is fully spatially defined. Enumerated Values YES NO
Conceptual Volume Segmentation Reference Sequence	(gggg,1312)	1C	Contains a segmented representation of the Conceptual Volume. Required when Conceptual Volume Segmentation Defined Flag (gggg,1311) equals YES and Conceptual Volume Combination Flag Indicator (gggg,1309) equals NO. Only a single Item shall be included in this Sequence. See 10.A6.1.2.
>Referenced Direct Segment Instance Sequence	(gggg,9875)	1	Reference to the SOP Instance that contains the Segment Reference Sequence (gggg,1341) in which the segment is defined. Only a single Item shall be included in this Sequence. See 10.A6.1.3
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>Referenced Segment Reference Index	(gggg,1340)	1	The Segment Reference Index (gggg,1342) in the Segment Reference Sequence (gggg,1341) corresponding to the segment representing this Conceptual Volume. In the segment Item referenced, the Direct Segment Reference Sequence (gggg,1343) shall be present.
Referenced Spatial Registration Sequence	(0070,0404)	1C	Registrations between referenced segmentations, of which the relation is not the unity transformation and which are present in Conceptual Volume Segmentation Reference Sequence (gggg,1312). Shall not be present if Conceptual Volume Combination Flag (gggg,1309) equals NO. May be present otherwise. One or more Items shall be included in this Sequence.
>Include Table 10-11 "SOP Instance Reference Macro Attributes"			

501

10.A6.1 Conceptual Volume Segmentation Reference and Combination Macro Attribute Description

10.A6.1.1 Conceptual Volume Combination Expression

For Conceptual Volumes specified as a combination of other Conceptual Volumes, the combination logic is specified by the text string value of the Conceptual Volume Combination Expression (gggg,1307).

A nested list notation is used to apply geometric operators to a set of Conceptual Volumes.

The first element of the list shall be one of the following geometric operators:

- UNION – geometric union of two or more arguments
- INTERSECTION – geometric intersection of two or more arguments
- NEGATION – geometric inverse of a single argument
- SUBTRACTION – geometric subtraction of second argument from the first
- XOR – geometric exclusive disjunction of two arguments

Note The result of a NEGATION operation is well-defined only if used as an operand to an INTERSECTION. NEGATION without context to an INTERSECTION results in an infinite Volume.

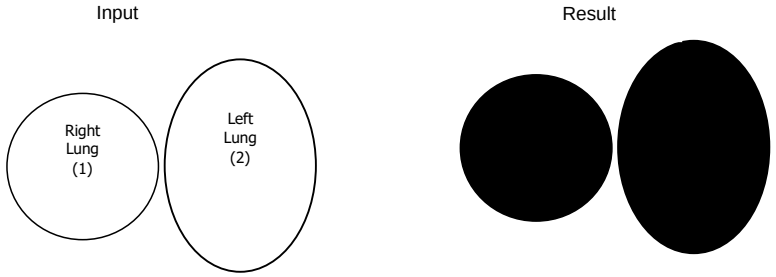
Subsequent elements shall specify arguments of the geometric operator. An argument is either a Conceptual Volume Constituent Index (gggg,1308) value (i.e., positive integer) or a parenthesized list of operations.

The grammar for the Conceptual Volume Combination Expression (<sexpr>) is shown below in BNF (Backus Naur Form):

```
<sexpr>          :: <cv> | <list>
<cv>             :: 1 | 2 | 3 | …
<list>           :: ( <op1><sp><sexpr> ) |
                    ( <op2><sp><sexpr><sp><sexpr> ) |
                    ( <op3><sp><args> )
<args>           :: <sexpr><sp><sexpr> | <args><sp><sexpr>
<op1>            :: NEGATION
<op2>            :: SUBTRACTION | XOR
<op3>            :: UNION | INTERSECTION
<sp>             :: 0x20
```

Examples:

1.) Union of paired organs 1 and 2 (disjoint)



Conceptual Volume Combination Expression (gggg,1307):

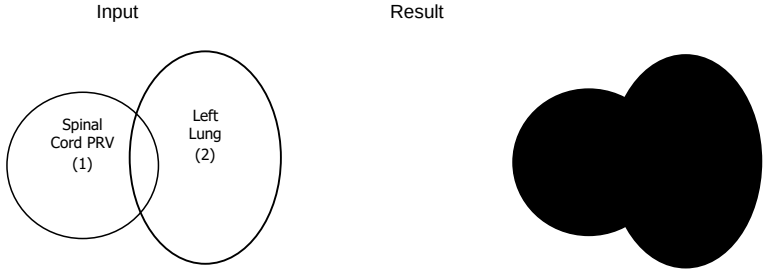
(UNION 1 2)

Items in Conceptual Volume Constituent Sequence (gggg,1303):

Table 10.A6-2
Conceptual Volume Example of Union of disjoint Volumes

Conceptual Volume Constituent Index (gggg,1308)	Conceptual Volume
1	Right Lung
2	Left Lung

2.) Union of paired organs 1 and 2 (non-disjoint)



Conceptual Volume Combination Expression (gggg,1307):

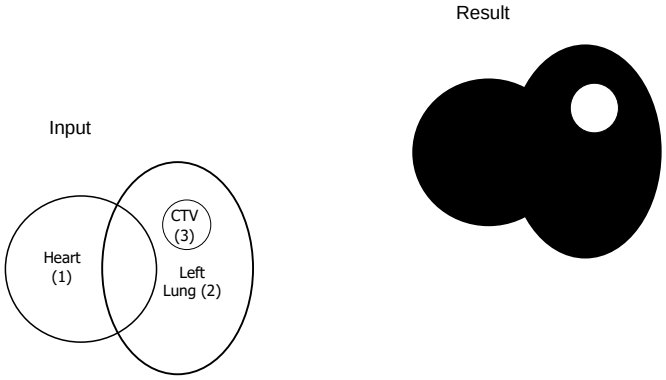
(UNION 1 2)

Items in Conceptual Volume Constituent Sequence (gggg,1303):

Table 10.A6-3
Conceptual Volume Example of Union of non-disjoint Volumes

Conceptual Volume Constituent Index (gggg,1308)	Conceptual Volume
1	Spinal Cord PRV
2	Left Lung

3.) Union of two organs 1 and 2 with excluded volume 3 using NEGATION



Conceptual Volume Combination Expression (gggg,1307):

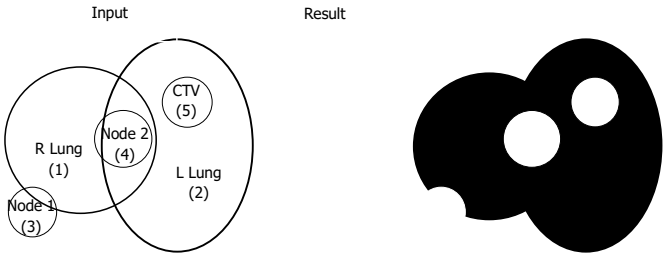
(INTERSECTION (UNION 1 2) (NEGATION 3))

Items in Conceptual Volume Constituent Sequence (gggg,1303):

Table 10.A6-4
Conceptual Volume Example of Intersection and Negation

Conceptual Volume Constituent Index (gggg,1308)	Conceptual Volume
1	Heart
2	Left Lung
3	CTV

4.) Union of paired organs 1 and 2, with exclusion of multiple volumes 3, 4 and 5



Conceptual Volume Combination Expression (gggg,1307):

(INTERSECTION (UNION 1 2) (NEGATION (UNION 3 4 5)))

Note: This combination can be expressed alternatively as:

(SUBTRACTION (UNION 1 2) (UNION 3 4 5))

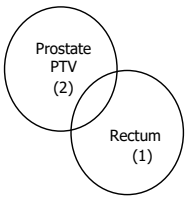
Items in Conceptual Volume Constituent Sequence (gggg,1303):

Table 10.A6-5
Conceptual Volume Example of Intersection and Union

Conceptual Volume Constituent Index (gggg,1308)	Conceptual Volume
1	R Lung
2	L Lung
3	Node 1
4	Node 2
5	CTV

5.) Intersection of overlapping volumes 1 and 2

Input Result



Conceptual Volume Combination Expression (gggg,1307):

(INTERSECTION 1 2)

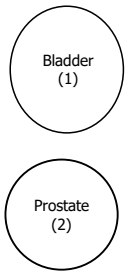
Items in Conceptual Volume Constituent Sequence (gggg,1303):

Table 10.A6-6
Conceptual Volume Example of Intersection of non-disjunct Volumes

Conceptual Volume Constituent Index (gggg,1308)	Conceptual Volume
1	Rectum
2	Prostate PTV

6.) Intersection of disjoint volumes 1 and 2

Input Result



Conceptual Volume Combination Expression (gggg,1307):

(INTERSECTION 1 2)

Items in Conceptual Volume Constituent Sequence (gggg,1303):

Table 10.A6-7
Conceptual Volume Example of Intersection of disjunct Volumes

Conceptual Volume Constituent Index (gggg,1308)	Conceptual Volume
1	Bladder
2	Prostate

10.A6.1.2 Conceptual Volume Segmentation Reference Sequence

The Conceptual Volume Segmentation Reference Sequence (gggg,1312) contains a reference to a segmentation which represents this volume geometrically.

In case of combination, the Conceptual Volume Segmentation Reference Sequence (gggg,1312) lists the segmentations used for definition of a combined Conceptual Volume. The segmentations referenced may be in one or more Frames of Reference. The constituent Conceptual Volumes in this Sequence shall not include the combined Conceptual Volume being defined. Applications that wish to combine existing segmentations within the same Conceptual Volume must create a new Segmentation Instance.

10.A6.1.3 Referenced Direct Segment Instance Sequence

A SOP Instance may only be referenced in this Sequence if it belongs to a SOP Class that includes the Segment Reference Module specified in section C.AA.D2.

10.A7 DEVICE MODEL MACRO

The Device Model Macro contains general Attributes needed to specify a device model.

Table 10.A7-1
Device Model Macro Attributes

Attribute Name	Tag	Type	Description
Manufacturer	(0008,0070)	2	Manufacturer of the device.
Manufacturer's Model Name	(0008,1090)	2	Manufacturer's model name of the device.
Manufacturer's Model Version	(gggg,1324)	2	A version number of the Manufacturer's model of the device.

615

616 **10.A8 DEVICE IDENTIFICATION MACRO**

617 The Device Identification Macro identifies a (physical or virtual) device.

618 **Table 10.A8-1**
619 **Device Identification Macro Attributes**

Attribute Name	Tag	Type	Attribute Description
Device Type Code Sequence	(gggg,5026)	1	The type of the device. Only a single Item shall be included in this Sequence.
>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Context ID may be defined in the macro invocation.*
Device Label	(gggg,5025)	1	User-defined label for this device.
Device Description	(gggg,5027)	3	User-defined description for this device.
Device Serial Number	(0018,1000)	2	Manufacturer's serial number of the device.
Software Versions	(0018,1020)	2	Manufacturer's designation of software version of the equipment.
UDI Sequence	(0018,100A)	3	Unique Device Identifier (UDI) of the device. Notes: Multiple Items may be present if the entire equipment has UDIs issued by different Issuing Authorities One or more Items are permitted in this Sequence.
>Include Table 10.29-1 "UDI Macro Attributes"			
Manufacturer's Device Identifier	(gggg,954D)	2	An identifier issued by the manufacturer. See Note.
Device Alternate Identifier	(gggg,1326)	2	An identifier intended to be read by a device such as a bar code reader.
Device Alternate Identifier Type	(gggg,1327)	1C	Defines the type of Device Alternate Identifier. Required if Device Alternate Identifier (gggg,1326) is present. Defined Terms: BARCODE RFID

Device Alternate Identifier Format	(gggg,1328)	1C	Description of the format in which the Device Alternate Identifier (gggg,1326) is issued. Required if Device Alternate Identifier (gggg,1326) is present. See 10.A8.1.1.

620

621 Note: Typically, the Device Identifier is a code which can be electronically read by the machine utilizing that device, e.g.
622 to verify the presence of that device.

623

624 **10.A8.1 Device Component Identification Macro Attribute Description**

625 **10.A8.1.1 Device Alternate Identifier Format**

626 The Device Alternate Identifier Format (gggg,1328) specifies the format of the value of the Device Alternate
627 Identifier (gggg,1326).

628 If the value of Device Alternate Identifier Type (gggg,1327) is RFID, a big variety of RFID formats exists (some
629 examples are DOD-96, DOD-64 UID, GID-96, sgtin-96). Supported format values shall be defined in the
630 Conformance Statement.

631 For Device Alternate Identifier Type (gggg,1327) = BARCODE see C.22.1.1.

632

Add the following columns in PS3.3 Section A.1.4, Table A.1-1 COMPOSITE INFORMATION OBJECT MODULES OVERVIEW – RADIOTHERAPY

A.1.4 Overview of the Composite IOD Module Content

…

IODs Modules		RT Physician Intent	RT Segment Annotation
Patient		**M**	**M**
Clinical Trial Subject		**U**	**U**
General Study		**M**	**M**
Patient Study		**U**	**U**
Clinical Trial Study		**U**	**U**
General Series		**M**	**M**
Clinical Trial Series		**U**	**U**
Enhanced RT Series		**M**	**M**
General Equipment		**M**	**M**
Enhanced General Equipment		**M**	**M**
Radiotherapy Common Instance		**M**	**M**
RT Physician Intent		**M**	
RT Prescription		**U**	
RT Treatment Phase Intent		**C**	
RT Segment Annotation			**M**
Segment Reference			**M**
General Reference Module		**M**	**M**
Common Instance Reference Module		**M**	**M**
SOP Common		**M**	**M**

Add the following to PS3.3 Annex A:

A.VV RT SECOND GENERATION

A.VV.1 RT Second Generation Objects

This section provides a brief description of the IODs of RT Second Generation. Specifically, this description includes:

- The Real-World Object which is represented by the IOD
- Information as to the scope of the represented object if appropriate

A.VV.1.1 RT Second Generation Common Information

This section provides a description of the Module structure which is shared by the RT Second Generation IODs.

A.VV.1.1.1 RT Second Generation Entity-Relationship Model

The E-R Model in Figure A.VV.1.1.1-1 depicts those components of the DICOM Information Model that are relevant to RT Second Generation IODs.

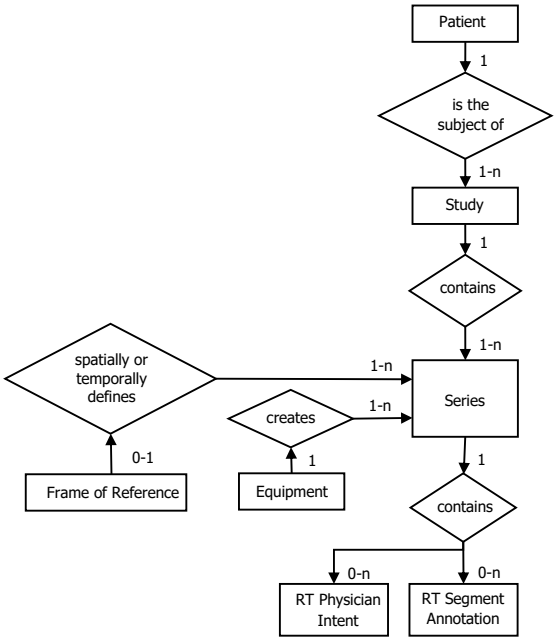


Figure A.VV.1.1.1-1 — RT Second Generation IOD information model

A.VV.1.1.1.1 Use of Study and Series in RT Second Generation Radiotherapy

For first generation IODs, no specific semantics are attached to a Study or a Series in RT. Similarly, for RT Second Generation IODs, internal references shall be used to relate and locate SOP Instances rather than making assumptions about how related SOP Instances are grouped into Studies or Series. For practical reasons it may be indicated to create a new Study separate from imaging Studies that are used for radiotherapeutic planning because of billing or reimbursement for Series that contain RT instances.

Implementers should also note, that the DICOM standard, in general, does place some restrictions on how such SOP Instances should be grouped, as defined in chapter A.1.2.3.

For non-image modalities like radiotherapy, the Series may not be the most efficient way to search for objects. Instead, an application might find it easier to use references in the RT Course object, Key Object Selection objects or Unified Worklist Procedure Steps to directly retrieve required instances rather than search for them.

666

667

668 **A.VV.1.2 RT Physician Intent Information Object Definition**

669 **A.VV.1.2.1 RT Physician Intent IOD Description**

670 The RT Physician Intent carries the prescriptions by which the physician describes the therapeutic goal and strategy
671 for the radiotherapeutic treatment.

672 **A.VV.1.2.2 RT Physician Intent IOD Entity-Relationship Model**

673 See Figure A.VV.1.1.1-1.

674 **A.VV.1.2.3 RT Physician Intent IOD Module Table**

675 **Table A.VV.1.2-1**
676 **RT Physician Intent IOD Modules**

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U
	Enhanced RT Series	C.AA.A1	M
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
RT Physician Intent	General Reference Module	C.12.4	M
	RT Physician Intent	C.AA.B1	M
	RT Enhanced Prescription	C.AA.B2	U
	Intended RT Treatment Phase Intent	C.AA.B3	C Required if RT Treatment Phase Intent Presence Flag (gggg,9808) equals YES.
	SOP Common	C.12.1	M
	Common Instance Reference Module	C.12.2	M
	Radiotherapy Common Instance Module	C.AA.A2	M

677

678 **A.VV.1.2.4 RT Physician Intent IOD Constraints**

679 **A.VV.1.2.4.1 Modality Attribute**

680 The value of Modality (0008,0060) shall be RTINTENT.

681

A.VV.1.3 RT Segment Annotation Information Object Definition

A.VV.1.3.1 RT Segment Annotation IOD Description

The RT Segment Annotation IOD annotates any general-purpose entity that represents geometric information such as Segmentation IOD, Surface Segmentation IOD, and RT Structure Set IOD with radiotherapy-specific information that cannot be encoded in the content of the annotated SOP Instance, or overrides that content with new or additional interpretation.

A.VV.1.3.2 RT Segment Annotation IOD Entity-Relationship Model

See Figure A.VV.1.1.1-1.

A.VV.1.3.3 RT Segment Annotation IOD Module Table

Table A.VV.1.3-1
RT Segment Annotation IOD Modules

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U
	Enhanced RT Series	C.AA.A1	M
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
RT Segment Annotation	General Reference Module	C.12.4	M
	RT Segment Annotation	C.AA.D1	M
	Segment Reference	C.AA.D2	M
	General Reference Module	C.12.4	M
	SOP Common	C.12.1	M
	Common Instance Reference Module	C.12.2	M
	Radiotherapy Common Instance Module	C.AA.A2	M

A.VV.1.3.4 RT Segment Annotation IOD Constraints

A.VV.1.3.4.1 Modality Attribute

The value of Modality (0008,0060) shall be RTSEGANN.

Make the following addition to PS3.3 Annex C, Section C.7.3:

Extend the list of Defined Terms of Section C.7.3.1.1.1 Modality by the following terms:

RTINTENT

701 **RTSEGANN**

702

703

704

Add the following to PS3.3 Annex C:

Note: C.AA.1 RT Second Generation Concepts shall be the first subsection of C.AA and will be used by other 2nd Generation supplements (Sup 175, 176ff). It shall be included by this supplement even without a subsection to ensure appropriate numbering for later use.

C.AA RT SECOND GENERATION MODULES

The following Attribute Macros and Modules are used by the RT Second Generation IODs.

C.AA.1 RT Second Generation Concepts

This section dicusses general concepts used in RT Second Generation Modules.

Note: See also explanations in Section 7.12 “Extension of the DICOM model of the real-world for Radiotherapy Second Generation Information Objects”and in IOD definitions in Section A.VV.1.

717

718 **C.AA.2 RT Second Generation Macros**

719 **C.AA.2.1 RT Second Generation General Purpose Macros**

720 **C.AA.2.1.1 Radiation Fraction Pattern Macro**

721 The Radiation Fraction Pattern Macro specifies the intended fraction pattern to be used to deliver the radiation
722 treatment.

723 **Table C.AA.2.1.1-1**
724 **Radiation Fraction Pattern Macro Attributes**

Attribute Name	Tag	Type	Description
Fraction Pattern Sequence	(gggg,9965)	1C	The pattern of delivery of fractions within and across days of the week in a machine-readable form. Required if a fraction pattern has been defined. Only a single Item shall be included in this Sequence.
>Number of Fraction Pattern Digits Per Day	(300A,0079)	1C	The maximum number of fractions encodable within a day in a Fraction Pattern (gggg,9993). Required if Weekday Fraction Pattern Sequence (gggg,9993) is present. See C.AA.2.1.1.1.1.
>Repeat Fraction Cycle Length	(300A,007A)	1C	Number of weeks needed to describe fraction pattern. Required if Weekday Fraction Pattern Sequence (gggg,9993) is present. See C.AA.2.1.1.1.1.
>Weekday Fraction Pattern Sequence	(gggg,9993)	3	Sequence of week-day based fraction patterns. Each Item represents an alternative pattern. One or more Items are permitted in this Sequence. See C.AA.2.1.1.1.1.
>>Fraction Pattern	(300A,007B)	3	String of 0's (no treatment) and 1's (treatment) describing the fraction pattern for the fractions defined by this set. Length of string is 7 x Number of Fraction Pattern Digits Per Day x Repeat Fraction Cycle Length. The first character of the string represents Monday. See C.AA.2.1.1.1.1.
>>Intended Start Day of Week	(gggg,9992)	3	String of 0's (no treatment) and 1's (treatment) describing the intended start fraction for this set. Length of string is 7 x Number of Fraction Pattern Digits Per Day x Repeat Fraction Cycle Length. The first character of the string represents Monday.

Attribute Name	Tag	Type	Description
			See C.AA.2.1.1.1.2.
>Minimum Hours between Fractions	(gggg,9990)	3	Minimum number of hours between consecutive fractions. Consecutive fractions are given in Number of Fraction Pattern Digits Per Day (300A,0079).
>Intended Fraction Start Time	(gggg,9991)	3	The intended time(s) of day when the first RT Treatment Fraction of the day should be started.

725

726 **C.AA.2.1.1.1 Radiation Fraction Pattern Macro Attribute Description**

727 **C.AA.2.1.1.1.1 Fraction Pattern**

728 The Radiation Fraction Pattern describes the intended scheme, i.e. how fractions are to be distributed along
729 calendar days for the actual radiation set.

730 Examples of FractionPatterns:

731 a) 1 fraction per day (Monday to Friday), no fractions on Saturday and Sunday, 1 week-pattern:

732 Number of Fraction Pattern Digits Per Day (300A,0079) = 1
733 Repeat Fraction Cycle Length (300A,007A) = 1
734 Fraction Pattern (300A,007B) = 1111100

735 b) 2 fractions per day (Monday to Friday), no fractions on Saturday and Sunday 1 week-pattern:

736 Number of Fraction Pattern Digits Per Day (300A,0079) = 2
737 Repeat Fraction Cycle Length (300A,007A) = 1
738 Fraction Pattern (300A,007B) = 11111111110000

739 c) 1 fraction per day (Monday, Wednesday, Friday), no fractions on Saturday and Sunday 1 week-pattern:

740 Number of Fraction Pattern Digits Per Day (300A,0079) = 1
741 Repeat Fraction Cycle Length (300A,007A) = 1
742 Fraction Pattern (300A,007B) = 1010100

743 d) 2 fractions per day (Monday, Wednesday, Friday), one fraction on Saturday morning and Sunday afternoon 1
744 week-pattern:

745 Number of Fraction Pattern Digits Per Day (300A,0079) = 2
746 Repeat Fraction Cycle Length (300A,007A) = 1
747 Fraction Pattern (300A,007B) = 11001100111001

748 e) 1 fraction per day every other day 2 week-pattern:

749 Number of Fraction Pattern Digits Per Day (300A,0079) = 1
750 Repeat Fraction Cycle Length (300A,007A) = 2
751 Fraction Pattern (300A,007B) = 10101010101010

752 **C.AA.2.1.1.1.2 Intended Start Day of Week**

753 The Intended Start Day of Week (gggg,9992) specifies the day(s) of the week, when the first fraction of the
754 treatment should be delivered. If more than one day is specified, one of the days may be selected to start the
755 treatment.

756 The treatment then continues as specified in Fraction Pattern (300A,007B), irrespective of when the actual delivery
757 starts.

758 Examples of Intended Start Day of Week and the relation to Fraction Pattern:

a) 1 Start Day, one fraction per day

The treatment should start on Wednesday and be continued at Friday of the first week, followed by treatments at Monday, Wednesday, Friday the next week etc. until all fractions are delivered.

Number of Fraction Pattern Digits Per Day (300A,0079) = 1
Repeat Fraction Cycle Length (300A,007A) = 1
Fraction Pattern (300A,007B) = 1010100
Intended Start Day of Week (gggg,9992) = 0010000

b) Start of any of 3 days, two fractions per day

Treatment should start

- on Monday morning and continued by 1 fraction on Monday afternoon, 2 fractions on Wednesday and Friday

- or on Monday afternoon and continued by 2 fractions on Wednesday and Friday

- or on Wednesday morning, followed by a fraction on Wednesday afternoon, folloed by 2 fractions on Friday.

The treatment will continue the next week with 2 fractions on Monday, Wednesday, Friday etc. until all fractions are delivered.

Number of Fraction Pattern Digits Per Day (300A,0079) = 1
Repeat Fraction Cycle Length (300A,007A) = 2
Fraction Pattern (300A,007B) = 11001100110000
Intended Start Day of Week (gggg,9992) = 11001000000000

779

780 **C.AA.2.1.2 RT Treatment Phase Macro**

781 The treatment phase macro contains the identification and additional information about an RT Treatment Phase.

782 **Table C.AA.2.1.2-1**
783 **RT Treatment Phase Macro Attributes**

Attribute Name	Tag	Type	Description
RT Treatment Phase Index	(gggg,9116)	1	Index of the RT Treatment Phase in the Sequence.
RT Treatment Phase UID	(gggg,9117)	2	A UID by which this RT Treatment Phase can be referenced.
Include Table 10.A3-1 "Entity Labeling Macro Attributes"			
Intended Phase Start Date	(gggg,988C)	2	The date when this treatment phase is intended to start. See section C.AA.2.1.2.1.1
Intended Phase End Date	(gggg,988E)	2	The date when this treatment phase is intended to be completed. See section C.AA.2.1.2.1.1

784

785 **C.AA.2.1.2.1 RT Treatment Phase Macro Attribute Description**

786 **C.AA.2.1.2.1.1 Intended Phase Start Date, Intended Phase End Date**

787 The Intended Phase Start Date (gggg,988C) and Intended Phase End Date (gggg,988E) contains the date when
788 this treatment phase is intended to be started or completed. Do not confuse the content of this Attribute with the
789 date when the treatment delivery is scheduled or when it actually starts or ends. The scheduled date is managed by
790 workflow systems where definitive treatment session scheduling is maintained. The actual date of performed
791 delivery will be available in the RT Radiation Record Instances. The actual dates may differ from the Intended
792 Phase Start Date (gggg,988C) and/or Intended Phase End Date (gggg,988E).

793 **C.AA.2.1.3 RT Treatment Phase Interval Macro**

794 The RT Treatment Phase Interval Macro contains the information about time-relationship between RT Treatment
795 Phases. This consists of sets of pair-wise relationships, declaring the relation of a earlier phase to a later, potentially
796 overlapping, phase.

797 **Table C.AA.2.1.3-1**
798 **RT Treatment Phase Interval Macro Attributes**

Attribute Name	Tag	Type	Description
RT Treatment Phase Interval Sequence	(gggg,9890)	2	Intervals between treatment phases. Zero or more Items shall be included in this Sequence. See C.AA.2.1.3.2.
>Basis RT Treatment Phase Index	(gggg,9143)	1	The RT Treatment Phase which provides the basis for this interval. This index corresponds to an Item in the Intended RT Treatment Phase Sequence (gggg,9880). See C.AA.2.1.3.1.

Attribute Name	Tag	Type	Description
>Related RT Treatment Phase Index	(gggg,9144)	1	The RT Treatment Phase which is related to the phase identified by Basis RT Treatment Phase Index (gggg,9143). Each RT Treatment Phase Index value shall appear in this Attribute in only one Item within this Sequence. This index corresponds to an Item in the Intended RT Treatment Phase Sequence (gggg,9880). See C.AA.2.1.3.1.
>Temporal Relationship Interval Anchor	(gggg,9892)	1C	The anchor point of the interval specified in this Item with respect to the phase referenced by the Basis RT Treatment Phase Index (gggg,9143). Enumerated Values: START: The interval is specified with respect to the start of the basis phase. END: The interval is specified with respect to the end of the basis phase. Required if a value is present in Minimum Number of Interval Days (gggg,9894) or Maximum Number of Interval Days (gggg,9896).
>Minimum Number of Interval Days	(gggg,9894)	2	The minimum number of days that the start of the related phase should follow the basis phase referenced in Basis RT Treatment Phase Index (gggg,9143). Fractional values are allowed. Negative values are allowed if Temporal Relationship Interval Anchor (gggg,9892) has a value of END.
>Maximum Number of Interval Days	(gggg,9896)	2	The maximum number of days that the start of the related phase should follow the basis phase referenced Basis RT Treatment Phase Index (gggg,9143). Fractional values are allowed. Negative values are allowed if Temporal Relationship Interval Anchor (gggg,9892) has a value of END.

799

800 **C.AA.2.1.3.1 Referenced RT Treatment Phases**

801 The RT Treatment Phase Interval Sequence (gggg,9890) allows the definition of an interval between two treatment
802 phases. RT Treatment Phases referenced by the Basis RT Treatment Phase Index (gggg,9143) and the Related
803 RT Treatment Phase Index (gggg,9144) are related in terms of the number of days between them. Note that the

number of days can also be negative and therefore the related treatment phase could start before the prior treatment phase starts respectively ends.

Each RT Treatment Phase identified by the Related RT Treatment Phase Index (gggg,9144) may be related to only one RT Treatment Phase identified by the Basis RT Treatment Phase Index (gggg,9143). Therefore, any Basis RT Treatment Phase Index (gggg,9143) must only appear once in Related RT Treatment Phase Index (gggg,9144) within the Sequence.

See also section C.AA.B2.1.4.

As a result of the combinations possible, the maximum number of Items in the RT Treatment Phase Interval Sequence (gggg,9890) shall be one less than the number of treatment phases present.

C.AA.2.1.3.2 RT Treatment Phase Interval Conflicts

The Standard does not preclude encoding conflicting information.

C.AA.2.1.4 Dosimetric Objective Macro

The Dosimetric Objective Macro specifies an intended goal to be used in the definition of the dosimetric plan, for plan optimization etc. . Dosimetric Objectives may define limits which affect the dose, such as dose volume constraints, minimum or maximum dose, treatment time or MU limits, and radiobiologic effects.

Dosimetric Objectives, such as dose volume constraints, minimum or maximum dose, etc. can be used to specify dose goals for anatomical or other treatment volumes that are referenced by Conceptual Volumes. Other Dosimetric Objectives can also be used to specify general plan optimization objectives not related to anatomical or other treatment volumes, such as Meterset Minimization etc.

Table C.AA.2.1.4-1
Dosimetric Objective Macro Attributes

Attribute Name	Tag	Type	Attribute Description
Dosimetric Objective UID	(gggg,9948)	1	A UID by which this Dosimetric Objective can be referenced. See C.AA.2.1.4.1.1.
Originating SOP Instance Reference Sequence	(gggg,1302)	1C	Reference to the SOP Instance that contains the original definition of this Dosimetric Objective identified by Dosimetric Objective UID (gggg,9948). Required when the Dosimetric Objective UID (gggg,0948) was not issued in the current SOP Instance, but read from another SOP instance.. Only a single Item shall be included in this Sequence.
>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
Dosimetric Objective Type Code Sequence	(gggg,9943)	1	The type of dose objective which this Item represents. Only a single Item shall be included in this Sequence.
>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Defined CID SUP147001 "Dosimetric Objective Types".*

Dosimetric Objective Parameter Sequence	(gggg,9950)	2	Parameters for the objective identified in Dosimetric Objective Type Code Sequence (gggg,9943). Zero or more Items shall be included in this Sequence. See C.AA.2.1.4.1.2.
>Include Table 10-2 "Content Item Macro Attributes"			
>Radiobiological Dose Effect Sequence	(gggg,1130)	1C	Describes the radiobiological effects if any that are taken into account to compute dose. Required if Dosimetric Objective Parameter Sequence (gggg,9950) contains a parameter which represents a dose. Only a single Item shall be included in this Sequence. See C.AA.2.1.4.1.2.
>>Include Table C.AA.2.1.5-1 "Radiobiological Dose Effect Description Macro Attributes"			
Absolute Dosimetric Objective Flag	(gggg,9954)	1	Whether the objective has to be met under all conditions or not. Enumerated Values: YES = Objective shall be met under all conditions NO = Objective not required to be met under all conditions.
Dosimetric Objective Purpose	(gggg,9958)	2	The purpose for which the objective is to be used. Enumerated Values: OPTIMIZATION = used as an input to the optimization process EVALUATION = used as a tool for evaluation BOTH = used as both OPTIMIZATION and EVALUATION

826

827 **C.AA.2.1.4.1 Dosimetric Objective Macro Attribute Description**

828 **C.AA.2.1.4.1.1 Dosimetric Objective UID**

829 Dosimetric Objectives (see C.AA.B2.1.6) are identified by UIDs. These UIDs serve as a key to allow references of
830 Dosimetric Objectives within or across various SOP Instances.

831 **C.AA.2.1.4.1.2 Dosimetric Objective Parameter Sequence**

832 A Dosimetric Objective is described by a type expressed in the Dosimetric Objective Type Code Sequence
833 (gggg,9943), and a Sequence of zero or more parameters to quantify the objective within the Dosimetric Objective
834 Parameter Sequence (gggg,9950).

835 Table C.AA.2.1.4-2 specifies the parameters that shall be sent.

836 **Table C.AA.2.1.4-2**
837 **Dosimetric Objective Parameters**

Dosimetric Objective Type Code Sequence (gggg,9943)	Parameter Concept Name Code(s)	Parameter Value Type(s)	Parameter Measurement Units Code(s)
Code included in: CID SUP147064 No-Parameter Dosimetric Objectives	none	none	none
Code included in: CID SUP147060 “Single Dose Parameter Dosimetric Objectives”	EV (S147025, 99SUP147, “Specified Radiation Dose”)	NUMERIC	Units = EV (Gy,UCUM,”Gray”)
Code included in: CID SUP147061 “Percentage and Dose Dosimetric Objectives”	EV (S147027, 99SUP147, “Specified Volume Percentage”)	NUMERIC	Units = EV (%,UCUM,”Percent”)
	EV (S147025, 99SUP147, “Specified Radiation Dose”)	NUMERIC	Units = EV (Gy,UCUM,”Gray”)
Code included in: CID SUP147062 “Volume and Dose Dosimetric Objectives”	EV (S147026, 99SUP147, “Specified Volume Size”)	NUMERIC	Units = EV (cm3,UCUM,”Cubic Centimeter”)
	EV (S147025, 99SUP147, “Specified Radiation Dose”)	NUMERIC	Units = EV (Gy,UCUM,”Gray”)
(S147010, 99SUP147, "Minimum Conformity Index")	EV (S147120, 99SUP147, "Specified Conformity Index")	NUMERIC	Units = EV (1,UCUM,”no units”)
	EV (S147025, 99SUP147, “Specified Radiation Dose”)	NUMERIC	Units = EV (Gy,UCUM,”Gray”)
(S147011, 99SUP147, "Minimum Healthy Tissue Conformity Index")	EV (S147121, 99SUP147, "Specified Healthy Tissue Conformity Index")	NUMERIC	Units = EV (1,UCUM,”no units”)
	EV (S147025, 99SUP147, “Specified Radiation Dose”)	NUMERIC	Units = EV (Gy,UCUM,”Gray”)
(S147012, 99SUP147, "Minimum Conformation Number")	EV (S147122, 99SUP147, "Specified Conformation Number")	NUMERIC	Units = EV (1,UCUM,”no units”)
	EV (S147025, 99SUP147, “Specified Radiation Dose”)	NUMERIC	Units = EV (Gy,UCUM,”Gray”)
(S147013, 99SUP147, "Maximum Homogeneity Index")	EV (S147123, 99SUP147, "Specified Homogeneity Index")	NUMERIC	Units = EV (1,UCUM,”no units”)
	EV (S147025, 99SUP147, “Specified Radiation Dose”)	NUMERIC	Units = EV (Gy,UCUM,”Gray”)

838

839 **C.AA.2.1.4.1.2.1 Dosimetric Objective Parameter Sequence Examples**

To describe the objective that a maximum of 30% of the volume can receive 50 Gy or more ($V_{50} \leq 30\%$), one would use the Dosimetric Objective Type Code Sequence (gggg,9943) with code value : (S147015, 99SUP147, "Maximum Percent Volume at Dose") with the parameters specified in the Dosimetric Objective Parameter Sequence (gggg,9950) as follows:

Dosimetric Objective Sequence (gggg,9942):

- Item 1:
- Dosimetric Objective Type Code Sequence (gggg,9943):
  - Item 1:
  - (S147015, 99SUP147, "Maximum Percent Volume at Dose")
- Dosimetric Objective Parameter Sequence (gggg,9950)
  - Item 1:
  - Value Type (0040,A040) = NUMERIC
  - Concept Name Code Sequence (0040,A043)
    - Item 1:
    - (S147027, 99SUP147; "Specified Volume Percentage")
  - Numeric Value (0040,A30A) = 30
  - Measurement Units Code Sequence (0040, 08EA)
    - Item 1:
    - (%, UCUM, "Percent")
  - Item 2:
  - Value Type (0040,A040) = NUMERIC
  - Concept Name Code Sequence (0040,A043)
    - Item 1:
    - (S147025, 99SUP147, "Specified Radiation Dose")
  - Numeric Value (0040,A30A) = 50
  - Measurement Units Code Sequence (0040,08EA)
    - Item 1:
    - (Gy, UCUM, "Gray")

C.AA.2.1.4.1.3 Radiobiological Dose Effect Sequence

The Radiobiological Dose Effect Sequence (gggg,1130) specifies whether a code value of (Gy,UCUM,"Gray") in the Measurement Units Code Sequence (0040,08EA) in the Dosimetric Objective Parameter Sequence (gggg,9950) denotes physical or effective dose.

C.AA.2.1.5 Radiobiological Dose Effect Description Macro

The Radiobiological Dose Effect Description Macro describes whether dose values are provided as physical dose or effective dose. An effective dose value incorporates adjustments to dose by taking into account the radiobiological effects.

Table C.AA.2.1.5-1
Radiobiological Dose Effect Description Macro Attributes

Attribute Name	Tag	Type	Attribute Description
Radiobiological Dose Effect Flag	(gggg,1131)	1	Whether radiobiological effects are taken into account for a given dose value. Enumerated Values: NO = physical dose YES = effective dose after correction for biological effect
Effective Dose Calculation Method Category Code Sequence	(gggg,1132)	2C	The category of the method used to calculate the effective dose. Required, if Radiobiological Dose Effect Flag (gggg,1131) equals YES. Zero or more Items shall be included in this Sequence.
>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Defined CID SUP147080 "Effective Dose Calculation Categories".*
>Effective Dose Calculation Method Code Sequence	(gggg,1134)	3	Defines the effective dose calculation method. One or more Items are permitted in this Sequence.
>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*See C.AA.2.1.5.1.1.*
Effective Dose Calculation Method Description	(gggg,1137)	2C	The description of the method used to calculate the effective dose. Required, if Radiobiological Dose Effect Flag (gggg,1131) is YES.

C.AA.2.1.5.1 Radiobiological Dose Effect Description Macro Attribute Description

C.AA.2.1.5.1.1 Effective Dose Method Modifier Code Sequence

The calculation of the radiobiological effect may be further described by a specific method.

If the Effective Dose Calculation Method Category Code Sequence (gggg,1132) has the code value specified in the left column below, the CID for Effective Dose Calculation Method Code Sequence (gggg,1134) shall be the one specified in the right column below.

Table C.AA.2.1.5-2
Effective Dose Calculation Method CIDs

Effective Dose Calculation Method Category Code Sequence (gggg,1132)	CID for Effective Dose Calculation Method Code Sequence (gggg,1134)
(S147500, 99SUP147, "Radiation transport-based method")	DCID SUP147081 "Radiation Transport-Based Effective Dose Method Modifiers"
(S147501, 99SUP147, "Fractionation-based or temporally-based method")	DCID SUP147082 "Fractionation-Based Effective Dose Method Modifers"

892

893 **C.AA.A1 Enhanced RT Series Module**

894 The RT Second Generation IODs use the General Series Module described in section C.7.3.1, specialized by the
895 Enhanced RT Series Module.

896 Table C.AA.A1-1 specifies the Attributes that identify and describe general information about the Enhanced RT
897 Series.

898 **Table C.AA.A1-1**
899 **Enhanced RT Series Module Attributes**

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Type of equipment that originally acquired the data used to create the Instances in this Series. See C.AA.A1.1.1.
Series Number	(0020,0011)	1	A number that identifies this series.
Series Date	(0008,0021)	1	Date the Series started.
Series Time	(0008,0031)	1	Time the Series started.
Referenced Performed Procedure Step Sequence	(0008,1111)	1C	Uniquely identifies the Performed Procedure Step SOP Instance that resulted in creation of the Series (e.g. a Modality or Unified Procedure Step SOP Instance). Only a single Item shall be included in this Sequence. Required if the series has been created as a result of a single procedure step request and the Instance-Level Referenced Performed Procedure Step Sequence (gggg,9802) is not present. If different instances Instances in the series are created as a result of a procedure step, the Instance-Level Referenced Performed Procedure Step Sequence (gggg,9802) in the Radiotherapy Common Instance Module shall be used.
>Include Table 10-11 "SOP Instance Reference Macro Attributes"			

900

901

902 **C.AA.A1.1 Enhanced RT Series Attribute Description**

903 **C.AA.A1.1.1 Modality**

904 The Modality (0008,0060) is defined for each IOD including the Enhanced RT Series Module. -

905 Enumerated Values are:

906 - RTINTENT

907 - RTSEGANN

C.AA.A2 Radiotherapy Common Instance Module

Table C.AA.A2-1 specifies the Attributes that identify and describe general information in RT Second Generation IODs.

Table C.AA.A2-1
Radiotherapy Common Instance Module Attributes

Attribute Name	Tag	Type	Attribute Description
Instance Creation Date	(0008,0012)	1	Date the SOP Instance was created.
Instance Creation Time	(0008,0013)	1	Time the SOP Instance was created.
Content Date	(0008,0023)	1	The date the content creation started.
Content Time	(0008,0033)	1	The time the content creation started.
Instance-Level Referenced Performed Procedure Step Sequence	(gggg,9802)	1C	Uniquely identifies the Performed Procedure Step SOP Instance that resulted in creation of this Instance (e.g. a Modality or Unified Procedure Step SOP Instance). Required if this Instance has been created as a result of a procedure step request and the Referenced Performed Procedure Step Sequence (0008,1111) is not present. One or more Items shall be included in this Sequence.
>Include Table 10-11 "SOP Instance Reference Macro Attributes"			

C.AA.B1 RT Physician Intent Module

The RT Physician Intent Module contains information about the overall intent of the treatment. The content is mostly descriptive text and allows for the presence of unstructured advice by the physician along the established nomenclature of the actual institution.

Table C.AA.B1-1
RT Physician Intent Module Attributes

Attribute Name	Tag	Type	Description
Include Table 10.A2-1 "Extended Content Identification Macro Attributes"			
RT Treatment Phase Intent Presence Flag	(gggg,9808)	1	Whether an RT Treatment Phase Intent definition is present. Enumerated Values: YES NO
RT Physician Intent Sequence	(gggg,9912)	1	The overall goals or aims intended by the physician, for the Radiotherapy. One or more Items shall be included in this Sequence. See C.AA.B1.1.1
>RT Physician Intent Index	(gggg,9913)	1	Index of the RT Physician Intent in the Sequence. The value shall start at 1 and increase monotonically by 1.
>Treatment Site	(gggg,9961)	1	A free-text label describing the anatomical treatment site.

Attribute Name	Tag	Type	Description
>Treatment Site Code Sequence	(gggg,9962)	2	Coded description of the treatment site. Zero or more Items shall be included in this Sequence.
>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*No Baseline CID is defined.*
>RT Physician Intent Narrative	(gggg,9915)	2	Narrative of RT Physician Intent.
>RT Treatment Intent Type	(gggg,9914)	2	Type of treatment intent. Defined Terms: CURATIVE PALLIATIVE PROPHYLACTIC
>RT Physician Intent Predecessor Sequence	(gggg,9910)	1C	Reference to the RT Physician Intent SOP Instance which was replaced by this Physician Intent. Required if this RT Physician Intent replaces a previous version. Only a single Item shall be included in this Sequence.
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>>Reason for Superseding	(gggg,9917)	2	Reason that the previous RT Physician Intent was superseded by this Physician Intent.
>RT Treatment Approach Label (TODO Rename)	(gggg,9911)	2	Characterization of the case and intended treatment approach. See C.AA.B1.1.4.
>RT Protocol Code Sequence	(gggg,9916)	2	The protocol(s) selected by the RT Physician. Zero or more Items shall be included in this Sequence. See C.AA.B1.1.2.
>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*No Baseline CID is defined.*
>RT Diagnosis Code Sequence	(gggg,9918)	2	Diagnosis codes to describe the condition handled by this RT Physician Intent. Zero or more Items shall be included in this Sequence.
>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*No Baseline CID is defined.*
>Intent Input Instance Sequence (TODO Rename)	(gggg,991A)	2	References to SOP Instances used to establish the RT Physician Intent. Zero or more Items shall be included in this Sequence. See C.AA.B1.1.3.
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			

Attribute Name	Tag	Type	Description
>>Purpose of Reference Code Sequence	(0040,A170)	1	Describes the purpose for which the reference is made. Only a single Item shall be included in this Sequence.
>>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*No Baseline CID is defined.*

920

921 **C.AA.B1.1 RT Physician Intent Attribute Description**

922 **C.AA.B1.1.1 RT Physician Intent Sequence**

923 The RT Physician Intent Sequence (gggg,9912) allows one or more clinical intents to be identified for treatment in a
924 treatment course. For example, the simultaneous treatment of multiple primary targets may require separate intents
925 to be defined, each with its own prescription(s) and having different sets of reference imaging studies.

926 **C.AA.B1.1.2 RT Protocol Code Sequence**

927 RT Protocol Code Sequence (gggg,9916) contains a coded description of the radiotherapy clinical protocol being
928 followed for the patient. This is not necessarily the same as the Procedure Step protocol.

929 **C.AA.B1.1.3 RT Diagnostic Object Sequence**

930 The purpose of this Sequence is to reference all the Instances that have been used by the RT Physician to establish
931 the Intent. It may include the Images that were used in the treatment planning process, which are also referenced in
932 the Planning Input Information Sequence (gggg,9960) of the RT Prescription Module.

933 **C.AA.B1.1.4 RT Plan Type (TODO)**

934 The RT Treatment Approach Label (gggg,9911) is a short human-readable text label that is meaningful in the
935 context of the patient's disease and the treatment site. Such labels may be found in the literature, or defined as local
936 departmental naming conventions. They are usually not standardized. Examples are terms like Conformal,
937 Conical_Arc, Conformal_Arc, Electron Boost for Breast, TBI, TMI, TSE, CSI, IMAT_VMAT, Total_Spine.

938 **C.AA.B2 RT Enhanced Prescription Module**

939 The RT Enhanced Prescription Module describes the delivery objectives and labels for intended treatment for a
940 specific target, as defined by the physician.

941 **Table C.AA.B2-1**
942 **RT Enhanced Prescription Module Attributes**

Attribute Name	Tag	Type	Description
RT Prescription Sequence	(gggg,9940)	1	Prescriptions to deliver therapeutic radiation. One or more Items shall be included in this Sequence.
>RT Prescription Label	(gggg,9902)	1	User-defined label for this prescription. See 10.A3.1.1.
>RT Prescription Index	(gggg,9118)	1	Index of the prescription in the Sequence. The value shall start at 1 and increase monotonically by 1.

Attribute Name	Tag	Type	Description
>Referenced RT Physician Intent Index	(gggg,9919)	1C	The value of the RT Physician Intent Index (gggg,9913) in the RT Physician Intent Sequence (gggg,9912) corresponding to the intent for which this prescription is created. Required if Parent RT Prescription Index (gggg,9149) is absent. See C.AA.B2.1.5.
>Parent RT Prescription Index	(gggg,9149)	1C	The value of the RT Prescription Index (gggg,9118) corresponding to a prescription that is the parent prescription to this one. Required if the Referenced RT Physician Intent Index (gggg,9919) is absent. Note: The prescription referenced by this attribute will contain the Referenced RT Physician Intent Index (gggg,9919). See C.AA.B2.1.5.
>Referenced Dosimetric Objectives Sequence	(gggg,9951)	1C	References to Dosimetric Objectives that are applicable to this prescription. Required if any of the Dosimetric Objectives identified by the values of Dosimetric Objective UID (gggg,9948) in the Dosimetric Objective Sequence (gggg,9942) are applicable to this prescription. See C.AA.B2.1.6. One or more Items shall be included in this Sequence.
>>Referenced Dosimetric Objective UID	(gggg,9949)	1	Reference to a Dosimetric Objective UID (gggg,9948) in the Dosimetric Objective Sequence (gggg,9942).
>>Dosimetric Objective Weight	(gggg,9956)	1C	Weight of importance to be applied to the Dosimetric Objective. A higher value means that this objective is more important. Values are only meaningful within the Items in this Sequence. The use of weight value in the process of optimization and treatment parameter definition is implementation-dependent. Required if Dosimetric Objective Requirement Type (gggg,9954) is NO.
>RT Anatomic Prescription Sequence	(gggg,9920)	1	Prescriptions for an anatomic region. One or more Items shall be included in this Sequence.
>>Include Table 10.A3-1 "Entity Labeling Macro Attributes"			

Attribute Name	Tag	Type	Description
>>Therapeutic Role Category Code Sequence	(gggg,9930)	1	The general category of the therapeutic role of this anatomic region. Only a single Item shall be included in this Sequence.
>>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Defined CID SUP147004 "Radiotherapy Therapeutic Role Categories".*
>>Therapeutic Role Type Code Sequence	(gggg,9931)	1	The specific property type of the therapeutic role of this anatomic region. Only a single Item shall be included in this Sequence. See C.AA.B2.1.1.
>>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Defined CID is defined in C.AA.B2.1.1.*
>>Conceptual Volume Optimization Precedence	(gggg,9933)	2	Value used to resolve usage of overlapping regions of Conceptual Volumes during dose optimization. An overlapping region is part of the Conceptual Volume(s) with the lowest number. An overlapping region is not part of any other Conceptual Volume with a higher number. Overlapping regions with equal precedence are part of all Conceptual Volumes with the same value. Any number takes precedence over an empty value.

Attribute Name	Tag	Type	Description
>>Conceptual Volume Blocking Constraint	(gggg,9935)	2	Constraints on primary radiation passing through the current Conceptual Volume. Enumerated Values: NONE = No constraint UPSTREAM = The optimization is constrained to minimize primary radiation from the source passing through the current Conceptual Volume. The Conceptual Volume is upstream of the target. DOWNSTREAM = The optimization is constrained to minimize primary radiation from the source passing through the current Conceptual Volume. The Conceptual Volume is downstream of the target. TOTAL = The optimization is constrained to minimize primary radiation passing through the current Conceptual Volume. Primary Radiation is defined as modulated or shaped radiation, as opposed to scattered radiation or transmission radiation.
>>Conceptual Volume Category Code Sequence (TODO)	(gggg,9934)	2	The general category of this Conceptual Volume for radiotherapy purposes. Zero or one Item shall be included in this Sequence.
>>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Defined CID SUP147002 "Prescription Anatomy Categories".*
>>Conceptual Volume Type Code Sequence (TODO)	(gggg,9936)	1C	The specific type of this Conceptual Volume for radiotherapy purposes. Only a single Item shall be included in this Sequence. Required if Anatomy Property Category Code Sequence (gggg,0934) sequence contains one Item. See C.AA.B2.1.2.
>>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Context groups are defined in C.AA.B2.1.2.*
>>Conceptual Volume Type Modifier Code Sequence	(gggg,9937)	3	The modifier of the specific type of this Conceptual Volume for radiotherapy purposes. Only a single Item is permitted in this Sequence.

Attribute Name	Tag	Type	Description
>>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Defined CID 244 "Laterality".*
>>Conceptual Volume Sequence	(gggg,1346)	1	Conceptual Volume for which therapeutic goals are prescribed. See C.AA.B2.1.3. Only a single Item shall be included in this Sequence. The same Conceptual Volume UID (gggg,1301) shall not appear in more than one Item of the RT Anatomic Prescription Sequence (gggg,9920).
>>>Include Table 10.A6-1 "Conceptual Volume Segmentation Reference and Combination Macro Attributes"			
>>Conceptual Volume Description	(gggg,1319)	2	Description of the Conceptual Volume.
>Referenced RT Treatment Phase Sequence	(gggg,9870)	1C	Referenced treatment phase(s) to which this prescription applies. Required if RT Treatment Phase Intent Presence Flag (gggg,9808) of this RT Physician Intent SOP Instance equals YES. One or more Items shall be included in this Sequence.
>>Referenced RT Treatment Phase Index	(gggg,9146)	1	Value of RT Treatment Phase Index (gggg,9116) in the Intended RT Treatment Phase Sequence (gggg,9880) where this prescription is related to.
>Fraction-Based Relationship Sequence	(gggg,9982)	2	The relationship of this prescription to another prescription, expressed in fractions. Zero or one Item shall be included in this Sequence. See C.AA.B2.1.4.
>>Referenced RT Prescription Index	(gggg,9148)	1	Value of RT Prescription Index (gggg,9118) in the RT Prescription Sequence (gggg,9940) specifying the prescription to which the current prescription is related.
>>Fraction-Based Relationship Interval Anchor	(gggg,9984)	1	The anchor point of this RT Prescription Sequence Item with respect to the prescription referenced by Referenced RT Prescription Index (gggg,9148). Enumerated Values: START: The interval is specified with respect to the start of the referenced prescription. END: The interval is specified with respect to the end of the referenced prescription.

Attribute Name	Tag	Type	Description
>>Number of Interval Fractions	(gggg,9971)	1	The interval expressed in number of fractions. The Fraction-Based Relationship Interval Anchor (gggg,9984) establishes the anchor point to which the interval is tied. A value of 0 means that the current prescription is intended to start simultaneously with the anchor of the related prescription. If Fraction-Based Relationship Interval Anchor (gggg,9984) equals START, the value shall be 0 or positive. This is the number of fractions after the first fraction of the delivery of the referenced prescription that the delivery of the current prescription is intended to start. If Fraction-Based Relationship Interval Anchor (gggg,9984) equals END, the value shall be negative or 0. This is the number of fractions prior to the last fraction of the delivery of the referenced prescription that the delivery of the current prescription is intended to start.
>Prior Treatment Dose Description	(gggg,9924)	2	Description of radiotherapy treatment previously delivered to the patient for the purpose of evaluation of prior dose.
>Prior Treatment Reference Sequence	(gggg,9925)	2	References to SOP Instances representing prior treatments, e.g. for the purpose of extracting information about prior dose. Zero or more Items shall be included in this Sequence.
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>Planning Input Information Sequence	(gggg,9960)	2	Instances of objects that are relevant to the planning for the delivery of this prescription. Zero or more Items shall be included in this Sequence. (TODO: same as in Intent)
>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>>Purpose of Reference Code Sequence	(0040,A170)	1	Describes the purpose for which the reference is made. Only a single Item shall be included in this Sequence.
>>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*No Baseline CID is defined.* *(TODO: Create CID)*
>Prescription Notes (TODO Rename)	(gggg,9970)	3	Notes on this prescription, such as special provisions for this patient's treatment or other patient conditions.

Attribute Name	Tag	Type	Description
>Number of Fractions	(gggg,9972)	3	Number of Fractions in this prescription.
>Intended Delivery Duration	(gggg,9973)	3	Number of days across which the fractions in this prescription will be delivered.
>Fractionation Notes	(gggg,9974)	3	Notes describing the fractionation approach.
>Delivery Time Structure Code Sequence	(gggg,9994)	3	The time structure, i.e. fractionation type, to be used for the delivery of treatment. Zero or one Items shall be included in this Sequence.
>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Baseline CID SUP147068 "Delivery Time Structure"*
>Include Table C.AA.2.1.1-1 "Radiation Fraction Pattern Macro Attributes"			
>Treatment Technique Notes	(gggg,9966)	3	Notes on the treatment technique to be used.
>Radiotherapy Treatment Type	(gggg,9810)	3	Type of radiotherapy. Enumerated Values: TELETHERAPY BRACHYTHERAPY
>Teletherapy Radiation Type	(gggg,9811)	3	Type of Radiation used to deliver Teletherapy. Defined Terms: PHOTON NEUTRON ELECTRON ION Maybe present only if Radiotherapy Treatment Type (gggg,9980) has a value of TELETHERAPY.
>Brachytherapy Source Type	(gggg,9812)	3	Type of Source used to deliver Brachytherapy. Defined Terms: ISOTOPIC ELECTRONIC Maybe present only if Radiotherapy Treatment Type (gggg,9980) has a value of BRACHYTHERAPY.
>RT Treatment Technique Code Sequence	(gggg,9976)	3	Treatment technique to be used. One or more Items are permiited in this Sequence.
>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Defined CID SUP147047 "Radiotherapy Procedure Techniques".*
>Patient Treatment Orientation Sequence	(gggg,5032)	2	Orientation of the Patient for the treatment. Zero or one Item shall be included in this Sequence.

Attribute Name	Tag	Type	Description
>>Patient Orientation Code Sequence	(0054,0410)	1	Orientation of the patient with respect to gravity. See C.8.4.6.1.1 for further explanation. Only a single Item shall be included in this Sequence.
>>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Defined CID 19 "Patient Orientation".*
>>>Patient Orientation Modifier Code Sequence	(0054,0412)	1C	Sequence describing the orientation of the patient with respect to gravity. Required if needed to fully specify the orientation of the patient with respect to gravity. Only a single Item shall be included in this Sequence.
>>>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Defined CID 20 "Patient Orientation Modifier".*
>>Patient Equipment Relationship Code Sequence	(gggg,5030)	1	Orientation of the patient with respect to equipment. Only a single Item shall be included in this Sequence. See C.AA.B2.1.8.
>>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Defined CID 21 "Patient Equipment Relationship".*
>Prescription Notes Sequence	(gggg,9978)	3	Annotations on aspects of the prescription, like preparation and execution of the treatment. One or more Items are permitted in this Sequence.
>>Include Table 10-2 "Content Item Macro Attributes"			*Defined TID is SUP147001 "RT Prescription Annotation"*
Dosimetric Objective Sequence	(gggg,9942)	1C	Dosimetric Objectives defined for one or more prescription within module. Required if the Dosimetric Objective UID (TODO) is present in the Dosimetric Object Sequence (TODO). One or more Items shall be included in this Sequence. See C.AA.B2.1.6.
>Include Table C.AA.2.1.4-1 "Dosimetric Objective Macro Attributes"			
>Referenced Conceptual Volume UID	(gggg,1306)	1C	The UID of the Conceptual Volume in the RT Anatomic Prescription Sequence (gggg,9920) to which this Dosimetric Objective applies. Required if the Dosimetric Objective applies to a specific anatomy.

Attribute Name	Tag	Type	Description
>Dosimetric Objective Evaluation Scope	(gggg,9926)	1	Whether the Dosimetric Objective is intended to be evaluated over a lifetime scope or only in respect to the current prescriptions. Enumerated Values: CURRENT The Dosimetric Objective applies to the referencing prescriptions LIFETIME The Dosimetric Objective applies to the referencing prescriptions and accumulated lifetime dose. See C.AA.B2.1.7.

C.AA.B2.1 RT Enhanced Prescription Attribute Description

C.AA.B2.1.1 Therapeutic Role Type Code Sequence

The Therapeutic Role Type Code Sequence (gggg,9931) further specifies the role of the anatomy along the Therapeutic Role Category (gggg,9930). The following requirements apply to the codes permitted in the Therapeutic Role Type Code Sequence (gggg,9931), when the code used in the Therapeutic Role Category Code Sequence (gggg,9930) is as follows:

Table C.AA.B2-2
Therapeutic Role Type Codes

Code Value of Therapeutic Role Category Sequence (gggg,9930)	CID for Therapeutic Role Property Type Sequence (gggg,9931)
(S147050, 99SUP147, “RT Target”)	DCID SUP147070 “Radiotherapy Targets”
(S147051, 99SUP147, “RT Dose Calculation Structure”)	DCID SUP147071 “Radiotherapy Dose Calculation Roles”

C.AA.B2.1.2 Anatomy Property Type Code Sequence

The Anatomy Property Type Code Sequence (gggg,9936) further specifies the type of the anatomy along the Anatomy Property Category Code Sequence (gggg,9934). The following requirements apply to the codes permitted in the Anatomy Property Type Code Sequence (gggg,9936), when the code used in the Anatomy Property Type Code Sequence (gggg,9936) is as follows:

Table C.AA.B2-3
Anatomy Property Type Codes

Code Value of Anatomy Property Category Code Sequence (gggg,9934)	CID for Anatomy Property Type Code Sequence (gggg,9936)
(T-D000A, SRT, “Anatomical Structure”)	BCID 4031 “Common Anatomic Regions”
(S147059, 99SUP147, “External Body Model”)	DCID SUP147008 “External Body Models”
(A-00004, 99SUP147, “Physical Object”)	BCID 7157 “Device Segmentation Types”, BCID 6040 “Non-lesion Object Type”
(S147057, 99SUP147, “Unclassified Volume”)	DCID SUP147009 “Nonspecific Segmentations”

For code values of the Anatomy Property Type Code Sequence (gggg,9936) not listed above no baseline CID is defined.

C.AA.B2.1.3 Conceptual Volume Sequence

The Conceptual Volume Sequence (gggg,1346) identifies the Conceptual Volume associated with an RT Anatomy Prescription Item. If the Conceptual Volume is associated with a segment, the segment is defined by the Referenced Segment Reference Index (gggg,1340) in the Conceptual Volume Reference Combination and Segmentation Macro (see section 10.A6). Alternatively, the anatomy volume may not (yet) be associated with a segment. For example, an initial prescription may be entered prior to the definition of an organ at risk.

C.AA.B2.1.4 Fraction-Based Relationship Sequence

The Fraction-Based Relationship Sequence (gggg,9982) is used to specify the relationship between two prescriptions.

The following example shows a treatment performed in 2 phases with a break of 7 days between phases.

In RT Treatment Phase 1, the treatment of Prescription B is intended to start 10 fractions prior to the end of Prescription A.

The RT Treatment Phase Intent Module C.AA.B1 is used to specify the relationship of treatment phases to each other.

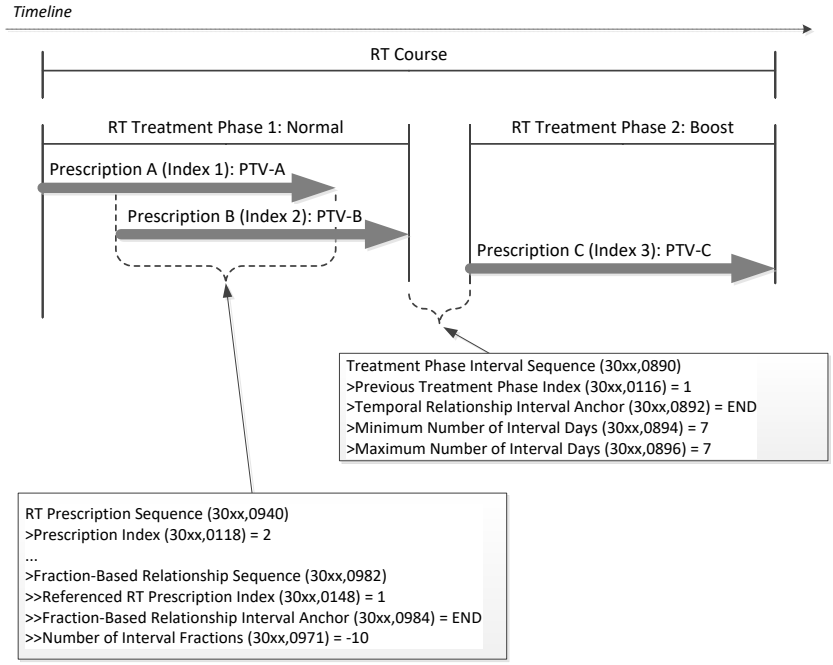


Figure C.AA.B2.1-1
Relationship of Phases and Prescriptions

C.AA.B2.1.5 Parent RT Prescription

The RT Prescription Module supports a two level prescription model in order to document an approach where a high-level prescription is created and then more details may be added. The first level would typically be created during the time of prescription definition with only high-level prescription information based on the RT Physician Intent. The second level would represent a derived prescription containing more detailed information, such as constraints and objectives.

C.AA.B2.1.6 Dosimetric Objective Sequence

The Dosimetric Objective Sequence (gggg,9942) specifies a set of intended dosimetric goals.

Each item of the Dosimetric Objective Sequence (gggg,9942) shall be referenced by at least one item of the Referenced Dosimetric Objectives Sequence (gggg,9951) in the current Instance.

Within an RT Physician Intent SOP Instance, a Dosimetric Objective is applicable to all Prescriptions in which the Dosimetric Objective UID (gggg,9948) is referenced.

A Dosimetric Objective is intended to be satisfied by the combined effect of all treatments associated with prescriptions that reference the Dosimetric Objective UID (gggg,9949).

For example, if there are primary and boost prescriptions that reference the same Dosimetric Objective UID (gggg,9948) then the combined effect of both prescriptions is intended to comply with the limit in this Dosimetric Objective.

C.AA.B2.1.7 Dosimetric Objective Evaluation Scope

For Dosimetric Objectives that include a dose value, the value defines the total dose for all fractions of all prescriptions referencing this Dosimetric Objective, and potentially dose from previous treatment, depending on the value of Dosimetric Objective Evaluation Scope (gggg,9926).

If Dosimetric Objective Evaluation Scope (gggg,9926) has a value of LIFETIME, information from prior treatments shall be included in the evalution of the Dosimetric Objective.

For example, if an organ has received dose in a prior treatment, and Dosimetric Objective Evaluation Scope (gggg,9926) is marked as LIFETIME, then the previously delivered dose shall be included in the evalution of this objective. Information about prior treatments may be described in Prior Treatment Dose Description (gggg,9924) or by Instances referenced by the Prior Treatment Reference Sequence (gggg,9925) in RT Prescription Sequence (gggg,9940).

If Dosimetric Objective Evaluation Scope (gggg,9926) has a value of CURRENT, the objective includes only those prescriptions which reference the same Dosimetric Objective, even if information of a prior treatment is available.

C.AA.B2.1.8 Patient Equipment Relationship Code Sequence

The Patient Equipment Relationship Code Sequence (gggg,5030) specifies the orientation of the patient relative to the front of the equipment viewed from the patient support device. For example, in case of the equipment being a gantry, this is the direction from the table (being the patient support device) towards the gantry. In cases where it is not possible to understand unambigously the direction for a certain equipment, the equipment vendor shall document this direction in its Conformance Statement.

C.AA.B3 Intended RT Treatment Phase Module

RT Treatment Phases define the intended phases of treatment and their temporal relationship.

Table C.AA.B3-1
RT Treatment Phase Intent Module Attributes

Attribute Name	Tag	Type	Description

Attribute Name	Tag	Type	Description
Intended RT Treatment Phase Sequence	(gggg,9880)	1	RT Treatment Phase definitions. RT Treatment Phases define the relationships between RT Radiation Set Instances which contain the treatment parameters for the radiation to be concurrently and/or subsequently delivered. The RT Treatment Phase Index (gggg,9116) shall define the temporal sequencing of the phases. One or more Items shall be included in this Sequence.
>Include Table C.AA.2.1.2-1 "RT Treatment Phase Macro Attributes"			*The RT Treatment Phase Index (gggg,9116) shall start at 1 and increase monotonically by 1 for successive Items in this Sequence.*
Include Table C.AA.2.1.3-1 "RT Treatment Phase Interval Macro Attributes"			

1022

1023

C.AA.D1 RT Segment Annotation Module

The RT Segment Annotation Module references segments and provides radiotherapy-specific annotations for them. The geometry of each segment is defined by a referenced Segmentation, Surface Segmentation, RT Structure Set or any other general-purpose Instance that represents geometric information.

The values of the following Attribute shall take precedence over values in the referenced SOP Instances:

- Segment Annotation Category Code Sequence (gggg,1353)
- Segment Annotation Type Code Sequence (gggg,1354)

Table C.AA.D1-1
RT Segment Annotation Module Attributes

Attribute Name	Tag	Type	Description
Include Table 10.A2-1 "Extended Content Identification Macro Attributes"			
RT Segment Annotation Sequence	(gggg,1352)	1	Annotations for segments are described in this Sequence. One or more Items shall be included in this Sequence.
>RT Segment Annotation Index	(gggg,9121)	1	Index of the Segment. The value shall start at 1 and increase monotonically by 1.
>Include Table 10.A4-1 "Entity Long Labeling Macro Attributes"			
>Referenced Segment Reference Index	(gggg,1340)	1	The Segment Reference Index (gggg,1342) in the Segment Reference Sequence (gggg,1341) corresponding to the segment this Sequence Item relates to.
>Segment Annotation Category Code Sequence	(gggg,1353)	2	Category of the annotation of this segment. Only a single Item shall be included in this Sequence.
>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Defined CID SUP147003 "Radiotherapy Segment Annotation Categories".*
>Segment Annotation Type Code Sequence	(gggg,1354)	1C	Specific type of the annotation of this segment. Required if Segment Annotation Category Code Sequence (gggg,1353) has a value. Only a single Item shall be included in this Sequence. See C.AA.D1.1.1.
>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Defined CID is defined in C.AA.D1.1.1.*
>Segmentation Creation Template Label (TODO Rename)	(gggg,1332)	3	Label for the template used to define the set of segments to be created from patient images and the names, codes, default presentation parameters associated with those segments.

Attribute Name	Tag	Type	Description
>Segmented RT Accessory Device Sequence	(gggg,1349)	2	RT accessory device identification information. Zero or more Items shall be included in this Sequence. See C.AA.D1.1.2.
>>Device Index	(gggg,9112)	1	Index of the Device. The value shall start at 1 and increase monotonically by 1.
>>Include Table 10.A7-1 "Device Model Macro Attributes"			
>>Include Table 10.A8-1 "Device Identification Macro Attributes"			*Defined CID SUP147040 "Segmented RT Accessory Devices".*
>Segment Characteristics Precedence	(gggg,134D)	2	Value used to resolve usage of characteristic of overlapping regions of Conceptual Volumes. In overlapping regions, the characteristic of the Conceptual Volume with the lowest number has precendence. Any number takes precedence over an empty value. The effect of precedence on the use of the characteristics is not defined in the standard. Non-empty values shall be unique within all Items of this Sequence.
>Segment Characteristics Sequence	(gggg,134B)	3	Characteristics associated with the current segment. One or more Items are permitted in this Sequence. See C.AA.D1.1.3.
>>Include Table 10-2 "Content Item Macro Attributes"			*Defined TID of Concept Name Code Sequence is TID SUP147003 "RT Segment Annotation Properties".*
>>Related Segment Characteristics Sequence	(gggg,134C)	3	Other concepts related to this characteristic. One or more Items are permitted in this Sequence.
>>>Include Table 10-2 "Content Item Macro Attributes"			*Content Items are defined in C.AA.D1.1.3.*
>Recommended Display Grayscale Value	(0062,000C)	3	A default single gray unsigned value in which it is recommended that the maximum pixel value in this surface be rendered on a monochrome display. The units are specified in P-Values from a minimum of 0000H (black) up to a maximum of FFFFH (white). Note: The maximum P-Value for this Attribute may be different from the maximum P-Value from the output of the Presentation LUT, which may be less than 16 bits in depth.

Attribute Name	Tag	Type	Description
>Recommended Display CIELab Value	(0062,000D)	3	A default triplet value in which it is recommended that the surface be rendered on a color display. The units are specified in PCS-Values, and the value is encoded as CIELab.
>Recommended Presentation Opacity	(0066,000C)	3	Specifies the opacity in which it is recommended that the surface be rendered. See C.27.1.1.3.
>Recommended Presentation Type	(0066,000D)	3	Specifies the representation type in which it is recommended that the surface be rendered. See C.27.1.1.3.

C.AA.D1.1 RT Segment Annotation Attribute Description

C.AA.D1.1.1 RT Segment Annotation Type Code Sequence

If the Segment Annotation Category Code Sequence (gggg,1353) has the code value specified in the left column below, the CID for Segment Annotation Type Code Sequence (gggg,1354) shall be the one specified in the right column below.

Table C.AA.D1-2
RT Segment Annotation Type CIDs

Code Value of Segment Annotation Category Code Sequence (gggg,1353)	CID for Segment Annotation Type Code Sequence (gggg,1354)
(S147050, 99SUP147, “RT Target”)	DCID SUP147070 “Radiotherapy Targets”
(S147051, 99SUP147, “RT Dose Calculation Structure”)	DCID SUP147071 “Radiotherapy Dose Calculation Roles”
(S147053, 99SUP147, “RT Geometric Information”)	DCID SUP147005 “RT Geometric Information”
(S147059, 99SUP147, “External Body Model”)	DCID SUP147008 “External Body Models”
(S147054, 99SUP147, “Fixation or Positioning Device”)	DCID SUP147006 “Fixation or Positioning Devices”
(S147055, 99SUP147, “Brachytherapy Device”)	DCID SUP147007 “Brachytherapy Devices”
(A-00004, SRT, “Physical Object”)	BCID 7157 “Device Segmentation Types”, BCID 6040 “Non-lesion Object Type”
(S147057, 99SUP147, “Nonspecific Segmentations”)	DCID SUP147009 “Nonspecific Segmentations”

For code values of the Segment Annotation Category Code Sequence (gggg,1353) not listed above no baseline CID is defined.

C.AA.D1.1.2 Segmented RT Accessory Device Sequence

RT accessory device identification information when this segment represents a device.

Note: For an RT accessory device, typically the Segmented Property Category Code Sequence (0062,0003) has one of the following values:

(S147054, 99SUP147, “Fixation or Positioning Device”)

(S147055, 99SUP147, “Brachytherapy Device”)

(A-00004, SRT, “Physical Object”)

C.AA.D1.1.3 Segment Characteristics Sequence

To express individual characteristics, only the Segment Characteristics Sequence (gggg,134B) is present.

To express a group of related characteristics both the Segment Characteristics Sequence (gggg,134B) and the Related Segment Characteristics Sequence (gggg,134C) are present. The concepts in Table C.AA.D1-3 shall be encoded as shown.

Table C.AA.D1-3
RT Segment Characteristics Modifier Content Item

Concept in Segment Characteristics Sequence (gggg,134B)	Unit of Concept in Segment Characteristics Sequence (gggg,134B)	Concept in Related Segment Characteristics Sequence (gggg,134C)	Unit of Content Item in Related Segment Characteristics Sequence (gggg,134C)
S147161, 99SUP147, "Atomic Number"	Units = EV(ratio, UCUM, "no units")	S147162, 99SUP147, “Elemental Composition Atomic Mass Fraction”	Units = EV (ratio, UCUM, "ratio")

C.AA.D2 Segment Reference Module

Commented [UBU1]: Review to continue here.

The Segment Reference Module references segments or regions of interest.

Table C.AA.D2-1
Segment Reference Module Attributes

Attribute Name	Tag	Type	Description
Segment Reference Sequence	(gggg,1341)	1	References to segments. One or more Items shall be included in this Sequence. See C.AA.D2.1.3.
>Segment Reference Index	(gggg,1342)	1	Index of the segment reference in the Sequence. The value shall start at 1 and increase monotonically by 1.
>Direct Segment Reference Sequence	(gggg,1343)	1C	Directly identifies a specific segment in a specific SOP Instance. Required if Combination Segment Reference Sequence (gggg,1344) is not present. Only a single Item shall be included in this Sequence. See C.AA.D2.1.3.
>>Referenced SOP Sequence	(0008,1199)	1	The SOP Instance that contains the referenced segment or region of interest. Only a single Item shall be included in this Sequence. See C.AA.D2.1.1.
>>>Include Table 10-11 “SOP Instance Reference Macro Attributes”			
>>Include Table 10.A5-1 “Conceptual Volume Macro Attributes”			
>>Referenced Segment Number	(0062,000B)	1C	Segment Number (0062,0004) in the referenced SOP Instance. Required as described in C.AA.D2.1.1. Only a single Item shall be included in this Sequence.
>>Referenced Fiducials UID	(gggg,5031)	1C	Fiducials UID (0070,031A) in the referenced SOP Instance. Required as described in C.AA.D2.1.1. See C.AA.D2.1.1.

Attribute Name	Tag	Type	Description
>>Referenced ROI Number	(3006,0084)	1C	ROI Number (3006,0022) in the referenced SOP Instance. Required as described in C.AA.D2.1.1. See C.AA.D2.1.1.
>>Referenced Surface Number	(0066,002C)	1C	Surface Number (0066,0003) in the referenced SOP Instance. Required as described in C.AA.D2.1.1. See C.AA.D2.1.1.
>Combination Segment Reference Sequence	(gggg,1344)	1C	Defines a segment as a combination of other segments present in the Direct Segment Reference Sequence (gggg,1343). Required if the Direct Segment Reference Sequence (gggg,1343) is not present. Only a single Item shall be included in this Sequence. See C.AA.D2.1.3.
>>Include Table 10.A6-1 "Conceptual Volume Segmentation Reference and Combination Macro Attributes"			*See C.AA.D2.1.2.*
>>Segmented Property Category Code Sequence	(0062,0003)	2	Sequence defining the general category of the property the segment combination represents. Only a single Item shall be included in this Sequence.
>>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Baseline CID 7150 "Segmentation Property Categories".*
>>Segmented Property Type Code Sequence	(0062,000F)	1C	Sequence defining the modifier of the property type the segment combination represents. Required if Segmented Property Category Code Sequence (0062,0003) has a value. Only a single Item shall be included in this Sequence.
>>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Baseline CID 7151 "Segmentation Property Types".*

C.AA.D2.1 Segment Reference Attribute Description

C.AA.D2.1.1 Segmentation SOP Instance Reference Sequence

The SOP Classes in Table C.AA.D2-2 shall be referenced as shown.

SOP Classes not in Table C.AA.D2-2 shall not be referenced.

Table C.AA.D2-2

Permitted SOP Classes

SOP Class Name	SOP Class UID	Referenced Attribute	Required Referencing Attribute
Segmentation Storage	1.2.840.10008.5.1.4.1.1.66.4	Segment Number (0062,0004)	Referenced Segment Number (0062,000B)

Surface Segmentation Storage	1.2.840.10008.5.1.4.1.1.66.5	Segment Number (0062,0004)	Referenced Segment Number (0062,000B)
Spatial Fiducials Storage	1.2.840.10008.5.1.4.1.1.66.2	Fiducials UID (0070,031A)	Referenced Fiducials UID (gggg,5031)
RT Structure Set	1.2.840.10008.5.1.4.1.1.481.3	ROI Number (3006,0022)	Referenced ROI Number (3006,0084)
Surface Scan Mesh Storage	1.2.840.10008.5.1.4.1.1.68.1	Surface Number (0066,0003)	Referenced Surface Number (0066,002C)
Surface Scan Point Cloud Storage	1.2.840.10008.5.1.4.1.1.68.2	None	None

The column Referenced Attribute identifies the Attribute used to identify the geometric representation in the SOP Instance referenced in the Segmentation Referenced SOP Sequence (0008,1199).

The column Required Referencing Attribute identifies the Attribute which is required to be present (by the condition for Type 1C) in the Direct Segment Reference Sequence (gggg,1343) to identifiy to this geometric representation in that Instance.

It is anticipated that in future additional referencing Attributes may be needed to accommodate new representations of segmentations. Hence the collection of Required Referencing Attributes in Table C.AA.D2-1 Permitted SOP Classes and the conditionally required Type 1C Attributes in the Segment Reference Module may be extended.

C.AA.D2.1.1.1 Multiplicity Requirements

The Segment Reference Sequence (gggg,1341) may contain more than one Item to indicate segmentations of more than one geometric type, represented by different SOP Classes.The following restrictions apply to the Referenced SOP Sequence (0008,1199):

- Any SOP Class may appear only once in this Sequence.
- All referenced SOP Instances must have the same Frame of Reference UID (0020,0052)
- If this Sequence contains a reference to a SOP Instance of RT Structure Set (1.2.840.10008.5.1.4.1.1.481.3), no other Instances shall be included in that Sequence.

C.AA.D2.1.2 Combination Segment Reference Sequence

A Conceptual Volume may be expressed as a combination of other segmented Conceptual Volumes. Those other segments are referenced in the Conceptual Volume Segmentation Reference and Combination Macro (see section 10.A6).

The Conceptual Volume Combination Flag (gggg,1309) shall be YES. The Conceptual Volume Segmentation Defined Flag (gggg,1311) shall be NO.

At least two Sequence Items shall be present in the Conceptual Volume Constituent Sequence (gggg,1303) of the Conceptual Volume Segmentation Reference and Combination Macro (see section 10.A6).

All Conceptual Volume References in this macro shall reference only segments that are defined in Items in the Direct Segment Reference Sequence (gggg,1343).

C.AA.D2.1.3 Conceptual Volumes

The Conceptual Volume UIDs of the Conceptual Volumes instantiated in either the Direct Segment Reference Sequence (gggg,1343) or the Combination Segment Reference Sequence (gggg,1344) shall be unique within the Segment Reference Sequence (gggg,1341).

Make the following additions to PS3.3, Annex F, Table F.4-1:

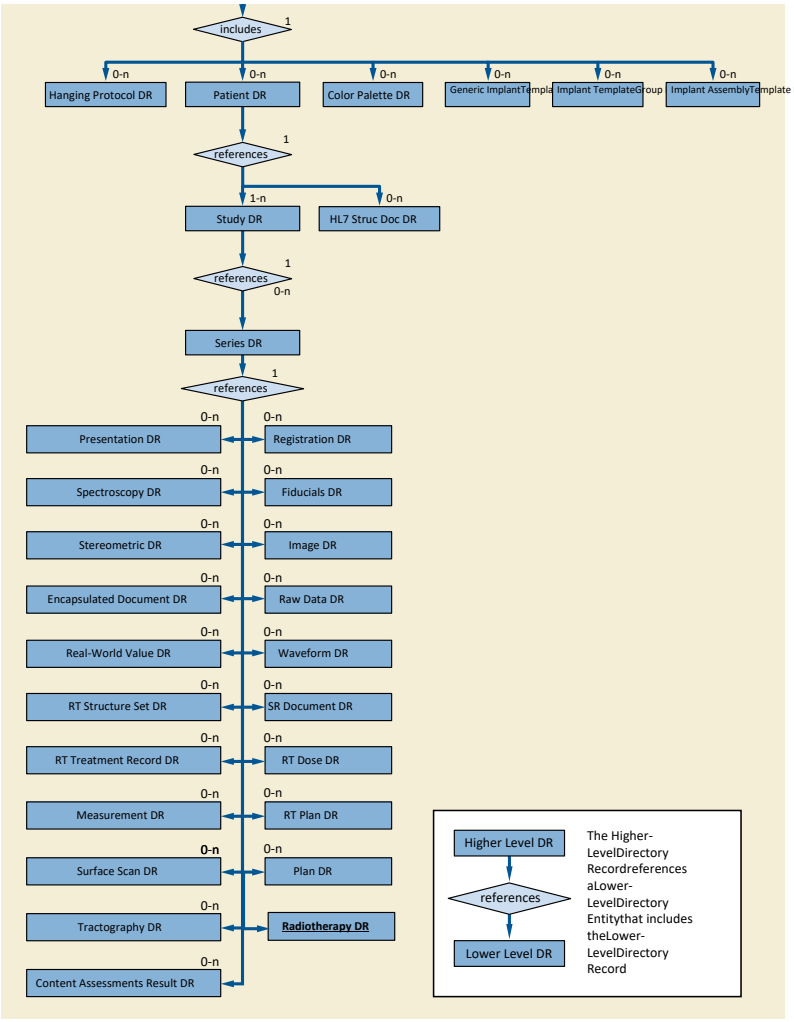
F.4 BASIC DIRECTORY IOD INFORMATION MODEL

Table F.4-1
RELATIONSHIP BETWEEN DIRECTORY RECORDS

Directory Record Type	Section	Directory Record Types which may be included in the next lower-level directory Entity
(Root Directory Entity)		PATIENT, HANGING PROTOCOL, PALETTE, PRIVATE
PATIENT	F.5.1	STUDY, HL7 STRUC DOC, PRIVATE
STUDY	F.5.2	SERIES, PRIVATE
SERIES	F.5.3	IMAGE, RT DOSE, RT STRUCTURE SET, RT PLAN, RT TREAT RECORD, PRESENTATION, WAVEFORM, SR DOCUMENT, KEY OBJECT DOC, SPECTROSCOPY, RAW DATA, REGISTRATION, FIDUCIAL, ENCAP DOC, VALUE MAP, STEREOMETRIC, PLAN, MEASUREMENT, SURFACE, TRACT, ASSESSMENT, **RADIOTHERAPY**, PRIVATE
IMAGE	F.5.4	PRIVATE
RT DOSE	F.5.19	PRIVATE
RT STRUCTURE SET	F.5.20	PRIVATE
RT PLAN	F.5.21	PRIVATE
RT TREAT RECORD	F.5.22	PRIVATE
PRESENTATION	F.5.23	PRIVATE
…		
ASSESSMENT	F.5.36	PRIVATE
RADIOTHERAPY	F.5.X	**PRIVATE**
PRIVATE	F.6.1	PRIVATE, (any of the above as privately defined)

Add the "RADIOTHERAPY DR" box at the bottom of PS3.3, Annex F, Figure F.4-1:

F.5 DEFINITION OF SPECIFIC DIRECTORY RECORDS



Add the following to PS3.3, Annex F, Section F.5.X:

F.5.X Radiotherapy Directory Record Definition

The Directory Record is based on the specification of Section F.3. It is identified by a Directory Record Type of Value "RADIOTHERAPY". Table F.5-X lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Instance-level IEs of RT Second-Generation IODs. This Directory Record shall be used to reference one of the classes of RT Second-Generation SOP Instances having a Modality (0008,0060) of as defined in chapter A.VV.1. and following. This type of Directory Record may reference a Lower-Level Directory Entity that includes one or more Directory Records as defined in Table F.4-1.

Table F.5-X
RADIOTHERAPY KEYS

Key	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Required if an extended or replacement character set is used in one of the keys.
Instance Number	(0020,0013)	1	
User Content Label	(gggg,51E0)	1C	Required if User Content Label (gggg,51E0) is present
User Content Long Label	(gggg,51E1)	1C	Required if User Content Long Label (gggg,51E1) is present
Content Description	(0070,0081)	2	
Content Creator's Name	(0070,0084)	2	
Any other Attribute of the Instance-level IE Modules		3	

Note: Because Referenced SOP Instance UID in File (0004,1511) may be used as a "pseudo" Directory Record Key (See Table F.3-3), it is not duplicated in this list of keys.

1134 **Part 4 Addendum**

1135 **Add the following to PS3.4, Appendix B.5, Table B.5-1**

SOP Class Name	SOP Class UID	IOD Spec (defined in PS 3.3)
RT Physician Intent Storage	1.2.840.10008.5.1.4.1.1.X.1.1	RT Physician Intent IOD
RT Segment Annotation Storage	1.2.840.10008.5.1.4.1.1.X.1.2	RT Segment Annotation IOD

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Part 6 Addendum

Add the following in PS3.6 Chapter 2 Normative References

2 NORMATIVE REFERENCES

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[FEUVRET] International Journal of Radiation Oncology, Biology, Physics, Volume 64, Issue 2, 2006, Page 333-342

[ICRU Report 50] International Commission on Radiation Units and Measurements. 1993. Prescribing, Recording, and Reporting Photon Beam Therapy.

Add the following data elements to PS3.6:

6 REGISTRY OF DICOM DATA ELEMENTS

(gggg,1130)	Radiobiological Dose Effect Sequence	RadiobiologicalDoseEffectSequence	SQ	1
(gggg,1131)	Radiobiological Dose Effect Flag	RadiobiologicalDoseEffectFlag	CS	1
(gggg,1132)	Effective Dose Calculation Method Category Code Sequence	EffectiveDoseCalculationMethodCategoryCodeSequence	SQ	1
(gggg,1134)	Effective Dose Calculation Method Code Sequence	EffectiveDoseCalculationMethodCodeSequence	SQ	1
(gggg,1137)	Effective Dose Calculation Method Description	EffectiveDoseMethodDescription	LO	1
(gggg,1301)	Conceptual Volume UID	ConceptualVolumeUID	UI	1
(gggg,1302)	Originating SOP Instance Reference Sequence	OriginatingSOPInstanceReferenceSequence	SQ	1
(gggg,1303)	Conceptual Volume Constituent Sequence	ConceptualVolumeConstituentSequence	SQ	1
(gggg,1304)	Equivalent Conceptual Volume Instance Reference Sequence	EquivalentConceptualVolumeInstanceReferenceSequence	SQ	1
(gggg,1305)	Equivalent Conceptual Volumes Sequence	EquivalentConceptualVolumesSequence	SQ	1
(gggg,1306)	Referenced Conceptual Volume UID	ReferencedConceptualVolumeUID	UI	1
(gggg,1307)	Conceptual Volume Combination Expression	ConceptualVolumeCombinationExpression	UT	1
(gggg,1308)	Conceptual Volume Constituent Index	ConceptualVolumeConstituentIndex	US	1
(gggg,1309)	Conceptual Volume Combination Flag	ConceptualVolumeCombinationFlag	CS	1

(gggg,1310)	Conceptual Volume Combination Description	ConceptualVolumeCombinationDescription	ST	1
(gggg,1311)	Conceptual Volume Segmentation Defined Flag	ConceptualVolumeSegmentationDefinedFlag	CS	1
(gggg,1312)	Conceptual Volume Segmentation Reference Sequence	ConceptualVolumeSegmentationReferenceSequence	SQ	1
(gggg,1314)	Conceptual Volume Constituent Segmentation Reference Sequence	ConceptualVolumeConstituentSegmentationReferenceSequence	SQ	1
(gggg,1315)	Constituent Conceptual Volume UID	ConstituentConceptualVolumeUID	UI	1
(gggg,1316)	Derivation Conceptual Volume Sequence	DerivationConceptualVolumeSequence	SQ	1
(gggg,1317)	Source Conceptual Volume UID	SourceConceptualVolumeUID	UI	1
(gggg,1318)	Conceptual Volume Derivation Algorithm Sequence	ConceptualVolumeDerivationAlgorithmSequence	SQ	1
(gggg,1319)	Conceptual Volume Description	ConceptualVolumeDescription	ST	1
(gggg,1320)	Source Conceptual Volume Sequence	Source Conceptual Volume Sequence	SQ	1
(gggg,1324)	Manufacturer's Model Version	ManufacturersModelVersion	LO	1
(gggg,1326)	Device Alternate Identifier	DeviceAlternateIdentifier	UC	1
(gggg,1327)	Device Alternate Identifier Type	DeviceAlternateIdentifierType	CS	1
(gggg,1328)	Device Alternate Identifier Format	DeviceAlternateIdentifierFormat	LT	1
(gggg,1332)	Segmentation Template Label	SegmentationTemplateLabel	LO	1
(gggg,1334)	Segmentation Template UID	SegmentationTemplateUID	UI	1
(gggg,1340)	Referenced Segment Reference Index	ReferencedSegmentReferenceIndex	US	1
(gggg,1341)	Segment Reference Sequence	SegmentReferenceSequence	SQ	1
(gggg,1342)	Segment Reference Index	SegmentReferenceIndex	US	1
(gggg,1343)	Direct Segment Reference Sequence	DirectSegmentReferenceSequence	SQ	1
(gggg,1344)	Combination Segment Reference Sequence	CombinationSegmentReferenceSequence	SQ	1
(gggg,1346)	Conceptual Volume Sequence	ConceptualVolumeSequence	SQ	1
(gggg,1349)	Segmented RT Accessory Device Sequence	SegmentedRTAccessoryDeviceSequence	SQ	1
(gggg,134B)	Segment Characteristics Sequence	SegmentCharacteristicsSequence	SQ	1

(gggg,134C)	Related Segment Characteristics Sequence	RelatedSegmentCharacteristicsSequence	SQ	1
(gggg,134D)	Segment Characteristics Precedence	SegmentCharacteristicsPrecedence	US	1
(gggg,1352)	RT Segment Annotation Sequence	RTSegmentAnnotationSequence	SQ	1
(gggg,1353)	Segment Annotation Category Code Sequence	SegmentAnnotationCategoryCodeSequence	SQ	1
(gggg,1354)	Segment Annotation Type Code Sequence	SegmentAnnotationTypeCodeSequence	SQ	1
(gggg,5025)	Device Label	DeviceLabel	LO	1
(gggg,5026)	Device Type Code Sequence	DeviceTypeCodeSequence	SQ	1
(gggg,5027)	Device Description	DeviceDescription	ST	1
(gggg,5030)	Patient Equipment Relationship Code Sequence	PatientEquipmentRelationshipCodeSequence	SQ	1
(gggg,5031)	Referenced Fiducials UID	ReferencedFiducialsUID	UI	1
(gggg,5032)	Patient Treatment Orientation Sequence	PatientTreatmentOrientationSequence	SQ	1
(gggg,51E0)	User Content Label	UserContentLabel	SH	1
(gggg,51E1)	User Content Long Label	UserContentLongLabel	LO	1
(gggg,51E2)	Entity Label	EntityLabel	SH	1
(gggg,51E3)	Entity Name	EntityName	LO	1
(gggg,51E4)	Entity Description	EntityDescription	ST	1
(gggg,51E5)	Entity Long Label	EntityLongLabel	LO	1
(gggg,9112)	Device Index	DeviceIndex	US	1
(gggg,9116)	RT Treatment Phase Index	RTTreatmentPhaseIndex	US	1
(gggg,9118)	RT Treatment Phase UID	RTTreatmentPhaseUID	UI	1
(gggg,9118)	RT Prescription Index	RTPrescriptionIndex	US	1
(gggg,9121)	RT Segment Annotation Index	RTSegmentAnnotationIndex	US	1
(gggg,9143)	Basis RT Treatment Phase Index	BasisRTTreatmentPhaseIndex	US	1
(gggg,9144)	Related RT Treatment Phase Index	RelatedRTTreatmentPhaseIndex	US	1
(gggg,9146)	Referenced RT Treatment Phase Index	ReferencedRTTreatmentPhaseIndex	US	1
(gggg,9148)	Referenced RT Prescription Index	ReferencedRTPrescriptionIndex	US	1
(gggg,9149)	Parent RT Prescription Index	ParentRTPrescriptionIndex	US	1
(gggg,954D)	Manufacturer's Device Identifier	ManufacturerDeviceIdentifier	ST	1
(gggg,9802)	Instance-Level Referenced Performed Procedure Step Sequence	InstanceLevelReferencedPerformedProcedureStepSequence	SQ	1

(gggg,9808)	RT Treatment Phase Intent Presence Flag	RTTreatmentPhaseIntentPresenceFlag	CS	1
(gggg,9810)	Radiotherapy Treatment Type	RadiotherapyTreatmentType	CS	1
(gggg,9811)	Teletherapy Radiation Type	TeletherapyRadiationType	CS	1-n
(gggg,9812)	Brachytherapy Source Type	BrachytherapySourceType	CS	1-n
(gggg,9870)	Referenced RT Treatment Phase Sequence	ReferencedRTTreatmentPhaseSequence	SQ	1
(gggg,9875)	Referenced Direct Segment Instance Sequence	ReferencedDirectSegmentInstanceSequence	SQ	1
(gggg,9880)	Intended RT Treatment Phase Sequence	IntendedRTTreatmentPhaseSequence	SQ	1
(gggg,988C)	Intended Phase Start Date	IntendedPhaseStartDate	DA	1
(gggg,988E)	Intended Phase End Date	IntendedPhaseEndDate	DA	1
(gggg,9890)	RT Treatment Phase Interval Sequence	RTTreatmentPhaseIntervalSequence	SQ	1
(gggg,9892)	Temporal Relationship Interval Anchor	TemporalRelationshipIntervalAnchor	CS	1
(gggg,9894)	Minimum Number of Interval Days	MinimumNumberOfIntervalDays	FD	1
(gggg,9896)	Maximum Number of Interval Days	MaximumNumberOfIntervalDays	FD	1
(gggg,9902)	RT Prescription Label	RTPrescriptionLabel	LO	1
(gggg,9910)	RT Physician Intent Predecessor Sequence	RTPhysicianIntentPredecessorSequence	SQ	1
(gggg,9911)	RT Plan Type	RTPlanType	LO	1
(gggg,9912)	RT Physician Intent Sequence	RTPhysicianIntentSequence	SQ	1
(gggg,9913)	RT Physician Intent Index	RTPhysicianIntentIndex	US	1
(gggg,9914)	RT Treatment Intent Type	RTTreatmentIntentType	CS	1
(gggg,9915)	RT Physician Intent Narrative	RTPhysicianIntentNarrative	UT	1
(gggg,9916)	RT Protocol Code Sequence	RTProtocolCodeSequence	SQ	1
(gggg,9917)	Reason for Superseding	ReasonForSuperseding	ST	1
(gggg,9918)	RT Diagnosis Code Sequence	RTDiagnosisCodeSequence	SQ	1
(gggg,9919)	Referenced RT Physician Intent Index	ReferencedRTPhysicianIntentIndex	US	1
(gggg,991A)	RT Diagnostic Object Sequence	RTDiagnosticObjectSequence	SQ	1
(gggg,9920)	RT Anatomic Prescription Sequence	RTAnatomicPrescriptionSequence	SQ	1
(gggg,9924)	Prior Treatment Dose Description	PriorTreatmentDoseDescription	UT	1

(gggg,9925)	Prior Treatment Reference Sequence	PriorTreatmentReferenceSequence	SQ	1
(gggg,9926)	Dosimetric Objective Evaluation Scope	DosimetricObjectiveEvaluationScope	CS	1
(gggg,9930)	Therapeutic Role Category Code Sequence	TherapeuticRoleCategoryCodeSequence	SQ	1
(gggg,9931)	Therapeutic Role Type Code Sequence	TherapeuticRoleTypeCodeSequence	SQ	1
(gggg,9933)	Conceptual Volume Optimization Precedence	ConceptualVolumeOptimizationPrecedence	US	1
(gggg,9934)	Anatomy Property Category Code Sequence	AnatomyPropertyCategoryCodeSequence	SQ	1
(gggg,9935)	Conceptual Volume Blocking Constraint	ConceptualVolumeBlockingConstraint	CS	1
(gggg,9936)	Anatomy Property Type Code Sequence	AnatomyPropertyTypeCodeSequence	SQ	1
(gggg,9937)	Conceptual Volume Type Modifier Code Sequence	ConceptualVolumeTypeModifierCodeSequence	SQ	1
(gggg,9940)	RT Prescription Sequence	RTPrescriptionSequence	SQ	1
(gggg,9942)	Dosimetric Objective Sequence	DosimetricObjectiveSequence	SQ	1
(gggg,9943)	Dosimetric Objective Type Code Sequence	DosimetricObjectiveTypeCodeSequence	SQ	1
(gggg,9948)	Dosimetric Objective UID	DosimetricObjectiveUID	UI	1
(gggg,9949)	Referenced Dosimetric Objective UID	ReferencedDosimetricObjectiveUID	UI	1
(gggg,9950)	Dosimetric Objective Parameter Sequence	DosimetricObjectiveParameterSequence	SQ	1
(gggg,9951)	Referenced Dosimetric Objectives Sequence	ReferencedDosimetricObjectivesSequence	SQ	1
(gggg,9952)	Radiobiological Dose Effect Flag	RadiobiologicalDoseEffectFlag	CS	1
(gggg,9954)	Dosimetric Objective Requirement Type	DosimetricObjectiveRequirementType	CS	1
(gggg,9956)	Dosimetric Objective Weight	DosimetricObjectiveWeight	FD	1
(gggg,9958)	Dosimetric Objective Purpose	DosimetricObjectivePurpose	CS	1
(gggg,9960)	Planning Input Information Sequence	PlanningInputInformationSequence	SQ	1
(gggg,9961)	Treatment Site	TreatmentSite	LO	1
(gggg,9962)	Treatment Site Code Sequence	TreatmentSiteCodeSequence	SQ	1
(gggg,9965)	Fraction Pattern Sequence	FractionPatternSequence	SQ	1
(gggg,9966)	Treatment Technique Notes	TreatmentTechniqueNotes	UT	1
(gggg,9970)	General Prescription Notes	GeneralPrescriptionNotes	UT	1

(gggg,9971)	Number of Interval Fractions	NumberOfIntervalFractions	IS	1
(gggg,9972)	Number of Fractions	NumberOfFractions	US	1
(gggg,9973)	Intended Delivery Duration	IntendedDeliveryDuration	US	1
(gggg,9974)	Fractionation Notes	FractionationNotes	UT	1
(gggg,9976)	RT Treatment Technique Code Sequence	RTTreatmentTechniqueCodeSequence	SQ	1
(gggg,9978)	Prescription Notes Sequence	PrescriptionNotesSequence	SQ	1
(gggg,9979)	Prescription Notes DateTime	PrescriptionNotesDateTime	DT	1
(gggg,9982)	Fraction-Based Relationship Sequence	FractionBasedRelationshipSequence	SQ	1
(gggg,9984)	Fraction-Based Relationship Interval Anchor	FractionBasedRelationshipIntervalAnchor	CS	1
(gggg,9990)	Minimum Hours between Fractions	MinimumHoursBetweenFractions	FD	1
(gggg,9991)	Intended Fraction Start Time	IntendedFractionStartTime	TM	1-n
(gggg,9992)	Intended Start Day of Week	IntendedStartDayOfWeek	LT	1
(gggg,9993)	Weekday Fraction Pattern Sequence	WeekdayFractionPatternSequence	SQ	1
(gggg,9994)	Delivery Time Structure Code Sequence	DeliveryTimeStructureCodeSequence	SQ	1

Add the following to PS3.6 Annex A:

ANNEX A REGISTRY OF DICOM UNIQUE IDENTIFIERS (UIDS) (NORMATIVE)

Table A-1 UID Values

UID Value	UID Name	UID Type	Part
1.2.840.10008.5.1.4.1.1.X.1.1	RT Physician Intent Storage	SOP Class	PS3.4
1.2.840.10008.5.1.4.1.1.X.1.2	RT Segment Annotation Storage	SOP Class	PS3.4

Table A-3 Context Group UID Values

Context UID	Context Identifier	Context Group Name
1.2.840.10008.6.1.S147.1	SUP147001	Dosimetric Objective Types
1.2.840.10008.6.1.S147.2	SUP147002	Prescription Anatomy Categories
1.2.840.10008.6.1.S147.3	SUP147003	Radiotherapy Segment Annotation Categories
1.2.840.10008.6.1.S147.4	SUP147004	Radiotherapy Therapeutic Role Categories
1.2.840.10008.6.1.S147.5	SUP147005	RT Geometric Information
1.2.840.10008.6.1.S147.6	SUP147006	Fixation or Positioning Devices
1.2.840.10008.6.1.S147.7	SUP147007	Brachytherapy Devices
1.2.840.10008.6.1.S147.8	SUP147008	External Body Models
1.2.840.10008.6.1.S147.9	SUP147009	Nonspecific Segmentations
1.2.840.10008.6.1.S147.12	SUP147012	General External Radiotherapy Procedure Techniques
1.2.840.10008.6.1.S147.13	SUP147013	Tomotherapeutic Radiotherapy Procedure Techniques
1.2.840.10008.6.1.S147.22	SUP147022	Fixation Devices
1.2.840.10008.6.1.S147.25	SUP147025	RT Patient Support Devices
1.2.840.10008.6.1.S147.31	SUP147031	Radiotherapy Bolus Device Types
1.2.840.10008.6.1.S147.32	SUP147032	Radiotherapy Block Device Types
1.2.840.10008.6.1.S147.33	SUP147033	Radiotherapy Accessory No-Slot Holder Device Types
1.2.840.10008.6.1.S147.34	SUP147034	Radiotherapy Accessory Slot Holder Device Types
1.2.840.10008.6.1.S147.40	SUP147040	Segmented RT Accessory Devices
1.2.840.10008.6.1.S147.42	SUP147042	Energy Unit
1.2.840.10008.6.1.S147.45	SUP147045	Multi-Source Radiotherapy Procedure Techniques
1.2.840.10008.6.1.S147.46	SUP147046	Robotic Radiotherapy Procedure Techniques
1.2.840.10008.6.1.S147.47	SUP147047	Radiotherapy Procedure Techniques
1.2.840.10008.6.1.S147.52	SUP147052	Radiation Therapy Particle

1.2.840.10008.6.1.S147.53	SUP147053	Ion Therapy Particle
1.2.840.10008.6.1.S147.56	SUP147056	Teletherapy Isotope
1.2.840.10008.6.1.S147.57	SUP147057	Brachytherapy Isotope
1.2.840.10008.6.1.S147.60	SUP147060	Single Dose Dosimetric Objectives
1.2.840.10008.6.1.S147.61	SUP147061	Percentage and Dose Dosimetric Objectives
1.2.840.10008.6.1.S147.62	SUP147062	Volume and Dose Dosimetric Objectives
1.2.840.10008.6.1.S147.64	SUP147064	No-Parameter Dosimetric Objectives
1.2.840.10008.6.1.S147.68	SUP147068	Delivery Time Structure
1.2.840.10008.6.1.S147.70	SUP147070	Radiotherapy Targets
1.2.840.10008.6.1.S147.71	SUP147071	Radiotherapy Dose Calculation Roles
1.2.840.10008.6.1.S147.80	SUP147080	Effective Dose Calculation Categories
1.2.840.10008.6.1.S147.81	SUP147081	Radiation Transport-Based Effective Dose Method Modifiers
1.2.840.10008.6.1.S147.82	SUP147082	Fractionation-Based Effective Dose Method Modifers

Part 16 Addendum

Add the following new CIDs to PS3.16, Annex B:

ANNEX B DCMR CONTEXT GROUPS (NORMATIVE)

CID SUP147001 DOSIMETRIC OBJECTIVE TYPES

Context ID SUP147001

Dosimetric Objective Types

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
Include CID SUP147064 "No-Parameter Dosimetric Objectives"		
Include CID SUP147060 "Single Dose Dosimetric Objectives"		
Include CID SUP147061 "Percentage and Dose Dosimetric Objectives"		
Include CID SUP147062 "Volume and Dose Dosimetric Objectives"		
99SUP147	S147120	Specified Conformity Index
99SUP147	S147121	Specified Healthy Tissue Conformity Index
99SUP147	S147122	Specified Conformation Number
99SUP147	S147123	Specified Homogeneity Index

CID SUP147002 PRESCRIPTION ANATOMY CATEGORIES

Context ID SUP147002

Prescription Anatomy Categories

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	T-D000A	Anatomical Structure	91723000	
99SUP147	S147059	External Body Model		
SRT	A-00004	Physical Object	260787004	
99SUP147	S147057	Nonspecific Segments		

CID SUP147003 RADIOTHERAPY SEGMENT ANNOTATION CATEGORIES

Context ID SUP147003

Radiotherapy Segment Annotation Categories

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147050	RT Target
99SUP147	S147051	RT Dose Calculation Structure
99SUP147	S147053	RT Geometric Information
99SUP147	S147059	External Body Model
99SUP147	S147054	Fixation or Positioning Device
99SUP147	S147055	Brachytherapy Device
SRT	A-00004	Physical Object
99SUP147	S147057	Nonobject Segmentations

CID SUP147004 RADIOTHERAPY THERAPEUTIC ROLE CATEGORIES

Context ID SUP147004

Radiotherapy Therapeutic Role Categories

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147050	RT Target
99SUP147	S147051	RT Dose Calculation Structure

CID SUP147005 RT GEOMETRIC INFORMATION

Context ID SUP147005

RT Geometric Information

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147100	Patient Setup Point
99SUP147	S147101	Room Laser Patient Setup Point
99SUP147	S147102	Moveable Laser Patient Setup Point
99SUP147	S147104	Reference Acquisition Point
99SUP147	S147105	Isocentric Treatment Location Point

CID SUP147006 FIXATION OR POSITIONING DEVICES

Context ID SUP147006

Fixation or Positioning Devices

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
Include CID SUP147022 "Fixation Devices"		
Include CID SUP147025 "RT Patient Support Devices"		

CID SUP147007 BRACHYTHERAPY DEVICES

Context ID SUP147007

Brachytherapy Devices

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147131	Brachytherapy source applicator
99SUP147	S147132	Brachytherapy channel shield
99SUP147	S147133	Brachytherapy channel

CID SUP147008 EXTERNAL BODY MODELS

Context ID SUP147008

External Body Models

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147090	Patient Anatomy Model
99SUP147	S147091	Extended Patient Anatomy Model

CID SUP147009 NONSPECIFIC VOLUMES

Context ID SUP147009

Nonspecific Volumes (TODO)

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147060	Arbitrary Volume Segment
99SUP147	S147145	Segment Combination

CID SUP147012 GENERAL EXTERNAL RADIOTHERAPY PROCEDURE TECHNIQUES

Context ID SUP147012

General External Radiotherapy Procedure Techniques

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147221	Static Beam
99SUP147	S147225	Arc Beam
99SUP147	S147226	Conformal Arc Beam
99SUP147	S147227	Step and Shoot Beam
99SUP147	S147228	Sliding Window Beam
99SUP147	S147229	VMAT

CID SUP147013 TOMOTHERAPEUTIC RADIOTHERAPY PROCEDURE TECHNIQUES

Context ID SUP147013

Tomotherapeutic Radiotherapy Procedure Techniques

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147240	Helical Beam
99SUP147	S147241	Topographic Beam

CID SUP147022 FIXATION DEVICES

Context ID SUP147022

Fixation Devices

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	A-01105	Bite block	228745001	
99SUP147	S147341	Headframe		
99SUP147	S147342	Head Mask		
99SUP147	S147343	Head and Neck Mask		
99SUP147	S147344	Mold		
99SUP147	S147345	Cast		
99SUP147	S147346	Headrest		
99SUP147	S147347	Breast Board		
99SUP147	S147348	Body Frame		
99SUP147	S147349	Vacuum Mold		
99SUP147	S147350	Whole Body Pod		
99SUP147	S147351	Rectal Balloon		
99SUP147	S147353	Vaginal Cylinder		

CID SUP147025 RT PATIENT SUPPORT DEVICES

Context ID SUP147025

RT Patient Support Devices

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	A-17350	Table	86407004	
99SUP147	S147411	Chair		

CID SUP147031 RADIOTHERAPY BOLUS DEVICE TYPES

Context ID SUP147031

Radiotherapy Bolus Device Types

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	A-010FB	Surface Bolus	228736002	

CID SUP147032 RADIOTHERAPY BLOCK DEVICE TYPES

Context ID SUP147032

Radiotherapy Block Device Types

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	A-010FE	Shielding Block	228739009	
99SUP147	S147471	Aperture Block		

CID SUP147033 RADIOTHERAPY ACCESSORY NO-SLOT HOLDER DEVICE TYPES

Context ID SUP147033

Radiotherapy Accessory No-Slot Holder Device Types

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147480	Accessory Tray

CID SUP147034 RADIOTHERAPY ACCESSORY SLOT HOLDER DEVICE TYPES

Context ID SUP147034

Radiotherapy Accessory Slot Holder Device Types

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147481	Radiotherapy Applicator

CID SUP147040 SEGMENTED RT ACCESSORY DEVICES

Context ID SUP147040

Segmented RT Accessory Devices

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
Include CID SUP147022 "Fixation Devices"		
Include CID SUP147007 "Brachytherapy Devices"		
Include CID SUP147025 "RT Patient Support Devices"		
Include CID SUP147031 "Radiotherapy Bolus Device Types"		
Include CID SUP147032 "Radiotherapy Block Device Types"		
Include CID SUP147033 "Radiotherapy Accessory No-Slot Holder Device Types"		
Include CID SUP147034 "Radiotherapy Accessory Slot Holder Device Types"		

CID SUP147042 ENERGY UNIT

Context ID SUP147042

Energy Unit

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
UCUM	MV	Megavolt
UCUM	MeV	Megaelectronvolt
UCUM	kV	Kilovolt

CID SUP147045 MULTI-SOURCE RADIOTHERAPY PROCEDURE TECHNIQUES

Context ID SUP147045

Multi-Source Radiotherapy Procedure Techniques

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147900	Multiple Fixed Sources

CID SUP147046 ROBOTIC RADIOTHERAPY PROCEDURE TECHNIQUES

Context ID SUP147046

Robotic Radiotherapy Procedure Techniques

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147910	Synchronized Robotic Treatment
99SUP147	S147911	Non-Synchronized Robotic Treatment

CID SUP147047 RADIOTHERAPY PROCEDURE TECHNIQUES

Context ID SUP147047

Radiotherapy Procedure Techniques

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
Include CID SUP147012 "General External Radiotherapy Procedure Techniques"		
Include CID SUP147013 "Tomotherapeutic Radiotherapy Procedure Techniques"		
Include CID SUP147045 "Multi-Source Radiotherapy Procedure Techniques"		
Include CID SUP147046 "Robotic Radiotherapy Procedure Techniques"		

CID SUP147052 RADIATION THERAPY PARTICLE

Context ID SUP147052

Radiation Therapy Particle

Type: Non-Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	F-61790	Photon	290006006	
SRT	C-10004	Electron	46602004	

CID SUP147053 ION THERAPY PARTICLE

Context ID SUP147053

Ion Therapy Particle

Type: Non-Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	C-10001	Ion		
SRT	C-10005	Proton	89177007	
99SUP147	S147951	Helium-3		
99SUP147	S147952	Helium-4		
99SUP147	S147953	Carbon-12		
99SUP147	S147954	Oxygen-16		

CID SUP147056 TELETHERAPY ISOTOPE

Context ID SUP147056

Teletherapy Isotope

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	C-144A6	^60^Cobalt	5405008	

CID SUP147057 BRACHYTHERAPY ISOTOPE

Context ID SUP147057

Brachytherapy Isotope

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	C-142B2	^137^Cesium	55117002	
SRT	C-142A5	^131^Cesium	13237009	
SRT	C-151B2	^192^Iridium	48341001	
SRT	C-114A6	^125^Iodine	68630002	
SRT	C-160A3	^103^Palladium	9351000	
SRT	C-124B4	^252^Californium	35978008	
SRT	C-144A6	^60^Cobalt	5405008	
SRT	C-136A5	^226^Radium	28243009	
SRT	C-162A7	^90^Yttrium	14691008	
SRT	C-146A9	^198^Gold	24301009	
SRT	C-106A1	^32^Phosphorus	32505007	
SRT	C-136B6	^222^Radon	51800004	
SRT	C-158A7	^90^Strontium	14071002	

SRT	C-180A5	^106^Ruthenium	8227001	
SRT	C-181A3	^169^Ytterbium	41758004	

CID SUP147060 SINGLE DOSE DOSIMETRIC OBJECTIVES

Context ID SUP147060

Single Dose Dosimetric Objectives

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147001	Minimum Surface Radiation Dose
99SUP147	S147002	Maximum Surface Radiation Dose
99SUP147	S147003	Minimum Radiation Dose
99SUP147	S147004	Maximum Radiation Dose
99SUP147	S147005	Minimum Mean Radiation Dose
99SUP147	S147006	Maximum Mean Radiation Dose
99SUP147	S147007	Minimum Equivalent Uniform Dose
99SUP147	S147008	Maximum Equivalent Uniform Dose
99SUP147	S147009	Prescription Radiation Dose

CID SUP147061 PERCENTAGE AND DOSE DOSIMETRIC OBJECTIVES

Context ID SUP147061

Percentage and Dose Dosimetric Objectives

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147014	Minimum Percent Volume at Radiation Dose
99SUP147	S147015	Maximum Percent Volume at Radiation Dose

CID SUP147062 VOLUME AND DOSE DOSIMETRIC OBJECTIVES

Context ID SUP147062

Volume and Dose Dosimetric Objectives

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147016	Minimum Absolute Volume at Radiation Dose
99SUP147	S147017	Maximum Absolute Volume at Radiation Dose

CID SUP147064 NO-PARAMETER DOSIMETRIC OBJECTIVES

Context ID SUP147064

No-Parameter Dosimetric Objectives

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147018	Minimize Meterset

CID SUP147068 DELIVERY TIME STRUCTURE

Context ID SUP147068

Delivery Time Structure

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147180	Single Fraction
99SUP147	S147181	Standard Fractionation
99SUP147	S147182	Hypo-fractionation
99SUP147	S147183	Hyper-fractionation
99SUP147	S147184	Continuous Temporary
99SUP147	S147185	Continuous Permanent

CID SUP147070 RADIOTHERAPY TARGETS

Context ID SUP147070

Radiotherapy Targets

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	SNOMED-CT Concept ID	UMLS Concept Unique ID
99SUP147	S147070	CTV Nodal		
99SUP147	S147071	CTV Primary		
SRT	R-429EB	CTV	228792002	
99SUP147	S147073	GTV Nodal		
99SUP147	S147074	GTV Primary		
SRT	R-429E0	GTV	228791009	
99SUP147	S147076	PTV Nodal		
99SUP147	S147077	PTV Primary		
SRT	R-429EC	PTV	228793007	
99SUP147	S147079	ITV		

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	SNOMED-CT Concept ID	UMLS Concept Unique ID
99SUP147	S147082	Treated Volume		
SRT	R-429DF	Irradiated Volume	228790005	
99SUP147	S147078	Entire Body as Target		
99SUP147	S147086	Radiation Dose Normalization Point		
99SUP147	S147087	Radiation Dose Reference Point		

CID SUP147071 RADIOTHERAPY DOSE CALCULATION ROLES

Context ID SUP147071

Radiotherapy Dose Calculation Roles

Type: Extensible Version: 20170224

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147080	Planning Organ At Risk Volume
99SUP147	S147081	Avoidance Volume
99SUP147	S147083	Organ At Risk
99SUP147	S147084	Radiation Dose Shaping Volume
99SUP147	S147085	Conformality Shell
99SUP147	S147088	Dose Calculation Bounding Volume
99SUP147	S147089	Radiation Interaction Volume

CID SUP147080 EFFECTIVE DOSE CALCULATION CATEGORIES

Context ID SUP147080

Effective Dose Calculation Method Categories

Type: Extensible Version: yyyymmdd

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147500	Radiation transport-based method
99SUP147	S147501	Fractionation-based or temporally-based method

CID SUP147081 RADIATION TRANSPORT-BASED EFFECTIVE DOSE METHOD MODIFIERS

Context ID SUP147081

Radiation Transport-Based Effective Dose Method Modifiers

Type: Extensible Version: yyyymmdd

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147510	LEM - Local Effect Model
99SUP147	S147511	MKM - Microdosimetric Kinetic Model

CID SUP147082 FRACTIONATION-BASED EFFECTIVE DOSE METHOD MODIFIERS

Context ID SUP147082

Fractionation-Based Effective Dose Method Modifers

Type: Extensible Version: yyyymmdd

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP147	S147520	Equivalent 2-Gray Fractions
99SUP147	S147521	Linear-Quadratic Model
99SUP147	S147522	Linear-Quadratic Model with Time Factor
99SUP147	S147523	Linear-Quadratic-Linear Model
99SUP147	S147524	Linear-Quadratic Model for Low-Dose Rate Brachytherapy

CID 7157 DEVICE SEGMENTATION TYPES

Context ID 7151

Type: Extensible

Version: 20170224

Device Segmentation Types

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	SNOMED-CT Concept ID	UMLS Concept Unique ID
Include CID SUP147006 "Fixation or Positioning Devices"				
Include CID SUP147007 "Brachytherapy Devices"				
SRT	A-12024	Bone Pin	77444004	C0175718
SRT	A-12030	Bone Screw	68183006	C0005975
SRT	A-11100	Cardiac Pacemaker	14106009	C0030163
SRT	A-11206	Defibrillator	72506001	C0162589
SRT	A-04200	Dental Prosthesis	27606000	C0162686
SRT	A-04036	Inlay Dental Restoration	272287005	C0441351
SRT	A-11FCD	Left ventricular assist device	360066001	C0181598
SRT	A-30360	Needle	79068005	C0027551
SRT	A-04034	Radioactive implant	19443004	C0521196

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	A-25500	Stent	65818007	C0038257

1362

1363

Add the following templates to PS3.16, Annex C:

ANNEX C ACQUISITION AND PROTOCOL CONTEXT TEMPLATES (NORMATIVE)

TID SUP147001 RT PRESCRIPTION ANNOTATION

The concepts in this TID are topics of advice or information provided by the prescribing physician for planning, preparation and delivery of treatment for a prescription.

TID SUP147001

RT Prescription Annotation

Type: Extensible Order: Non-Significant

	Value Type	Concept Name	VM	Req Type	Condition	Value Set Constraint
1	TEXT	EV (S147030, 99SUP147, "Radiation Description")	1	U		
2	TEXT	EV (S147031, 99SUP147, "Beam Shaping Note")	1	U		
3	TEXT	EV (S147032, 99SUP147, "Treatment Planning Note")	1	U		
4	TEXT	EV (S147033, 99SUP147, "Special Procedure Note")	1	U		
5	TEXT	EV (S147034, 99SUP147, "Patient Positioning Note")	1	U		
6	TEXT	EV (S147036, 99SUP147, "Patient Setup Note")	1	U		
7	TEXT	EV (S147037, 99SUP147, "Previous Treatment Note")	1	U		
8	TEXT	EV (S147038, 99SUP147, "Planning Imaging Note")	1	U		
9	TEXT	EV (S147039, 99SUP147, "Delivery Verification Note")	1	U		
10	TEXT	EV (S147040, 99SUP147, "Simulation Note")	1	U		
11	CODE	DT (S147041, 99SUP147, "Radiation Therapy Particle")	1-n	U		BCID (SUP147052) Radiation Therapy Particle
12	CODE	DT (S147045, 99SUP147, "Ion Therapy Particle")	1-n	U		BCID (SUP147053) Ion Therapy Particle
13	CODE	DT (S147046, 99SUP147, "Brachytherapy Isotope")	1-n	U		BCID (SUP147057) Brachytherapy Isotope
14	CODE	DT (S147048, 99SUP147, "Teletherapy Isotope")	1-n	U		BCID (SUP147056) Teletherapy Isotope
15	NUMERIC	DT (S147042, 99SUP147, "RT Beam Energy")	1-n	U		UNITS=DCID (SUP147042) Energy Unit
16	CODE	DT (S147043, 99SUP147, "Patient Positioning Procedure")	1-n	U		BCID (9242) Radiotherapy Acquisition Workitem

						Definition
17	TEXT	EV (S147044, 99SUP147, “QA Process Note”)	1	U		
18	TEXT	EV (S147035, 99SUP147, “4D Radiation Treatment Note”)	1	U		
19	TEXT	EV (S147047, 99SUP147, “Adaptive Radiation Therapy Note”)	1	U		

Content Item Descriptions

Row 11, 12, 13, 14	The source of radiation to be used for this RT treatment. More than one source indicates that the RT treatment may use any combination for treatment. There is no defined relationship between the entries in Row 11, 12, 13, 14 and entries in the Rows 15 and 16.
Row 15	Includiing several energies indicates that they may be used in any combination.
Row 16	The codes identify procedures supporting the patient positioning process prior to RT treatment. Includiing several procedures indicates that they may be used in any combination.

TID SUP147003 RT SEGMENT ANNOTATION PROPERTIES

TID SUP147003

RT Segment Annotation Properties

Type: Extensible Order: Non-Significant

	Value Type	Concept Name	VM	Req Type	Condition	Value Set Constraint
1	NUMERIC	EV (S147150, 99SUP147, “Relative Mass Density”)	1	U		Units = EV (ratio, UCUM, "ratio")
2	NUMERIC	EV (S147151, 99SUP147, "Relative Electron Density")	1	U		Units = EV (ratio, UCUM, "ratio")
3	NUMERIC	EV (S147152, 99SUP147, "Effective Z")	1	U		Units = EV (1, UCUM, "no units")
4	NUMERIC	EV (S147153, 99SUP147, "Effective Z per A")	1	U		Units = EV (u^{-1}, UCUM, " u^{-1}")
5	NUMERIC	EV (S147154, 99SUP147, "Relative Linear Stopping Power")	1	U		Units = EV (ratio, UCUM, "ratio")
6	NUMERIC	EV (S147156, 99SUP147, "Linear Cell Kill Factor")	1	U		Units = EV (ratio, UCUM, "ratio")
7	NUMERIC	EV (S147157, 99SUP147, "Quadratic Cell Kill Factor")	1	U		Units = EV (ratio, UCUM, "ratio")
8	NUMERIC	EV (S147158, 99SUP147, "High Dose Fraction Linear Cell Kill Factor")	1	U		Units = EV (ratio, UCUM, "ratio")
9	NUMERIC	EV (S147159, 99SUP147, "Half-time for Tissue Repair ")	1	U		Units = EV (s, UCUM, "second")
10	NUMERIC	EV (S147160, 99SUP147, "High	1	U		Units = EV (Gy, UCUM,

		Dose Fraction Transition Dose")				"Gray")
11	NUMERIC	EV (S147161, 99SUP147, "Atomic Number")	1-n	U		Units = EV (1, UCUM, "no units")
12	NUMERIC	EV (S147163, 99SUP147, "alpha gEUD value")	1	U		Units = EV (ratio, UCUM, "ratio")

1380

1381

Add the following to the table in PS3.16, Annex D:

ANNEX D DICOM CONTROLLED TERMINOLOGY DEFINITIONS (NORMATIVE)

Code Value	Code Meaning	Definition	Notes
S147001	Minimum Surface Radiation Dose	An objective to achieve a radiation dose which is greater than or equal to the specified radiation dose at the surface of a volume.	
S147002	Maximum Surface Radiation Dose	An objective to achieve a radiation dose which is less than or equal to the specified radiation dose at the surface of a volume.	
S147003	Minimum Radiation Dose	An objective to achieve a radiation dose which is greater than or equal to the specified radiation dose throughout a volume.	
S147004	Maximum Radiation Dose	An objective to achieve a radiation dose which is less than or equal to the specified radiation dose throughout a volume.	
S147005	Minimum Mean Radiation Dose	An objective to achieve a mean radiation dose over the volume which is greater than or equal to the specified radiation dose.	
S147006	Maximum Mean Radiation Dose	An objective to achieve a mean radiation dose over the volume which is less than or equal to the specified radiation dose.	
S147007	Minimum Equivalent Uniform Dose	An objective to achieve an equivalent uniform dose (EUD) which is greater than or equal to the specified radiation dose.	
S147008	Maximum Equivalent Uniform Dose	An objective to achieve an equivalent uniform dose (EUD) which is less than or equal to the specified radiation dose.	
S147009	Prescription Radiation Dose	An objective to achieve a radiation dose which is equal to the specified radiation dose throughout the volume.	
S147010	Minimum Conformity Index	An objective to achieve a conformity index which is greater than or equal to the specified conformity index for a radiation dose which is equal to the specified radiation dose throughout the volume. Minimum Conformity Index as defined in [FEUVRET], page 335.	
S147011	Minimum Healthy Tissue Conformity Index	An objective to achieve a healthy tissue conformity index which is greater than or equal to the specified healthy tissue conformity index for a radiation dose which is equal to the specified radiation dose throughout the volume. Minimum Healthy Tissue Conformity Index as defined in [FEUVRET], page 335.	

Code Value	Code Meaning	Definition	Notes
S147012	Minimum Conformation Number	An objective to achieve a conformation number greater which is than or equal to the specified conformation number greater for a radiation dose which is equal to the specified radiation dose throughout the volume. Minimum Conformation Number as defined in [FEUVRET], page 335.	
S147013	Maximum Homogeneity Index	An objective to achieve a homogeneity index which is less than or equal to the specified homogenity index for a radiation dose which is equal to the specified radiation dose throughout the volume. Maximum Homogeneity Index as defined in [FEUVRET], page 335.	
S147014	Minimum Percent Volume at Radiation Dose	An objective to achieve a radiation dose which is greater than or equal to the specified radiation dose for at least a specified volume percentage.	
S147015	Maximum Percent Volume at Radiation Dose	An objective to achieve a radiation dose which is less than or equal to the specified radiation dose for at least a specified volume percentage.	
S147016	Minimum Absolute Volume at Radiation Dose	An objective to achieve a radiation dose which is greater than or equal to the specified radiation dose for at least a specified volume size.	
S147017	Maximum Absolute Volume at Radiation Dose	An objective to achieve a radiation dose which is less than or equal to the specified radiation dose for at least a specified volume size.	
S147018	Minimize Meterset	An objective to minimize the total meterset.	
S147025	Specified Radiation Dose	The radiation dose value for a Dosimetric Objective.	
S147026	Specified Volume Size	The specified volume size of an anatomical region in a Dosimetric Objective.	
S147027	Specified Volume Percentage	The percentage which represents a fractional parameter used by a Dosimetric Objective.	
S147030	Radiation Description	Free text note describing characteristics of the radiation.	
S147031	Beam Shaping Note	Free text note describing the devices and techniques used to shape the radiation beam.	
S147032	Treatment Planning Note	Free text note to describe suggestions or advices to treatment planning.	
S147033	Special Procedure Note	Free text note describing additional activities that address individual patient needs.	
S147034	Patient Positioning Note	Free text note describing the process to position the patient for the procedure.	

Code Value	Code Meaning	Definition	Notes
S147035	4D Radiation Treatment Note	Free text note describing management of patient motion during the radiation treatment.	
S147036	Patient Setup Note	Free text note describing the setup of the patient on the patient support device(s).	
S147037	Previous Treatment Note	Free text note describing previously delivered treatments.	
S147038	Planning Imaging Note	Free text note describing the intended use of images for planning.	
S147039	Delivery Verification Note	Free text note describing how delivery is to be verified.	
S147040	Simulation Note	Free text note describing preferred simulation procedures.	
S147041	Radiation Therapy Particle	Particle used for Radiotherapy treatment.	
S147042	RT Beam Energy	Energy of the Radiotherapy treatment beam.	
S147043	Patient Positioning Procedure	Free text note describing the procedure for acquiring and applying information about patient position.	
S147044	QA Process Note	Free text note describing the Quality Assurance Process for the treatment of the patient.	
S147045	Ion Therapy Particle	Particle for a radiotherapeutic treatment using beams of energetic protons, positive ions or other particles.	
S147046	Brachytherapy Isotope	Isotope for a radiotherapeutic treatment where a decaying radiation source is placed inside or next to a target area, called Brachytherapy.	
S147047	Adaptive Radiation Therapy Note	Free text note describing how adaptive radiotherapy is to be performed.	
S147048	Teletherapy Isotope	Isotope for a radiotherapeutic treatment where a decaying radiation source is placed outside the body.	
S147050	RT Target	Volume containing tissues to be irradiated to a specified radiation dose, typically encompassing a tumor, and possibly including surrounding subclinical disease, and margin(s) to account for uncertainties in patient positioning and organ motion.	
S147051	RT Dose Calculation Structure	Non-target structure or volume used when calculating the radiation dose, e.g. during an optimzation process. This may be a structure whose proximity to the target and/or radiosensitivity restrict the radiation dose deliverable to the target.	
S147053	RT Geometric Information	Points or volumes used as spatial references, e.g., treatment or imaging device isocenter or fiducial markers.	

Code Value	Code Meaning	Definition	Notes
S147054	Fixation or Positioning Device	Device used to reproducibly position or limit the motion of a patient or portion of a patient during treatment.	
S147055	Brachytherapy Device	Device used to deliver Brachtherapy treatments. This includes both devices containing radioactive sources (seeds, eye plaques) and devices used to position radioactive sources (source applicators, channels etc.).	
S147057	Non-specific Volume (TODO rename)	A volume that does not represent a named physical entity.	
S147059	External Body Structure	A segment representing the external shape of the patient body used in radiotherapeutic procedures.	
S147060	Unclassified Volume (TODO rename)	A volume that does not correspond to an identifiable physical entity and has user specified boundaries.	
S147070	CTV Nodal	Clinical Target Volume encompassing diseased lymph node(s), with margin to include surrounding sub-clinical disease. See [ICRU Report 50].	
S147071	CTV Primary	Clinical Target Volume encompassing primary tumor(s), with margin to include surrounding sub-clinical disease. See [ICRU Report 50].	
S147073	GTV Nodal	Gross Tumor Volume encompassing diseased lymph nodes. See [ICRU Report 50].	
S147074	GTV Primary	Gross Tumor Volume encompassing primary tumor(s). See [ICRU Report 50].	
S147076	PTV Nodal	Planning Target Volume encompassing a nodal CTV, with margin to account for uncertainty in patient positioning and organ motion. See [ICRU Report 50].	
S147077	PTV Primary	Planning Target Volume encompassing a primary CTV, with margin to account for uncertainty in patient positioning and organ motion. See [ICRU Report 50].	
S147078	Entire Body as Target	Entire Body as a target for radiotherapy treatment. The usual term for a treatment technique irradiating this target is Full Body Irradiation.	
S147079	ITV	Internal Target Volume encompassing the CTV, with margin to account for internal motion, often delineated using multiple images, e.g., acquired over a breathing cycle, cardiac cycle, etc. See [ICRU Report 50].	

Code Value	Code Meaning	Definition	Notes
S147080	Planning Organ At Risk Volume	Volume encompassing the Organ At Risk (Planning organ at Risk Volume) with margin to account for uncertainty in patient positioning and organ motion. See [ICRU Report 50].	
S147081	Avoidance Volume	Volume to which delivered radiation dose should be minimized or limited. See [ICRU Report 50].	
S147082	Treated Volume	Volume enclosed by an isodose surface appropriate to achieve the purpose of treatment (e.g., tumor eradication or palliation). See [ICRU Report 50].	
S147083	Organ At Risk	Normal tissue that receives undesired radiation and may be damaged by the radiation treatment. The treatment is typically planned to limit the radiation dose to such an organ. See [ICRU Report 50].	
S147084	Radiation Dose Shaping Volume	A volume used to express dosimetric constraints for shaping the radiation dose distribution.	
S147085	Conformality Shell	A volume surrounding the target to achive a high radiation dose gradient using a low radiation dose constraint.	
S147086	Radiation Dose Normalization Point	A point for which a specific radiation dose value is chosen. The rest of the radiation dose distribution is normalized against this value.	
S147087	Radiation Dose Reference Point	A point at which the radiation dose is observed.	
S147088	Dose Calculation Bounding Volume	Volume for which radiation dose is calculated.	
S147089	Radiation Interaction Volume	Volume in which the interaction of radiation with matter is taken into account.	
S147090	Patient Anatomy Model	The external boundary of patient tissue without additional devices.	
S147091	Extended Patient Anatomy Model	The external boundary of patient tissue plus devices that may be attached or adjacent to the body (such as Bolus, Patient Positioning Devices, Patient Immobilization Devices).	
S147100	Patient Setup Point	Point at which the patient is initially positioned prior to any other positioning procedure.	
S147101	Room Laser Patient Setup Point	A reference point used for patient setup based on room lasers.	
S147102	Moveable Laser Patient Setup Point	A reference point used for patient setup based on movable lasers.	

Code Value	Code Meaning	Definition	Notes
S147104	Reference Acquisition Point	A reference point at which patient position verification references are acquired.	
S147105	Isocentric Treatment Location Point	A point representing the machine isocenter for isocentric devices.	
S147120	Specified Conformity Index	The Conformity Index for a Dosimetric Objective. See [FEUVRET], page 335.	
S147121	Specified Healthy Tissue Conformity Index	The Healthy Tissue Conformity Index for a Dosimetric Objective. See [FEUVRET], page 335.	
S147122	Specified Conformation Number	The Conformation Number for a Dosimetric Objective. See [FEUVRET], page 335.	
S147123	Specified Homogeneity Index	The Homogeneity Index for a Dosimetric Objective. See [FEUVRET], page 335.	
S147131	Brachytherapy Source Applicator	Source applicator used in brachytherapy treatment delivery	
S147132	Brachytherapy Channel Shield	Channel shield used in brachytherapy treatment delivery	
S147133	Brachytherapy Channel	Channel device used in brachytherapy treatment delivery	
S147145	Unclassified Combination (TODO rename)	A logical combination of two or more volumes for which the combination is not classified.	
S147150	Relative Mass Density	Ratio of the mass density of a material relative to the mass density of water.	
S147151	Relative Electron Density	Ratio of the electron density of a material relative to the electron density of water.	
S147152	Effective Z	The average atomic number of a material.	
S147153	Effective Z per A	Ratio of effective atomic number to mass (AMU^{-1}) for a material.	
S147154	Relative Linear Stopping Power	Ratio of the linear stopping power of a material to the linear stopping power of water.	
S147156	Linear Cell Kill Factor	Linear Cell Kill Factor (α) as defined in J. Deacon et al (Rad. Onc 2(4): 317-323, 1984), page 318-	
S147157	Quadratic Cell Kill Factor	Quadratic Cell Kill Factor (β) as defined in J. Deacon et al (Rad. Onc 2(4): 317-323, 1984), page 318.	
S147158	High Dose Fraction Linear Cell Kill Factor	High Dose Fraction Linear Cell Kill Factor (γ) as defined in Frederick W. McKenna et (J. Med. Phys, 36(2): 100–106, 2011), page 102.	
S147159	Half-time for Tissue Repair	Half-time for Tissue Repair as defined in R Singh R, et al. (Medical Dosimetry 28(4): 225-259, 2003), page 256.	

Code Value	Code Meaning	Definition	Notes
S147160	High Dose Fraction Transition Dose	High Dose Fraction Transition Dose as defined in Astrahan, M. (Med. Phys., 35(9): 4161–4172, 2008), page 4164.	
S147161	Atomic Number	The atomic number of an element.	
S147162	Elemental Composition Atomic Mass Fraction	The fractional weight of the element in a compound.	
S147163	αlpha gEUD Value	Tissue-specific parameter that describes the volume effect of radiation dose delivered to a volume. See AAPM Report 166 (http://www.aapm.org/pubs/reports/RPT_166.pdf) for additional information.	
S147180	Single Fraction	A treatment consisting of a single treatment fraction, e.g. for stereotactic treatments.	
S147181	Standard Fractionation	A treatment consisting of a one treatment fraction per day, typically 1.8-2.0Gy per treatment fraction.	
S147182	Hypo-fractionation	A treatment consisting of a reduced number of treatment fractions relative to a standard fractionation, typically with a higher radiation dose per fraction.	
S147183	Hyper-fractionation	A treatment consisting of an increased number of fractions relative to a standard fractionation, typically two per day with smaller radiation dose per fraction.	
S147184	Continuous Temporary	A treatment consisting of a continuous delivery using a temporary implant.	
S147185	Continuous Permanent	A treatment consisting of a continuous delivery using a permanent implant.	
S147221	Static Beam	A treatment technique in which the field shape and the source position do not change during delivery.	
S147225	Arc Beam	A treatment technique in which the field shape does not change during delivery while the source position follows an arc.	
S147226	Conformal Arc Beam	A treatment technique in which the field shape changes during delivery while the source position follows an arc.	
S147227	Step and Shoot Beam	A treatment technique in which the field shape does not change during an exposure. Several field shapes may be used in different exposures at the same source position.	
S147228	Sliding Window Beam	A treatment technique in which the field shape continously changes during an exposure at the same source position.	
S147229	VMAT	A treatment technique in which the field shape, gantry speed and radiation dose rate changes during delivery while the source position follows an arc.	

Code Value	Code Meaning	Definition	Notes
S147240	Helical Beam	A treatment technique in which the field shape continously changes during delivery while the source position follows a continous arc in parallel to a simultaneous patient support movement.	
S147241	Topographic Beam	A treatment technique in which the field shape and the source position do not change during delivery while the patient support is moving.	
S147341	Headframe	A device attached to the tabletop that is also screwed into the skull of the patient's head to position and orient the head in a prescribed geometry relative to the tabletop. The device is commonly known as a "halo".	
S147342	Head Mask	A device that is placed over the patient's face and attached to the tabletop to prevent the patient from moving relative to the tabletop.	
S147343	Head and Neck Mask	A device that is placed over the patient's face and neck and attached to the tabletop to prevent the patient from moving relative to the tabletop.	
S147344	Mold	A device that is modified by pressure (molded) to fit another object (such as the patient's anatomy) and then used to control the reproducibility of the patient's treatment position.	
S147345	Cast	A device that is fabricated from a mold of another object (like the patient's anatomy) and then used to control the reproducibility of the patient's treatment position.	
S147346	Headrest	A device placed beneath a patient to support the head in a prescribed position and orientation relative to the table top.	
S147347	Breast Board	A device placed on the tabletop to support the chest and arms of a patient in a prescribed position and orientation.	
S147348	Body Frame	A device placed beneath a patient to support the whole body in a prescribed position and orientation relative to the table top.	
S147349	Vacuum Mold	A device placed beneath a patient to support a body part in a prescribed position and orientation relative to the table top. It is commonly a bag containing low density polystyrene spheres that becomes semi-hard when vacuum is applied conforming to the bottom surface of the patient.	

Code Value	Code Meaning	Definition	Notes
S147350	Whole Body Pod	A device placed beneath a patient to support the whole body in a prescribed position and orientation relative to the table top. It is commonly shaped like a hollow half cylinder. The space between the patient and the wall is commonly filled with a dual component foam that hardens conforming to the bottom surface of the patient.	
S147351	Rectal Balloon	A flexible fluid container inserted into the rectum to maintain an immovable geometry during treatment.	
S147353	Vaginal Cylinder	An intracavity cylinder inserted into the vagina to achieve greater radiation dose control and radiation dose shaping. Radioactive sources are inserted into the cylinder for treatment.	
S147411	Chair	A device placed beneath a patient to support the patient in seated position.	
S147471	Aperture Block	A device, typically made of a low temperature alloy, such as Lipowitz's metal, that provides an opening in a beam block with constant attenuation across an area of the beam to prevent or reduce radiation dose delivery to normal tissues.	
S147480	Accessory Tray	A device placed into a machine slot or an applicator to which accessories are attached.	
S147481	Radiotherapy Applicator	A device placed into a radiotherapy machine slot which provide slot to add other devices and/or to limit the beam.	
S147500	Radiation transport-based method	~~A Radiation Transport–based method has been used to incorporate the Relative Biological Effectiveness based on the quality of the radiation used.~~ A radiation transport–based method has been used to predict the Relative Biological Effectiveness of an ion beam based on the quality of the radiation used. [Wambersie A, RBE, reference RBE and clinical RBE: Applications of these concepts in hadron therapy, Strahlentherapie und Onkologie 1999 June, 175(2): 39-43] [Paganetti H, et al., Relative biological effectiveness (RBE) values for proton beam therapy, Int J Rad. Onc Biol Phys, 2002 June; 53(2): 407-421]	

Code Value	Code Meaning	Definition	Notes
S147501	Fractionation-based or temporally-based method	A Fractionation-based or temporally-based method has been used to assess the Biologically Effective Dose. [Thames HD, Hendry JH. Fractionation in radiotherapy. New York: Taylor & Francis; 1987] [Barendsen, G.W (1982) Dose fractionation, dose rate and iso-effect relationships for normal tissue responses, Int. J. Radiat. Oncol. Biol. Phys. 8 (11): 1981-1997.] ~~(TODO: David claims, that the article is insufficiently defining. Over archiving sentence)~~ ~~[Fowler JF, <TODO Title>, Br J Radiol. 2010 July; 83(991): 554–568]~~	
S147510	LEM - Local Effect Model	~~Local effect model (LEM) for radiation transport~~ The Local Effect Model (LEM) has been used to predict the Relative Biological Effectiveness of dose delivered using ion beams. [Grun, R. Friedrich, T. Elasasser, T. Kramer, M. Zink, K. Karger, C. P. Durante, M. Engenhard-Cabillic, R. Scholz, M. (2012) "Impact of enhancements in the local effect model (LEM) on the predicted RBE-weighted target dose distribution in carbon ion therapy" Physics in Medicine and Biology 57: 7261 - 7274.]	
S147511	MKM - Microdosimetric Kinetic Model	~~Microdosimetric kinetic model (MKM) for radiation transport~~ The Microdosimetric Kinetic Model (MKM) has been used to predict the Relative Biological Effectiveness of dose delivered using ion beams. [Inaniwa, T. Furukawa, T. Kase, Y. Matsufuji, N. Toshito, T. Matsumoto, Y. Furusawa, Y. Node, K. (2010) "Treatment planning for a scanned carbon beam with a modified microdosimetric kinetic model" Physics in Medicine and Biology 55: 6721 - 6737.]	
S147520	Equivalent 2-Gray Fractions	~~Biologically Effective Dose has been converted to equivalent 2 Gy dose fractions~~ The linear quadratic model has been used to compute the equivalent Biologically Effective Dose (BED) delivered in 2 Gy dose fractions. Fowler JF. The linear-quadratic formula and progress in fractionated radiotherapy. Br J Radiol. 1989 Aug; 62 (740): 679–94.	

Code Value	Code Meaning	Definition	Notes
S147521	Linear-Quadratic Model	~~Biologically Effective Dose has been calculated using a Linear-Quadratic dose-response model~~ The linear quadratic model has been used to compute the equivalent Biologically Effective Dose (BED) delivered at an infinitely low dose-rate. [Fowler JF, Br J Radiol. 1989; 62: 679-694]	
S147522	Linear-Quadratic Model with Time Factor	~~Biologically Effective Dose has been calculated using a Linear-Quadratic dose-response model with tumor repopulation time factor~~ A modified linear quadratic model with time factor has been used to compute the equivalent Biologically Effective Dose (BED) delivered at an infinitely low dose-rate, taking into account tumor repopulation during treatment. [Fowler JF, Semin. Radiat. Oncol. 1992; 2(1): 16-21]	
S147523	Linear-Quadratic-Linear Model	~~Biologically Effective Dose has been calculated using a Linear-Quadratic-Linear dose-response model for high-dose fractions~~ A linear-quadratic-linear dose-response model has been used to compute the equivalent Biologically Effective Dose (BED) delivered at an infinitely low dose-rate, taking into account linear cell survival with high dose fractions. [Astrahan M, Med.Phys. 2008; 35: 4161-4172]	
S147524	Linear-Quadratic Model for Low-Dose Rate Brachytherapy	~~Biologically Effective Dose has been calculated using a Linear-Quadratic dose-response model for permanent-seed brachytherapy~~ A linear-quadratic dose-response model modified for low-dose rate brachytherapy has been used to compute the equivalent Biologically Effective Dose (BED) delivered at an infinitely low dose-rate. [Sing R, Al-Hallaq H, Med.Dosim. 2003; 28(4): 225-259]	
S147900	Multiple Fixed Sources	A treatment technique using multiple decaying radiation sources at fixed spatial locations.	
S147910	Synchronized Robotic Treatment	A treatment technique using a robotic delivery device with real-time motion tracking and compensation.	
S147911	Non-Synchronized Robotic Treatment	A treatment technique using a robotic delivery device without real-time motion tracking and compensation.	

Code Value	Code Meaning	Definition	Notes
S147951	Helium-3	Ionized helium atom with 2 protons and 1 neutron.	
S147952	Helium-4	Ionized helium atom with 2 protons and 2 neutrons.	
S147953	Carbon-12	Ionized carbon atom with 6 protons and 6 neutrons.	
S147954	Oxygen-16	Ionized oxygen atom with 8 protons and 8 neutrons.	

1387