

# DICOM Correction Proposal

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Correction Number	CP2297
Log Summary:	Strengthen Dose Semantics of Dose References
Name of Standard	PS3.3, PS3.6
Rationale for Correction:	<p>With today's clinical practice there exist two main use cases for the items in the Dose Reference Sequence: the use of a prescribed dose in a Treatment Management System for tracking progress of a treatment and for billing, and the definition of point dose values for QA purposes to verify the correctness of the plan.</p> <p>Both use cases utilize the same underlying principles in the RT Plan which is described in section C.8.8.14.7, but of which the result differs semantically, depending on the use case:</p> <p>For the first use case of dose tracking, the resulting value may be a nominal or a calculated dose value. This is typically the value prescribed by a physician and one of the key identifiers of a target or even a plan. This value may or may not have an actual physical representation in the plan, but the main use is that this dose value is accumulated over the course of a treatment to indicate progress. The value can then potentially also be used to compare against a prescribed value in a HIS to initiate a billing process.</p> <p>For the second use case, an actual point in the patient space is defined and for which a dose value is calculated. For quality assurance procedures, this dose value can then be compared against either a measured value or another calculated value determined by a different system.</p> <p>Yet, this difference in dose interpretation (nominal vs. calculated) and potential purpose (tracking vs. QA) is not clear in the current definition of the Standard.</p> <p>Therefore, two attributes are added to the Dose Reference Sequence (300A,0010):</p> <ul style="list-style-type: none"> <li>- The Dose Value Purpose (300A,061D), introduced with the RT Radiation Set IOD, to indicate the use case (TRACKING vs QA).</li> <li>- A new attribute Dose Value Interpretation (gggg,eeee), to indicate how the accumulated dose is to be interpreted (NOMINAL vs ACTUAL).</li> </ul> <p>This missing semantics came up during the discussion of the IHE-RO draft profile "Consistent Dose for External Beam Planning" and is the base for further work on this profile.</p>
Correction Wording:	

Add to PS3.3 C.8.8.10

## C.8.8.10 RT Prescription Module

Table C.8-46. RT Prescription Module Attributes

Attribute Name	Tag	Type	Attribute Description
Prescription Description	(300A,000E)	3	User-defined description of treatment prescription.

Attribute Name	Tag	Type	Attribute Description
Dose Reference Sequence	(300A,0010)	3	Sequence of Dose References. One or more Items are permitted in this Sequence.
>Dose Reference Number	(300A,0012)	1	Identification number of the Dose Reference. The value of Dose Reference Number (300A,0012) shall be unique within the RT Plan in which it is created.
>Dose Reference UID	(300A,0013)	3	A unique identifier for a Dose Reference that can be used to link the same entity across multiple RT Plan objects.
>Dose Reference Structure Type	(300A,0014)	1	Structure type of Dose Reference.  Defined Terms: <b>POINT</b> dose reference point specified as ROI <b>VOLUME</b> dose reference volume specified as ROI <b>COORDINATES</b> point specified by Dose Reference Point Coordinates (300A,0018) <b>SITE</b> dose reference clinical site
<u>&gt;Dose Value Purpose</u>	<u>(300A,061D)</u>	<u>3</u>	<u>Purpose(s) for which the accumulated dose contributions are provided.</u>  <u>Defined Terms:</u>  <u>TRACKING</u> The dose values are used for tracking.  <u>QA</u> The dose values are used for quality assurance.  <u>See C.8.8.10.n1 and C.8.8.14.7.</u>
<u>&gt;Dose Value Interpretation</u>	<u>(gggg,eeee)</u>	<u>3</u>	<u>Interpretation of the accumulated dose values.</u>  <u>Enumerated Values:</u>  <u>NOMINAL</u> The dose has a nominal value only.  <u>ACTUAL</u> The dose represents an actual real-world value, see Note 1.  <u>See C.8.8.10.n2 and C.8.8.14.7.</u>
>Dose Reference Description	(300A,0016)	3	User-defined description of Dose Reference.
>Referenced ROI Number	(3006,0084)	1C	Uniquely identifies ROI representing the dose reference specified by ROI Number (3006,0022) in Structure Set ROI Sequence (3006,0020) in <u>Structure Set Module</u> within RT Structure Set in Referenced Structure Set Sequence (300C,0060) in RT General Plan Module. Required if Dose Reference Structure Type (300A,0014) is POINT or VOLUME.
>Dose Reference Point Coordinates	(300A,0018)	1C	Coordinates (x,y,z) of Reference Point in the Patient-Based Coordinate System described in <u>Section C.7.6.2.1.1</u> (mm). Required if Dose Reference Structure Type (300A,0014) is COORDINATES.
>Nominal Prior Dose	(300A,001A)	3	Dose (in Gy) from prior treatment to this Dose Reference (e.g., from a previous course of treatment).
>Dose Reference Type	(300A,0020)	1	Type of Dose Reference.

Attribute Name	Tag	Type	Attribute Description
			Defined Terms: <b>TARGET</b> treatment target (corresponding to GTV, PTV, or CTV in [ICRU Report 50]) <b>ORGAN_AT_RISK</b> Organ at Risk (as defined in [ICRU Report 50])
>Constraint Weight	(300A,0021)	3	Relative importance of satisfying constraint, where high values represent more important constraints.

**Note 1** The term ACTUAL is also used when it comes to recording of measured values in the treatment records. The usage here rather denotes the fact that it is a dose that is a result of a calculation during a dose planning process, contrary to a nominal value that was provided as an input to that process.

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#### **C.8.8.10.n1 Dose Value Purpose**

The Dose Value Purpose (300A,061D) provides information for consuming systems on the utility of a Dose Reference. For example, a Treatment Management System may decide to only use Dose References with a Dose Value Purpose (300A,061D) with value TRACKING. Such Dose References may typically have dose values with a Dose Value Interpretation (gggg,eeee) of NOMINAL or ACTUAL. Quality Assurance Systems may only be using Dose References with a Dose Value Purpose (300A,061D) of QA. In these cases the Dose Value Interpretation (gggg,eeee) is typically of value ACTUAL.

Other use cases may be defined using additional Defined Terms and shall be documented in the Conformance Statement of the application.

#### **C.8.8.10.n2 Dose Value Interpretation**

The dose references listed in the Dose Reference Sequence (300A,0010) may receive dose contributions accumulated from different beams. Whereas the Beam Dose (300A,0084) that is used to determine the dose contribution of a beam to the Dose Reference may be calculated individually for each beam or on a fraction level carrying a nominal dose only, the accumulated dose values may also be interpreted as nominal or actual. For potential use cases, see Table C.8-46.n, for an example, and see C.8.8.14.7.

The Enumerated Value NOMINAL represents a nominal value that was provided as an input for treatment planning. Such a value may be used to track delivered dose over a number of delivered RT Treatment Fractions in a Treatment Management System, or eventually to match against a prescribed dose value in a Hospital Information System for billing purposes.

The Enumerated Value ACTUAL represents an actual real-world value that was calculated during planning time. Such a value may be used for quality assurance purposes where the plan parameters are used to re-calculate the dose and where a re-calculated value is expected to match the dose value provided by the Dose Reference.

**Table C.8-46.n Dose Value Interpretation Example Use Cases**

		<b>Dose Reference Structure Type (300A,0014)</b>	
		<b><u>VOLUME/SITE</u></b>	<b><u>POINT/COORDINATE</u></b>
<b><u>Dose Value Interpretation (gggg.eeee)</u></b>	<b><u>NOMINAL</u></b>	<b><u>Tracking a nominal (e.g. prescribed) dose.</u></b>	<b><u>Tracking a nominal (e.g. prescribed) dose (“prescribed point dose”).</u></b>
	<b><u>ACTUAL</u></b>	<b><u>Tracking an actual (calculated) dose.</u></b>	<b><u>Comparison of calculated/measured dose values.</u></b>

*Update PS3.3, C.8.8.14.7*

#### **C.8.8.14.7 Cumulative Dose Reference Coefficient**

The Cumulative Dose Reference Coefficient (300A,010C) is the value by which Beam Dose (300A,0084) is multiplied to obtain the dose to the referenced dose reference site at the current control point (and after previous control points have been successfully administered). The Cumulative Dose Reference Coefficient (300A,010C) is by definition zero for the initial control point. The Cumulative Dose Reference Coefficient (300A,010C) of the final control point multiplied by Beam Dose (300A,0084) results in the final dose to the referenced dose reference site for the current beam. Dose calculation for dose reference sites other than points is not well defined.

**The sum of the doses of all beams calculated to the referenced dose reference may be used in different clinical scenarios, indicated by the Dose Value Purpose (300A,061D) attribute value, see C.8.8.10.n1.**

#### **Example**

**In a single target case with two beams, a volume prescription of 20 Gy over 10 fractions, the single target may be represented by two Items in the Dose Reference Sequence (300A,0010): one for tracking of the dose values over the course of the delivery of a treatment plan, and one for QA purposes, where the dose value is recalculated and compared to the planned value. The first Item may therefore contain a nominal dose by a physician (e.g. 20Gy), the second Item a calculated dose at a given spatial location (e.g. 21.785Gy). The dose values are determined using the Beam Dose (300A,0084) with a Beam Dose Meaning (300A,008B) FRACTION LEVEL (indicating that the beam dose was calculated on fraction level and carries a nominally distributed dose only).**

<b><u>Dose Reference Sequence</u></b>	<b><u>(300A,0010)</u></b>	<b><u>&lt;Sequence&gt;</u></b>
<b><u>&gt;Item 1</u></b>		
<b><u>&gt;Dose Reference Number</u></b>	<b><u>(300A,0012)</u></b>	<b><u>1</u></b>
<b><u>&gt;Dose Reference UID</u></b>	<b><u>(300A,0013)</u></b>	<b><u>1.2.3.4.1</u></b>
<b><u>&gt;Dose Reference Structure Type</u></b>	<b><u>(300A,0014)</u></b>	<b><u>VOLUME</u></b>
<b><u>&gt;Dose Value Purpose</u></b>	<b><u>(300A,061D)</u></b>	<b><u>TRACKING</u></b>
<b><u>&gt;Dose Value Interpretation</u></b>	<b><u>(gggg.eeee)</u></b>	<b><u>NOMINAL</u></b>
<b><u>&gt;Dose Reference Description</u></b>	<b><u>(300A,0016)</u></b>	<b><u>Tumor</u></b>

>Referenced ROI Number (3006,0084) 5  
>Dose Reference Type (300A,0020) TARGET  
>Item 2  
>Dose Reference Number (300A,0012) 2  
>Dose Reference UID (300A,0013) 1.2.3.4.2  
>Dose Reference Structure Type (300A,0014) COORDINATES  
>Dose Value Purpose (300A,061D) QA  
>Dose Value Interpretation (gggg,eeee) CALCULATED  
>Dose Reference Description (300A,0016) Tumor  
>Dose Reference Point Coordinates (300A,0018) 3.1\4.2\5.3  
>Dose Reference Type (300A,0020) TARGET

**Table C.8-46.n Cumulative Dose Reference Calculation Example**

	<u>Beam Dose</u> (300A,0084)  <u>with Beam Dose Meaning</u> (300A,008B): FRACTION L EVEL	<u>Dose Reference Number (300A,0012): 1</u>			<u>Dose Reference Number (300A,0012): 2</u>		
		<u>Final value of Cumulative Dose Reference Coefficient</u> (300A,010C)	<u>Final Dose Value</u>	<u>Dose Value Purpose (300A,061D) / Dose Value Interpretation</u> (gggg,eeee)	<u>Final value of Cumulative Dose Reference Coefficient</u> (300A,010C)	<u>Final Dose Value</u>	<u>Dose Value Purpose (300A,061D) / Dose Value Interpretation</u> (gggg,eeee)
<u>Beam 1</u>	1.2 Gy	1.0	1.2 Gy		1.1476	1.3771 Gy	
<u>Beam 2</u>	0.8 Gy	1.0	0.8 Gy		1.00175	0.8014 Gy	
<u>Sum</u>			2.0 Gy	<u>TRACKING / NOMINAL</u>		2.1785 Gy	<u>QA / ACTUAL</u>
<u>Sum x Fractions</u>			20.0 Gy			21.785 Gy	

Add to PS 3.6, Chapter 6

**Table 6-1. Registry of DICOM Data Elements**

Tag	Name	Keyword	VR	VM	
...					
(gggg,eeee)	<u>Dose Value Interpretation</u>	<u>DoseValueInterpretation</u>	<u>CS</u>	<u>1</u>	