Digital Imaging and Communications in Medicine (DICOM)

Supplement 191: Patient Radiation Dose Report (P-RDSR)

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Foreword

This supplement to the DICOM standard introduces a template for Patient – Radiation Dose Reporting in DICOM. The concepts of Structured Reporting will be used in this context.

This document is a Supplement to the DICOM Standard. It 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
PS 3.17	Explanatory Information

This work was undertaken in liaison with the America Association of Physicists in Medicine (AAPM) and European Federation of Medical Physicists (EFOMP).

Scope and Field of Application

This Supplement is creating a structured report to contain the information concerning the recording of the estimated radiation dose to a patient.

This includes radiation dose from CT, projection X-Ray, and radiopharmaceutical administration (diagnostic and therapeutic). Dose from external beam therapy, ion beam therapy, or brachytherapy is out of scope. Also excludes occupational radiation exposures.

There are multiple methodologies and models that can be used to estimate patient dose and these methods are rapidly changing. Yet, once an estimate of the radiation dose absorbed by a patient is performed the storing and transferring in a standard format is needed for the method used, parameters used within the method and the resulting dose estimate.

The approach taken here for the Patient Radiation Dose Structured Report (P-RDSR) is to define a new Structured Report (SR) object template and SOP Class. This SR object, independent of the images or the MPPS, could be routed to an appropriate Dose Information Reporter System. A system that claims conformance to such an SR object would then be expected, as a concomitant of the conformance claim, to appropriately deal with such data items.

Such an SR dose object allows the data flow and data management of patient estimated radiation dose reports to be disentangled from the data flow and data management of images.

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OPEN Points

Item	Content
1	
2	
3	
4	
5	
6	

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110 CLOSED Points

Item	Response
1	Consider a summary of use cases, specific of how an EMR, etc. may use this data. This would be an IHE Task
2	Data missing in current Radiation Dose SR needs to be addressed to support this P-RDSR. This is an ongoing WG28/WG02 task
3	References to proprietary model, version, etc. may need be put into separate containers. This is covered in prdsrCD082, DCM, “Radiation Dose Estimate Method Reference, see TID prdsrT04 Dose Estimate Methodology

112 Tasks

Item	
1	
2	
3	
4	

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Changes to NEMA Standards Publication PS 3.2-xxxx

122 # Digital Imaging and Communications in Medicine (DICOM)

Part 2: Conformance

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Item #01: Add new SOP Classes in Table A.1-2

126

Table A.1-2
UID VALUES

UID Value	UID NAME	Category
…		
1.2.840.10008.5.1.4.1.1.88.x	**Patient Radiation Dose SR**	**Transfer**
…		

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Changes to NEMA Standards Publication PS 3.3-xxxx

138 # Digital Imaging and Communications in Medicine (DICOM)

Part 3: Information Object Definitions

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Add the following column in PS 3.3 Section A.1.4, Table A.1-3 Composite Information Object Modules Overview - More Non-Images

IODs Modules	PRD SR
Patient	**M**
Clinical Trial Subject	**U**
General Study	**M**
Patient Study	**U**
Clinical Trial Study	**U**
SR Document Series	**M**
Clinical Trial Series	**U**
Synchronization	**C**
General Equipment	**M**
Enhanced General Equipment	**M**
SR Document General	**M**
SR Document Content	**M**
SOP Common	**M**

Item #02: Add PS3.3 Section A.35.X:

A.35.X P-RDSR Information Object Definition

A.35.X.1 P-RDSR Information Object Description

The P-RDSR IOD is used to convey the information used in the calculations for estimating the radiation dose to an individual patient. The complexity of the calculations and the precision of the resulting dose estimate will vary depending on the need.

This IOD is not meant for determining patient dose from therapeutic use of radiation in oncology settings. The therapeutic dose in oncology settings is reported by the RT Dose IOD.

A.35.X.2 P-RDSR IOD Entity-Relationship Model

The E-R Model in Section A.1.2 of this Part applies to the P-RDSR IOD. Table A.35.X-1 specifies the Modules of the P-RDSR IOD.

A.35.X.3 P-RDSR IOD Module Table

Table A.35.X-1
P-RDSR 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	SR Document Series	C.17.1	M
	Clinical Trial Series	C.7.3.2	U
Frame of Reference	Synchronization	C.7.4.2	C - shall be present if system time is synchronized to an external reference. May be present otherwise.
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Document	SR Document General	C.17.2	M
	SR Document Content	C.17.3	M
	SOP Common	C.12.1	M

A.35.X.3.1 P-RDSR IOD Content Contraints

A.35.X.3.1.1 Template

The document may be constructed from Baseline TID prdsrT01 "Patient Radiation Dose Report" (defined in PS3.16) invoked at the root node.

Note: This IOD may be used with other Templates defined for Patient Radiation Dose Reporting. Such other Templates maybe specialized for specific modalities or future dose measurement techniques.

A.35.X.3.1.2 Value Type

Value Type (0040,A040) in the Content Sequence (0040,A730) of the SR Document Content Module is constrained to the following Enumerated Values (see Table C.17.3-7 for Value Type definitions):

TEXT
CODE
NUM
DATETIME
UIDREF
PNAME
COMPOSITE
IMAGE

CONTAINER

178

A.35.X.3.1.3 Relationship Constraints

180 Relationships between content items in the content of this IOD may be conveyed by-value. Table A.35.X-2 specifies the relationship constraints of this IOD. See Table C.17.3-2 for Relationship Type definitions.

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Table A.35.X-2

184 **RELATIONSHIP CONTENT CONSTRAINTS FOR P-RDSR IOD**

Source Value Type	Relationship Type (Enumerated Values)	Target Value Type
CONTAINER	CONTAINS	TEXT, CODE, NUM, DATETIME, UIDREF, PNAME, IMAGE, COMPOSITE, CONTAINER
CONTAINER	HAS OBS CONTEXT	DATETIME, CODE, TEXT, UIDREF, PNAME
TEXT, CODE, NUM	HAS OBS CONTEXT	TEXT, CODE, NUM, DATETIME, UIDREF, PNAME, COMPOSITE
CONTAINER, IMAGE, COMPOSITE	HAS ACQ CONTEXT	TEXT, CODE, NUM, DATETIME, UIDREF, PNAME, CONTAINER.
any type	HAS CONCEPT MOD	TEXT, CODE
TEXT, CODE, NUM	HAS PROPERTIES	TEXT, CODE, NUM, DATETIME, UIDREF, PNAME, IMAGE, COMPOSITE, CONTAINER.
PNAME	HAS PROPERTIES	TEXT, CODE, DATETIME, DATE, TIME, UIDREF, PNAME
TEXT, CODE, NUM	INFERRED FROM	TEXT, CODE, NUM, DATETIME, UIDREF, IMAGE, COMPOSITE, CONTAINER.

186 Note: The SOP Classes to which an IMAGE or COMPOSITE Value Type may refer, is documented in the Conformance Statement for an application (see PS 3.2 and PS 3.4).

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190 # Changes to NEMA Standards Publication PS 3.4-xxxx

Digital Imaging and Communications in Medicine (DICOM)

192 ## Part 4: Service Class Specifications

Item #05: Add SOP Class to Table B.3-3

Table B.3-3
STANDARD AND RELATED GENERAL SOP CLASSES

SOP Class Name	Related General SOP Class Name
…	
P-RDSR	
	Comprehensive SR

Item #06: Add SOP Class to Table B.5-1

B.5 STANDARD SOP CLASSES

Table B.5-1
STANDARD SOP CLASSES

SOP Class Name	SOP Class UID	IOD (See PS 3.3)
…		
P-RDSR	**1.2.840.10008.5.1.4.1.1.88.X**	**P-RDSR IOD**

Item #07: Add Structured Reporting SOP Class to Section B.5.1.5

B.5.1.5 Structured Reporting Storage SOP Classes

The requirements of Annex O apply to the following SOP Classes:

- …
- **P-RDSR**

Item #08: Add SOP Class to Table I.4-1

I.4 MEDIA STORAGE SOP CLASSES

Table I.4-1
Media Storage Standard SOP Classes

SOP Class Name	SOP Class UID	IOD (See PS 3.3)
…		
P-RDSR	**1.2.840.10008.5.1.4.1.1.88.X**	**P-RDSR IOD**

Item #09: Add SOP Class to Section I.4.1.2

I.4.1.2 Structured Reporting Storage SOP Classes

The requirements of Annex O apply to the following SOP Classes:

- …
- **P-RDSR**

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226 **Changes to NEMA Standards Publication PS 3.6-xxxx**

Digital Imaging and Communications in Medicine (DICOM)

228 **Part 6: Data Dictionary**

Item #10: Add the following row to Table A-1

UID Value	UID Name	UID Type	Part
…			
1.2.840.10008.5.1.4.1.1.88.X	**P-RDSR**	**SOP Class**	**PS 3.4**
…			

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240 **Changes to NEMA Standards Publication PS 3.16-xxxx**

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242 **Part 16: Content Mapping Resource**

Item #11: Add new Section to Annex A

P-RDSR IOD TEMPLATES

The templates that comprise the P-RDSR are interconnected as in Figure A-x.

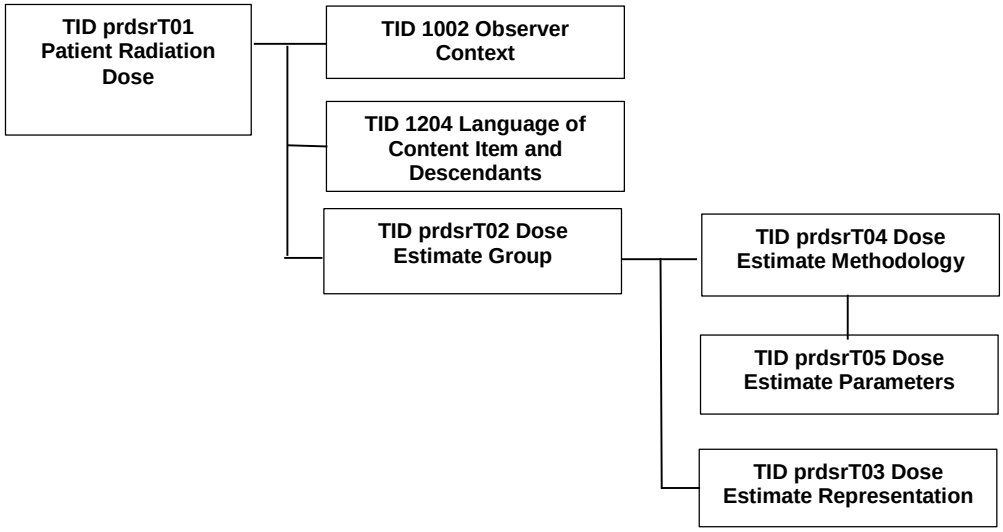

Figure A-x: P-RDSR IOD Template Structure

TID prdsrT01 Patient Radiation Dose

This template defines a container (the root) with subsidiary content items for determining an estimated radiation dose to a patient.

TID prdsrT01
Patient Radiation Dose
Type: Extensible
Order: Non Significant
Root: Yes

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (prdsrCD001, DCM, “Patient Radiation Dose Report”)	1	M		
2	>	HAS CONCEPT MOD	INCLUDE	DTID 1204 “Language of Content Item and Descendants”	1	M		
3	>	HAS OBS CONTEXT	INCLUDE	DTID (1002) Observer Context	1-n	M		
4	>	CONTAINS	INCLUDE	DTID (prdsrT02, “Dose Estimate Group”)	1-n	M		
5	>	CONTAINS	TEXT	EV (121106, DCM, “Comment”)	1	U		

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Content Item Descriptions

Row 3	Identify all observers and devices involved with organ estimations included in this PRDSR.
Row 4	For the same irradiation of an organ or set of organs there can be multiple dose estimates groups.

260

TID prdsrT02 Dose Estimate Group

262 The dose estimate group is used to record the results from one or more analysis methods from a single radiation source and/or from multiple sources. Organ dose estimates are calculated from one or more
264 irradiation events to a patient. The output from one or more sources of radiation can be used separately or combined to estimate the dose to a patient or individual organs.

266 **TID prdsrT02**
Dose Estimate Group
268 **Type: Extensible**
Order: Non Significant

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1		CONTAINS	CONTAINER	EV (prdsrCD002, DCM, “Dose Estimate Group”)	1	M		
2	>	HAS CONCEPT MOD	TEXT	EV (prdsrCD003, DCM, “Dose Estimate Group Name”)	1	M		
3	>	HAS PROPERTIES	CODE	EV (prdsrCD093, DCM, “Source Category”	1	M		DCID prdsrCI01 “Source Categories”
4	>	CONTAINS	TEXT	EV (121106, DCM, “Comment”)	1	U		
5	>	CONTAINS	INCLUDE	DTID (prdsrT04, DCM, “Dose Estimate Methodology”)	1	M		
6	>	CONTAINS	INCLUDE	DTID (prdsrT03, DCM, “Dose Estimate Representation”)	1	U		
7	>	CONTAINS	CONTAINER	EV (113517, DCM, “Organ Dose Information”)	1-n	M		
8	>>	CONTAINS	CODE	EV (T-D0060,SRT, “Organ”)	1	M		DCID prdsrCI12 “Organs for Dose Estimations”
9	>>	CONTAINS	TEXT	EV (121106, DCM, “Comment”)	1	U		
10	>>	CONTAINS	NUM	EV (prdsrCD113, DCM, “Absorbed Dose”)	1	M		UNITS = EV (mGy, UCUM, “mGy”)
11	>>>	HAS CONCEPT MOD	CODE	EV (121401, DCM, “Derivation”)	1	M		DCID prdsrCI02 “Dose Derivation Types”

12	>>>	HAS PROPERTIES	NUM	DCID 225 "Measurement Uncertainty Concepts"")	1-n	U		UNITS = EV (mGy, UCUM, "mGy")
13	>>>>	HAS PROPERTIES	TEXT	EV (prdsrCD111, DCM, "Reference to uncertainty determination method")	1	U		
14	>>	CONTAINS	NUM	EV (prdsrCD112, DCM, "Equivalent Dose")	1	U		UNITS = EV (mSv, UCUM, "mSv")
15	>>>	HAS CONCEPT MOD	CODE	EV (121401, DCM, "Derivation")	1	M		DCID prdsrCI02 "Dose Derivation Types"
16	>>>	HAS PROPERTIES	NUM	DCID 225 "Measurement Uncertainty Concepts"")	1-n	U		UNITS = EV (mSv, UCUM, "mSv")
17	>>>>	HAS PROPERTIES	TEXT	EV (prdsrCD111, DCM, "Reference to uncertainty determination method")	1	U		
18	>>	CONTAINS	TEXT	EV (121106, DCM, "Comment")	1	U		

Content Item Descriptions

Row 3	Provide classification of the radiation source(s) used.
Row 4	Reason these sources, e.g. multiple x-ray tubes (bi-plane XA and dual source CT), radioactive sources, etc. are combined.
Row 14	Equivalent Dose is an international quantity and includes the use of a Radiation Weighting Factor to compensate for the radiation type, e.g. photon, neutron, beta particle. Stating equivalent dose is not recommended in almost all dosimetry situations, except in Radiopharmaceutical dose. This is not Effective Dose.

TID prdsrT03 Dose Estimate Representation

Different representations (e.g. images) of the distribution of absorbed energy allows a better understanding of how this energy may affect tissue.

TID prdsrT03
Dose Estimate Representation
Type: Extensible
Order: Non Significant

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (prdsrCD012, DCM, "Dose Estimate Representation")	1-n	M		
2	>	CONTAINS	CODE	EV (prdsrCD013, DCM, "Distribution Model")	1	M		DCID prdsrCI13 "Dose Estimate Distribution Models"

3	>	CONTAINS	IMAGE	EV (prdsrCD014, DCM, “Dose Representation Data”)	1	MC	XOR Row 4	
4	>	CONTAINS	COMPOSITE	EV (prdsrCD014, DCM, “Dose Representation Data”)	1	MC	XOR Row 3	
5	>	CONTAINS	CODE	EV (T-D0060,SRT, “Organ”)	1-n	M		DCID prdsrCI12 “Organs for Dose Estimations”
6	>	CONTAINS	TEXT	EV (121106, DCM, “Comment”)	1	U		

Content Item Descriptions

Row 3 and 4	Reference to an Instance that contains the dose representation, e.g. surface segmentation, mesh, parametric map, RT dose IOD’s, Secondary Capture, etc.
Row 5	Listing of organs included in the representation shall contain only organs given in Row 7 TID prdsrT02 “Dose Estimate Group”. Some organs listed in TID prdsrT02 “Dose Estimate Group” may not be included in the representation data.

TID prdsrT04 Dose Estimate Methodology

This template includes the information specific to the organ dose calculation methodology used when estimating dose to individual organs, entire body or a phantom from imaging studies that use ionizing radiation.

TID prdsrT04
Dose Estimate Methodology
Type: Extensible
Order: Non Significant

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (prdsrCD015, DCM, “Dose Estimate Methodology”)	1	M		
2	>	CONTAINS	COMPOSITE	EV (prdsrCD016, DCM, “Source Radiation Dose SR”)	1-n	M		
2A	>>	CONTAINS	COMPOSITE	EV (prdsrCD0YY, DCM, “RDSR Spatial Fiducials”)	1	U		
3	>>	HAS PROPERTIES	UIDREF	EV (prdsrCD029, DCM, ”Source Event UID”)	1-n	MC	IFF some Events in the Structured Report were not used in calculating the dose.	
4	>	CONTAINS	CONTAINER	EV (prdsrCD100, DCM, “Patient Dose Model”)	1	M		
5	>>	CONTAINS	CODE	EV (prdsrCD017, DCM, “Patient Model Type”)	1	M		DCID prdsrCI03 “Patient Model Type”.

6	>>	CONTAINS	CODE	EV (prdsrCD020, DCM, “Radiation Transport Model Type”)	1	M		DCID prdsrCI04 “Radiation Transport Model Type”.
7	>>	CONTAINS	IMAGE	EV (prdsrCD025, DCM, “Patient Dose Model Data”)	1	UC	XOR Row 8, 8A	
8	>>	CONTAINS	COMPOSITE	EV (prdsrCD025, DCM, “Patient Dose Model Data”)	1	UC	XOR Row 7, 8A	
8A	>>	CONTAINS	UIDREF	EV (prdsrCD025, DCM, “Patient Dose Model Data”)	1	UC	XOR Row 7, 8	
9	>>	CONTAINS	TEXT	EV (prdsrCD026, DCM, “Patient Dose Model Reference”)	1	U		
10	>>	CONTAINS	TEXT	EV (121106, DCM, “Comment”)	1	U		
11	>>	CONTAINS	CONTAINER	EV (prdsrCD027, DCM, “Patient Model Demographics”)	1	M		
12	>>>	CONTAINS	NUM	EV (prdsrCD028, DCM, “Minimum age”)	1	MC	IF minimum age is defined for the model	DCID 7456 “Units of Measured Age”
13	>>>	CONTAINS	NUM	EV (prdsrCD030, DCM, “Maximum age)	1	MC	IF maximum age is defined for the model	DCID 7456 “Units of Measured Age”
14	>>>	CONTAINS	CODE	EV (prdsrCD037, DCM, “Model Patient sex”)	1	MC	IF Model requires sex be defined.	DCID 7455 “Sex”
15	>>>	CONTAINS	NUM	EV (prdsrCD038, DCM, “Minimum weight”)	1	MC	IF minimum weight is defined for the model	UNITS = EV (kg, UCUM, “kg”)
16	>>>	CONTAINS	NUM	EV (prdsrCD041, DCM, “Maximum weight”)	1	MC	IF maximum weight is defined for the model	UNITS = EV (kg, UCUM, “kg”)
17	>>>	CONTAINS	NUM	EV (prdsrCD039, DCM, “Minimum height”)	1	MC	IF minimum height is defined for the model	UNITS = EV (cm, UCUM, "cm")
18	>>>	CONTAINS	NUM	EV (prdsrCD042, DCM, “Maximum height”)	1	MC	IF maximum height is defined for the model	UNITS = EV (cm, UCUM, "cm")
19	>>	CONTAINS	CONTAINER	EV (prdsrCD056, DCM, “Registration of Patient Model with Radiation Dose SR”)	1-n	U		
20	>>>	CONTAINS	TEXT	EV (121106, DCM, “Comment”)	1	U		
21	>>>	CONTAINS	CODE	EV (prdsrCD046 DCM “Registration Method”)	1	M		DCID 7100 “RCS Registration Method Type”
~~22~~	~~>>>~~	~~CONTAINS~~	~~COMPOSITE~~	~~EV (prdsrCD044, DCM, “Spatial Fiducials”)~~	~~1~~	~~MC~~	~~IF row 21 is (125022, DCM, “Fiducial Alignment”)~~	
23	>>>	CONTAINS	COMPOSITE	EV (prdsrCD044, DCM, “Spatial Registration”)	1	MC	IFF Row 7, 8 or 8A are present and FOR is defined	

24	>	CONTAINS	CONTAINER	EV (prdsrCD057, DCM, “X-Ray Beam Attenuator Information”)	1-n	MC	IF Attenuators used in estimation	
25	>>	CONTAINS	CODE	EV (prdsrCD058, DCM, “Attenuator Material Category”)	1	M		DCID prdsrCI07 “Attenuator Material Category”
26	>>	CONTAINS	CODE	EV (prdsrCD065, DCM, “Equivalent Attenuator Material”)	1	M		DCID 10006B “Radiation Attenuator Materials”
27	>>	CONTAINS	NUM	EV (prdsrCD069, DCM, “Equivalent Attenuator Thickness”)	1	M		UNITS = EV (mm, UCUM, “mm”)
28	>>	CONTAINS	TEXT	EV (prdsrCD068, DCM, “Attenuator Description”)	1	U		
29	>>	CONTAINS	CONTAINER	EV (prdsrCD072, DCM, “X-Ray Beam Attenuator Model”)	1	U		
30	>>>	CONTAINS	CODE	EV (prdsrCD020, DCM, “Radiation Transport Model Types”)	1	U		DCID prdsrCI04 “Radiation Transport Model Types”
31	>>>	CONTAINS	TEXT	EV (prdsrCD074, DCM, “X-Ray Beam Attenuator Model Reference”)	1	U		
31 A	>>>	CONTAINS	IMAGE	EV (prdsrCD0XX, DCM, “X-Ray Attenuator Model Data”)	1	UC	XOR Row 31B, 31C	
31 B	>>>	CONTAINS	COMPOSITE	EV (prdsrCD0XX, DCM, “X-Ray Attenuator Model Data”)	1	UC	XOR Row 31A, 31C	
31 C	>>>	CONTAINS	UIDREF	EV (prdsrCD0XX, DCM, “X-Ray Attenuator Model Data”)	1	UC	XOR Row 31B, 31A	
32	>>	CONTAINS	CONTAINER	EV (prdsrCD075, DCM, “Registration of X-Ray Beam Attenuator Model with Radiation Dose SR”)	1-n	U		
33	>>>	CONTAINS	CODE	EV (prdsrCD046 DCM “Registration Method”)	1	MC		DCID 7100 “RCS Registration Method Type”
34	>>>	CONTAINS	TEXT	EV (121106, DCM, “Comment”)	1	U		
~~34~~	~~>>>~~	~~CONTAINS~~	~~COMPOSITE~~	~~EV (prdsrCD044, DCM, “Spatial Fiducials”)~~	~~1~~	~~MC~~	~~IF row 33 is equal (125022, DCM, “Fiducial Alignment”)~~	
35	>>>	CONTAINS	COMPOSITE	EV (prdsrCD044, DCM, “Spatial Registration”)	1	MC	IFF Row 31A, 31B or 31C are present and FOR is defined	

36	>	CONTAINS	CONTAINER	EV (prdsrCD076, DCM, “Radiation Dose Estimate Method”)	1-n	M		
37	>>	CONTAINS	CODE	EV (prdsrCD077, DCM, “Radiation Dose Estimate Method Type”)	1	M		DCID prdsrCI10 “Estimate Method Types”
38	>>	CONTAINS	INCLUDE	DTID prdsrT05 “Radiation Dose Estimate Parameters”	1	U		
39	>>	CONTAINS	TEXT	EV (prdsrCD082, DCM, “Radiation Dose Estimate Method Reference”)	1	U		

294 **Content Item Descriptions**

Row 2	List the Radiation Dose SR’s used in the dose estimation. If an Radiation Dose SR does not exist one must be created from estimated data. These can be from any modality, e.g. CT, projection X-Ray radiopharmaceutical (diagnostic or therapeutic).
Row 2A	Reference to fiducial IOD that defines the FOR of the RDSR if there is no acquired patient images associated with RDSR to define the FOR.
Row 3	Reference to Irradiation Event UID’s that are being used in the Dose Estimate Methodology only if all irradiation events are not included in the methodology.
Rows 7 and 8	Reference to an instance that contains the model e.g. Surface Segmentation, Mesh, Parametric Map, etc. This can be spatial fiducials IOD.
Row 8A	Reference to the series of images that contains the model, e.g. CT, MRI, etc.
Row 9	Reference to Publication describing the model used. May be proprietary, if so reference the manufacturer model and version
Rows 11 through 18	These are the demographics of the patient model used to estimate dose. These are not necessarily the actual patient demographics (e.g. the values input at time of the irradiation event may be incorrect).
~~Row 19~~	~~Contains the Spatial Registration from each RDSR FOR to the patient model FOR.~~ ~~The FOR of patient model is defined by the space of patient model coordinates.~~ ~~The FOR of the RDSR is the FOR of the acquired patient images. If no FOR of the acquired patient images exists fiducials can be used to define FOR in both the equipment space, i.e. RDSR, and Patient Model space and referenced in Row 8.~~
Rows 23 and 35	Contains the Spatial Registration from each RDSR FOR to the patient or x-ray attenuator model FOR. The FOR of patient or x-ray attenuator model is defined by the space of model coordinates. The FOR of the RDSR is the FOR of the acquired patient images. If no FOR of the acquired patient images exists fiducials can be used to define FOR in both the equipment space, i.e. RDSR, and Patient Model space and referenced in Row 8 or Row 31C. If RCS Registration Method Type is Visual Alignment it is assumed any translation/rotation information from the visual alignment is added to other alignment translation/rotation information and saved as a single Spatial Registration IOD.
Rows 24	One content per attenuator. This can be information about materials in the radiation beam that is used in the estimation method and that may or may not have been included in the Radiation Dose SR. If the beam Attenuator (e.g. filter) is included here and is also in the Radiation Dose SR it is assumed additional information relative to the beam Attenuator material, shape, size, location was needed and this information was not in the Radiation Dose SR or the Radiation Dose SR information is considered incorrect or incomplete.
Row 26	The estimation method may use an equivalent material rather than the actual material, e.g. a plastic table may be use equivalent aluminum attenuation.
Rows 31A and 31B	Reference to an instance that contains the model e.g. Surface Segmentation, Mesh, Parametric Map, etc.

Row 31C	Reference to the series of images that contains the model, e.g. CT, MRI, etc. This can be spatial fiducials IOD.
Row 31 and 39	Provide name of method, reference to a publication or the manufacturer model and version

296 **TID prdsrT05 Dose Estimate Parameters**

298 This template includes the parameters that are specific to the Dose Estimate Method used in the algorithms when estimating dose to individual organs, phantoms or the entire body from imaging studies that use ionizing radiation.

300

302 **TID prdsrT05**
Dose Estimate Parameters
Type: Extensible
304 **Order: Non Significant**

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (prdsrCD034, DCM, "Dose Estimate Parameters")	1	M		
2	>	CONTAINS	NUM	DCID rdsrCI06A "Radiation Dose Estimation Parameter"	1-n	MC	IF Row 6 absent	UNITS = DCID 82 "Units of Measurement"
~~3~~	~~>>~~	~~HAS PROPERTIES~~	~~TEXT~~	~~EV(prdsrCD035 , DCM, "Radiation Dose Estimation Parameter Name")~~	~~1~~	~~MC~~	~~XOR Row 4~~	
4	~~>>~~	~~HAS PROPERTIES~~	~~CODE~~	~~EV(prdsrCD035 , DCM, "Radiation Dose Estimation Parameter Name")~~	~~1~~	~~MC~~	~~XOR Row 3~~	~~DCID rdsrCI06A "Radiation Dose Estimation Parameter"~~
5	>>	HAS PROPERTIES	CODE	EV(prdsrCD064, DCM, "Radiation Dose Estimate Parameter Type")	1	M		DCID prdsrCI06 "Radiation Dose Estimate Parameter Type"
5A	>	CONTAINS	COMPOSITE	DCID prdsrCIYYY "Radiation Dose Composite Parameter" or DCID rdsrCI06A "Radiation Dose Estimation Parameter"	1-n	MC	IF Row 2 absent	
5B	>>	HAS PROPERTIES	CODE	EV(prdsrCD064, DCM, "Radiation Dose Estimate Parameter Type")	1	U		DCID prdsrCI06 "Radiation Dose Estimate Parameter Type"

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Content Item Descriptions

Row 2	These are the parameters of the method specified in Row 39 of TID prdsrT04 Dose Estimate Methodology
Row 5A	References to Parametric Map Image, Mesh IOD or other similar IOD.

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Item #12: Add the following CID's to Part 16 Annex B:

310 **CID prdsrCI01 Source Categories**

Table CID prdsrCI01
312 **Source Categories**
Type: Extensible Version: yyyymmdd

Coding Scheme Designator	Code Value	Code Meaning
DCM	prdsrCD089	Single source estimation
DCM	prdsrCD090	Multi-source estimation

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CID prdsrCI12 Organs for Dose Estimates

316 **Table CID prdsrCI12**
Organs for Dose Estimates
318 **Type: Extensible Version: yyyymmdd**

Coding Scheme Designator	Code Value	Code Meaning
Include CID 10044 "Radiosensitive Organs"		
SRT	**T-D0010**	**Entire Body**
DCM	**113681**	**Phantom**

320 Table CID 225 is included for reference only, no changes required.

CID 225 Measurement Uncertainty Concepts

322 **Measurement Uncertainty Concepts**
Type: Extensible Version: 20030327

Coding Scheme Designator	Code Value	Code Meaning
SRT	R-00363	+/-, range of measurement uncertainty
SRT	R-00364	+, range of upper measurement uncertainty
SRT	R-00362	-, range of lower measurement uncertainty

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CID prdsrCI02 Dose Derivation Types

Table CID prdsrCI02
Dose Derivation Types

Type: Extensible Version: yyyymmdd

Coding Scheme Designator	Code Value	Code Meaning
SRT	G-A437	Maximum
SRT	R-404FB	Minimum
SRT	R-00317	Mean
DCM	prdsrCD095	Single Dose Value

CID prdsrCI13 Dose Estimate Distribution Representation

Table CID prdsrCI13
Dose Estimate Distribution Representation
Type: Extensible Version: yyyymmdd

Coding Scheme Designator	Code Value	Code Meaning
DCM	prdsrCD084	Isodose
DCM	prdsrCD085	Skin dose map
DCM	prdsrCD086	Screen capture
DCM	prdsrCD087	3D dose map
DCM	prdsrCD088	Dose gradient
DCM	prdsrCD096	Point Cloud
DCM	121342	Dose Image

CID prdsrCI03 Patient Model Types

Table CID prdsrCI03
Patient Model Types

Type: Extensible Version: yyyymmdd

Coding Scheme Designator	Code Value	Code Meaning
DCM	prdsrCD018	Simple Object
DCM	prdsrCD004	Anthropomorphic
DCM	prdsrCD094	Patient Segmented

CID prdsrCI04 Radiation Transport Model Type

Table CID prdsrCI04
Radiation Transport Model Type
Type: Extensible Version: yyyymmdd

Coding Scheme Designator	Code Value	Code Meaning
DCM	prdsrCD021	Geometric
DCM	prdsrCD022	Voxelized
DCM	prdsrCD023	Mesh
DCM	prdsrCD024	NURBS
DCM	prdsrCD097	Measured radiation dose
DCM	prdsrCD006	BREP

Table CID 7456 is included for reference only, no changes required.

Table CID 7456. Units of Measure for Age

Table CID 7456
Units of Measure for Age
Type: Non-Extensible Version: 20020904

Coding Scheme Designator	Code Value	Code Meaning
UCUM	a	year
UCUM	mo	month
UCUM	wk	week
UCUM	d	day
UCUM	h	hour
UCUM	min	minute

Table CID 7100 is included for reference only, no changes required.

CID 7100 RCS Registration Method Type

Table CID 7100
RCS Registration Method Type
Type: Extensible Version: 20040115

Coding Scheme Designator	Code Value	Code Meaning
DCM	125021	Frame of Reference Identity
DCM	125022	Fiducial Alignment
DCM	125023	Acquisition Equipment Alignment
DCM	125024	Image Content-based Alignment

DCM	125025	Visual Alignment

CID prdsrCI07 Attenuator Material Category

Table CID prdsrCI07
Attenuator Material Category
Type: Extensible Version: yyyymmdd

Coding Scheme Designator	Code Value	Code Meaning
DCM	prdsrCD059	Table
DCM	prdsrCD060	Table core
DCM	prdsrCD061	Table outer liner
DCM	prdsrCD062	Table pad
DCM	prdsrCD063	Patient protection shield
DCM	prdsrCD031	Beam block
DCM	prdsrCD092	Patient Support
DCM	113771	X-Ray Filters

Table CID 10006B. Radiation Attenuator Materials

Table CID 10006B
Radiation Attenuator Materials
Type: Extensible Version: yyyymmdd

Coding Scheme Designator	Code Value	Code Meaning
Include Table CID 10006 X-Ray Filter Materials		
DCM	**prdsrCD066**	**Carbon fiber or Carbon fiber equivalent material**
DCM	**prdsrCD067**	**Composite**
SRT	**C-139F9**	**Tin or Tin compound**

CID prdsrCI10 Estimate Method Types

Table CID prdsrCI10
Estimate Method Types
Type: Extensible Version: yyyymmdd

Coding Scheme Designator	Code Value	Code Meaning
DCM	prdsrCD078	Monte Carlo
DCM	prdsrCD079	Tabular data
DCM	prdsrCD080	Analytical
DCM	prdsrCD081	Empirical

CID prdsrCI06A Radiation Dose Estimation Parameter

Table CID prdsrCI06A
Radiation Dose Estimation Parameter
Type: Extensible Version: yyyymmdd

Coding Scheme Designator	Code Value	Code Meaning
DCM	prdsrCD005	Breast thickness
DCM	111634	HVL
DCM	111046	Percent fibroglandular tissue
DCM	prdsrCD007	Normalized mean glandular dose (DgN)
DCM	prdsrCD008	Patient AP dimension
DCM	prdsrCD009	Patient lateral dimension
DCM	prdsrCD010	f-s coefficient
DCM	prdsrCD011	Backscatter
DCM	**defined in CP1525**	Water equivalent diameter (Dw)
DCM	prdsrCD033	Tissue air ratio

CID prdsrCI06 Radiation Dose Estimate Parameter Type

Table CID prdsrCI06
Radiation Dose Estimate Parameter Type
Type: Extensible Version: yyyymmdd

Coding Scheme Designator	Code Value	Code Meaning
DCM	prdsrCD052	Correction factor
DCM	prdsrCD053	Curve fit parameter
DCM	prdsrCD055	Homogeneity factor
DCM	prdsrCD122	Normalization factor
DCM	prdsrCD123	Offset factor
DCM	112031	Attenuation Coefficient
DCM	prdsrCD126	Tissue Fraction
DCM	prdsrCD127	Distance correction
DCM	prdsrCD128	Conversion factor
DCM	121206	Distance
DCM	111634	HVL

Item #: Add the following Coded terms to Part 16 Annex D: Table D-1

386 **Table D-1. DICOM Controlled Terminology Definitions**

Code Value	Code Meaning	Definition	Notes
prdsrCD001	Patient Radiation Dose Report (P-RDSR)	A report of estimated absorbed energy from ionizing radiation to a patient.	
prdsrCD002	Dose Estimate Group	One or more estimates of absorbed energy from ionizing radiation.	
prdsrCD003	Dose Estimate Group Name	Name used to identify a dose estimate group.	
prdsrCD004	Anthropomorphic	A mathematical description of patient model for estimating radiation dose that describes or thought of as having a human form or human attributes	
prdsrCD005	Breast thickness	Thickness of the breast	
prdsrCD006	BREP	Boundary based representation of the model for the estimation of radiation transport and absorbed dose in materials.	
prdsrCD007	Normalized mean glandular dose (DgN)	Conversion values used to calculate the absorbed dose from radiation to the fibroglandular tissue component of the breast from the exposure in air.	
prdsrCD008	Patient AP dimension	The size of a patient in the anterior-posterior dimension	
prdsrCD009	Patient lateral dimension	The size of a patient in the lateral dimension	
prdsrCD010	f-s coefficient	Conversion factor for Size Specific Dose Estimate (SSDE) calculations from $CTDI_{vol}$	
prdsrCD011	Backscatter	Scattering of radiation or particles in a direction opposite to that of the incident radiation	
prdsrCD012	Dose Estimate Representation	The representation of the estimated absorbed energy to an organ, a set of organs or the whole body, e.g., surface segmentation, mesh, parametric map, RT dose IOD's, Secondary Capture, etc.	
prdsrCD013	Distribution Model	The form of the model used to represent the distribution of the radiation dose.	
prdsrCD014	Dose Representation Data	The absorbed energy data created from the estimation method.	
prdsrCD015	Dose Estimate Methodology	The methodology and parameters used to estimate the radiation dose to an organ, the whole body or a phantom.	

prdsrCD016	Source Radiation Dose SR	Radiation Dose Structured Report or Radiopharmaceutical Radiation Dose Structured Report used as the source of the irradiation event output information	
prdsrCD017	Patient Model Type	The type of model used to define the shape, size, location of objects, etc. for use in radiation transport analysis.	
prdsrCD018	Simple Object	A simple object used to model a patient or organ, e.g. cylinder for estimating radiation dose	
prdsrCD019	Radiation Dose Estimation Parameter Set	Reference to any non-image IOD that contains the parameters used in the estimation method. This can be used for more complex listing of parameters than just single numerical values	
prdsrCD020	Radiation Transport Model Types	The model used to estimate energy transport and absorbed dose in materials	
prdsrCD021	Geometric	A geometrical shape used as the model for the estimation of radiation transport and absorbed dose in materials	
prdsrCD022	Voxelized	A volumetric pixel format for the model for the estimation of radiation transport and absorbed dose in materials	
prdsrCD023	Mesh	A mesh structure representation for the model for the estimation of radiation transport and absorbed dose in materials	
prdsrCD024	NURBS	Surfaces of a non-uniform rational B-spline (NURBS) based representation for the model for the estimation of radiation transport and absorbed dose in materials	
prdsrCD025	Patient Dose Model Data	The stored data from the model used to estimate radiation dose to a patient or organ	
prdsrCD026	Patient Model Reference	A reference to the methodology or rational for the model used in the estimation of radiation dose	
prdsrCD027	Patient Model Demographics	Parameters used by the radiation dose estimation method that are indicative of the patient type or population	
prdsrCD028	Minimum Age	The minimum age of the patient model used in the radiation dose estimation method	
prdsrCD029	Source Event UID	Unique Identifier of an irradiation event or a radiopharmaceutical administration event	

prdsrCD030	Model Maximum Age	The maximum patient age supported by the model	
prdsrCD031	Beam Block	A material placed in the radiation beam that is used to completely attenuate the beam in a specific region of the field of view	
prdsrCD032	Radiation Dose Estimation Parameter Value	The numerical value of the parameters used in the algorithms for determining the radiation dose to a patient, organs, or any material	
prdsrCD033	Tissue air ratio	Ratio of the absorbed dose at a given depth in tissue to the absorbed dose at the same point in air.	
prdsrCD034	Dose Estimate Parameters	The parameters used in the algorithms for determining the radiation dose to a patient, organs, or any material	
prdsrCD035	Radiation Dose Estimation Parameter Name	The name of the parameters used in the algorithms for determining the radiation dose to a patient, organs, or any material	
prdsrCD037	Model Patient Sex	The patient sex supported by the model	
prdsrCD038	Minimum Weight	The minimum weight of the patient model used in the radiation dose estimation method	
prdsrCD039	Minimum Height	The minimum height of the patient model used in the radiation dose estimation method	
prdsrCD041	Maximum Weight	The maximum weight of the patient model used in the radiation dose estimation method	
prdsrCD042	Maximum Height	The maximum height of the patient model used in the radiation dose estimation method	
prdsrCD044	Spatial Registration	Reference to the Spatial Registration IOD, Deformable Spatial Registration IOD or Spatial Fiducials IOD used	
prdsrCD046	Registration Method	Name of the method to register the frame of reference for two or more data sets	
prdsrCD052	Correction factor	A factor that is used to make an adjustment to a calculation to account for deviations in the method	
prdsrCD053	Curve fit parameter	A value used in a mathematical statement from the empirical determination of a curve or function that approximates a set of data	
prdsrCD055	Homogeneity factor	A value that is used to describe the uniformity or composition of a data set or a material that relates to the same degree of variability	

prdsrCD056	Registration of Patient Model to Radiation Dose SR	The registration of patient model to the Radiation Dose SR data	
prdsrCD057	X-Ray Beam Attenuator Information	Additional attenuators that are in the radiation beam that may alter the estimated radiation dose to the patient or organ	
prdsrCD058	Attenuator Material Category	The type of attenuator that is in the radiation beam that may alter the estimated radiation dose to the patient or organ	
prdsrCD059	Table	The table a patient is sitting, standing or lying on and that is in the radiation beam such that it may alter the estimated radiation dose to the patient or organ	
prdsrCD060	Table core	The core material of a table a patient is sitting, standing or lying on and that is in the radiation beam such that it may alter the estimated radiation dose to the patient or organ	
prdsrCD061	Table outer liner	The outer shell of a table a patient is sitting, standing or lying on and that is in the radiation beam such that it may alter the estimated radiation dose to the patient or organ	
prdsrCD062	Table pad	The padding on a table a patient is sitting, standing or lying on and that is in the radiation beam such that it may alter the estimated radiation dose to the patient or organ	
prdsrCD063	Patient protection shield	A material placed within the radiation beam to protect the patient from radiation that may alter the estimated radiation dose to the patient or organ	
prdsrCD064	Estimation Parameter	Parameters used in mathematical, simulation or empirical calculations	
prdsrCD065	Equivalent Attenuator Material	The equivalent material that was used in the methodology to estimate the radiation dose to the patient or organ	
prdsrCD066	Carbon fiber or Carbon fiber compound	A material consisting of thin, strong crystalline filaments of carbon	
prdsrCD067	Composite	A material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components	
prdsrCD068	Attenuator Description	An explanation of the actual attenuator material and how it was used in the estimation of radiation dose	

prdsrCD069	Equivalent Attenuator Thickness	The thickness of the equivalent attenuator used to estimate radiation dose to a patient or organ	
prdsrCD072	X-Ray Beam Attenuator Model	A model of an object of attenuator placed in the radiation beam that modifies the beam and is used in the estimation of radiation dose	
prdsrCD073	Tin or Tin compound	A material made from Tin or alloys and mixtures that contain Tin	
prdsrCD074	X-Ray Beam Attenuator Model Reference	A reference to the methodology or rational for the model of the beam Attenuator used in the estimation of radiation dose	
prdsrCD075	Registration of X-Ray Beam Attenuator Model with Radiation Dose SR	The registration of beam Attenuator model to the Radiation Dose SR output information	
prdsrCD076	Radiation Dose Estimate Method	Name of the grouping of radiation dose estimation methods and parameters for a set of organs, tissues or phantoms	
prdsrCD077	Radiation Dose Estimate Method Type	Type of method used to estimate the radiation dose to a patient or organ	
prdsrCD078	Monte Carlo	Algorithms that rely on repeated random sampling to obtain numerical results.	
prdsrCD079	Tabular data	Table of values indexed by a key.	
prdsrCD080	Analytical	Algorithms that use mathematical models that have a deterministic result.	
prdsrCD081	Empirical	Algorithms that use mathematical models that use parameters derived from observation.	
prdsrCD082	Radiation Dose Estimate Method Reference	A reference to the methodology or rationale for the estimation methodology used for the estimation of radiation dose.	
prdsrCD084	Isodose	Representation of radiation dose of equal intensity as a curve or line	
prdsrCD085	Skin dose map	Representation of radiation dose of equal intensity as a surface on the skin	
prdsrCD086	Screen capture	Representation of radiation dose from a secondary capture image	
prdsrCD087	3D dose map	Representation of radiation dose as a 3D shape or object	

prdsrCD088	Dose gradient	Representation of the change in radiation dose with respect to the change in another variable. Often represented as a change with respect to time or distance.	
prdsrCD089	Single source estimation	Radiation that originates from a single source (e.g. a single x-ray tube, a radioactive tracer within the body).	
prdsrCD090	Multi-source estimation	More than one source of radiation that are being combined for the estimation of radiation dose (e.g. dual source CT, radioactive tracer and CT sources, both planes of bi-plane XA system).	
prdsrCD092	Patient Support	Device used to support a patient during an imaging study	
prdsrCD093	Source Specification	The sources of radiation that were used in the estimated radiation dose to organs	
prdsrCD094	Patient Segmented	A patient model for estimating radiation dose defined from the actual patient anatomy or characteristics	
prdsrCD095	Single Dose Value	Radiation dose specified at a single location. This can be at the reference point.	
prdsrCD096	Point Cloud	Radiation dose represented as a distribution of points	
prdsrCD097	Measured radiation dose	The measured amount of energy that is deposited in a material by ionizing radiation	
prdsrCD100	Patient Dose Model	A computational representation of a human body or other object used to simulate the attenuation of radiation in human tissue	
prdsrCD111	Reference to uncertainty determination method	A reference to the uncertainty in the results of the methodology used for the estimation of radiation dose.	
prdsrCD112	Equivalent Dose	Absorbed dose to a tissue or organ multiplied by a quality factor to normalize the dose to the type of radiation that is depositing the dose	
prdsrCD113	Absorbed Dose	energy from ionizing radiation absorbed per unit mass by a material	
prdsrCD120	Radiation Source Model	The model of the source of radiation used in Monte Carlo Simulations	
prdsrCD122	Normalization factor	A factor that is used to make an adjustment to a calculation to normalize the data set	

prdsrCD123	Offset factor	A factor that is used to make an adjustment to a calculation to translate or move the data set in a defined manner	
prdsrCD126	Tissue Fraction	The amount of a specific tissue content in a material	
prdsrCD127	Distance correction	A correction factor for a measurement or a location	
prdsrCD128	Conversion factor	A numerical ratio to express a measurement from one unit to another unit	

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396 **Changes to NEMA Standards Publication PS 3.17-xxxx**

Digital Imaging and Communications in Medicine (DICOM)

398 **Part 17: Explanatory Information**

Item #15: Add Patient Radiation Dose Reporting Use Cases Annex

XXX P-RDSR Document (Informative)

This Annex contains examples of the use of Patient Radiation Dose templates within P-RDSR Documents

XXX.1 Skin Dose Map Example

The following example shows the report of the skin dose map calculated from the dose delivered during an X-Ray interventional cardiology procedure.

The calculation uses a Radiation Dose SR provided by a Single Plane X-Ray Angiography equipment of the manufacturer “A”. The Radiation Dose SR is created during one procedure step, corresponding to the coronary stenting of an adult male of 83 kg and 179 cm height.

The skin dose calculations are performed by an application on a separated workstation of the manufacturer “B”, operated by the medical physicist, who is logged into the workstation at the time of the creation of the P-RDSR document.

The dose calculation application generates a P-RDSR document and a Secondary Capture containing an image of the dose distribution over the deployed skin of the patient model.

The dose calculation application uses the following settings and assumptions:

RDSR Source Data:

- All the Irradiation Event UIDs are used in the calculation of the skin dose map.

Patient Model:

- The Patient model is a combination of two elliptic cylinders to represent the chest and neck of the patient.
- The actual dimensions of the model are determined by the age, gender, height and weight of the patient.
- In this example the exact height and weight of the patient are used to the creation of the model. The resulting elliptic cylinder for the chest of the model is 31 cm in the AP dimension and 74 cm in the lateral dimension.
- The application creates internally a 3D voxelized model that is stored in a DICOM Instance.

Patient Model Registration:

- The distance from the top of the patient’s head to the head of the table (measured during the procedure) is known. The location of the patient head and table head are stored in a Spatial Fiducial instance.
- The application uses fiducials to register the patient model with the data of the source Radiation Dose SR.
- A-priori knowledge of the distance from the table head to the system Isocenter at table zero position is calibrated offline.
- The table tilt, cradle and rotation angles are ignored because the description of the acquisition geometry is incomplete in the Radiation Dose SR. Only table translations relative to the Isocenter are considered in the calculations.

Beam Attenuators:

- A-priori knowledge of the model of the table and mattress (i.e. shape, dimensions, and absorption material) is calibrated offline, and it’s referenced internally by the application. The model contains the same coordinate system as the one used in the equipment referenced in the Radiation Dose SR, so there is no need of another registration instance.

- The X-Ray filter information from the source Radiation Dose SR is used by the application. There is no other a-priori knowledge of the X-Ray filtration.

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Table XXX.1-1. Skin Dose Map Example

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Node	Code Meaning of Concept Name	Code or Example Value	TID
1	Patient Radiation Dose Report	*<CONTAINER>*	TID prdsrT01
1.1	Language of Content Item and Descendants	(En, IETF4646, “**English**”)	TID 1204
1.2	Observer Type	(121007,DCM, ”**Device**”)	TID 1002
1.3	Device Observer UID	<UID of Physicist Workstation>	TID 1004
1.4	Device Observer Name	**MedPhys-01**	TID 1004
1.5	Device Observer Manufacturer	**Manufacturer B**	TID 1004
1.6	Device Observer Model Name	**DW**	TID 1004
1.7	Observer Type	(121006, DCM, "**Person**")	TID 1002
1.8	Person Observer Name	**Doe^John^^Dr^PhD**	TID 1003
1.9	Person Observer's Role in the Organization	(C1708969, UMLS, “**Medical Physicist**”)	TID 1003
1.10	Dose Estimate Group	*<CONTAINER>*	TID prdsrT02
1.10.1	Dose Estimate Group Name	**Skin Dose Map**	TID prdsrT02
1.10.2	Source Category	(prdsrCD089, DCM, “**Single source estimation**”)	TID prdsrT02
1.10.3	Comment	**Single Plane XA**	TID prdsrT02
1.10.4	Dose Estimate Methodology	*<CONTAINER>*	TID prdsrT04
1.10.4.1	Source Radiation Dose SR	<UID of Radiation Dose SR #1>	TID prdsrT04
1.10.4.2	Patient Dose Model	*<CONTAINER>*	TID prdsrT04
1.10.4.2.1	Patient Model Type	(prdsrCD018, DCM, “**Simple Object**”)	TID prdsrT04
1.10.4.2.2	Radiation Transport Model Type	(prdsrCD022, DCM, “**Voxelized**”)	TID prdsrT04
1.10.4.2.3	Patient Dose Model Data	<UID of 3D Voxelized Patient Model>	TID prdsrT04
1.10.4.2.4	Patient Dose Model Reference	**DOI:1.2.3.4**	TID prdsrT04
1.10.4.2.5	Comment	**Combined Elliptic Cylinders**	TID prdsrT04

Node	Code Meaning of Concept Name	Code or Example Value	TID
1.10.4.2.6	Patient Model Demographics	*<CONTAINER>*	TID prdsrT04
1.10.4.2.6.1	Minimum age	**18** (a, UCUM, "**year**")	TID prdsrT04
1.10.4.2.6.2	Maximum age	**90** (a, UCUM, "**year**")	TID prdsrT04
1.10.4.2.6.3	Model Patient sex	(M, DCM, "**Male**")	TID prdsrT04
1.10.4.2.6.4	Minimum weight	**83** (kg, UCUM, "**kg**")	TID prdsrT04
1.10.4.2.6.5	Maximum weight	**83** (kg, UCUM, "**kg**")	TID prdsrT04
1.10.4.2.6.6	Minimum height	**179** (cm, UCUM, "**cm**")	TID prdsrT04
1.10.4.2.6.7	Maximum height	**179** (cm, UCUM, "**cm**")	TID prdsrT04
1.10.4.2.7	Registration of Patient Model with Radiation Dose SR	*<CONTAINER>*	TID prdsrT04
1.10.4.2.7.1	Comments	**Distance from the top of patient's head to the head of the table = 10 cm**	TID prdsrT04
1.10.4.2.7.2	Registration Method	(125023, DCM, "**Fiducial Alignment**")	TID prdsrT04
1.10.4.2.7.3	Spatial Fiducials	<UID of "**Spatial Fiducials**">	TID prdsrT04
1.10.4.2.7.4	Spatial Registration	<UID of "**Spatial Registration**">	TID prdsrT04
1.10.4.3	X-Ray Beam Attenuator Information	*<CONTAINER>*	TID prdsrT04
1.10.4.3.1	Attenuator Material Category	(prdsrCD059, DCM, "**Table**")	TID prdsrT04
1.10.4.3.2	Equivalent Attenuator Material	(prdsrCD066, DCM, "**Carbon fiber or Carbon fiber equivalent material**")	TID prdsrT04
1.10.4.3.3	Equivalent Attenuator Thickness	**100** (mm, UCUM, "**mm**")	TID prdsrT04
1.10.4.3.4	Attenuator Description	**X-Ray Table with mattress**	TID prdsrT04
1.10.4.3.5	X-Ray Beam Attenuator Model	*<CONTAINER>*	TID prdsrT04
1.10.4.3.5.1	Radiation Transport Model Types	(prdsrCD021, DCM, "**Geometric**")	TID prdsrT04
1.10.4.3.5.2	X-Ray Beam Attenuator Model Reference	**DOI:1.4.2.3**	TID prdsrT04
1.10.4.4	Radiation Dose Estimate Method	*<CONTAINER>*	TID prdsrT04
1.10.4.4.1	Radiation Dose Estimate Method Type	(prdsrCD080, DCM, "**Analytical**")	TID prdsrT04
1.10.4.4.2	Dose Estimate Parameters	*<CONTAINER>*	TID prdsrT05

Node	Code Meaning of Concept Name	Code or Example Value	TID
1.10.4.4.2.1	Radiation Dose Estimation Parameter Value	**1.06** ({ratio}, UCUM, "**ratio**")	TID prdsrT05
1.10.4.4.2.1.1	Radiation Dose Estimation Parameter Name	(prdsrCD033, DCM, "**Tissue air ratio**")	TID prdsrT05
1.10.4.4.2.1.2	Radiation Dose Estimate Parameter Type	(prdsrCD128, DCM, "**Conversion factor**")	TID prdsrT05
1.10.4.4.2.2	Radiation Dose Estimation Parameter Value	**31** (cm, UCUM, "**cm**")	TID prdsrT05
1.10.4.4.2.2.1	Radiation Dose Estimation Parameter Name	(prdsrCD008, DCM, "**Patient AP dimension** »)	TID prdsrT05
1.10.4.4.2.2.2	Radiation Dose Estimate Parameter Type	(121206, DCM, "**Distance**")	TID prdsrT05
1.10.4.4.2.3	Radiation Dose Estimation Parameter Value	**74** (cm, UCUM, "**cm**")	TID prdsrT05
1.10.4.4.2.3.1	Radiation Dose Estimation Parameter Name	(prdsrCD009, DCM, "**Patient lateral dimension**")	TID prdsrT05
1.10.4.4.2.3.2	Radiation Dose Estimate Parameter Type	(121206, DCM, "**Distance**")	TID prdsrT05
1.10.4.4.2.4	Radiation Dose Estimation Parameter Value	**0.010536** (/cm, UCUM, "**/Centimeter**")	TID prdsrT05
1.10.4.4.2.4.1	Radiation Dose Estimation Parameter Name	**Linear attenuation coefficient of the table and mattress**	TID prdsrT05
1.10.4.4.2.4.2	Radiation Dose Estimate Parameter Type	(112031, DCM, "**Attenuation Coefficient**")	TID prdsrT05
1.10.4.4.3	Radiation Dose Estimate Method Reference	**DOI:4.2.13.4**	TID prdsrT04
1.10.5	Dose Estimate Representation	*<CONTAINER>*	TID prdsrT03
1.10.5.1	Distribution Model	(prdsrCD085, DCM, "**Skin dose map**")	TID prdsrT03
1.10.5.2	Dose Representation Data	<UID of Secondary Capture>	TID prdsrT03
1.10.5.3	Organ	(T-00009, SRT, "**Skin**")	TID prdsrT03
1.10.5.4	Comment	**2D map of the dose on the deployed skin**	TID prdsrT03
1.10.6	Organ Dose Information	*<CONTAINER>*	TID prdsrT02
1.10.6.1	Organ	(T-00009, SRT, "**Skin**")	TID prdsrT02
1.10.6.2	Comment	**Skin in the area of the chest and neck**	TID prdsrT02
1.10.6.3	Absorbed Dose	**3000** (mGy, UCUM, "**mGy**")	TID prdsrT02
1.10.6.3.1	Derivation	(G-A437, SRT, "**Maximum**")	TID prdsrT02
1.11	Comment	**Skin dose map report**	TID prdsrT01

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XXX.2 Dual-source CT Organ Dose Example

The following example shows the report of the organ dose calculated for a dual-source CT scan, where organ dose from each source individually as well as combined are reported.

The calculation uses a Radiation Dose SR provided by a CT system that has dual x-ray tubes. The Radiation Dose SR is created during the acquisition of Neck DE_CAROTID CT scan of an adult male of 75 kg and 165 cm height.

The dose calculations are performed on the CT system. The dose calculation application generates a P-RDSR document and a Point Cloud containing an image of the dose distribution for the patient model.

The dose calculation application uses the following settings and assumptions:

RDSR Source Data:

- All the Irradiation Event UIDs are used in the calculation of the skin dose map.

Patient Model:

- The Patient model is a stylized anthropomorphic model of the patient.
- Organs are represented by simple geometric shapes described by mathematical equations. The parameters of the equations describing the location, shape and dimension of the organs are stored in a DICOM Instance.
- In this example the gender and age of the patient are used to select the appropriate phantom from the existing phantom library.

Patient Model Registration:

- Instance Image Content-based Alignment between the CT images FOR and the 3D stylized model FOR is used for registration.

Beam Attenuators:

- Additional Aluminum filtration is used in the methodology and the equivalent HVL for the scanner model used in the method is given.

Table XXX.2-1. Dual-source CT Organ Dose Example

Node	Code Meaning of Concept Name	Code or Example Value	TID
1	Patient Radiation Dose Report	*<CONTAINER>*	TID prdsrT01
1.1	Language of Content Item and Descendants	(En, IETF4646, “**English**”)	TID 1204
1.1.1	Country of Language	(CA, ISO3166_1, “**Canada**”)	TID 1204
1.2	Observer Type	(121007, DCM, “**Device”**)	TID 1002
1.3	Device Observer UID	**xxxxx**	TID 1004
1.4	Device Observer Name	**RUMC-xxxxx**	TID 1004
1.5	Device Observer Manufacturer	**Manufacturer X**	TID 1004

Node	Code Meaning of Concept Name	Code or Example Value	TID
1.6	Device Observer Model Name	**Scanner X**	TID 1004
1.7	Dose Estimate Group	*<CONTAINER>*	TID prdsrT02
1.7.1	Dose Estimate Group Name	**Dual-source Neck DE_CAROTID CT scan Tube A**	TID prdsrT02
1.7.2	Source Category	(prdsrCD090, DCM, "**Multi-source estimation**")	TID prdsrT02
1.7.3	Comment	**Tube A only**	TID prdsrT02
1.7.4	Dose Estimation Methodology	*<CONTAINER>*	TID prdsrT04
1.7.4.1	Source Radiation Dose SR	**1.3.12.2.xxxxx**	TID prdsrT04
1.7.4.1.1	Irradiation Event UID	**1.3.12.2.xxxxxx**	TID prdsrT04
1.7.4.2	Patient Dose Model	*<CONTAINER>*	TID prdsrT04
1.7.4.2.1	Patient Model Type	(prdsrCD004, DCM, "**Anthropomorphic**")	TID prdsrT04
1.7.4.2.2	Radiation Transport Model types	(prdsrCD021, DCM, "**Geometric**")	TID prdsrT04
1.7.4.2.3	Patient Model Data	< UID of "**Patient Model Data"**>	TID prdsrT04
1.7.4.2.4	Patient Dose Model Reference	**Cristy et al. 1987**	TID prdsrT04
1.7.4.2.5	Patient Model Demographics	*<CONTAINER>*	TID prdsrT04
1.7.4.2.5.1	Minimum age value used in model	**18 years**	TID prdsrT04
1.7.4.2.5.2	Maximum age value used in model	**18 years**	TID prdsrT04
1.7.4.2.5.3	Patient sex used in the model	**M**	TID prdsrT04
1.7.4.2.5.4	Minimum weight value used in model	**75 kg**	TID prdsrT04
1.7.4.2.5.5	Maximum weight value used In model	**75 kg**	TID prdsrT04
1.7.4.2.5.6	Minimum height value used in model	**165 cm**	TID prdsrT04
1.7.4.2.5.7	Maximum height value used in model	**165 cm**	TID prdsrT04
1.7.4.2.6	Registration of Patient Model with Radiation Dose SR	*<CONTAINER>*	TID prdsrT04
1.7.4.2.6.1	Registration Method	(125024, DCM, "**Image Content-based Alignment**")	TID prdsrT04
1.7.4.2.6.2	Spatial Registration	<UID of "**Spatial Registration**">	TID prdsrT04

Node	Code Meaning of Concept Name	Code or Example Value	TID
1.7.4.3	X-ray Beam Modifier Information	*<CONTAINER>*	TID prdsrT04
1.7.4.3.1	Attenuator Material Category	(113771, DCM, "**X-ray filters**")	TID prdsrT04
1.7.4.3.2	Equivalent Attenuator Material	(prdsrCD067, DCM, "**Composite"**)	TID prdsrT04
1.7.4.3.3	Attenuator Description	**Aluminum**	TID prdsrT04
1.7.4.3.4	Attenuator Thickness	**1.4 mm**	TID prdsrT04
1.7.4.3.5	X-ray Beam Attenuator Model	*<CONTAINER>*	TID prdsrT04
1.7.4.3.5.1	Radiation Transport Model Types	(prdsrCD021, DCM, "**Geometric**")	TID prdsrT04
1.7.4.4	Radiation Dose Estimate Method	*<CONTAINER>*	TID prdsrT04
1.7.4.4.1	Radiation Dose Estimate Method Type	<prdsrCD078, DCM, "**Monte Carlo**")	TID prdsrT04
1.7.4.4.2	Dose Estimate Parameters	*<CONTAINER>*	TID prdsrT05
1.7.4.4.2.1	Radiation Dose Estimation Parameter Value	**8.5** ({mm}, UCUM, "mm")	TID prdsrT05
1.7.4.4.2.1.1	Radiation Dose Estimation Parameter Name	(111634, DCM, "**HVL**")	TID prdsrT05
1.7.4.4.2.1.2	Radiation Dose Estimate Parameter Type	(111634, DCM, "**HVL**")	TID prdsrT05
1.7.4.4.3	Radiation Dose estimate Method Reference	**Simulation package XX version YY**	TID prdsrT04
1.7.5	Dose estimate Representation	*<CONTAINER>*	TID prdsrT03
1.7.5.1	Distribution Model	(prdsrCD096, DCM, "**Point Cloud**")	TID prdsrT03
1.7.5.2	Dose Distribution Data	<UID of "**Dose Distribution Data**">	TID prdsrT03
1.7.5.3	Organ	(T-D0010, SRT, "**Entire Body**")	TID prdsrT03
1.7.6	Organ Dose Information	*<CONTAINER>*	TID prdsrT02
1.7.6.1	Organ	(T-28000, SRT, "**Lung**")	TID prdsrT02
1.7.6.2	Absorbed Dose	**4.8** (mGy, UCUM, "mGy")	TID prdsrT02
1.7.6.2.1	Derivation	(R-00317, SRT, "**Mean**")	TID prdsrT02
1.8	Dose Estimate Group	*<CONTAINER>*	TID prdsrT02
1.8.1	Dose Estimate Group Name	**Dual-source Neck DE_CAROTID CT scan Tube B**	TID prdsrT02
1.8.2	Source Category	(prdsrCD090, DCM, "**Multi-source estimation"**)	TID prdsrT02

Node	Code Meaning of Concept Name	Code or Example Value	TID
1.8.3	Comment	**Tube B only**	TID prdsrT02
1.8.4	Dose Estimation Methodology	*<CONTAINER>*	TID prdsrT04
1.8.4.1	Source Radiation Dose SR	**1.3.12.2.xxxxx**	TID prdsrT04
1.8.4.1.1	Irradiation Event UID	**1.3.12.2.xxxxxx**	TID prdsrT04
1.8.4.2	Patient Dose Model	*<CONTAINER>*	TID prdsrT04
1.8.4.2.1	Patient Model Type	(prdsrCD004, DCM, "**Anthropomorphic**")	TID prdsrT04
1.8.4.2.2	Radiation Transport Model types	(prdsrCD021, DCM, "**Geometric**")	TID prdsrT04
1.8.4.2.3	Patient Model Data	<UID of "**Patient Model Data**" >	TID prdsrT04
1.8.4.2.4	Patient Dose Model Reference	**Cristy et al. 1987**	TID prdsrT04
1.8.4.2.5	Patient Model Demographics	*<CONTAINER>*	TID prdsrT04
1.8.4.2.5.1	Minimum age value used in model	**18 years**	TID prdsrT04
1.8.4.2.5.2	Maximum age value used in model	**18 years**	TID prdsrT04
1.8.4.2.5.3	Patient sex used in the model	**M**	TID prdsrT04
1.8.4.2.5.4	Minimum weight value used in model	**75 kg**	TID prdsrT04
1.8.4.2.5.5	Maximum weight value used In model	**75 kg**	TID prdsrT04
1.8.4.2.5.6	Minimum height value used in model	**165 cm**	TID prdsrT04
1.8.4.2.5.7	Maximum height value used in model	**165 cm**	TID prdsrT04
1.8.4.2.6	Registration of Patient Model with Radiation Dose SR	*<CONTAINER>*	TID prdsrT04
1.8.4.2.6.1	Registration Method	(125024, DCM, "**Image Content-based Alignment**")	TID prdsrT04
1.8.4.2.6.2	Spatial Registration	<UID of "**Spatial Registration**">	TID prdsrT04
1.8.4.3	X-ray Beam Modifier Information	*<CONTAINER>*	TID prdsrT04
1.8.4.3.1	Attenuator Material Category	(113771, DCM, "**X-ray filters**")	TID prdsrT04
1.8.4.3.2	Equivalent Attenuator Material	(prdsrCD067, DCM, "**Composite"**)	TID prdsrT04
1.8.4.3.3	Attenuator Description	**Aluminum**	TID prdsrT04
1.8.4.3.4	Attenuator Thickness	**1.4 mm**	TID prdsrT04

Node	Code Meaning of Concept Name	Code or Example Value	TID
1.8.4.3.5	X-ray Beam Attenuator Model	*<CONTAINER>*	TID prdsrT04
1.8.4.3.5.1	Radiation Transport Model Types	(prdsrCD021, DCM, "**Geometric**")	TID prdsrT04
1.8.4.4	Radiation Dose Estimate Method	*<CONTAINER>*	TID prdsrT04
1.8.4.4.1	Radiation Dose Estimate Method Type	<prdsrCD078, DCM, "**Monte Carlo**")	TID prdsrT04
1.8.4.4.2	Radiation Dose Estimate Parameters	*<CONTAINER>*	TID prdsrT05
1.8.4.4.2.1	Radiation Dose Estimation Parameter Value	**8.5** ({mm}, UCUM, "mm")	TID prdsrT05
1.8.4.4.2.1.1	Radiation Dose Estimation Parameter Name	(111634, DCM, "**HVL**")	TID prdsrT05
1.8.4.4.2.1.2	Radiation Dose Estimate Parameter Type	(111634, DCM, "**HVL**")	TID prdsrT05
1.8.4.4.3	Radiation Dose estimate Method Reference	**Simulation package XX version YY**	TID prdsrT04
1.8.5	Dose estimate Representation	*<CONTAINER>*	TID prdsrT03
1.8.5.1	Distribution Model	(prdsrCD096, DCM, "**Point Cloud**")	TID prdsrT03
1.8.5.2	Dose Distribution Data	<UID of "**Dose Distribution Data**">	TID prdsrT03
1.8.5.3	Organ	(T-D0010, SRT, "**Entire Body**")	TID prdsrT03
1.8.6	Organ Dose Information	*<CONTAINER>*	TID prdsrT02
1.8.6.1	Organ	(T-28000, SRT, "**Lung**")	TID prdsrT02
1.8.6.2	Absorbed Dose	**4.8** (mGy, UCUM, "mGy")	TID prdsrT02
1.8.6.2.1	Derivation	(R-00317, SRT, "**Mean**")	TID prdsrT02
1.9	Dose Estimate Group	*<CONTAINER>*	TID prdsrT02
1.9.1	Dose Estimate Group Name	**Dual-source Neck DE_CAROTID CT scan Tube A&B**	TID prdsrT02
1.9.2	Source Category	(prdsrCD090, DCM, "**Multi-source estimation**")	TID prdsrT02
1.9.3	Comment	**Tube A and B combined**	TID prdsrT02
1.9.4	Dose Estimation Methodology	*<CONTAINER>*	TID prdsrT04
1.9.4.1	Source Radiation Dose SR	**1.3.12.2.xxxxx**	TID prdsrT04
1.9.4.1.1	Irradiation Event UID	**1.3.12.2.xxxxxx**	TID prdsrT04
1.9.4.2	Patient Dose Model	*<CONTAINER>*	TID prdsrT04

Node	Code Meaning of Concept Name	Code or Example Value	TID
1.9.4.2.1	Patient Model Type	(prdsrCD004, DCM, "**Anthropomorphic**")	TID prdsrT04
1.9.4.2.2	Radiation Transport Model types	(prdsrCD021, DCM, "**Geometric**")	TID prdsrT04
1.9.4.2.3	Patient Model Data	< UID of **"Patient Model Data** ">	TID prdsrT04
1.9.4.2.4	Patient Dose Model Reference	**Cristy et al. 1987**	TID prdsrT04
1.9.4.2.5	Patient Model Demographics	*<CONTAINER>*	TID prdsrT04
1.9.4.2.5.1	Minimum age value used in model	**18 years**	TID prdsrT04
1.9.4.2.5.2	Maximum age value used in model	**18 years**	TID prdsrT04
1.9.4.2.5.3	Patient sex used in the model	**M**	TID prdsrT04
1.9.4.2.5.4	Minimum weight value used in model	**75 kg**	TID prdsrT04
1.9.4.2.5.5	Maximum weight value used In model	**75 kg**	TID prdsrT04
1.9.4.2.5.6	Minimum height value used in model	**165 cm**	TID prdsrT04
1.9.4.2.5.7	Maximum height value used in model	**165 cm**	TID prdsrT04
1.9.4.2.6	Registration of Patient Model with Radiation Dose SR	*<CONTAINER>*	TID prdsrT04
1.9.4.2.6.1	Registration Method	(125024, DCM, "**Image Content-based Alignment**")	TID prdsrT04
1.9.4.2.6.2	Spatial Registration	<UID of "**Spatial Registration**">	TID prdsrT04
1.9.4.3	X-ray Beam Modifier Information	*<CONTAINER>*	TID prdsrT04
1.9.4.3.1	Attenuator Material Category	(113771, DCM, "**X-ray filters**")	TID prdsrT04
1.9.4.3.2	Equivalent Attenuator Material	(prdsrCD067, DCM, "**Composite**")	TID prdsrT04
1.9.4.3.3	Attenuator Description	**Aluminum**	TID prdsrT04
1.9.4.3.4	Attenuator Thickness	**1.4 mm**	TID prdsrT04
1.9.4.3.5	X-ray Beam Attenuator Model	*<CONTAINER>*	TID prdsrT04
1.9.4.3.5.1	Radiation Transport Model Types	(prdsrCD021, DCM, "**Geometric**")	TID prdsrT04
1.9.4.4	Radiation Dose Estimate Method	*<CONTAINER>*	TID prdsrT04
1.9.4.4.1	Radiation Dose Estimate Method Type	<prdsrCD078, DCM, "**Monte Carlo**")	TID prdsrT04
1.9.4.4.2	Radiation Dose Estimate Parameters	*<CONTAINER>*	TID prdsrT05

Node	Code Meaning of Concept Name	Code or Example Value	TID
1.9.4.4.2.1	Radiation Dose Estimation Parameter Value	**8.5** ({mm}, UCUM, “mm”)	TID prdsrT05
1.9.4.4.2.1.1	Radiation Dose Estimation Parameter Name	(111634, DCM, “**HVL**”)	TID prdsrT05
1.9.4.4.2.1.2	Radiation Dose Estimate Parameter Type	(111634, DCM, “**HVL**”)	TID prdsrT05
1.9.4.4.3	Radiation Dose estimate Method Reference	**Simulation package XX version YY**	TID prdsrT04
1.9.5	Dose estimate Representation	*<CONTAINER>*	TID prdsrT03
1.9.5.1	Distribution Model	(prdsrCD096, DCM, “**Point Cloud**”)	TID prdsrT03
1.9.5.2	Dose Distribution Data	<UID of “**Dose Distribution Data**”>	TID prdsrT03
1.9.5.3	Organ	(T-D0010, SRT, “**Entire Body**”)	TID prdsrT03
1.9.6	Organ Dose Information	*<CONTAINER>*	TID prdsrT02
1.9.6.1	Organ	(T-28000, SRT, “**Lung**”)	TID prdsrT02
1.9.6.2	Absorbed Dose	**9.6** (mGy, UCUM, “mGy”)	TID prdsrT02
1.9.6.2.1	Derivation	(R-00317, SRT, “**Mean**”)	TID prdsrT02

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