Gestión global de la dosis en TC. Sistema de registro y gestión

–IV Jornada de Protección Radiológica Hospitalaria SARH–

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SOCIEDAD ANDALUZA DE RADIOFÍSICA HOSPITALARIA

sefm SOCIEDAD ESPAÑOLA DE FÍSICA MÉDICA

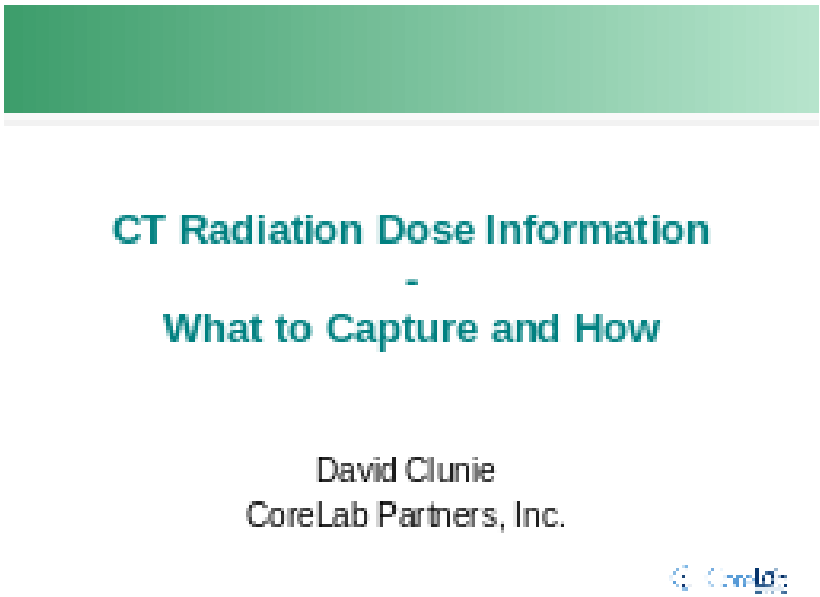
IHE España

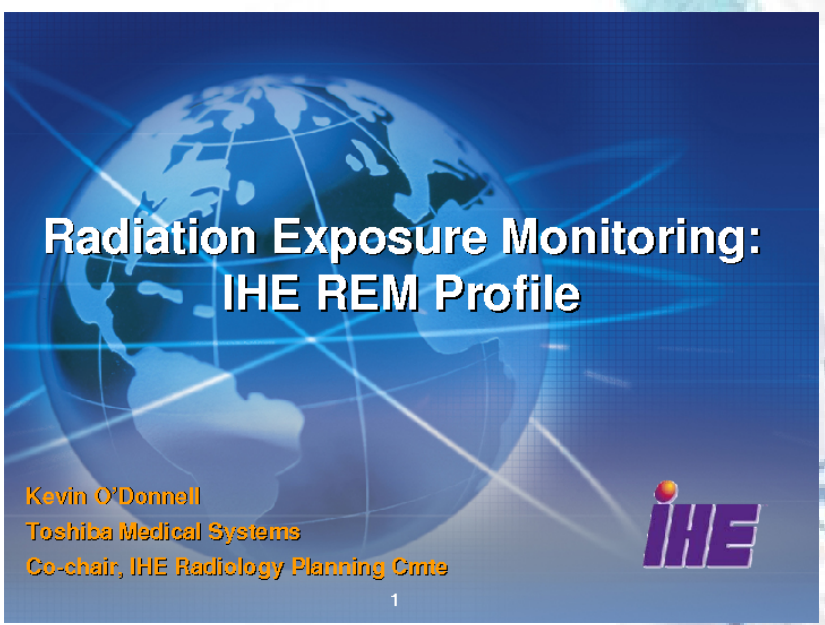
Thanks !

1. Kevin O'Donnell

   &

2. David Clunie



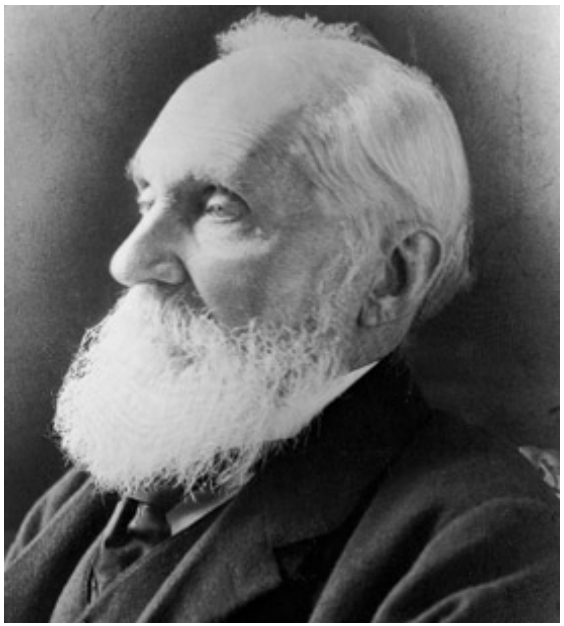


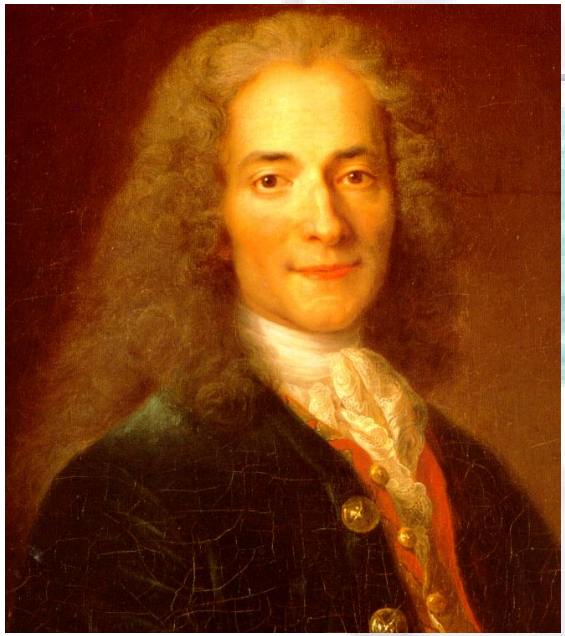
"I think patient dose is improving"

"I think it's getting worse"

Lord Kelvin (William Thomson 1824-1907)

"If you can not measure it, you can not improve it."
1st President of IEC (International Electrotechnical Commission)



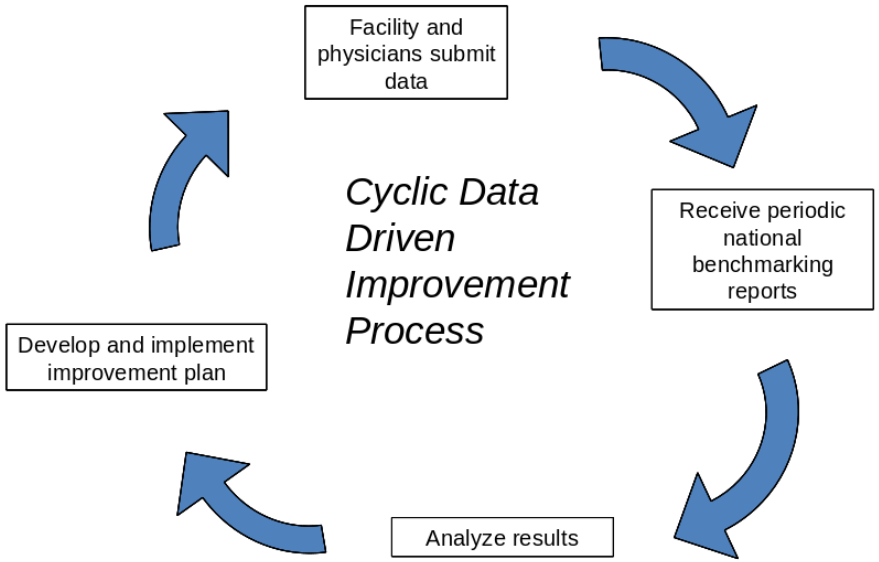


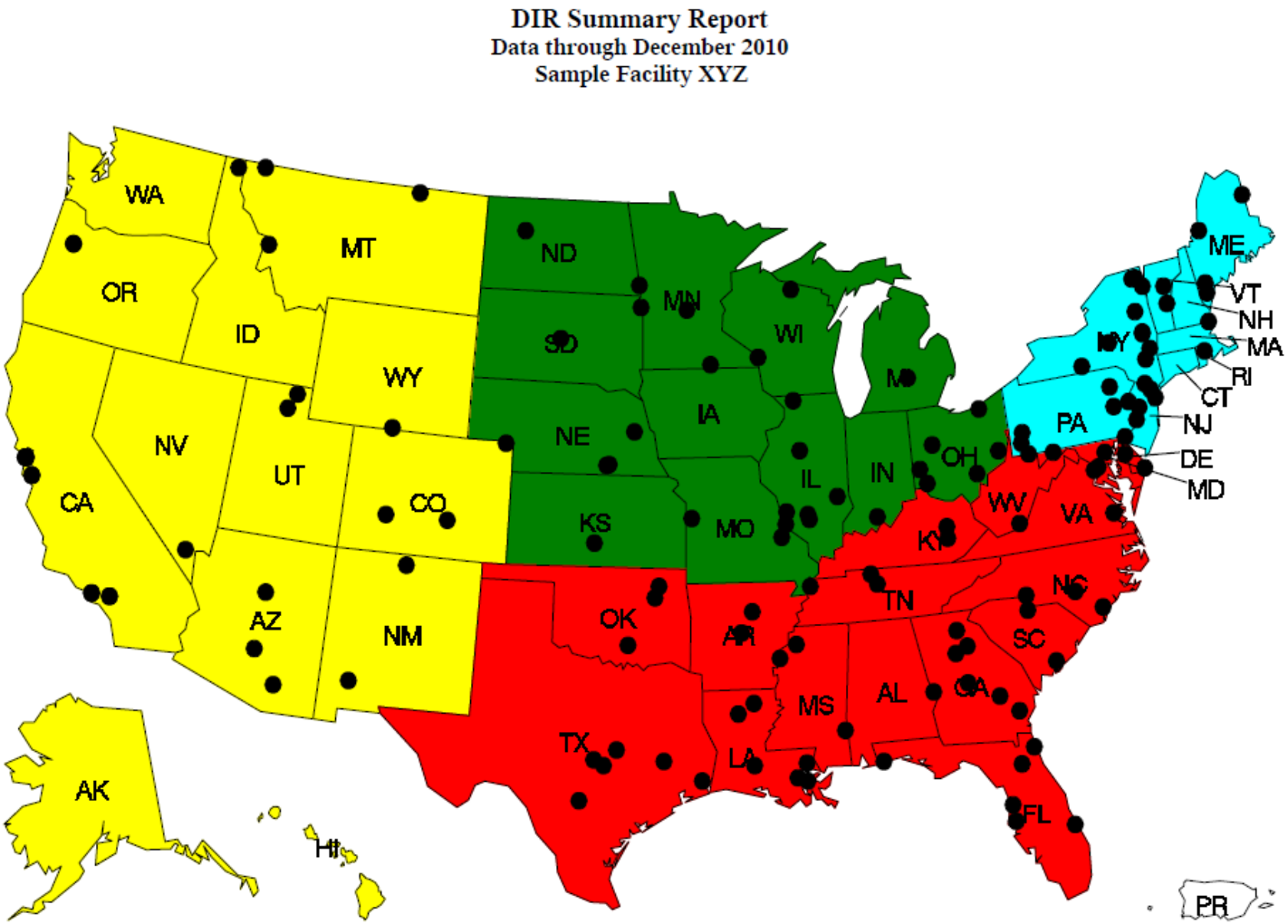
Voltaire (1764)

"The perfect is the enemy of the good."
"Le mieux est l'ennemi du bien."

What is the Dose Index Registry?

- Registry to collect and compare dose index information across facilities
- Uses standard methods of data collection
  - DICOM SR, IHE REM Profile
- Establishes national benchmarks and practice patterns in dose indices




DIR Summary Report
Data through December 2010
Sample Facility XYZ
WA
OR
CA
ID
NV
MT
WY
UT
AZ
CO
NM
ND
SD
NE
KS
MN
IA
MO
WI
IL
MI
IN
OH
KY
WV
VA
TN
NC
SC
GA
AL
MS
AR
LA
OK
TX
FL
PA
NY
ME
VT
NH
MA
RI
CT
NJ
DE
MD
AK
HI
PR

Objectives of patient dosimetry

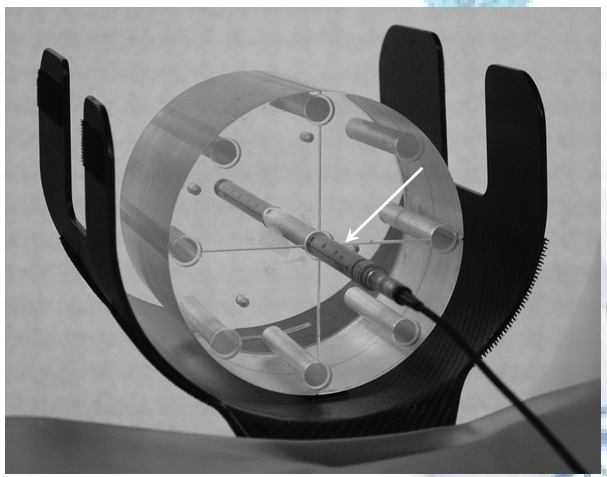
- Monitoring the procedure
  - Important in high dose procedures and high risk patients (paediatrics)
- Risk estimation
  - Individual and population exposure
    - Personal history
    - Regional & national archives
- Quality assurance
  - Procedure optimisaton
  - Comparisons with Reference Levels
  - Comparison with other techniques

- DLP, CTDIvol, kVp, mA, s + Effective Dose (Optional)

Sources & Storage of Data

- Utilization, billing or survey information
  - indication
  - type of procedure
  - age/sex
- National Dose Index Registries
  - type of procedure
  - dose delivered (CTDIvol, Total DLP)
- Institutions' internal databases
  - manual or automated logging
- Longitudinal patient-specific record
  - lifetime record, across institutions
  - part of EHR or separate dose-specific system

- What would be absorbed by a phantom
  - CTDIvol (mGy)
  - DLP (mGy.cm)
- Effect of what was absorbed
  - Effective Dose (mSv)
- What is the additional risk
  - Lifetime Attributable Risk of cancer
- All are estimates, not measured



Output versus Actual

- What the machine output
  - CTDIvol and DLP describe the output of the scanner as if absorbed by a phantom, not measured in the actual patient
- Extrapolation to real patients
  - requires patient size information
  - impact on organs (tissue weighting factors)
  - assumes knowledge of impact on risk

Capture what we can

- Easy to capture
  - per acquisition CTDIvol and DLP
  - total procedure DLP
- Can be captured
  - standard code/term for procedure type
  - standard code/term for anatomy
  - proxies for patient size – height, weight, sex
- Harder to capture
  - actual measures of patient size (localizer?)
  - actual organs exposed and extent (segment images?)

Patient Name: Exam no:

Accession Number:

Patient ID: Discovery CT750 HD

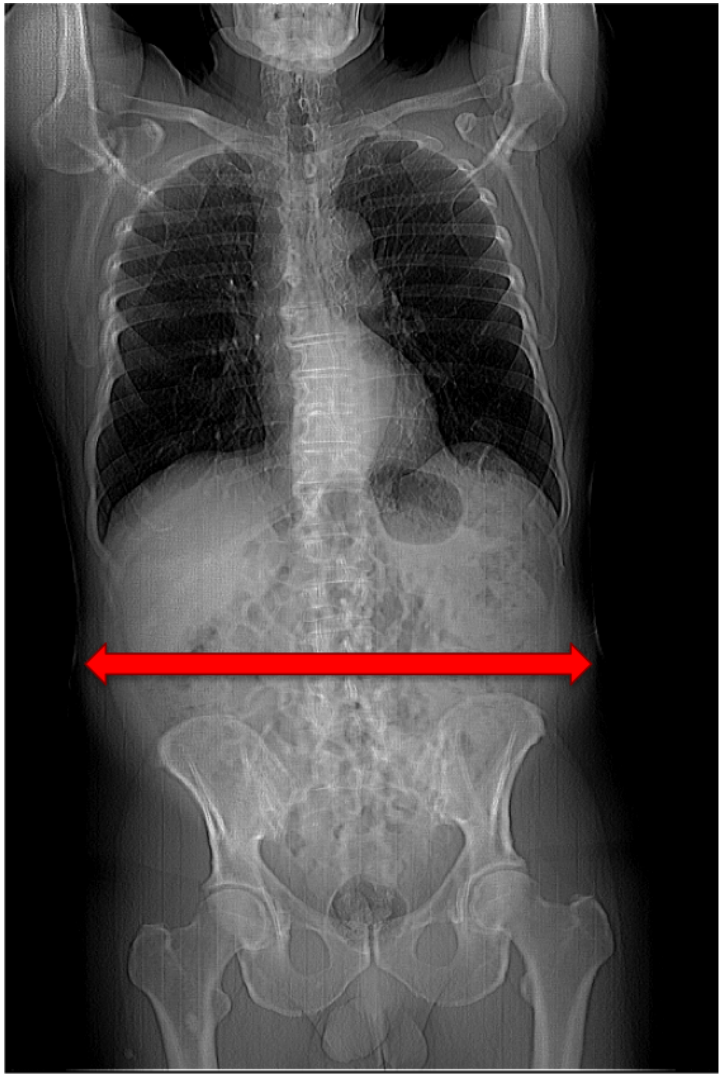
Exam Description: CT HALS/THORAX/ABDOMEN

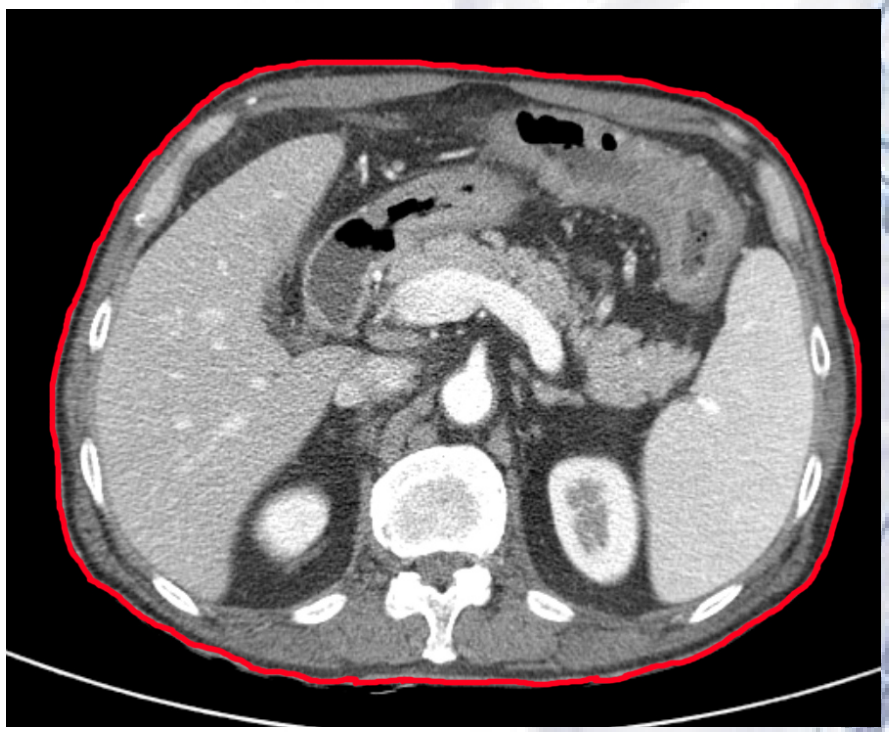
Dose Report

Series	Type	Scan Range (mm)	CTDIvol (mGy)	DLP (mGy-cm)	Phantom cm
1	Scout	-	-	-	-
2	Helical	S15.750-I650.250	5.10	373.00	Body 32
5	Helical	S188.000-I105.000	5.10	182.72	Body 32
			Total Exam DLP:	555.72	

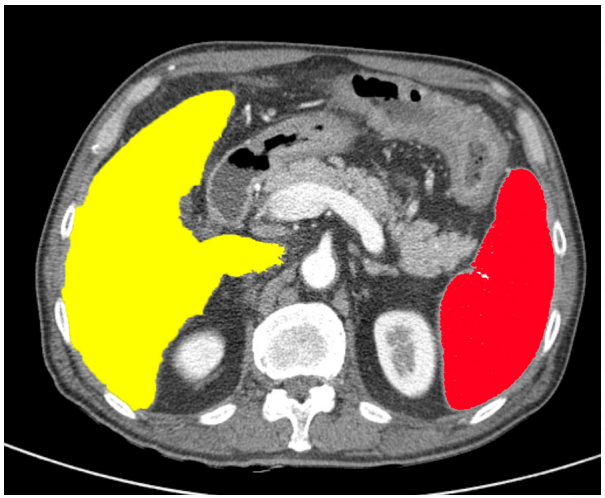
1/1

Size from Localizer or Axial





- Fully automated organ segmentation from axial slices is non-trivial but tractable
- Might be useful for more refined tissue factor weighting based estimates of organ dose or total dose rather than depending on nominal procedure type
- Certainly useful for patient-specific Monte Carlo simulations of dose
- Cannot segment beyond reconstructed images (e.g., over-ranging for helical scans, scatter beyond scan extent), but could be used to scale to fit anthropomorphic phantoms



Dose DICOM sources

- Multiple possible DOSE sources
  - DICOM
    - Image "header"
    - Modality Performed Procedure Step
    - Dose Screen OCR or "header"
    - Radiation Dose Structured Report
  - Other
    - Text Documents (.doc, .pdf, .txt, ...) send by ...
    - Monitoring :)

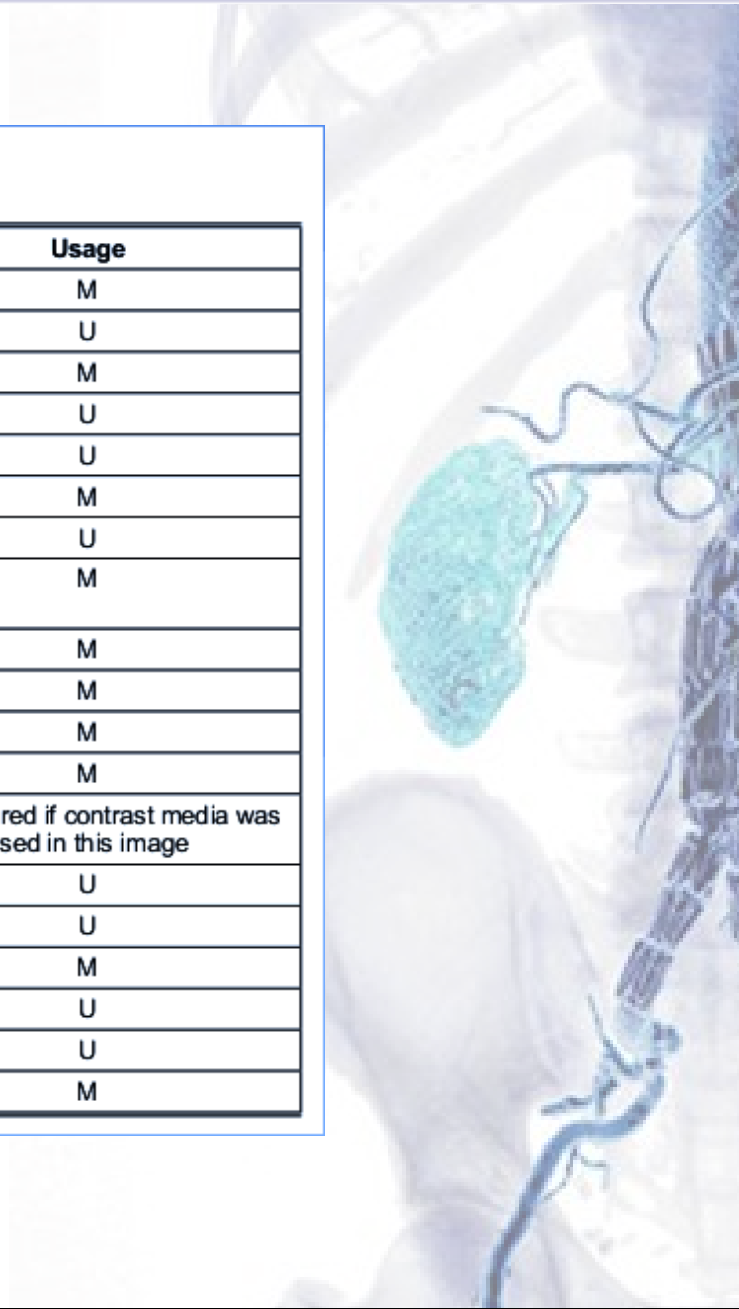
Dose from Modality - Images

- Images are insufficient
  - Technique only
    - kVP,mAs, not usually CTDIvol
    - not DLP, which spans entire acquisition
  - No image ⇒ No dose
  - Multiple reconstructions per exposure.
    More images ⇒ apparently more dose
    - soft tissue and bone reconstructions, MPRs
    - might count more than once
  - Timing of encoding
    - images encoded/sent before acquisition ends

A.3.3 CT Image IOD Module Table

Table A.3-1
CT IMAGE 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
Frame of Reference	Frame of Reference	C.7.4.1	M
Equipment	General Equipment	C.7.5.1	M
Image	General Image	C.7.6.1	M
	Image Plane	C.7.6.2	M
	Image Pixel	C.7.6.3	M
	Contrast/bolus	C.7.6.4	C - Required if contrast media was used in this image
	Device	C.7.6.12	U
	Specimen	C.7.6.22	U
	CT Image	C.8.2.1	M
	Overlay Plane	C.9.2	U
	VOI LUT	C.11.2	U
	SOP Common	C.12.1	M



Dose from Modality - Images

Table C.7-4a
PATIENT STUDY MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Admitting Diagnoses Description	(0008,1080)	3	Description of the admitting diagnosis (diagnoses)
Admitting Diagnoses Code Sequence	(0008,1084)	3	A sequence that conveys the admitting diagnosis (diagnoses). One or more Items may be included in this Sequence.
>Include 'Code Sequence Macro' Table 8.8-1		*No Baseline Context ID is defined.*	
Patient's Age	(0010,1010)	3	Age of the Patient.
Patient's Size	(0010,1020)	3	Length or size of the Patient, in meters.
Patient's Weight	(0010,1030)	3	Weight of the Patient, in kilograms.
Occupation	(0010,2180)	3	Occupation of the Patient.
Additional Patient's History	(0010,21B0)	3	Additional information about the Patient's medical history.
Admission ID	(0038,0010)	3	Identifier of the visit as assigned by the healthcare provider
Issuer of Admission ID Sequence	(0038,0014)	3	Identifier of the Assigning Authority that issued the Admission ID (0038,0010). Only a single Item shall be permitted in this sequence.
>Include HL7v2 Hierarchic Designator Macro Table 10-17			
Service Episode ID	(0038,0060)	3	Identifier of the Service Episode as assigned by the healthcare provider
Issuer of Service Episode ID Sequence	(0038,0064)	3	Identifier of the Assigning Authority that issued the Service Episode ID (0038,0060). Only a single Item shall be permitted in this sequence.
>Include HL7v2 Hierarchic Designator Macro Table 10-17			
Service Episode Description	(0038,0062)	3	Description of the type of service episode.
Patient's Sex Neutered	(0010,2203)	2C	Whether or not a procedure has been performed in an effort to render the patient sterile. Enumerated value:

Dose from Modality - Images

```
# Dicom-File-Format

# Dicom-Meta-Information-Header
# Used TransferSyntax: Little Endian Explicit
(0002,0000) UL 214                                      #   4, 1 FileMetaInformationGroupLength
(0002,0001) OB 00\01                                    #   2, 1 FileMetaInformationVersion
(0002,0002) UI =CTImageStorage                          #  26, 1 MediaStorageSOPClassUID
(0002,0003) UI [1.2.840.113619.2.55.3.1745521693.760.1304509692.396.1] #  54, 1 MediaStorageSOPInstance
JID
(0002,0010) UI =LittleEndianExplicit                    #  20, 1 TransferSyntaxUID
(0002,0012) UI [1.2.276.0.7230010.3.0.3.6.0]            #  28, 1 ImplementationClassUID
(0002,0013) SH [OFFIS_DCMTK_360]                        #  16, 1 ImplementationVersionName
(0002,0016) AE [cthrt16]                                #   8, 1 SourceApplicationEntityTitle

# Dicom-Data-Set
# Used TransferSyntax: Little Endian Explicit
(0008,0000) UL 478                                      #   4, 1 GenericGroupLength
(0008,0005) CS [ISO_IR 100]                             #  10, 1 SpecificCharacterSet
(0008,0008) CS [ORIGINAL\PRIMARY\LOCALIZER]             #  26, 3 ImageType
(0008,0012) DA [20110504]                               #   8, 1 InstanceCreationDate
(0008,0013) TM [140300]                                 #   6, 1 InstanceCreationTime
(0008,0016) UI =CTImageStorage                          #  26, 1 SOPClassUID
(0008,0018) UI [1.2.840.113619.2.55.3.1745521693.760.1304509692.396.1] #  54, 1 SOPInstanceUID
(0008,0020) DA [20110504]                               #   8, 1 StudyDate
(0008,0021) DA [20110504]                               #   8, 1 SeriesDate
(0008,0022) DA [20110504]                               #   8, 1 AcquisitionDate
(0008,0023) DA [20110504]                               #   8, 1 ContentDate
(0008,0030) TM [140244]                                 #   6, 1 StudyTime
(0008,0031) TM [140244]                                 #   6, 1 SeriesTime
(0008,0032) TM [140257.077144]                          #  14, 1 AcquisitionTime
(0008,0033) TM [140300]                                 #   6, 1 ContentTime
(0008,0050) SH (no value available)                     #   0, 0 AccessionNumber
(0008,0060) CS [CT]                                     #   2, 1 Modality
(0008,0070) LO [GE MEDICAL SYSTEMS]                     #  18, 1 Manufacturer
(0008,0080) LO [Virgen de las Nieves H.R.T.]            #  28, 1 InstitutionName
(0008,0090) PN (no value available)                     #   0, 0 ReferringPhysicianName
(0008,1010) SH [cthrt16]                                #   8, 1 StationName
(0008,1030) LO (no value available)                     #   0, 0 StudyDescription
(0008,103e) LO [Scout]                                  #   6, 1 SeriesDescription
(0008,1050) PN (no value available)                     #   0, 0 PerformingPhysicianName
```

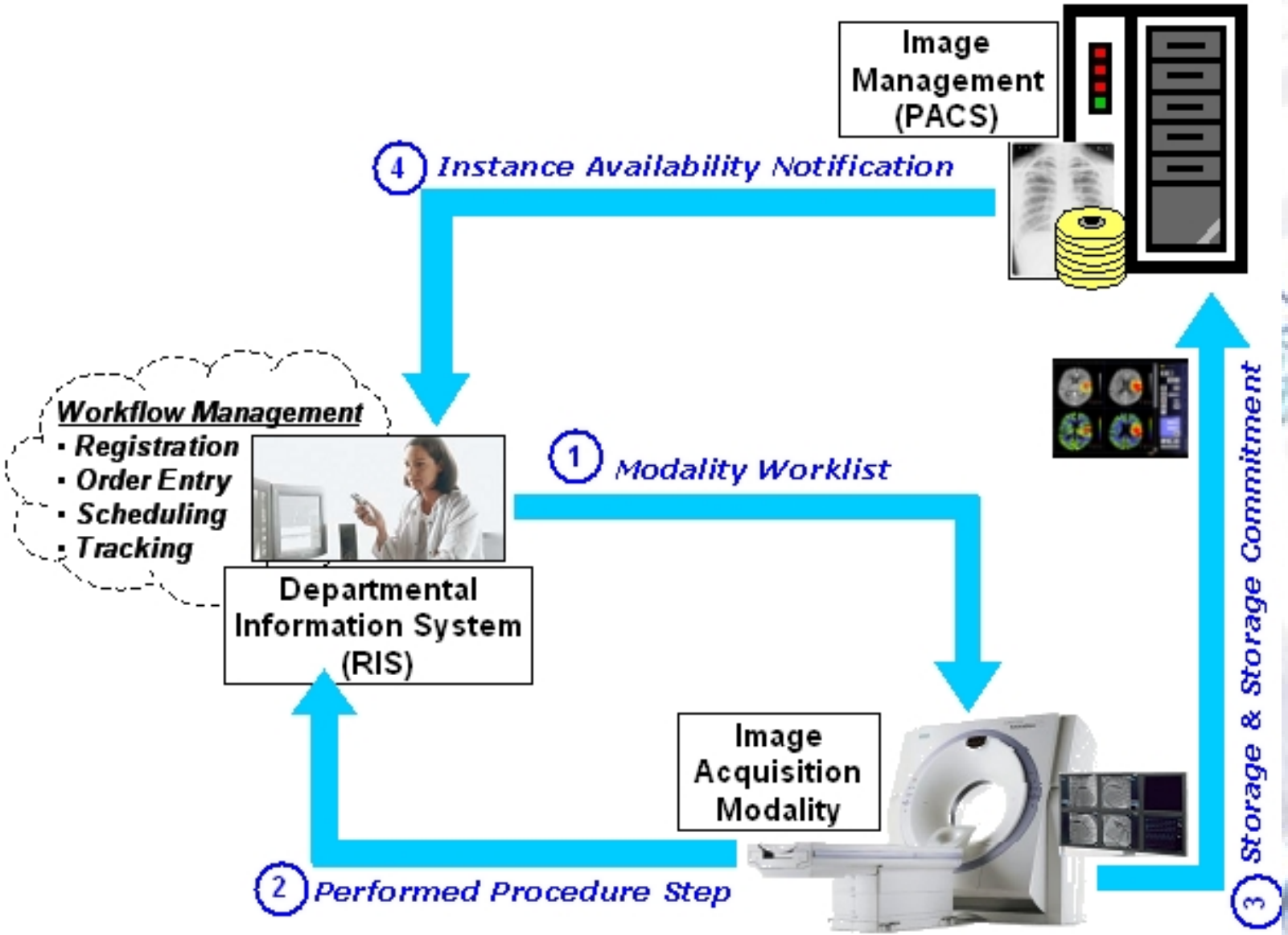
Dose from Modality - Images

```
(0009,1027) SL 1304517764                          #   4, 1 ImageActualDate
(0009,10e3) UI (no value available)                #   0, 0 EquipmentUID
(0010,0000) UL 66                                  #   4, 1 GenericGroupLength
(0010,0010) PN (no value available)                #   0, 0 PatientName
(0010,0020) LO [getest]                            #   6, 1 PatientID
(0010,0030) DA (no value available)                #   0, 0 PatientBirthDate
(0010,0040) CS (no value available)                #   0, 0 PatientSex
(0010,1000) LO (no value available)                #   0, 0 OtherPatientIDs
(0010,1010) AS [000Y]                              #   4, 1 PatientAge
(0010,21b0) LT (no value available)                #   0, 0 AdditionalPatientHistory
(0018,0000) UL 322                                 #   4, 1 GenericGroupLength
(0018,0022) CS [SCOUT MODE]                        #  10, 1 ScanOptions
(0018,0050) DS [280.727277]                        #  10, 1 SliceThickness
(0018,0060) DS [120]                               #   4, 1 KVP
(0018,0088) DS [10.000000]                         #  10, 1 SpacingBetweenSlices
(0018,0090) DS [500.000000]                        #  10, 1 DataCollectionDiameter
(0018,1020) LO [10BW27.7]                          #   8, 1 SoftwareVersions
(0018,1030) LO [1.1 CRANEO RUTINA]                 #  18, 1 ProtocolName
(0018,1100) DS (no value available)                #   0, 0 ReconstructionDiameter
(0018,1110) DS [949.075000]                        #  10, 1 DistanceSourceToDetector
(0018,1111) DS [541.000000]                        #  10, 1 DistanceSourceToPatient
(0018,1120) DS [0.000000]                          #   8, 1 GantryDetectorTilt
(0018,1130) DS [160.000000]                        #  10, 1 TableHeight
(0018,1140) CS [CW]                                #   2, 1 RotationDirection
(0018,1150) IS [2878]                              #   4, 1 ExposureTime
(0018,1151) IS [10]                                #   2, 1 XRayTubeCurrent
(0018,1152) IS [28]                                #   2, 1 Exposure
(0018,1160) SH [BODY FILTER]                       #  12, 1 FilterType
(0018,1170) IS [1200]                              #   4, 1 GeneratorPower
(0018,1190) DS [0.700000]                          #   8, 1 FocalSpots
(0018,1210) SH [STANDARD]                          #   8, 1 ConvolutionKernel
(0018,5100) CS [HFS]                               #   4, 1 PatientPosition
(0019,0000) UL 290                                 #   4, 1 PrivateGroupLength
(0019,0010) LO [GEMS_ACQU_01]                      #  12, 1 PrivateCreator
(0019,1002) SL 912                                 #   4, 1 NumberOfCellsInDetector
(0019,1003) DS [389.750000]                        #  10, 1 CellNumberAtTheta
(0019,1004) DS [1.023900]                          #   8, 1 CellSpacing
(0019,100f) DS [579.500000]                        #  10, 1 HorizontalFrameOfReference
(0019,1011) SS 0                                   #   2, 1 SeriesContrast
(0019,1018) LO [S]                                 #   2, 1 FirstScanRAS
(0019,101a) LO [I]                                 #   2, 1 LastScanRAS
(0019,1023) DS [0.000000]                          #   8, 1 TableSpeed
```

Dose from Modality - MPPS

- Modality Performed Procedure Step (MPPS) is insufficient
  - limited ability to encode complex data
  - transient message to notify the status of the study from the modality to RIS and/or PACS, nor a persistent object
  - cannot be "stored" long term or queried
  - intended to manage scheduling system
  - also not very widely implemented
  - perceived as offering little benefit in addition to work list
  - RIS/PACS can read the information of MMPS and store them in the database, but no rule and no standard that indicate which information should be stored in the database

Dose from Modality - MPPS



MPPS

```
Operation Received = N-CREATE
(some tags are removed for simplicity)

(0008,0060)  : 1 : Modality                          : XA
(0010,0010)  : 1 : Patient's Name                    : XXXXXXXX
(0010,0020)  : 1 : Patient ID                        : YYYYYYYY
(0020,0010)  : 1 : Study ID                          : ART. MESENT. SUP
(0040,0244)  : 1 : Performed Procedure Step Start: 30/05/2006
(0040,0245)  : 1 : Performed Procedure Step Start: 11:30:18
(0040,0250)  : 1 : Performed Procedure Step End D: 30/05/2006
(0040,0251)  : 1 : Performed Procedure Step End T: 13:03:08
(0020,000D)  : 1 : Study Instance UID                :
1.3.46.670589.28.3711508483448.20060530093017670.13850

Operation Received = N-SET
(0018,115E)  : 1 : Image Area Dose Product           : 2391.62
(0040,0250)  : 1 : Performed Procedure Step End D: 30/05/2006
(0040,0251)  : 1 : Performed Procedure Step End T: 13:03:08
(0040,0252)  : 1 : Performed Procedure Step Statu: COMPLETED
(0040,0300)  : 1 : Total Time of Fluoroscopy         : 1330
(0040,0301)  : 1 : Total Number of Exposures         : 70
(0040,0302)  : 1 : Entrance Dose                     : 19
```

"Dose Screens"

- Usually no explicit dose information
  - just technique (kVP, mA, etc.)
  - scanner-specific dosimetry efforts (ImPACT)
- Human-readable "dose screens"
  - CTDIvol and DLP per series & total DLP
  - not (generally) machine-readable
  - can use Optical Character Recognition (OCR)

Dose Screen - GE

Patient Name: Exam no:

Accession Number:

Patient ID: Discovery CT750 HD

Exam Description: CT HALS/THORAX/ABDOMEN

Dose Report

Series	Type	Scan Range (mm)	CTDIvol (mGy)	DLP (mGy-cm)	Phantom cm
1	Scout	-	-	-	-
2	Helical	S15.750-I650.250	5.10	373.00	Body 32
5	Helical	S188.000-I105.000	5.10	182.72	Body 32
			Total Exam DLP:	555.72	

1/1

Key Fields to Extract

Patient Name: Exam no:
Accession Number:
Patient ID: Discovery CT750 HD
Exam Description: CT HALS/THORAX/ABDOMEN

Dose Report

Series	Type	Scan Range (mm)	CTDIvol (mGy)	DLP (mGy-cm)	Phantom cm
1	Scout	-	-	-	-
2	Helical	S15.750-I650.250	5.10	373.00	Body 32
5	Helical	S188.000-I105.000	5.10	182.72	Body 32
			Total Exam DLP:	555.72	

1/1

Additional Fields to Extract

Patient Name: Exam no:

Accession Number:

Patient ID: Discovery CT750 HD

Exam Description: CT HALS/THORAX/ABDOMEN

Dose Report

Series	Type	Scan Range (mm)	CTDIvol (mGy)	DLP (mGy-cm)	Phantom cm
1	Scout	-	-	-	-
2	Helical	S15.750-I650.250	5.10	373.00	Body 32
5	Helical	S188.000-I105.000	5.10	182.72	Body 32
			Total Exam DLP:	555.72	

1/1

Available from "Header"

Patient Name: Exam no:
Accession Number:
Patient ID: Discovery CT750 HD
Exam Description: CT HALS/THORAX/ABDOMEN

Dose Report

Series	Type	Scan Range (mm)	CTDIvol (mGy)	DLP (mGy-cm)	Phantom cm
1	Scout	-	-	-	-
2	Helical	S15.750-I650.250	5.10	373.00	Body 32
5	Helical	S188.000-I105.000	5.10	182.72	Body 32
			Total Exam DLP:	555.72	

1/1

Dose Screen - Siemens

15-Jul-20

Ward:
Physician:
Operator:

Total mAs 15323 Total DLP 1601 mGy*cm

	Scan	KV	mAs / ref.	CTDIvol mGy	DLP mGy*cm	TI s	cSL mm
Patient Position H-SP							
AP Scout	1	120	36 mA			2.7	0.6
Lateral Scout	2	120	36 mA			2.7	0.6
CCS	3D	120	150	8.49	122	0.2	3.0
Last scan no.	10						
PreMonitoring	11	120	20	0.90	1	0.33	10.0
I.V. Bolus							
Monitoring	12	120	20	9.73	10	0.33	10.0
Last scan no.	22						
Coronary Angio	23D	120	350	91.74	1468	0.33	0.6

Key Fields to Extract

15-Jul-20

Ward:
Physician:
Operator:

Total mAs 15323 Total DLP 1601 mGy*cm

	Scan	kV	mAs / ref.	CTDIvol mGy	DLP mGy*cm	TI s	cSL mm
Patient Position H-SP							
AP Scout	1	120	36 mA			2.7	0.6
Lateral Scout	2	120	36 mA			2.7	0.6
CCS	3D	120	150	8.49	122	0.2	3.0
Last scan no.	10						
PreMonitoring	11	120	20	0.90	1	0.33	10.0
I.V. Bolus							
Monitoring	12	120	20	9.73	10	0.33	10.0
Last scan no.	22						
Coronary Angio	23D	120	350	91.74	1468	0.33	0.6

Additional Fields to Extract

15-Jul-20

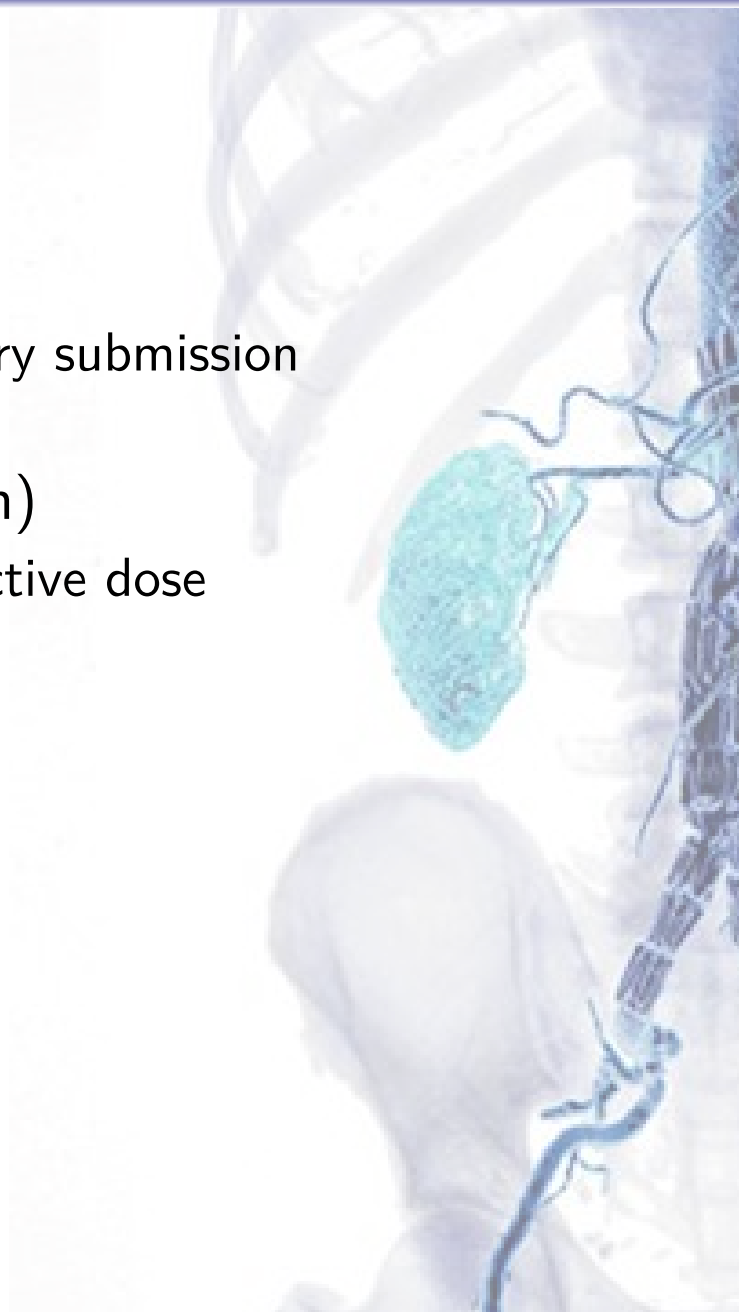
Ward:
Physician:
Operator:

Total mAs 15323 Total DLP 1601 mGy*cm

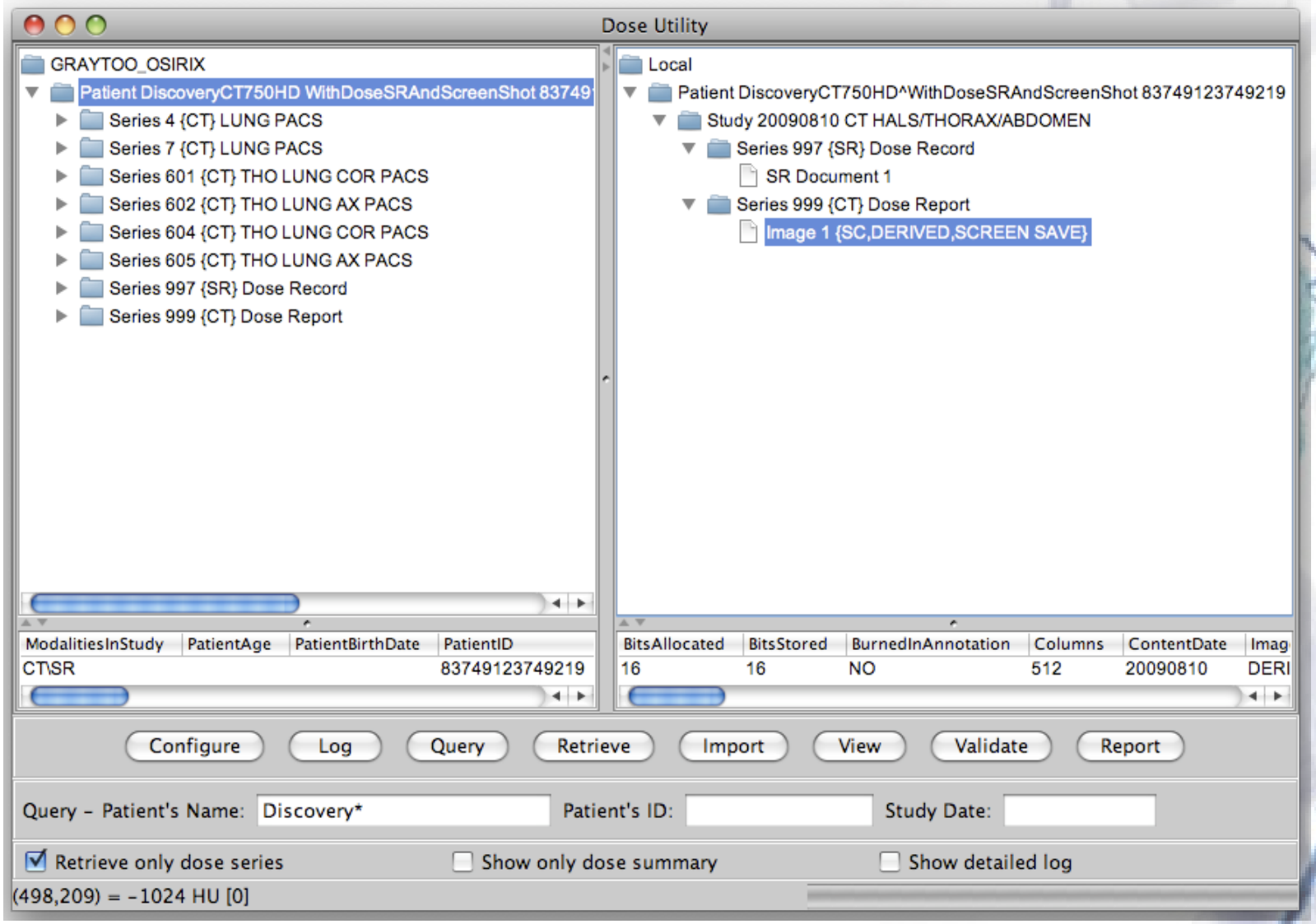
	Scan	KV	mAs / ref.	CTDIvol mGy	DLP mGy*cm	TI s	cSL mm
Patient Position H-SP							
AP Scout	1	120	36 mA			2.7	0.6
Lateral Scout	2	120	36 mA			2.7	0.6
CCS	3D	120	150	8.49	122	0.2	3.0
Last scan no.	10						
PreMonitoring	11	120	20	0.90	1	0.33	10.0
I.V. Bolus							
Monitoring	12	120	20	9.73	10	0.33	10.0
Last scan no.	22						
Coronary Angio	23D	120	350	91.74	1468	0.33	0.6

- Query and retrieval of dose screens
- Extracting sufficient information
  - matching against actual series
  - information from reconstructed images
  - extracting anatomy and procedure
  - extracting phantom information
  - extracting scanning range
  - establishing scope of accumulation
  - absence of an Irradiation Event UID
- No coded anatomy information present
  - legacy scanner consoles
    - no place to select anatomy from standard list
    - not available from Modality Work List (MWL)
    - not copied from protocols
  - so Body Part Examined and Anatomic Region Sequence usually empty or absent
- Attempt to parse plain text
  - challenging across multiple languages
  - abbreviations and punctuation are problematic
    - C/A/P versus CAP versus Chest/Abdomen/Pelvis

- PixelMed (open source, D. Clunie)
  - OCR, toolkit, utilities, services, registry submission
  - http://www.pixelmed.com/
- Radiance (open source, T, Cook UPenn)
  - dose management system, OCR, effective dose
  - http://radiancedose.com
- Valkyrie (G. Shih, Weill-Cornell)
  - unknown
  - Google "Valkyrie George Shih"
  - http://www.weillcornell.org/gshih/



Dose Utility Prototype



Dose Utility Prototype

Patient Name: Exam no:
Accession Number:
Patient ID: Discovery CT750 HD
Exam Description: CT HALS/THORAX/ABDOMEN

Dose Report

Series	Type	Scan Range (mm)	CTDIvol (mGy)	DLP (mGy-cm)	Phantom cm
1	Scout	-	-	-	-
2	Helical	S15.750-I650.250	5.10	373.00	Body 32
5	Helical	S188.000-I105.000	5.10	182.72	Body 32
			Total Exam DLP:	555.72	

1/1

Reporting started
Dose 2009/08/10 13:03:28 CT CT HALS/THORAX/ABDOMEN DLP Total=555.72 mGycm
Series=2 Helical S15.750-I650.250 mm 5.10 mGy 373.00 mGycm BODY32
Series=5 Helical S188.000-I105.000 mm 5.10 mGy 182.72 mGycm BODY32
Reporting complete

Clear

Dose Utility Prototype

Patient Name: Exam no:
Accession Number:
Patient ID: Discovery CT750 HD
Exam Description: CT HALS/THORAX/ABDOMEN

Dose Report

Series	Type	Scan Range (mm)	CTDIvol (mGy)	DLP (mGy-cm)	Phantom cm
1	Scout	-	-	-	-
2	Helical	S15.750-I650.250	5.10	373.00	Body 32
5	Helical	S188.000-I105.000	5.10	182.72	Body 32
		Total Exam DLP:		555.72	

1/1

Reporting started
Dose 2009/08/10 13:03:28 CT CT HALS/THORAX/ABDOMEN DLP Total=555.72 mGycm
Series=2 Helical S15.750-I650.250 mm 5.10 mGy 373.00 mGycm BODY32
Series=5 Helical S188.000-I105.000 mm 5.10 mGy 182.72 mGycm BODY32
Reporting complete

Clear

Radiation Dose Structured Report

- persistent document-like object
- store to PACS, RIS, XDS, CD media
- extensible coded structured content
- similar to other DICOM "evidence document" structured content like measurements
- allows transfer and addition of more content
- contains aggregate and per event exposure
- contains detailed technique description

CT RADIATION DOSE SR IOD TEMPLATES

The templates that comprise the CT Radiation Dose SR are interconnected as in Figure A-12

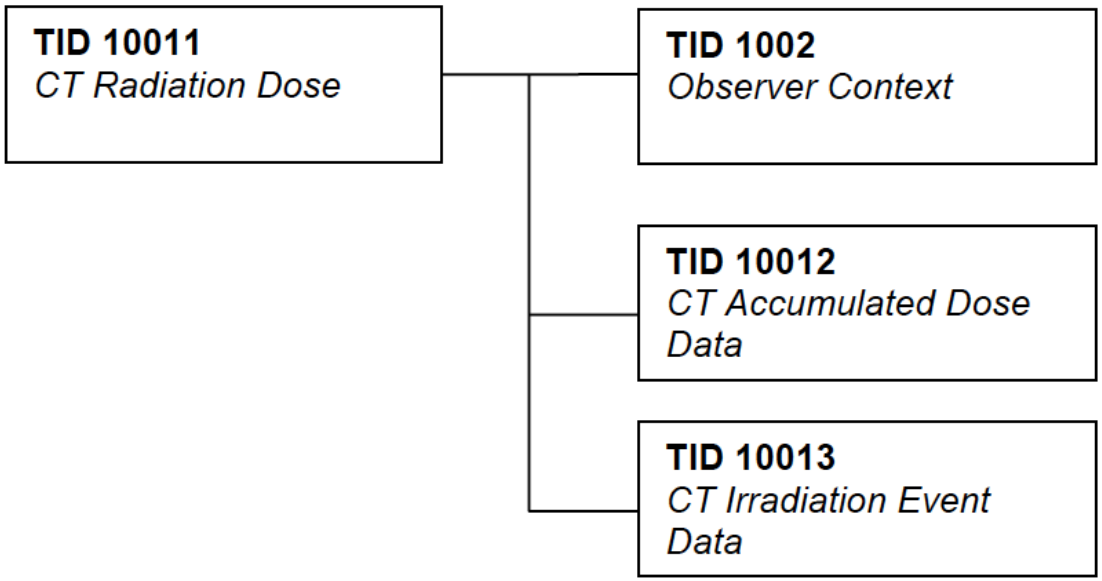


Figure A-12: CT Radiation Dose SR IOD Template Structure

PS 3.16-2009

Digital Imaging and Communications in Medicine (DICOM)

Part 16: Content Mapping Resource

- Standard -

TID 10011
CT RADIATION DOSE
Type: Extensible

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (113701, DCM, "X-ray Radiation Dose Report")	1	M		
2	>	HAS CONCEPT MOD	CODE	EV (121058, DCM, "Procedure reported")	1	M		EV (P5-08000,SRT, "Computed Tomography X-ray")
3	>>	HAS CONCEPT MOD	CODE	EV (G-C0E8, SRT, "Has Intent")	1	M		DCID (3629) Procedure Intent
4	>		INCLUDE	DTID (1002) Observer Context	1-n	M		
5	>	HAS OBS CONTEXT	DATETIME	EV (113809, DCM, "Start of X-ray Irradiation")	1	M		
6	>	HAS OBS CONTEXT	DATETIME	EV (113810, DCM, "End of X-ray Irradiation")	1	M		

- Standard -

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7	>	HAS OBS CONTEXT	CODE	EV (113705, DCM, "Scope of Accumulation")	1	M		DCID (10000) Scope of Accumulation
8	>>	HAS PROPERTIES	UIDREF	DCID (10001) UID Types	1	M		
9	>	CONTAINS	INCLUDE	DTID (10012) CT Accumulated Dose Data	1	M		
10	>	CONTAINS	INCLUDE	DTID (10013) CT Irradiation Event Data	1-n	M		
11	>	CONTAINS	TEXT	EV (121106, DCM, "Comment")	1	U		

CT ACCUMULATED DOSE DATA
Type: Extensible

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (113811, DCM, "CT Accumulated Dose Data")	1	M		
2	>	CONTAINS	NUM	EV (113812, DCM, "Total Number of Irradiation Events")	1	M		Units = EV ({events} UCUM, "events")
3	>	CONTAINS	NUM	EV (113813, DCM, "CT Dose Length Product Total")	1	M		Units = EV (mGycm, UCUM, "mGycm")

- Standard -

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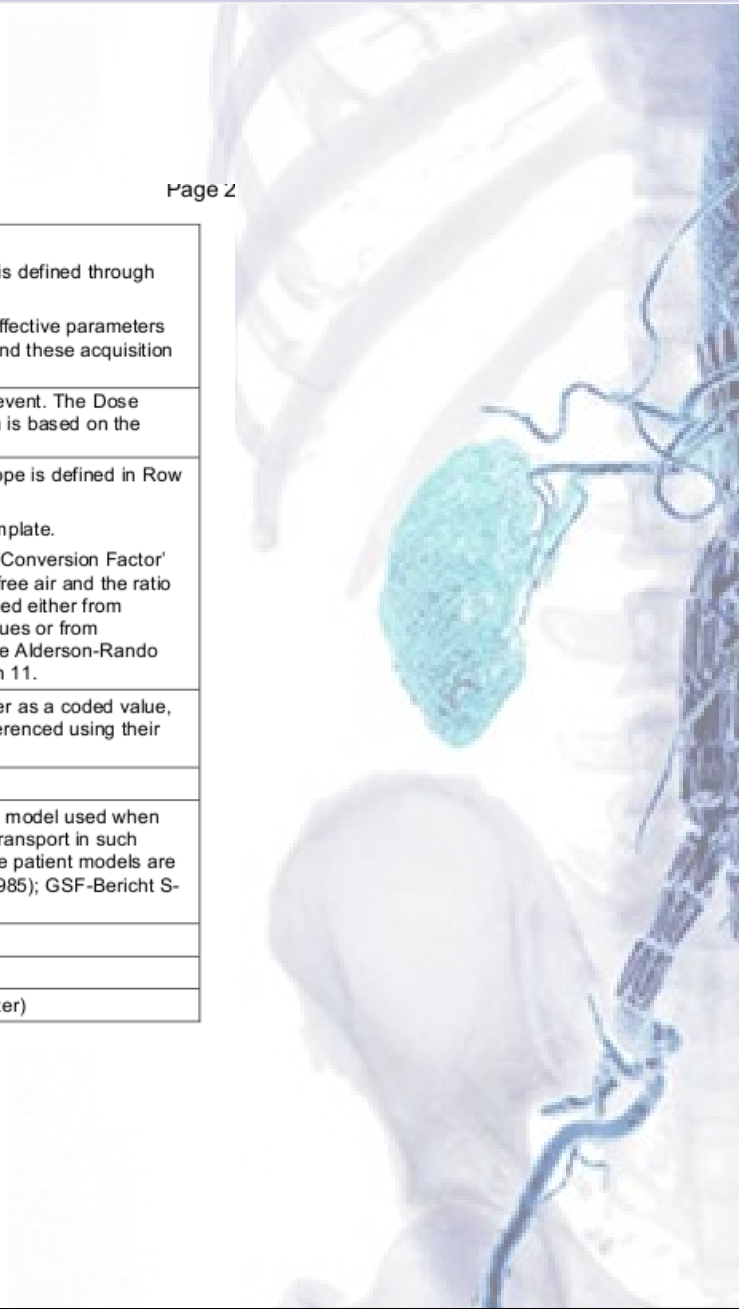
4	>	CONTAINS	NUM	EV (113814, DCM, "CT Effective Dose Total")	1	U		Units = EV (mSv, UCUM, "mSv")
5	>>	HAS PROPERTIES	TEXT	EV (121406,DCM, "Reference Authority")	1	MC	XOR row 6	
6	>>	HAS PROPERTIES	CODE	EV (121406,DCM, "Reference Authority")	1	MC	XOR row 5	DCID (10015) CT Dose Reference Authority
7	>>	HAS CONCEPT MOD	CODE	EV (G-C036,SRT, "Measurement Method")	1	M		DCID (10011) Effective Dose Evaluation Method
8	>>	HAS PROPERTIES	TEXT	EV (113815,DCM, "Patient Model")	1	MC	IF the value of row 7 equals (113800, DCM, "DLP to E conversion via MC computation") or equals (113801, DCM, "CTDIfreeair to E conversion via MC computation")	
9	>>	HAS PROPERTIES	CONTAINER	EV (113816, DCM, "Condition Effective Dose measured")	1	MC	IF the value of row 7 equals (113802, DCM, "DLP to E conversion via measurement") or equals (113803, DCM, "CTDIfreeair to E conversion via measurement")	

Row 2	Total Number of CT irradiation events . A CT irradiation event is one continuous irradiation procedure and is defined through consistent acquisition parameters. In the case of dose modulation the calculations are based on the effective parameters (e.g. the effective mA recorded in the Mean X-ray Tube Current), and these acquisition parameters are consistent.
Row 3	The Dose Length Product (DLP) is calculated for every irradiation event. The Dose Length Product Total is the sum of the DLP values. The calculation is based on the $CTDI_{vol}$ result of each irradiation event.
Row 4	Effective dose (E, in units of mSv) evaluated as a total over the scope is defined in Row 6 of template TID 10011. Effective dose is defined by the reference in Rows 5 or 6 of this template. It may be calculated from a product of DLP and an 'Effective Dose Conversion Factor' (E/DLP). Or it may be calculated from a product of the Mean CTDIfree air and the ratio E/CTDIfree air. The ratios E/DLP or E/CTDIfree air may be evaluated either from computer simulations applying Monte Carlo (MC) sampling techniques or from dosimetric measurements in an anthropomorphic phantom, e.g., the Alderson-Rando phantom.. The specific method used is identified in Rows 7 through 11.
Row 5 - 6	Reference of the base publication defining the Effective Dose, either as a coded value, or a textual bibliographic reference. ICRP Publications shall be referenced using their assigned coded values.
Row 7	Description of the method used for Effective Dose evaluations.
Row 8	Description of the reference-patient mathematical or computational model used when Effective Dose is derived via Monte Carlo simulations of radiation transport in such models. Examples of publications which specify particular reference patient models are NUREG/CR-1159, ORNL/NUREG/TM-367 (1980); NRPB-R186 (1985); GSF-Bericht S-885 (1986); Fill et al., Health Physics Vol. 86 (3): 253-272 (2004).
Row 9	Description of the condition Effective Dose measured
Row 10	Type of Effective Dose phantom used, e.g. Alderson-Rando
Row 11	Type of dosimeter used, e.g. TLD (Thermo Luminescence Dosimeter)

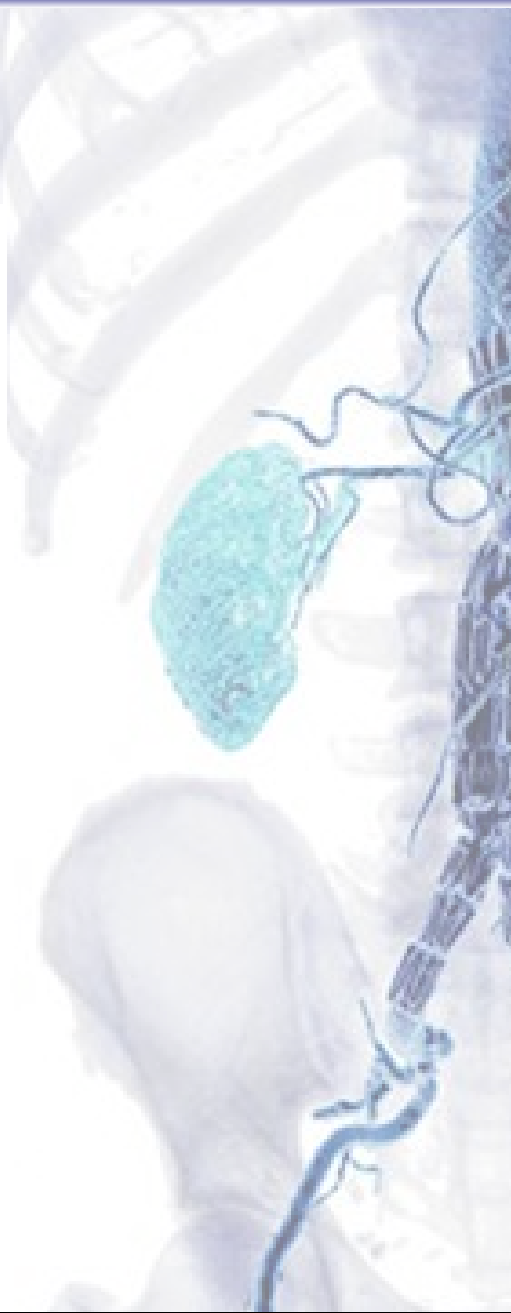


Radiation Dose Structured Report

TID 10013
CT IRRADIATION EVENT DATA
Type: Extensible

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (113819, DCM, "CT Acquisition")	1	M		
2	>	CONTAINS	TEXT	EV (125203, DCM, "Acquisition Protocol")	1	U		
3	>	CONTAINS	CODE	EV (123014 , DCM, "Target Region")	1	M		DCID (4030) CT and MR Anatomy Imaged
4	>	CONTAINS	CODE	EV (113820, DCM, "CT Acquisition Type")	1	M		DCID (10013) CT Acquisition Types
5	>	CONTAINS	CODE	EV (G-C32C, SRT, "Procedure Context")	1	U		DCID (10014) Contrast Imaging Technique
6	>	CONTAINS	UIDREF	EV (113769, DCM, "Irradiation Event UID")	1	M		
7	>	CONTAINS	CONTAINER	EV (113822, DCM, "CT Acquisition Parameters")	1	M		
8	>>	CONTAINS	NUM	EV (113824, DCM, "Exposure Time")	1	M		Units = EV (s, UCUM, "s")
9	>>	CONTAINS	NUM	EV (113825, DCM, "Scanning Length")	1	M		Units = EV (mm, UCUM, "mm")
10	>>	CONTAINS	NUM	EV (113826, DCM, "Nominal Single Collimation Width")	1	M		Units = EV (mm, UCUM, "mm")
11	>>	CONTAINS	NUM	EV (113827, DCM, "Nominal Total Collimation Width")	1	M		Units = EV (mm, UCUM, "mm")
12	>>	CONTAINS	NUM	EV (113828, DCM, "Pitch Factor")	1	MC	IF row 4 equals (P5-08001, SRT, "Spiral Acquisition") or equals (113804, DCM, "Sequenced Acquisition")	Units = EV ({ratio}, UCUM, "ratio")
13	>>	CONTAINS	NUM	EV (113823, DCM, "Number of X-ray Sources")	1	M		Units = EV ({X-ray sources}, UCUM, "X-ray sources")
14	>>	CONTAINS	CONTAINER	EV (113831, DCM, "CT X-ray Source Parameters")	1-n	M		
15	>>>	CONTAINS	TEXT	EV (113832, DCM, "Identification Number of the X-ray Source")	1	M		
16	>>>	CONTAINS	NUM	EV (113733, DCM, "KVP")	1	M		Units = EV (kV, UCUM, "kV")

21	>	CONTAINS	CONTAINER	EV (113829, DCM, "CT Dose")	1	MC	IF row 4 does not equal (113805, DCM, "Constant Angle Acquisition")	
22	>>	CONTAINS	NUM	EV (113830, DCM, "Mean CTDIvol ")	1	M		Units = EV (mGy, UCUM, "mGy")
23	>>	CONTAINS	CODE	EV (113835, DCM, "CTDIw Phantom Type")	1	M		DCID (4052) Phantom Devices
24	>>	CONTAINS	NUM	EV (113836, DCM, "CTDIfreeair Calculation Factor")	1	U		Units = EV (mGy/mAs, UCUM, "mGy/mAs")
25	>>	CONTAINS	NUM	EV (113837, DCM, "Mean CTDIfreeair")	1	U		Units = EV (mGy, UCUM, "mGy")
26	>>	CONTAINS	NUM	EV (113838, DCM, "DLP")	1	M		Units = EV (mGycm, UCUM, "mGycm")
27	>>	CONTAINS	NUM	EV (113839, DCM, "Effective Dose")	1	U		Units = EV (mSv, UCUM, "mSv")
28	>>>	HAS CONCEPT MOD	CODE	EV (G-C036, SRT, "Measurement Method")	1	MC	IF row 27 is present	DCID (10011) "Effective Dose Evaluation Method")
29	>>>>	HAS PROPERTIES	NUM	EV (113840, DCM, "Effective Dose Conversion Factor")	1	MC	IF row 28 is present and equals (113800, DCM, "DLP to E conversion via MC computation") or equals (113802, DCM, "DLP to E conversion via measurement")	Units = EV (mSv/mGycm, UCUM, "mSv/mGycm")
30	>	CONTAINS	TEXT	EV (113842, DCM, "X-ray Modulation Type")	1	U		
31	>	CONTAINS	TEXT	EV (121106, DCM, "Comment")	1	U		
32	>	CONTAINS	INCLUDE	DTID (1020) Person Participant	1-n	U		$PersonProcedureRole = EV (113851, DCM, "Irradiation Administering")
33	>	CONTAINS	INCLUDE	DTID (1021) Device Participant	1	M		$DeviceProcedureRole = EV (113859, DCM, "Irradiating Device")



Radiation Dose Structured Report

- : CONTAINER: X-Ray Radiation Dose Report [SEPARATE] (DCMR,10011)
  - HAS CONCEPT MOD: CODE: Procedure reported = Computed Tomography X-ray
    - HAS CONCEPT MOD: CODE: Has Intent = Diagnostic Intent
  - HAS OBS CONTEXT: CODE: Observer Type = Device
  - HAS OBS CONTEXT: TEXT: Device Observer Name = ilqhfaatc1ws444
  - HAS OBS CONTEXT: TEXT: Device Observer Manufacturer = Philips
  - HAS OBS CONTEXT: TEXT: Device Observer Model Name = Brilliance 64
  - HAS OBS CONTEXT: TEXT: Device Observer Physical Location During Observation = PMSTL
  - HAS OBS CONTEXT: DATETIME: Start of X-ray Irradiation = 20100422162839.030
  - HAS OBS CONTEXT: CODE: Scope of Accumulation = Study
    - HAS PROPERTIES: UIDREF: Study Instance UID = 1.2.840.113704.1.111.6084.1271942101.12
  - CONTAINS: CONTAINER: CT Accumulated Dose Data [SEPARATE]
    - CONTAINS: NUM: Total Number of Irradiation Events = 2 events
    - CONTAINS: NUM: CT Dose Length Product Total = 19.67375 mGycm
  - CONTAINS: CONTAINER: CT Acquisitions [SEPARATE]
  - CONTAINS: CONTAINER: CT Acquisitions [SEPARATE]
    - CONTAINS: CODE: Acquisition Type = Sequenced Acquisition
    - CONTAINS: CODE: Procedure Context = CT without contrast
    - CONTAINS: UIDREF: Irradiation Event UID = 1.2.840.113704.1.111.6084.1271942101.12.2
    - CONTAINS: CONTAINER: CT Acquisition Parameters [SEPARATE]
      - CONTAINS: NUM: Exposure Time = 4254 s
      - CONTAINS: NUM: Scanning Length = 10 mm
      - CONTAINS: NUM: Nominal Single Collimator Width = 0.625 mm
      - CONTAINS: NUM: Nominal Total Collimator Width = 1.25 mm
      - CONTAINS: NUM: Number of X-ray Sources = 1 X-ray sources
      - CONTAINS: CONTAINER: CT X-ray Source Parameters [SEPARATE]
    - CONTAINS: CONTAINER: CT Dose [SEPARATE]
      - CONTAINS: NUM: Mean CTDIvol = 1.3978125 mGy
      - CONTAINS: CODE: CTDIw Phantom Type = IEC Body Dosimetry Phantom
      - CONTAINS: NUM: DLP = 16.77375 mGycm
    - CONTAINS: CODE: Device Role in Procedure = Irradiating Device
      - HAS PROPERTIES: TEXT: Device Manufacturer = Philips
      - HAS PROPERTIES: TEXT: Device Model Name = Brilliance 64
  - CONTAINS: CODE: Source of Dose Information = Automated Data Collection

Radiation Dose Structured Report

- : CONTAINER: X-Ray Radiation Dose Report [SEPARATE] (DCMR,10011)
  - HAS CONCEPT MOD: CODE: Procedure reported = Computed Tomography X-ray
    - HAS CONCEPT MOD: CODE: Has Intent = Diagnostic Intent
  - HAS OBS CONTEXT: CODE: Observer Type = Device
  - HAS OBS CONTEXT: TEXT: Device Observer Name = ilqhfaatc1ws444
  - HAS OBS CONTEXT: TEXT: Device Observer Manufacturer = Philips
  - HAS OBS CONTEXT: TEXT: Device Observer Model Name = Brilliance 64
  - HAS OBS CONTEXT: TEXT: Device Observer Physical Location During Observation = PMSTL
  - HAS OBS CONTEXT: DATETIME: Start of X-ray Irradiation = 20100422162839.030
  - HAS OBS CONTEXT: CODE: Scope of Accumulation = Study
    - HAS PROPERTIES: UIDREF: Study Instance UID = 1.2.840.113704.1.111.6084.1271942101.12
  - CONTAINS: CONTAINER: CT Accumulated Dose Data [SEPARATE]
    - CONTAINS: NUM: Total Number of Irradiation Events = 2 events
    - CONTAINS: NUM: CT Dose Length Product Total = 19.67375 mGycm
  - CONTAINS: CONTAINER: CT Acquisitions [SEPARATE]
  - CONTAINS: CONTAINER: CT Acquisitions [SEPARATE]
    - CONTAINS: CODE: Acquisition Type = Sequenced Acquisition
    - CONTAINS: CODE: Procedure Context = CT without contrast
    - CONTAINS: UIDREF: Irradiation Event UID = 1.2.840.113704.1.111.6084.1271942101.12.2
    - CONTAINS: CONTAINER: CT Acquisition Parameters [SEPARATE]
      - CONTAINS: NUM: Exposure Time = 4254 s
      - CONTAINS: NUM: Scanning Length = 10 mm
      - CONTAINS: NUM: Nominal Single Collimator Width = 0.625 mm
      - CONTAINS: NUM: Nominal Total Collimator Width = 1.25 mm
      - CONTAINS: NUM: Number of X-ray Sources = 1 X-ray sources
      - CONTAINS: CONTAINER: CT X-ray Source Parameters [SEPARATE]
    - CONTAINS: CONTAINER: CT Dose [SEPARATE]
      - CONTAINS: NUM: Mean CTDIvol = 1.3978125 mGy
      - CONTAINS: CODE: CTDIw Phantom Type = IEC Body Dosimetry Phantom
      - CONTAINS: NUM: DLP = 16.77375 mGycm
    - CONTAINS: CODE: Device Role in Procedure = Irradiating Device
      - HAS PROPERTIES: TEXT: Device Manufacturer = Philips
      - HAS PROPERTIES: TEXT: Device Model Name = Brilliance 64
  - CONTAINS: CODE: Source of Dose Information = Automated Data Collection

Radiation Dose Structured Report

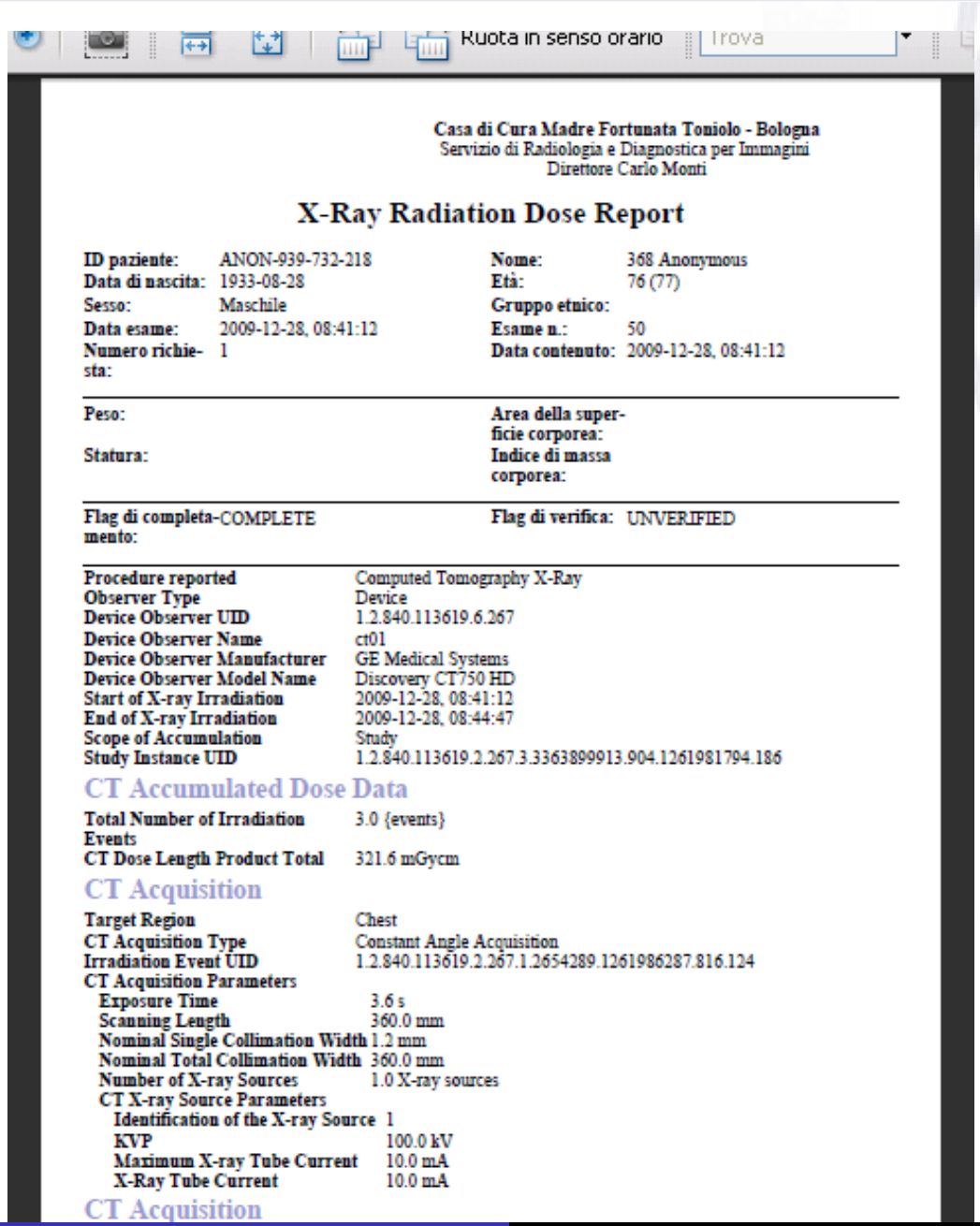
```
CT Accumulated Dose Data:
-------------------------------------------------------------------------
Total Number of Irradiation Events: 4.0 events
CT Dose Length Product Total: 93.51 mGycm

CT Irradiation Event Data:
-------------------------------------------------------------------------
   Acquisition Protocol: Topogram
   Target Region: Heart
   CT Acquisition Type: Constant Angle Acquisition
   Procedure Context: CT without contrast
   Irradiation Event UID: 1.3.12.2.1107.5.1.4.61999.300000090227084527312(
   Comment: Internal technical scan parameters: Organ Characteristic = Ca
Modulation Type = OFF
   Device Role in Procedure: Irradiating Device

   CT Acquisition Parameters:
   ---------------------------------------------------------------------
      Exposure Time: 5.28 s
      Scanning Length: 541.0 mm
      Nominal Single Collimation Width: 0.6 mm
      Nominal Total Collimation Width: 3.6 mm
      Pitch Factor: null
      Number of X-ray Sources: 1.0 X-ray sources

      CT X-ray Source Parameters:
      ------------------------------------------------------------------
         Identification of the X-ray Source: A
         KVP: 120.0 kV
         Maximum X-ray Tube Current: 36.0 mA
         X-Ray Tube Current: 36.0 mA
         Exposure Time per Rotation:

CT Irradiation Event Data:
-------------------------------------------------------------------------
   Acquisition Protocol: PreMonitoring
   Target Region: Heart
   CT Acquisition Type: Sequenced Acquisition
   Procedure Context: CT without contrast
   Irradiation Event UID: 1.3.12.2.1107.5.1.4.61999.300000090227084527312(
```



Ruota in senso orario | Trova

Casa di Cura Madre Fortunata Toniolo - Bologna
Servizio di Radiologia e Diagnostica per Immagini
Direttore Carlo Monti

X-Ray Radiation Dose Report

ID paziente:	ANON-939-732-218	**Nome:**	368 Anonymous
Data di nascita:	1933-08-28	**Età:**	76 (77)
Sesso:	Maschile	**Gruppo etnico:**	
Data esame:	2009-12-28, 08:41:12	**Esame n.:**	50
Numero richiesta:	1	**Data contenuto:**	2009-12-28, 08:41:12
Peso:		**Area della superficie corporea:**	
Statura:		**Indice di massa corporea:**	
Flag di completamento:	COMPLETE	**Flag di verifica:**	UNVERIFIED

Procedure reported	Computed Tomography X-Ray
Observer Type	Device
Device Observer UID	1.2.840.113619.6.267
Device Observer Name	ct01
Device Observer Manufacturer	GE Medical Systems
Device Observer Model Name	Discovery CT750 HD
Start of X-ray Irradiation	2009-12-28, 08:41:12
End of X-ray Irradiation	2009-12-28, 08:44:47
Scope of Accumulation	Study
Study Instance UID	1.2.840.113619.2.267.3.3363899913.904.1261981794.186

CT Accumulated Dose Data

Total Number of Irradiation Events	3.0 {events}
CT Dose Length Product Total	321.6 mGycm

CT Acquisition

Target Region	Chest
CT Acquisition Type	Constant Angle Acquisition
Irradiation Event UID	1.2.840.113619.2.267.1.2654289.1261986287.816.124
CT Acquisition Parameters	
Exposure Time	3.6 s
Scanning Length	360.0 mm
Nominal Single Collimation Width	1.2 mm
Nominal Total Collimation Width	360.0 mm
Number of X-ray Sources	1.0 X-ray sources
CT X-ray Source Parameters	
Identification of the X-ray Source	1
KVP	100.0 kV
Maximum X-ray Tube Current	10.0 mA
X-Ray Tube Current	10.0 mA

CT Acquisition

Radiation Dose Structured Report

CT Acquisition Parameters

Exposure Time	3.6 s
Scanning Length	360.0 mm
Nominal Single Collimation Width	1.2 mm
Nominal Total Collimation Width	360.0 mm
Number of X-ray Sources	1.0 X-ray sources

CT X-ray Source Parameters

Identification of the X-ray Source	1
KVP	100.0 kV
Maximum X-ray Tube Current	10.0 mA
X-Ray Tube Current	10.0 mA

CT Acquisition

Target Region	Chest
CT Acquisition Type	Spiral Acquisition
Irradiation Event UID	1.2.840.113619.2.267.1.2654289.1261986287.841.124

CT Acquisition Parameters

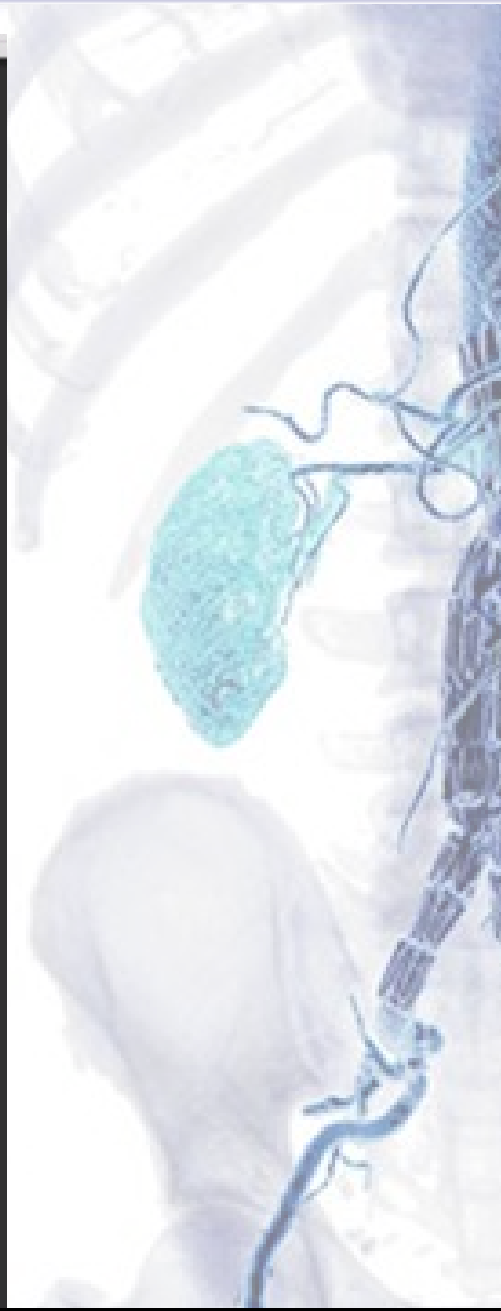
Exposure Time	4.1 s
Scanning Length	225.0 mm
Nominal Single Collimation Width	0.6 mm
Nominal Total Collimation Width	20.0 mm
Pitch Factor	1.0 {ratio}
Number of X-ray Sources	1.0 X-ray sources

CT X-ray Source Parameters

Identification of the X-ray Source	1
KVP	100.0 kV
Maximum X-ray Tube Current	550.0 mA
X-Ray Tube Current	384.6 mA
Exposure Time per Rotation	0.6 s

CT Dose

Mean CTDIvol	11.9 mGy
CTDIw Phantom Type	IEC Body Dosimetry Phantom
DLP	321.6 mGycm

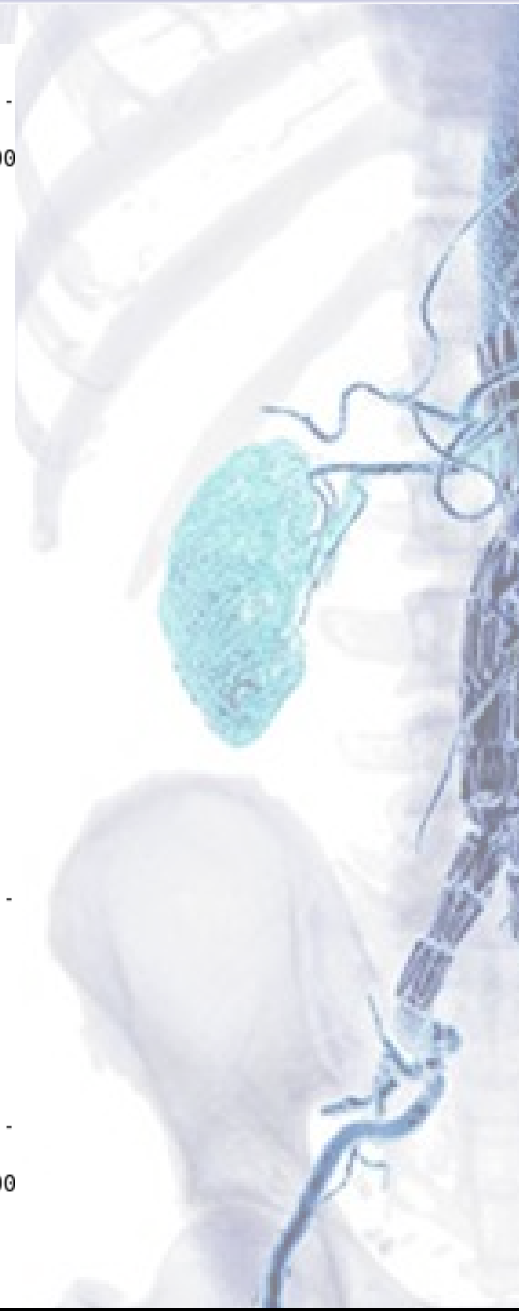


Radiation Dose Structured Report

```
Irradiation Event X-Ray Data:
-------------------------------------------------------------------------
   Acquisition Protocol: FL Card
   Irradiation Event UID: 1.3.12.2.1107.5.4.5.161998.30000090119083857500
   Distance Source to Detector: 989.0 mm
   Distance Source to Isocenter: 785.0 mm
   Table Longitudinal Position: 1.0 mm
   Table Lateral Position: -620.0 mm
   Table Height Position: -999.0 mm
   Acquisition Plane: Single Plane
   Irradiation Event Type: Fluoroscopy
   Dose Area Product: 6.8E-6 Gym2
   Dose (RP): 0.00156 Gy
   Positioner Primary Angle: -1.0 °
   Positioner Secondary Angle: -1.1 °
   Positioner Primary End Angle: 0.0 °
   Positioner Secondary End Angle: 0.0 °
   Fluoro Mode: Pulsed
   Pulse Rate: 15.0 pulse/s
   Number of Pulses: 28.0 no units
   KVP: 74.0 kV
   X-Ray Tube Current: 162.8 mA
   Exposure Time: 235.2 ms
   Pulse Width: 8.4 ms
   Exposure: 38290.0 uAs
   Focal Spot Size: 0.4 mm
   Acquired Image: 1

   X-Ray Filters:
   ----------------------------------------------------------------------
      X-Ray Filter Type: Strip Filter
      X-Ray Filter Material: Copper or Copper compound
      X-Ray Filter Thickness Minimum: 0.2 mm
      X-Ray Filter Thickness Maximum: 0.2 mm


Irradiation Event X-Ray Data:
-------------------------------------------------------------------------
   Acquisition Protocol: FL Card
   Irradiation Event UID: 1.3.12.2.1107.5.4.5.161998.30000090119083857500
   Distance Source to Detector: 989.0 mm
   Distance Source to Isocenter: 785.0 mm
```



X-Ray Radiation Dose Report

Procedure reported :	113704 Projection X-Ray
Has Intent :	R-002E9 Combined Diagnostic and Therapeutic Procedure
Observer Type :	121007 Device
:	1.2.840.113619.2.245.532486548143262608781228670545.1506.3
Device Observer Name :	TERRA
Device Observer Manufacturer :	GE MEDICAL SYSTEMS
Device Observer Model Name :	DL
Device Observer Serial Number :	Unknown
Scope of Accumulation :	113016 Performed Procedure Step
:	1.2.840.113619.2.245.532486548143262608781228670545.1506.4
Comment :	Dose report of Innova
Source of Dose Information :	113856 Automated Data Collection

Accumulated X-Ray Dose Data

Acquisition Plane :	113622 Single Plane
Dose Area Product Total :	3.7695 Gym2
Dose (RP) Total :	0.00563482 Gy
Fluoro Dose Area Product Total :	0.0 Gym2
Fluoro Dose (RP) Total :	0.0 Gy
Total Fluoro Time :	0 S
Acquisition Dose Area Product Total :	3.72126 Gym2
Acquisition Dose (RP) Total :	0.00563482 Gy
Total Acquisition Time :	28 s
Total Number of Radiographic Frames :	100 No units
Reference Point Definition :	113860 15cm from Isocenter toward Source

- Radiation Dose Structured Report
  - general structure common to all modalities
  - specific content for different modalities
  - CT versus projection X-Ray
  - fluoroscopy versus individual exposures
  - allows for shared infrastructure to manage all ionizing radiation producing diagnostic modalities
  - future extension to nuclear medicine & PET
  - irradiation event: uniquely identified
  - scope: event, series, PPS, study
  - accumulated & per-event data
  - phantom dose required (CTDIvol, DLP)
  - effective dose (mSv) optional (ICRP 60, 103)
  - per-event acquisition parameters (kV,...)
  - standard coded region (anatomy)
  - standard coded CT type (sequenced,spiral,...)

RDSR Extensible – CP 1068

CP-1068
Scan location in CT dose reports

Date: 2011/01/27
Status: Letter Ballot

DICOM Correction Item

Correction Number	CP-1068
Log Summary: Scan location in CT dose reports	
Type of Modification Correction	Name of Standard PS 3.16 2009
Rationale for Correction The CT dose reports include for each irradiation event the scanning length, and clearly define that for spiral acquisitions, this scanning length might be longer than the programmed acquisition length. This is due to the additional rotations at the beginning and end of the scan (so-called "overranging"). There is no provision currently to record the length of the reconstructable volume with which to compare the (actual) scanning length, nor to record the amount of overranging, nor to record the start and end positions of these ranges, which would be useful to compare the coverage of multiple acquisitions (i.e., to detect when the same region has been irradiated multiple times). Add new content items and codes for these.	

RDSR Extensible – CP 1068

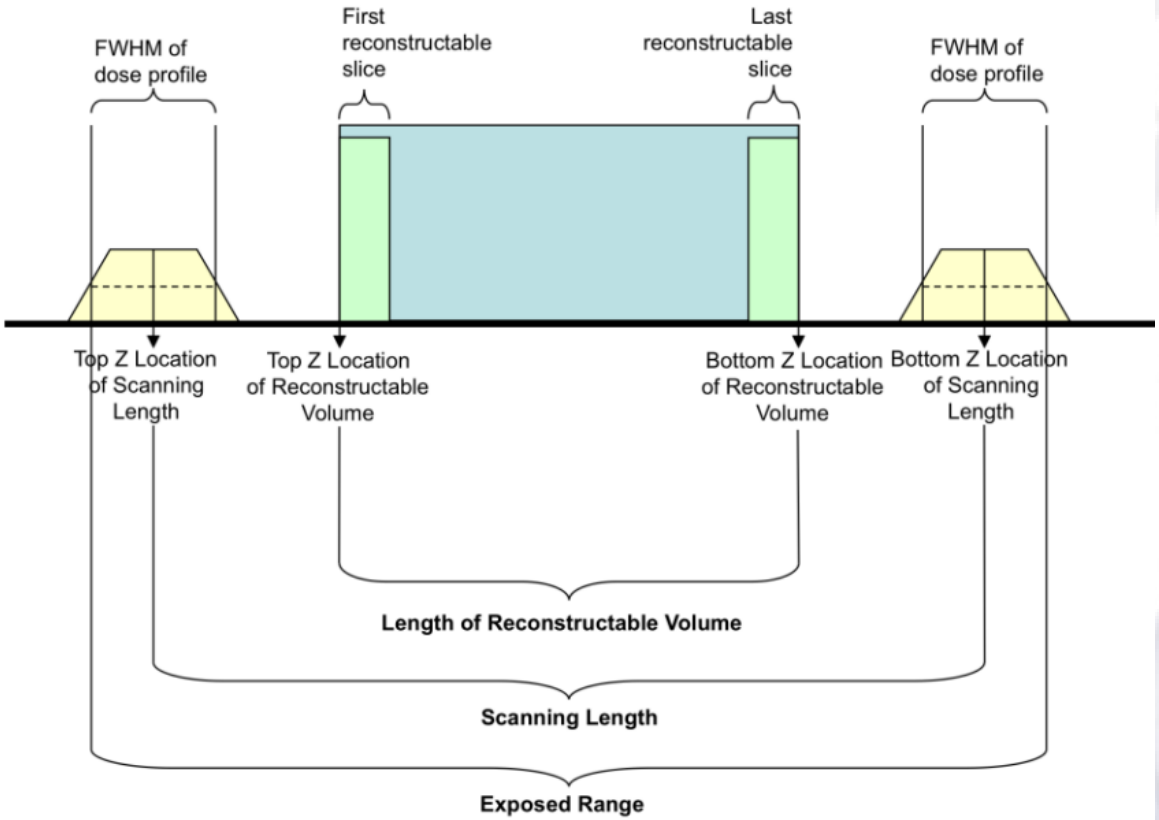


Figure A-x Spiral Acquisition Parameters

Management – IHE REM

Integrating the Healthcare Enterprise

IHE Radiology Technical Framework

Supplement 2007-2008

Radiation Exposure Monitoring (REM)
Integration Profile

Trial Implementation Draft

Publication date: July 3, 2008

Management – IHE REM

Integrating the Healthcare Enterprise

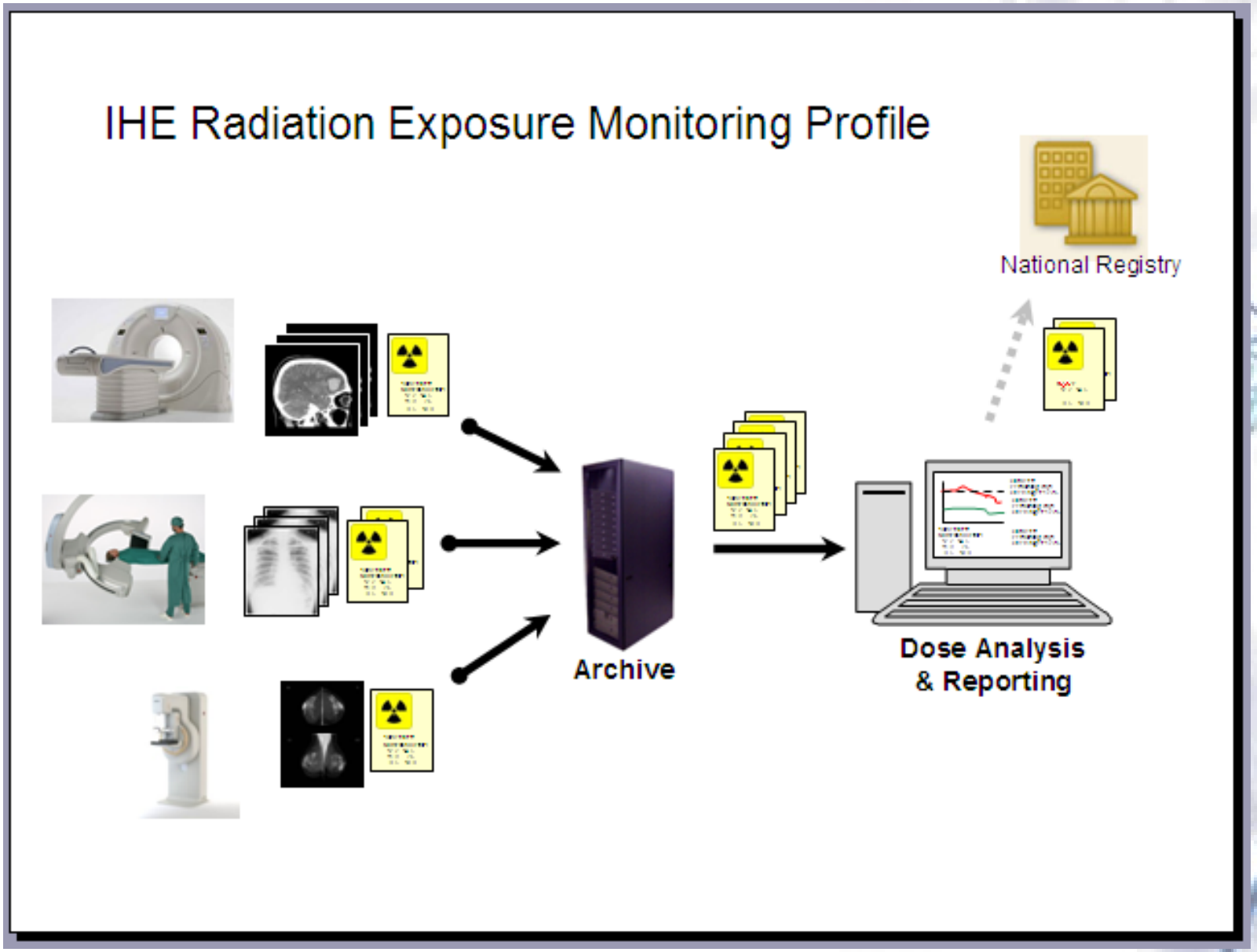
IHE Radiology

Technical Framework Supplement

Radiation Exposure Monitoring (REM)

Trial Implementation

Date: November 16, 2010
Editor: Kevin O'Donnell
Email: radiology@ihe.net


IHE Radiation Exposure Monitoring Profile
National Registry
Archive
Dose Analysis
& Reporting

Acquisition Modality

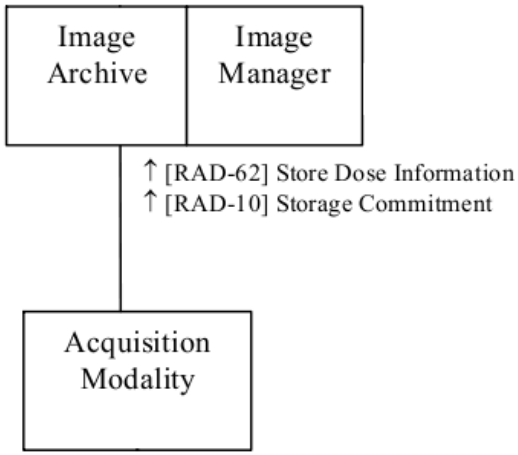
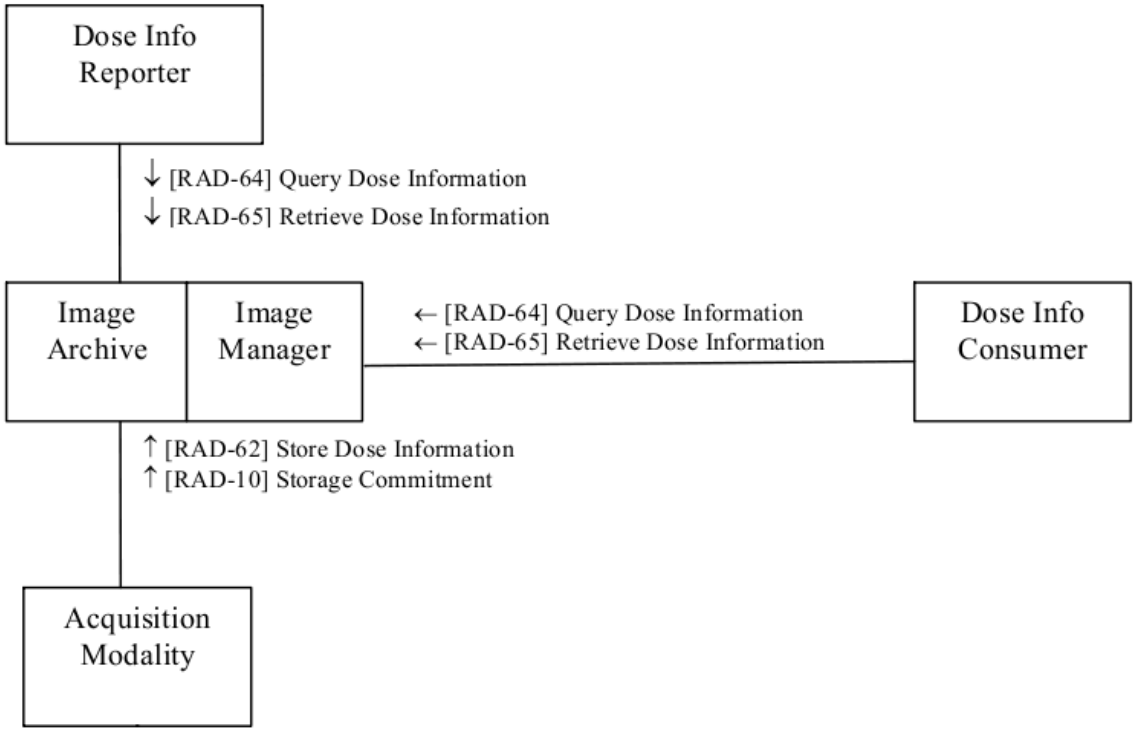
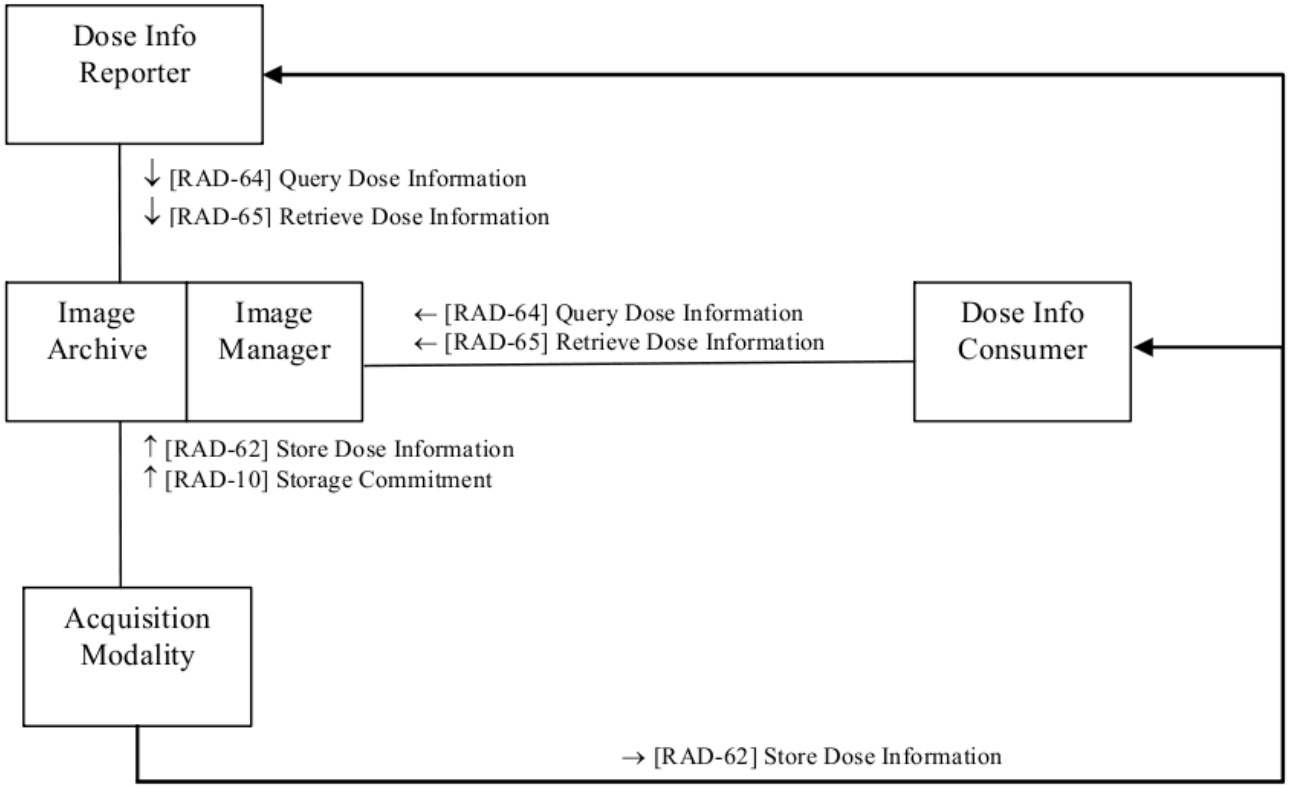
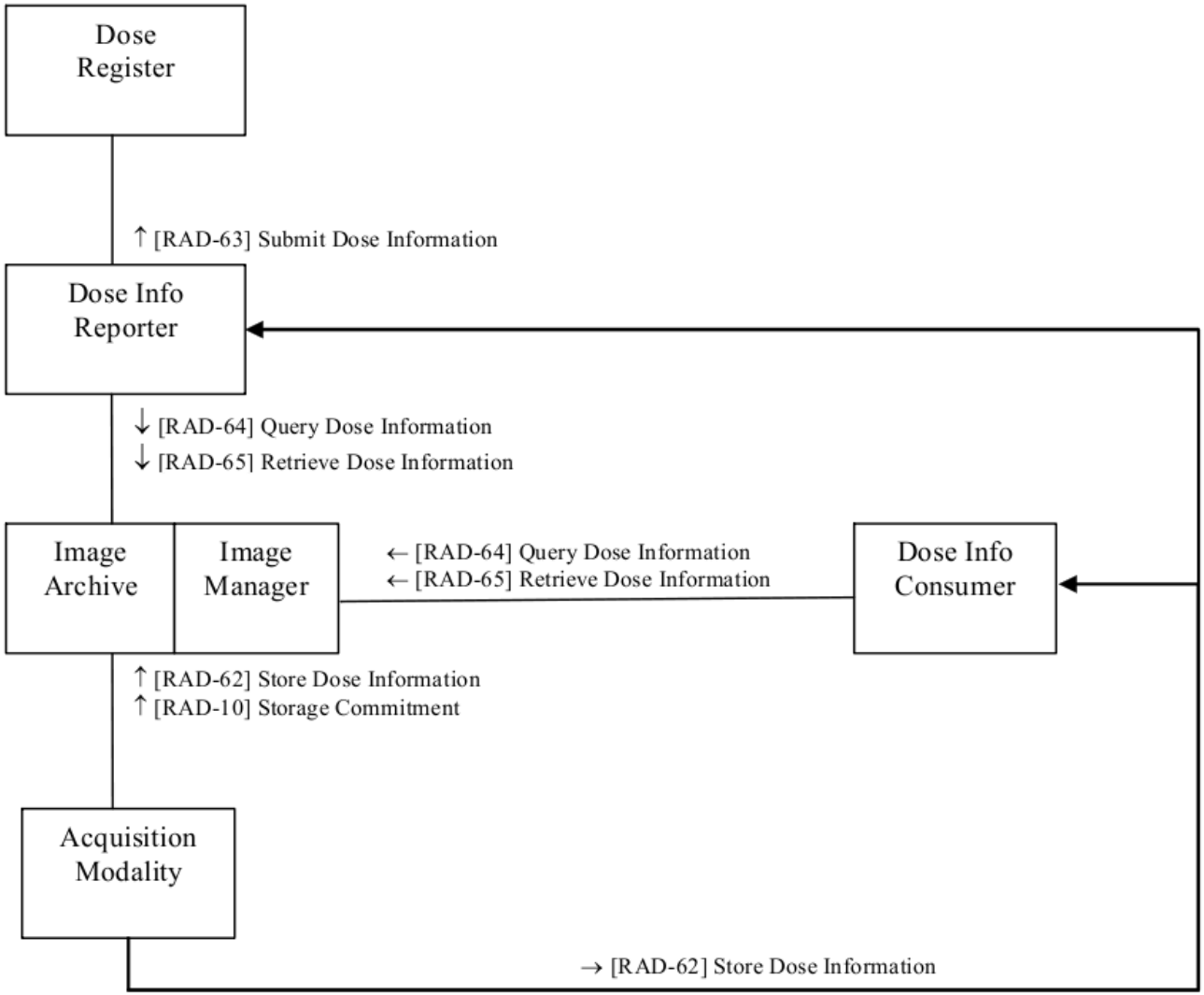


Image Archive
Image Manager
↑ [RAD-62] Store Dose Information
↑ [RAD-10] Storage Commitment
Acquisition Modality


Dose Info Reporter
↓ [RAD-64] Query Dose Information
↓ [RAD-65] Retrieve Dose Information
Image Archive
Image Manager
← [RAD-64] Query Dose Information
← [RAD-65] Retrieve Dose Information
Dose Info Consumer
↑ [RAD-62] Store Dose Information
↑ [RAD-10] Storage Commitment
Acquisition Modality


Dose Info Reporter
↓ [RAD-64] Query Dose Information
↓ [RAD-65] Retrieve Dose Information
Image Archive
Image Manager
← [RAD-64] Query Dose Information
← [RAD-65] Retrieve Dose Information
Dose Info Consumer
↑ [RAD-62] Store Dose Information
↑ [RAD-10] Storage Commitment
Acquisition Modality
→ [RAD-62] Store Dose Information

Radiation Dose Structured Report



IHE Radiation Exposure Monitoring Profile

- Integration of systems reporting dose and systems which receive, store, or process those reports
- Modalities, PACS, RIS, Workstations, Registries
- Facilitate compliance with Euratom 97/43, ACR Guidelines, ...
- DICOM Dose Reports
- Creation, Collection, Distribution, Processing

DICOM Structured Dose Reports – "SR Objects" – "RDSR"

- Easily ingested (and regurgitated) by PACS
- Granularity : "Irradiation Event"
  - + Accumulated Dose over Study, Series
- Templates:
  - CT, Projection X-Ray (Mammo, Fluoro)

NEMA
Setting Standards for Excellence
The Association of Electrical and Medical Imaging Equipment Manufacturers

NEMA Standards Publication XR 25-2010

Computed Tomography Dose Check

- Check BEFORE operator irradiates
- Notifications
  - will prescribed scan exceed preset limits ?
- Alerts
  - will delivered + prescribed exceed limits ?
  - also alerts prior to saving protocols
- Override
  - record identity and reason

- Record Dose Check activity in RDSR
- CP 1047
- Stores
  - configured notification & alert values
  - estimated values
  - CTDIvol and DLP
  - operator identity and reason for override
- Allows for central monitoring

AAPM Dose Check Guidelines version 1.0 04/27/2011

AAPM Recommendations Regarding Notification and Alert Values for CT Scanners: Guidelines for Use of the NEMA XR 25 CT Dose-Check Standard[1]

A new U.S. technical standard (XR 25) has been published by the National Electrical Manufacturers Association (NEMA)[1]. CT scanners in compliance with this standard can be configured to inform users when scan settings would likely yield values of $CTDI_{vol}$ or *DLP* that would exceed pre-assigned values. Compliant scanners allow users, before proceeding with scanning, to confirm or correct settings that might otherwise lead to unnecessarily high exposures. Manufacturers may include pre-assigned values in their default protocols, but all values are user-configurable.

Application to Clinical Practice:

The XR 25 standard[1] specifies the features that must be incorporated in CT systems. It does not specify how the features are to be used clinically. We anticipate at least two different ways that these new features will be used in clinical practice:

1) *To identify and track all situations where dose indices may exceed established diagnostic reference levels (DRLs).*

2) *To avoid excessively high patient exposures by identifying dose indices that are much higher than typical for a given examination type and providing an opportunity for the operator to confirm or change settings before proceeding.*

AAPM Recommendations:

The AAPM Working Group on Standardization of CT Nomenclature and Protocols[4], which includes members from the FDA, ACR, and manufacturers, has established a particular set of notification values (Table 1). Manufacturers may use these as default values for CT scanners compliant with the XR 25 standard[1]. The AAPM-recommended values ***do not*** correspond to optimal or "target" settings, ***are not*** considered acceptable "upper limits" of dose, and ***do not*** represent diagnostic reference levels.

AAPM Dose Check Guidelines

The notification values in Table 1 are starting points. As facilities gain more experience using the NEMA "CT Dose-Check" standard[1], they are encouraged to work with a medical physicist to adjust the values to better suit their individual practice.

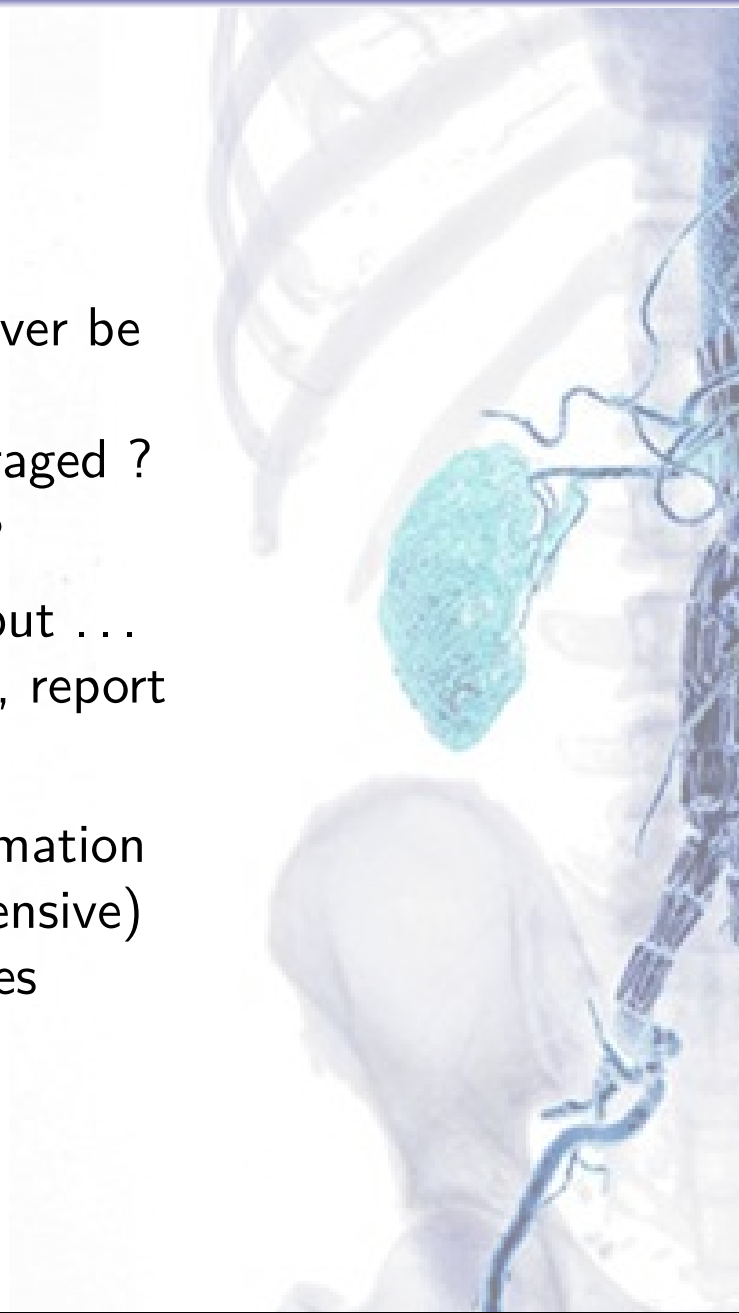
Table 1: Notification Values recommended by the AAPM Working Group on Standardization of CT Nomenclature and Protocols

CT Scan Region (of each individual scan in an examination)	CTDIvol Notification Value (mGy)
Adult Head	80
Adult Torso	50
Pediatric Head	
<2 years old	50
2 – 5 years old	60
Pediatric Torso	
<10 years old (16-cm phantom)[a]	25
<10 years old (32-cm phantom)[b]	10
Brain Perfusion (examination that repeatedly scans the same anatomic level to measure the flow of contrast media through the anatomy)	600
Cardiac	
Retrospectively gated (spiral)	150
Prospectively gated (sequential)	50

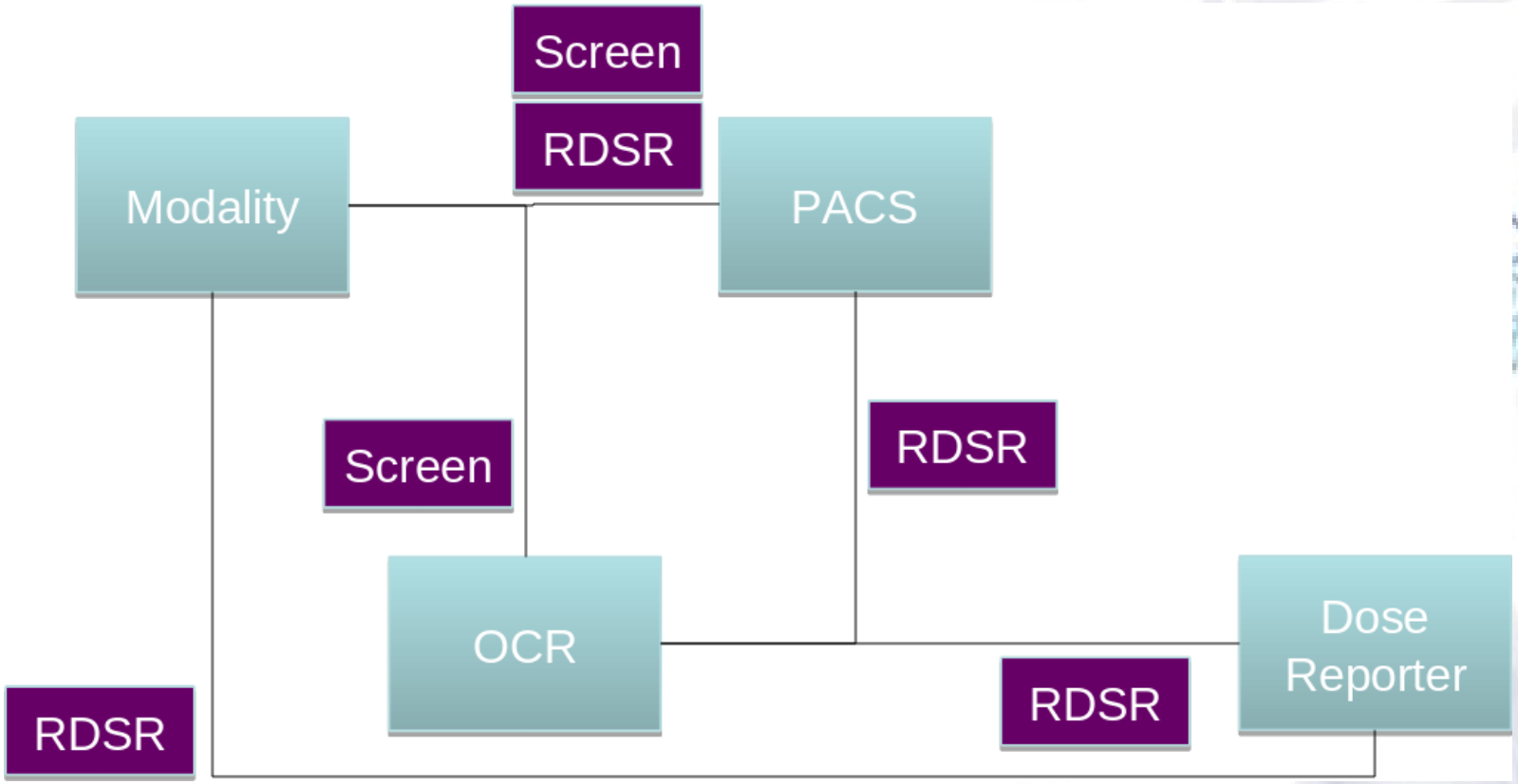
[a] As of January 2011, GE, Hitachi and Toshiba scanners use the 16-cm-diameter CTDI phantom as the basis for evaluating dose indices ($CTDI_{vol}$ and DLP) displayed and reported for pediatric body examinations.

[b] As of January 2011, Siemens and Philips scanners use the 32-cm-diameter CTDI phantom as the basis for evaluating dose indices ($CTDI_{vol}$ and DLP) displayed and reported for pediatric body examinations.

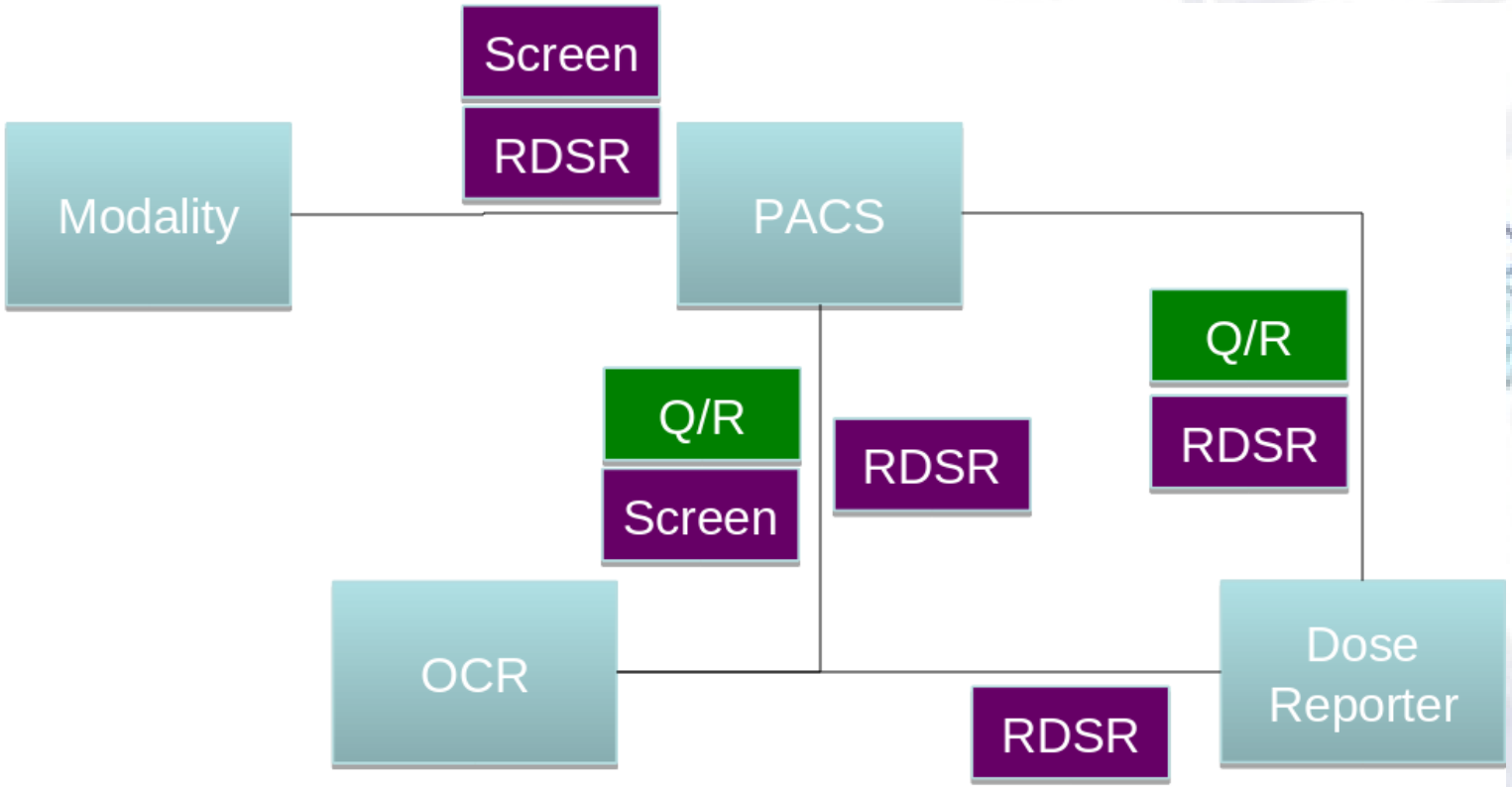
- What to do about older scanners
  - that are not yet updated, and may never be
  - vast majority of global installed base
  - what existing capabilities can be leveraged ?
- What about new objects in old PACS ?
  - new modalities may produce RDSR, but ...
  - site has no system to view, aggregate, report
- Even for old images in the archive ...
  - vast collection of reference dose information
  - manual recording is tedious (== expensive)
  - prior data for patients with new studies



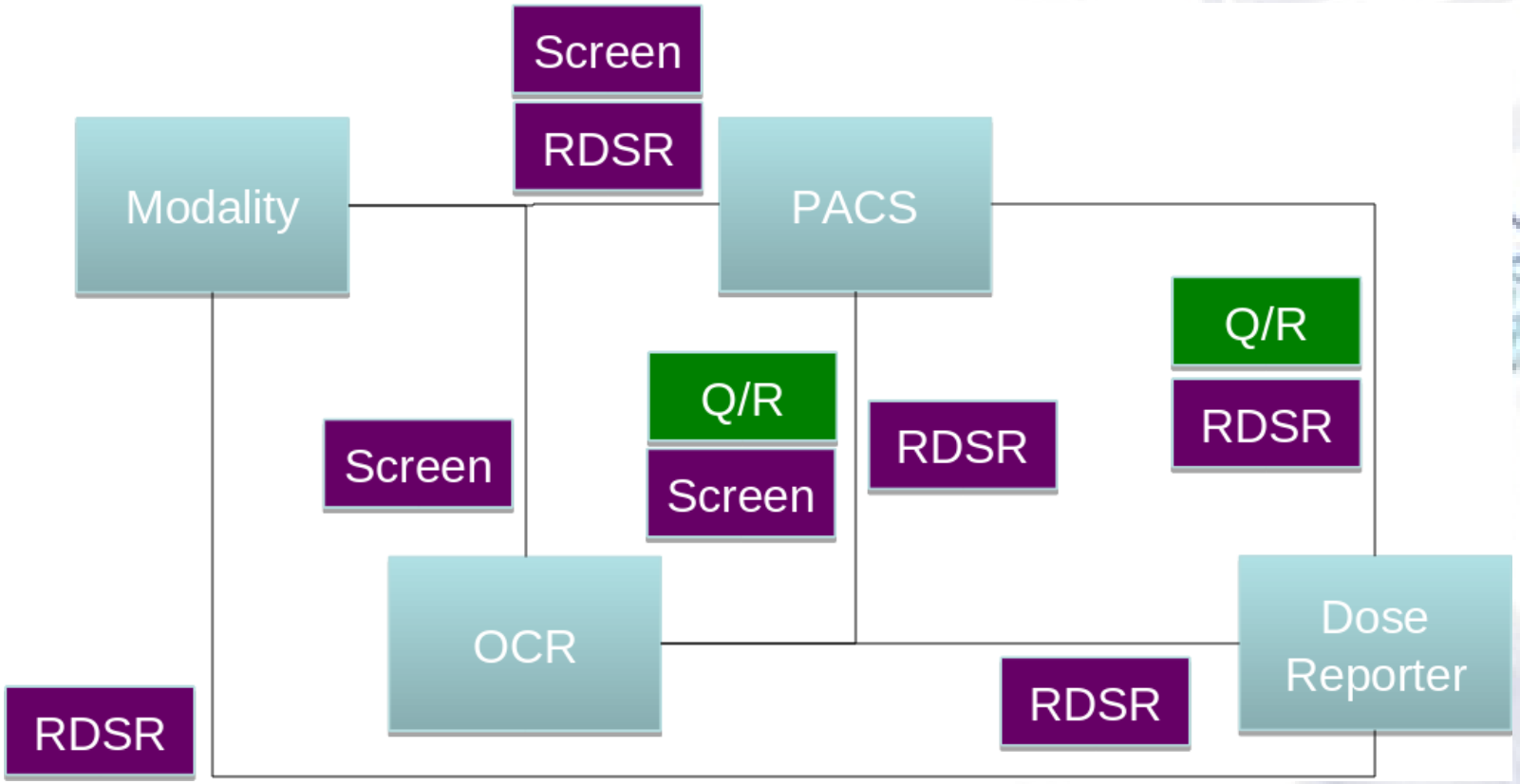
RDSR & OCR Deployment



RDSR & OCR Deployment



RDSR & OCR Deployment



- Regardless of actual risk, perceived risk requires action
- Monitoring and reporting of exposure information is feasible
- CT vendors are cooperating to provide standard information using DICOM RDSR
- Legacy devices can be incorporated through OCR
- National Dose Index Registries can use this information to provide aggregate reporting
- Incorporation in cross-enterprise patient record remains challenging
- CT vendors are also providing "dose check" (NEMA XR-25) at the console to reduce operator error

DICOM Conformance Statements

- CT Siemens
- CT GE
- CT Toshiba
- CT Philips

¿ Preguntas ?

"Patient dose is improving"