CT Radiation Dose Information - What to Capture and How

David Clunie
CoreLab Partners, Inc.

Affiliations & Disclosures

- **CTO, CoreLab Partners, Princeton, NJ**
- **PixelMed Publishing, Bangor, PA**

- **Editor, DICOM Standard**
- **Co-chair, IHE Radiology Tech. Committee**

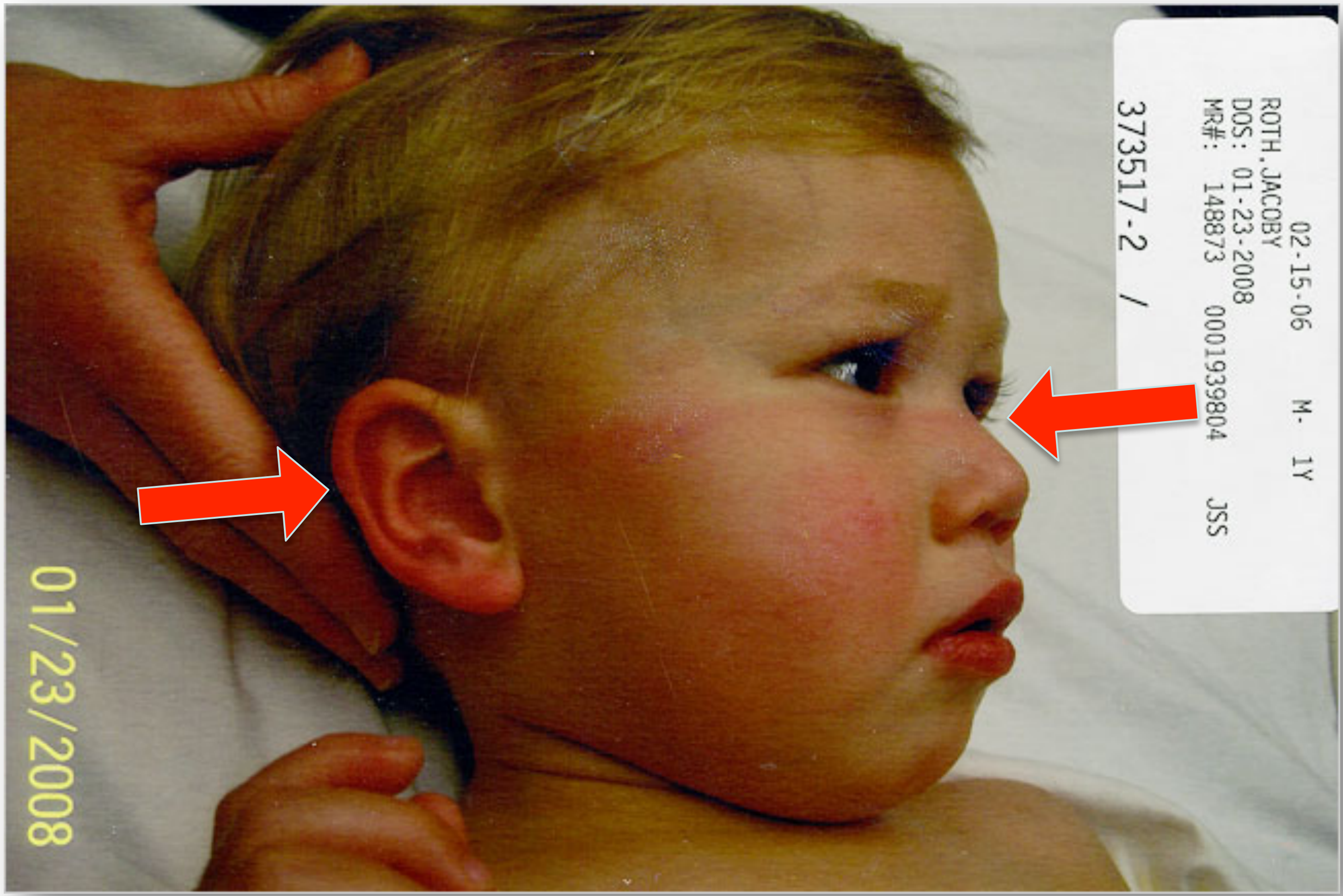
Background

- **Utilization of CT has exploded**
- **Technology allows faster delivery of higher doses**
- **Speed has led to newer applications that acquire many more slices at same location (e.g., perfusion)**
- **Radiation dose *may* be harmful**
- **Monitoring & alerting is required**

Perceived or Real Risk

- **Incidents of deterministic events in popular press (hair loss, erythema)**
- **Acknowledged rising CT use and source of dose relative to background**
- **Cancer risk estimates based on linear non-threshold (NLT) model**
- **Epidemiological studies documenting observed increase in risk**

Jacoby Roth Incident



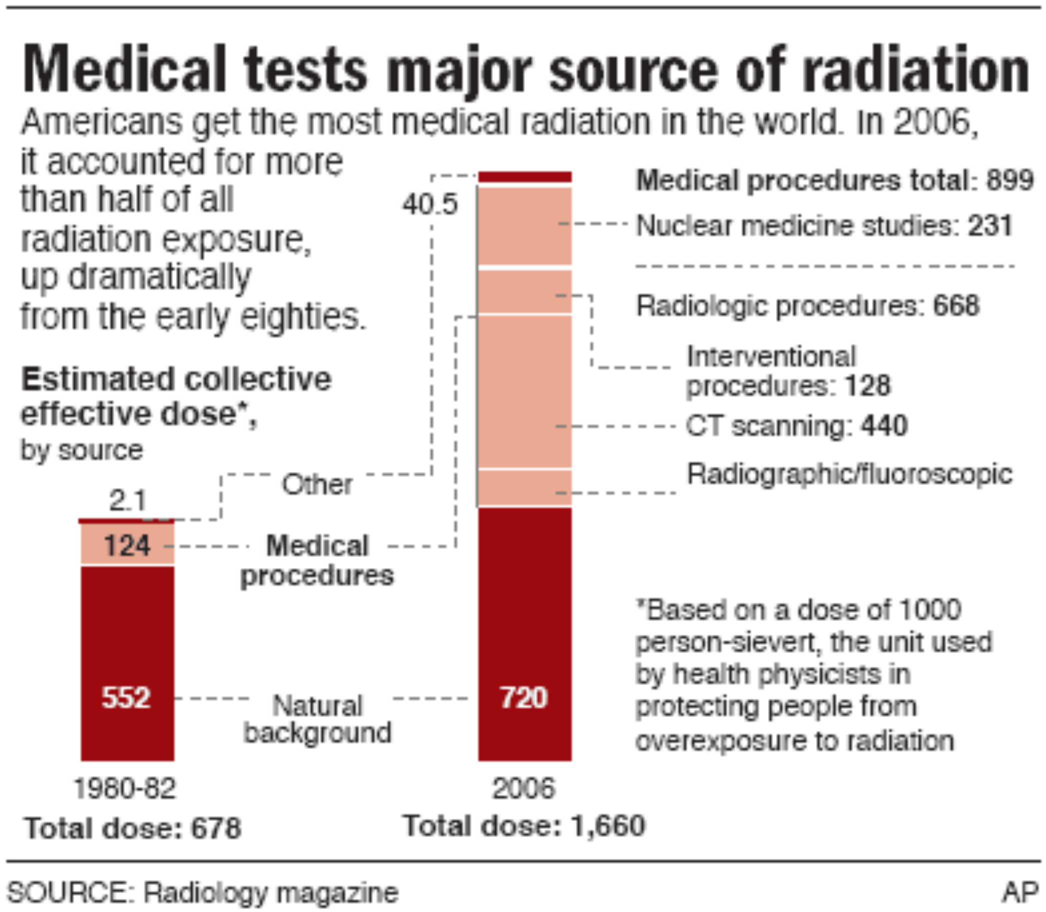
New York Times 2009/10/16 (supplied by family's attorney with PHI as published)

Cedars-Sinai Incident

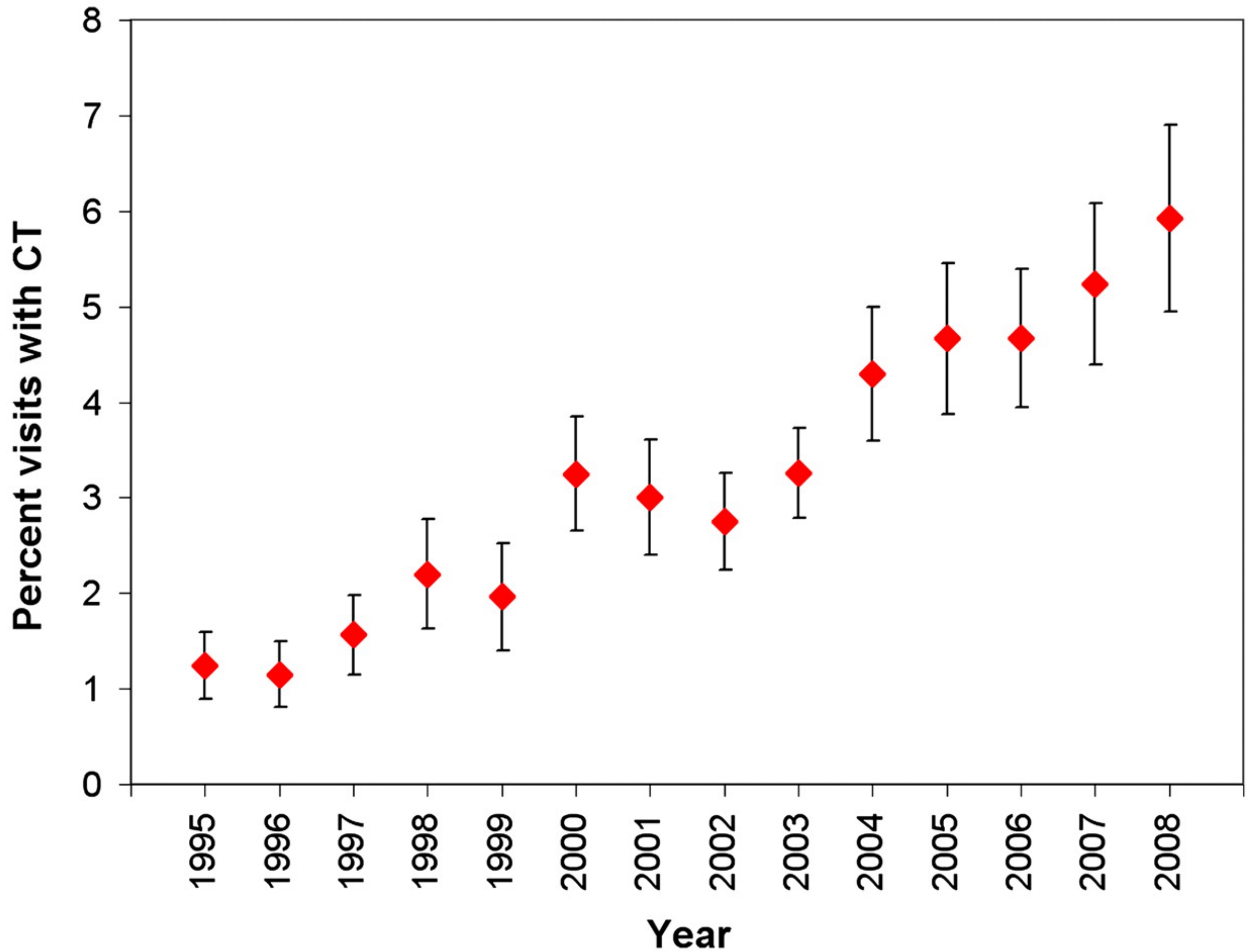




Popular Press



Graph illustrates percentages of ED visits with CT from 1995 to 2008 in patients younger than 18 years.

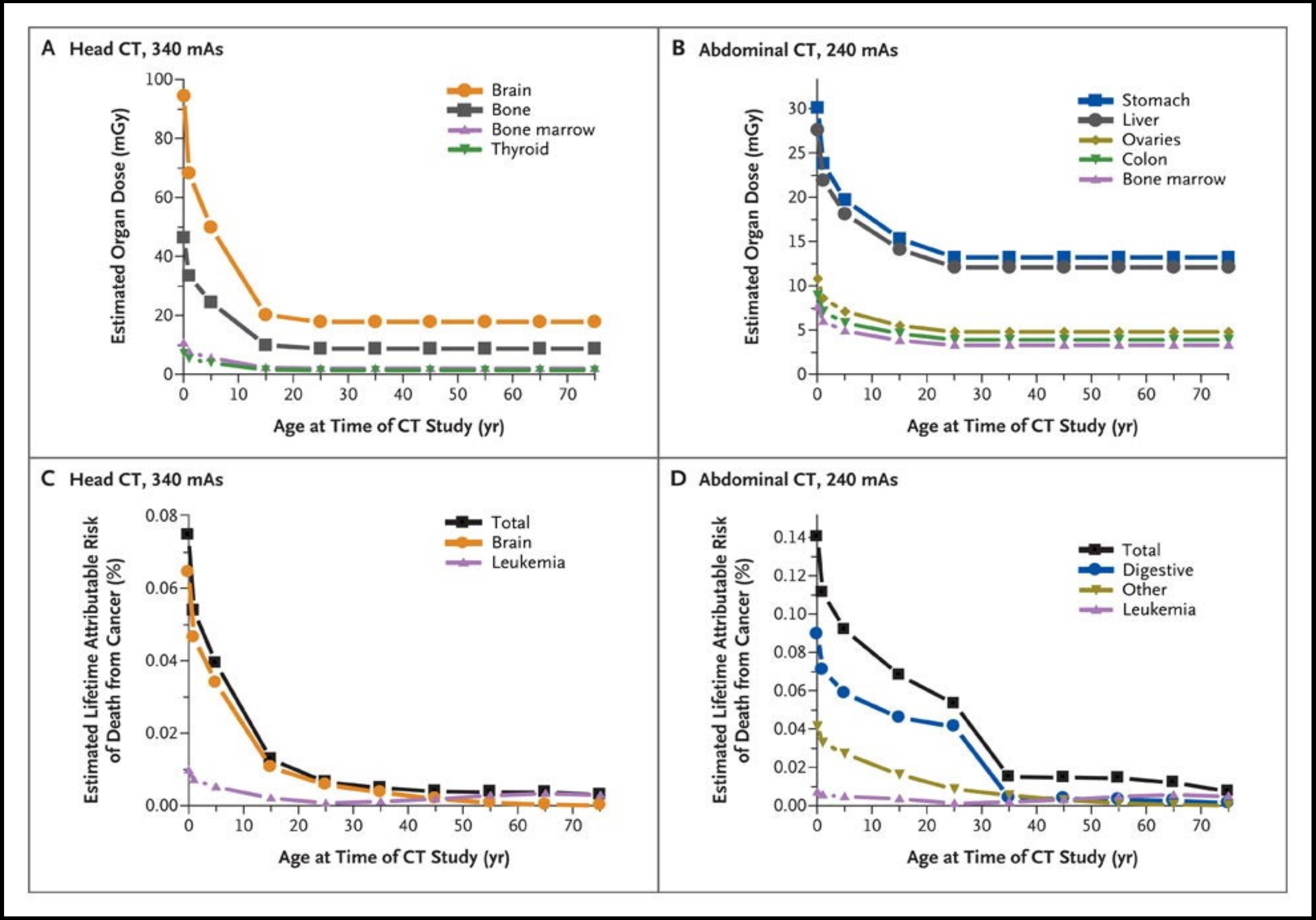


Larson D B et al. Radiology doi:10.1148/radiol.11101939

Radiology

©2011 by Radiological Society of North America

Estimated Organ Doses and Lifetime Cancer Risks from Typical Single CT Scans of the Head and the Abdomen.



Brenner DJ, Hall EJ. N Engl J Med 2007;357:2277-2284.

The NEW ENGLAND JOURNAL of MEDICINE

Variable	HR (95% CI)
Sex, male	
Unadjusted	1.002 (0.963–1.042)
Adjusted	1.504 (1.443–1.568)
Age (per year)	
Unadjusted	1.039 (1.037–1.040)
Adjusted	1.045 (1.043–1.047)
Radiation from cardiac procedures (per milliSievert)*	
Unadjusted	1.001 (1.000–1.002)
Adjusted	1.003 (1.002–1.004)
Radiation from cardiac procedures*	
Per 10-mSv increase	1.013 (1.002–1.023)
Unadjusted	1.028 (1.018–1.039)
Adjusted	
Per 20-mSv increase	
Unadjusted	1.025 (1.004–1.047)
Adjusted	1.058 (1.036–1.080)
Per 30-mSv increase	
Unadjusted	1.038 (1.006–1.072)
Adjusted	1.088 (1.054–1.122)
Per 40-mSv increase	
Unadjusted	1.051 (1.008–1.097)
Adjusted	1.119 (1.073–1.166)
Radiation from noncardiac procedures (per milliSievert)	
Unadjusted	1.009 (1.007–1.011)
Adjusted	1.008 (1.006–1.010)

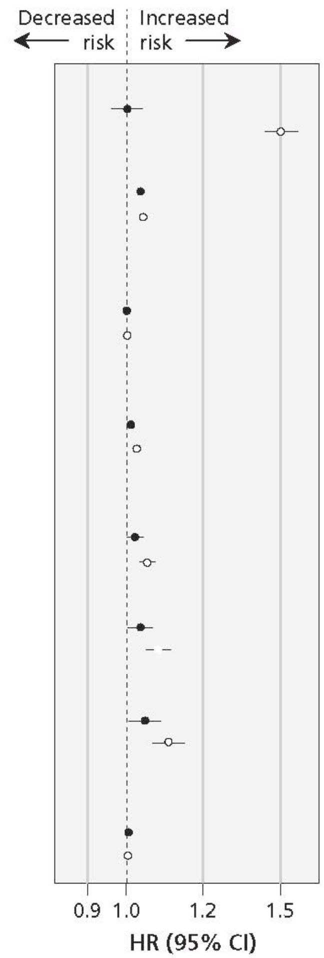


Figure 1: Relation between cumulative exposure to low-dose ionizing radiation (measured in milliSieverts) from cardiac imaging and therapeutic procedures after acute myocardial infarction and the risk of cancer during a mean follow-up period of 5.0 years. Hazard ratios (HRs) above 1.0 indicate an increased risk of cancer. Adjusted HRs were derived from models adjusted for age, sex and exposure to low-dose ionizing radiation from noncardiac procedures. *Among patients who were exposed to more than 0 mSv of radiation. Note: CI = confidence interval, mSv = milliSieverts.

Eisenberg M J et al. CMAJ DOI:10.1503/cmaj.100463

Assuring Minimal Dose

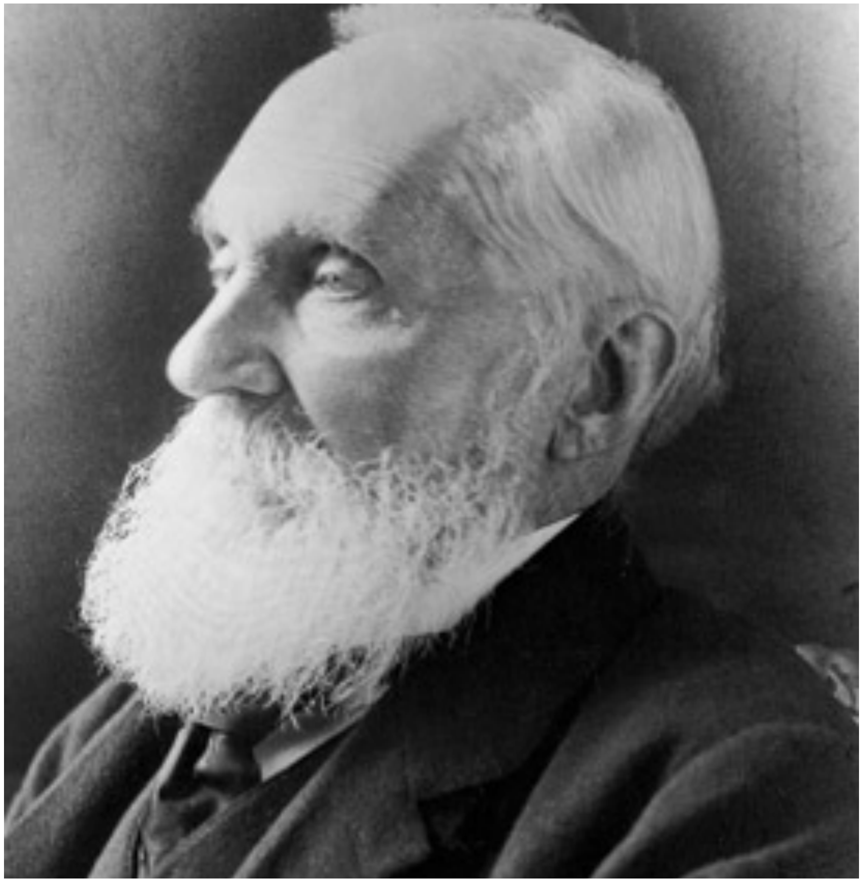
- **Reducing operator error**
- **Reducing inappropriate use of CT**
- **Improving protocols**
- **Improving low-dose technology**

- **Improving surveillance**
- **Greater regulation and reporting**
- **Better knowledge base**

"If you can not measure it, you can not improve it."

Lord Kelvin (William Thomson 1824-1907)

1st President of IEC (International Electrotechnical Commission)



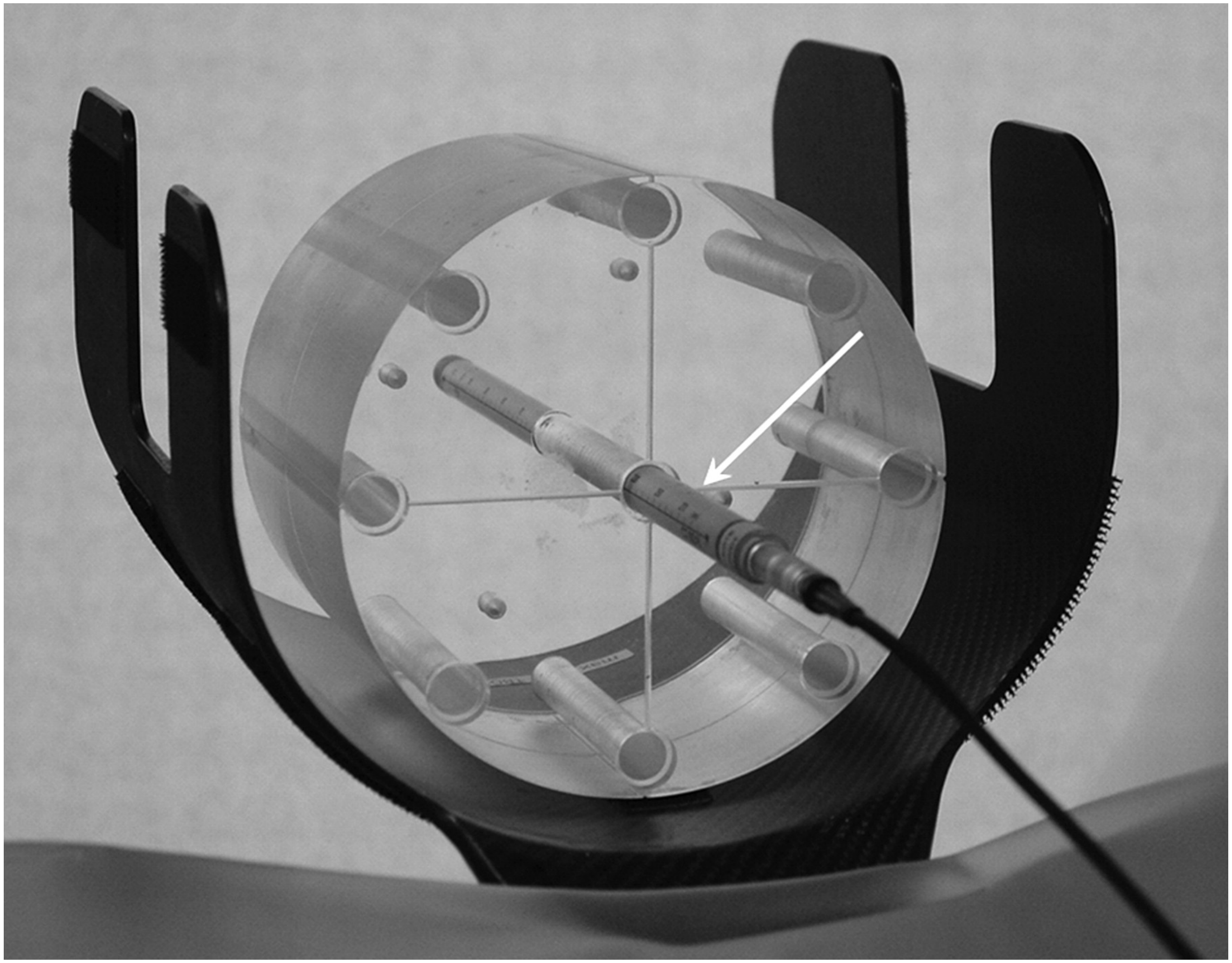
Sources & Storage of Data

- **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

Procedure Dose Data

- **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**

Figure 5a. (a) A solid-state real-time dosimeter (arrow) is inserted into a head CTDI phantom to measure the CTDI100.



Bauhs J A et al. Radiographics 2008;28:245-253

RadioGraphics

©2008 by Radiological Society of North America

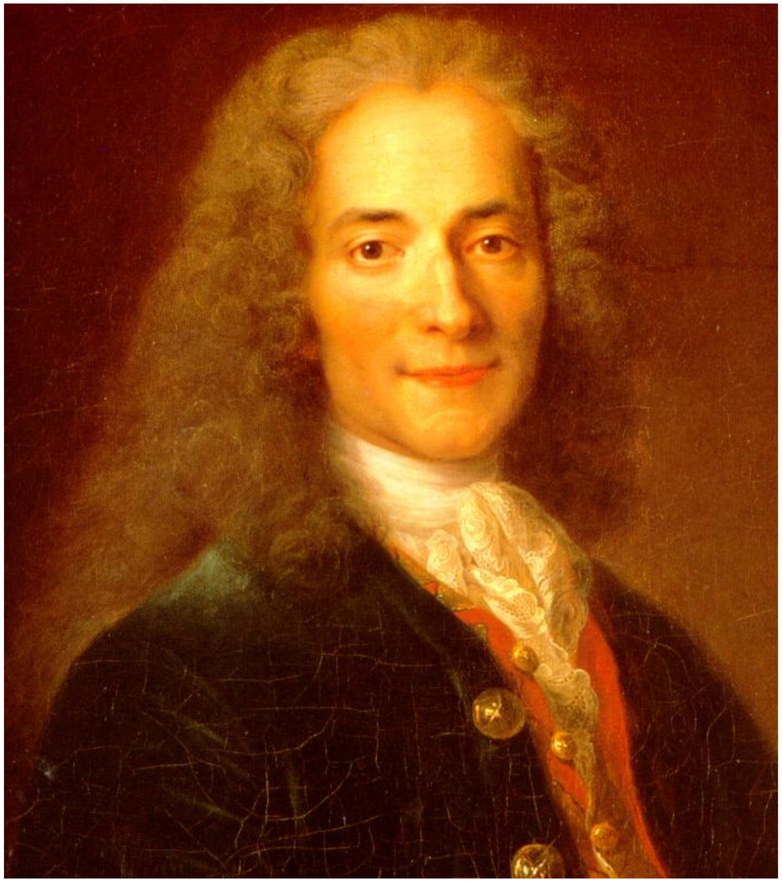
Output versus Actual

- **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

“The perfect is the enemy of the good.”

Voltaire (1764)

“Le mieux est l'ennemi du bien.”



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?)

CTDIvol & DLP

Patient Name: Exam no:

Accession Number:

Patient ID: Discovery CT750 HD

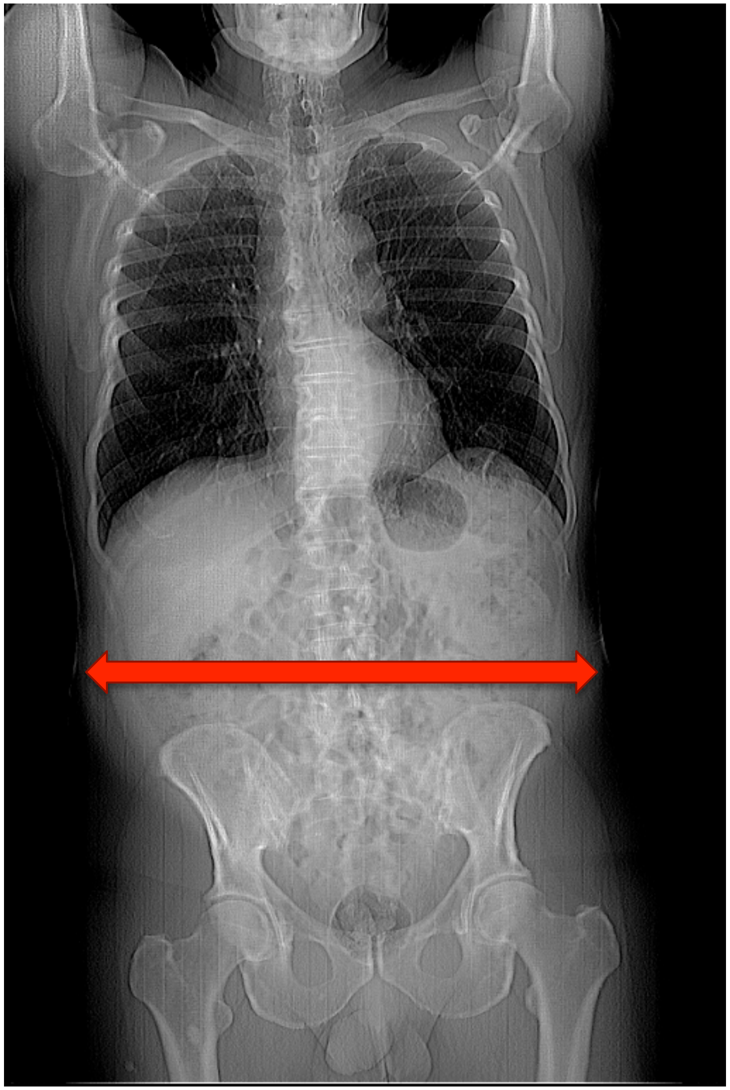
Exam Description: CT HALS/THORAX/ABDOMEN

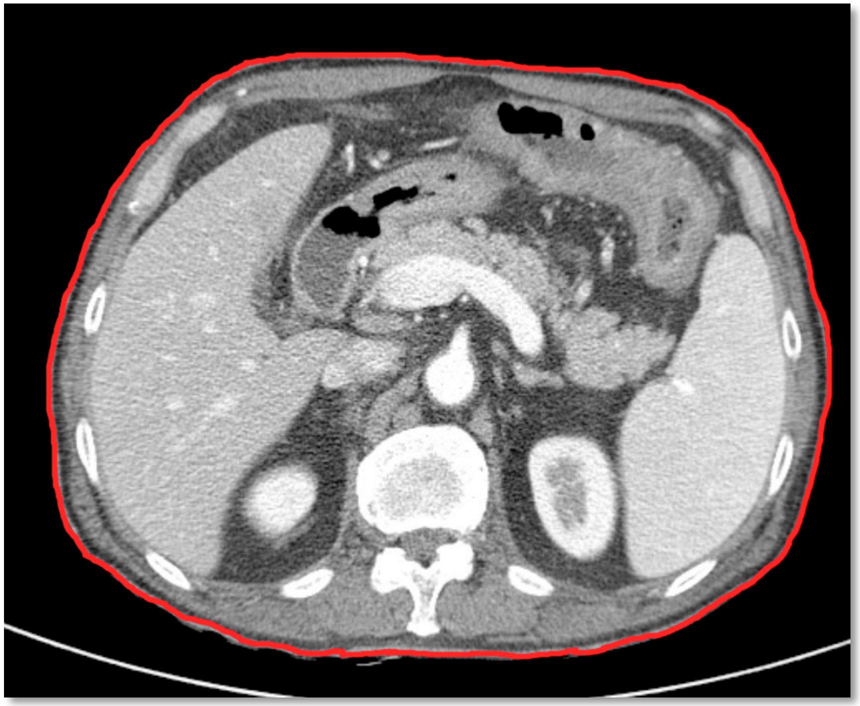
Dose Report

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

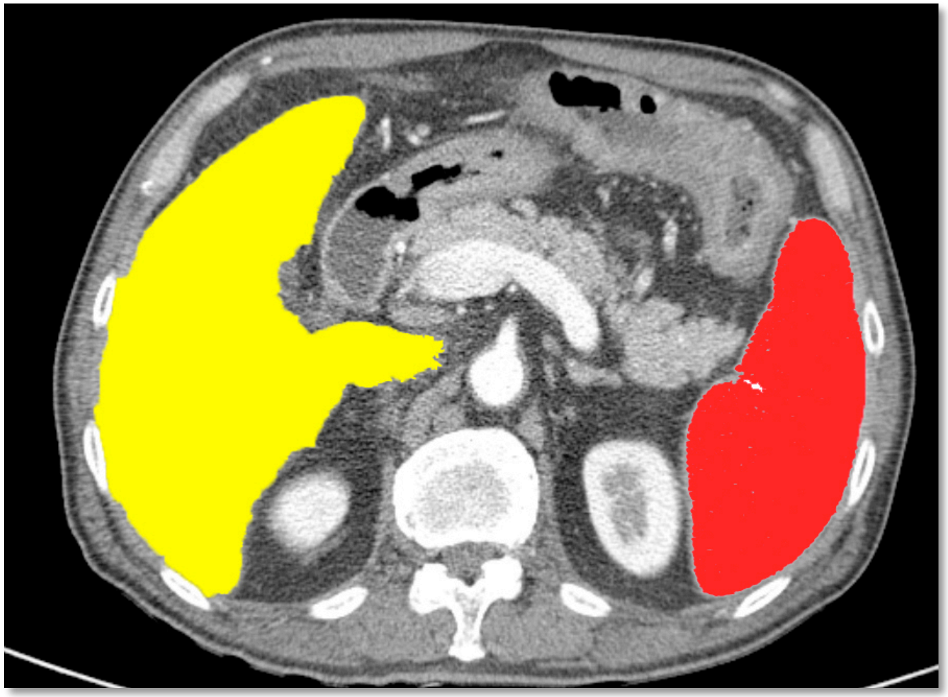
Size from Localizer or Axial





Segmentation

- 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



What was done ?

- **(Performed) Procedure Type**
  - – varies from site to site
  - – varies from scanner to scanner
  - – varies between operator !#$%
  - – limited and non-standard codes
  - – non-standard strings (Study Description)
  - – language and locale specific
  - – may or may not include anatomic region

Dose from Modality

- **Multiple possible DICOM sources**

- **Image "header"**
- **Modality Performed Procedure Step**
- **Radiation Dose Structured Report**
- **Dose Screen OCR or "header"**

Dose from Modality - Images

- **Images are insufficient**
  - technique only
    - kVP,mAs, not usually CTDIvol
    - not DLP, which spans entire acquisition
  - multiple reconstructions per exposure
    - soft tissue and bone reconstructions, MPRs
    - might count more than once
  - timing of encoding
    - images encoded/sent before acquisition ends

Dose from Modality - MPPS

- **MPPS is insufficient**
  - limited ability to encode complex data
  - transient message, 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

Dose from Modality - RDSR

- **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

DICOM CT RDSR

CT RADIATION DOSE SR IOD TEMPLATES

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

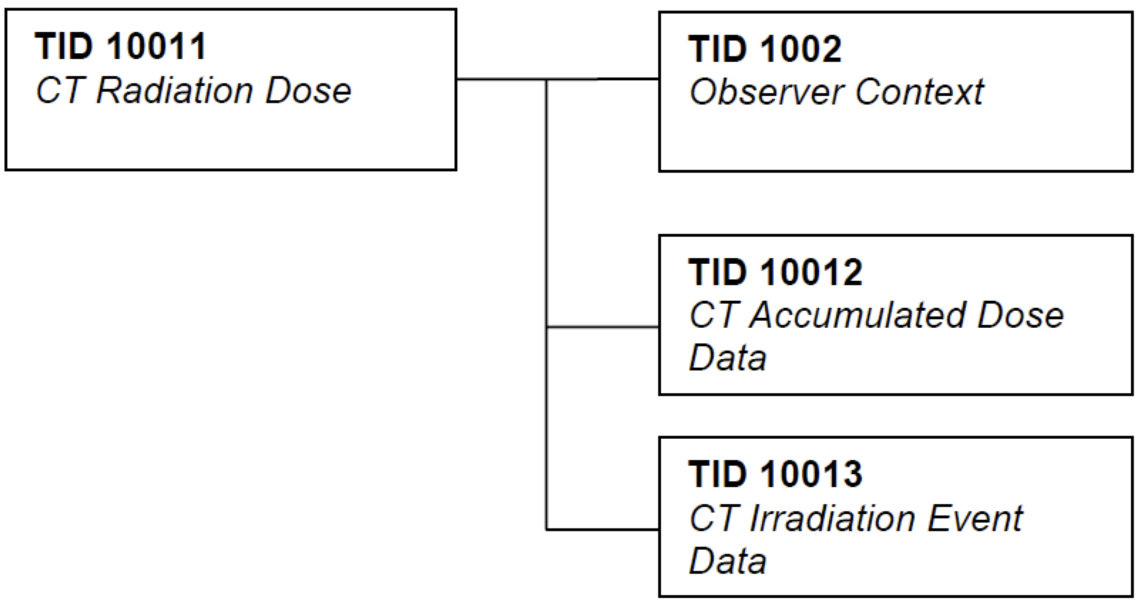


Figure A-12: CT Radiation Dose SR IOD Template Structure

DICOM CT RDSR

- : 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

DICOM CT RDSR

- : 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

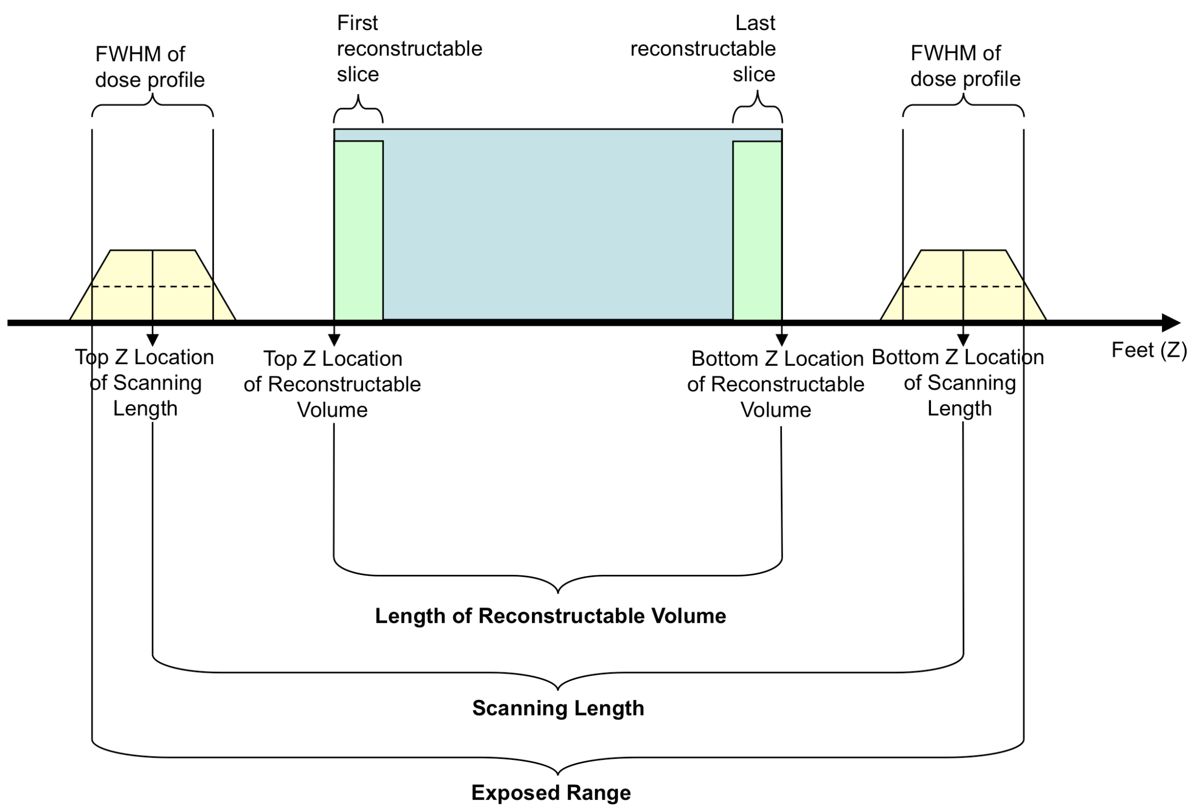
Dose from Modality - RDSR

- **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

Dose from Modality - RDSR

- **Radiation Dose Structured Report**
  - 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,…)

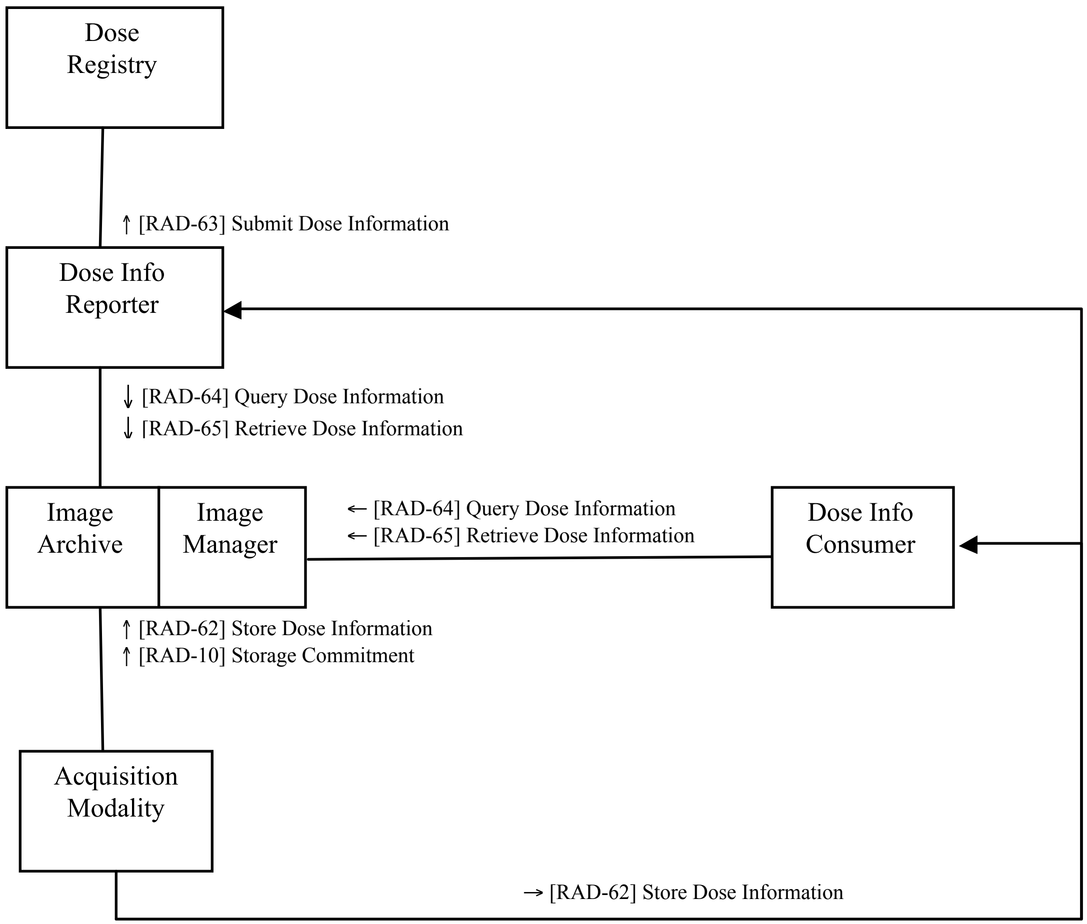
RDSR Extensible – CP 1068



Management – IHE REM

- **Radiation Exposure Monitoring (REM)**
  - Integrating the Healthcare Enterprise (IHE)
  - profile to specify actors & transactions
  - create, store, distribute, report and register
  - Modalities create
  - PACS (IM/IA) stores
  - Dose Information Consumer uses
  - Dose Information Reporter sends to Registry

IHE REM Profile



Standards for the Future

- **Way forward is clear**
  - all new equipment should encode dose in DICOM Radiation Dose Structured Reports (RDSR)
  - all devices should support IHE Radiation Exposure Monitoring (REM) profile, which addresses modality, storage, reporting and registry submission
- **Commitment by vendors to update**
  - “current platform” only

PRODUCT FAMILY	LIGHTSPEED			
Product	Software	Slices	DICOM DOSE SR	DICOM SC
LightSpeed QX/i		4		
LightSpeed (H-power gantry)		4		
LightSpeed Plus (Compact gantry)		4		
LightSpeed Plus (H-power gantry)		4		
LightSpeed Ultra (Compact gantry)		8		
LightSpeed Ultra (H-power gantry)		8		
LightSpeed 16 (Compact gantry)		16		
LightSpeed 16 (H-power gantry)		16		
LightSpeed Pro 32		32		
LightSpeed RT	07MW11.10	4, 8, 16		
	07BW08.x			
	08BW17.7			
	08BW44.1			
	09HW30.4			
LightSpeed VCT	07MW18.4	64		
	08MW33.2	64		
	09MW08.10	64		
	09MW08.11	64		
	10MW06.5	64		

Dilemma

- **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

Old Scanners

- **Usually no explicit dose information**
  - just technique (kVP, mA, etc.)
  - scanner-specific dosimetry efforts (ImPACT)
  - Garcia MS et al. 2009
- **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

Challenges

- **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

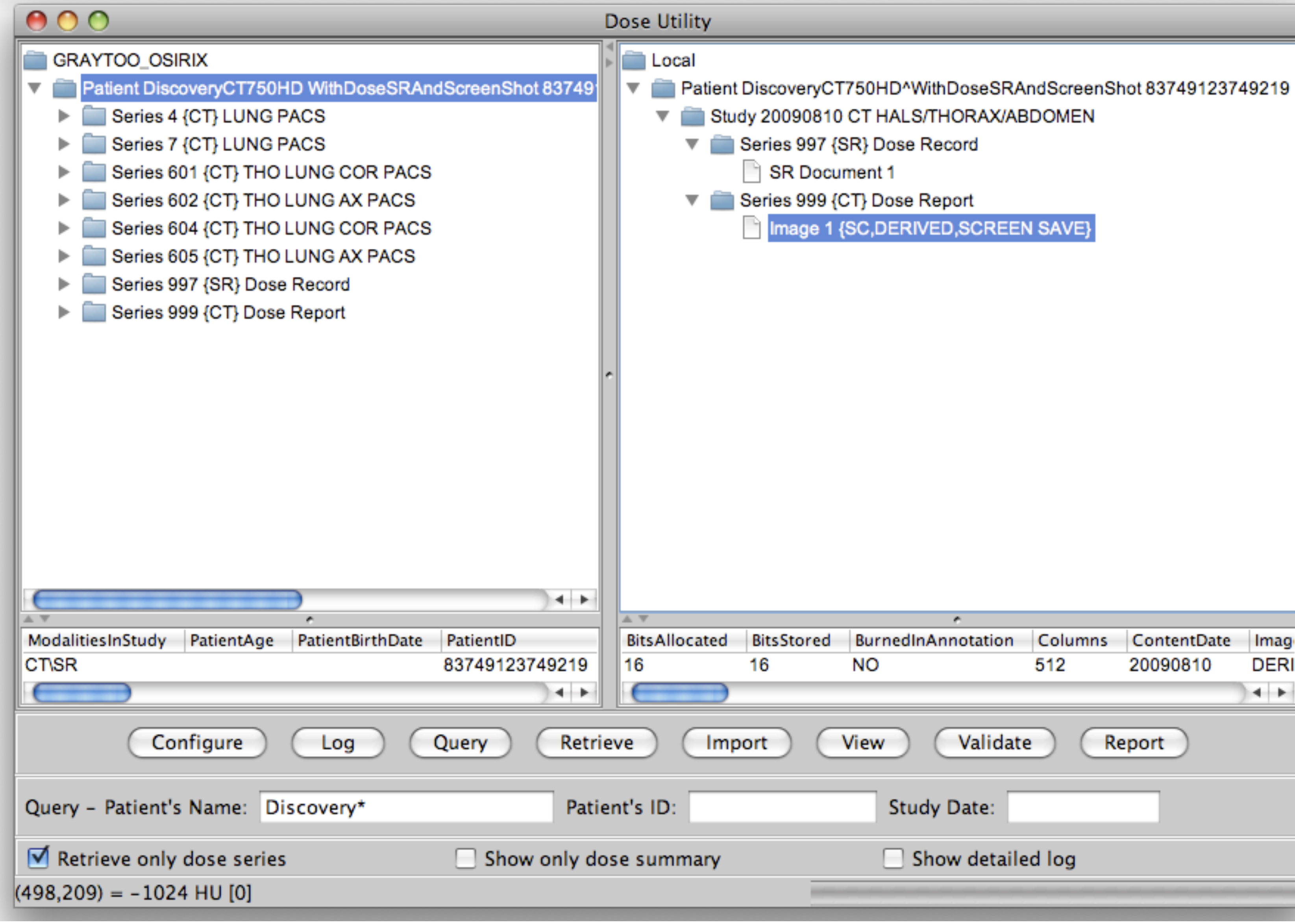
Challenges - Anatomy

- **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

OCR Implementations

- **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

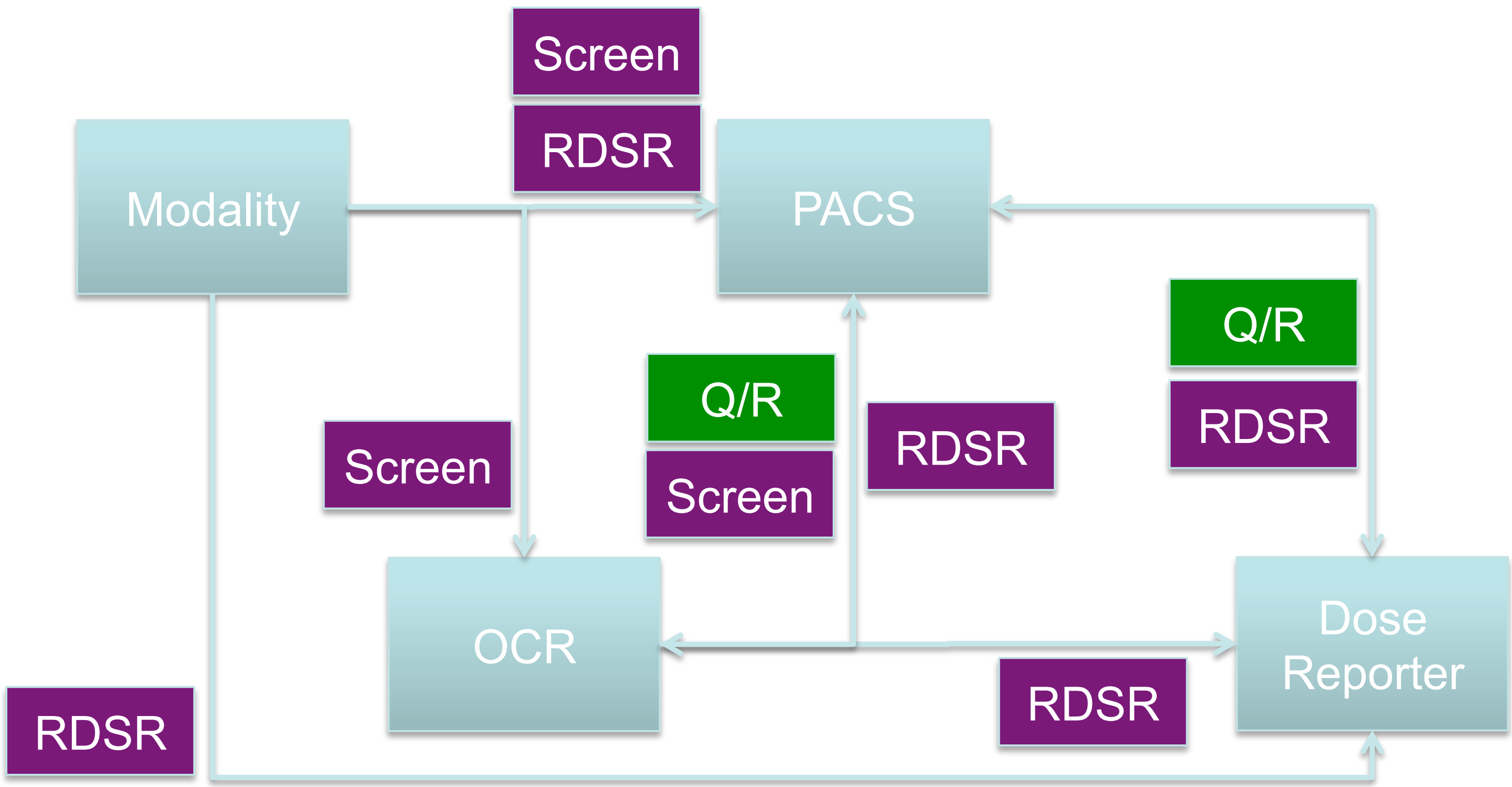
Series	Type	Scan Range (mm)	CTDIvol (mGy)	DLP (mGy-cm)	Phantom cm
1	Scout	-	-	-	-
2	Helical	S15.750-I650.250	5.10	373.00	Body 32
5	Helical	S188.000-I105.000	5.10	182.72	Body 32
			Total Exam DLP:	555.72	

1/1

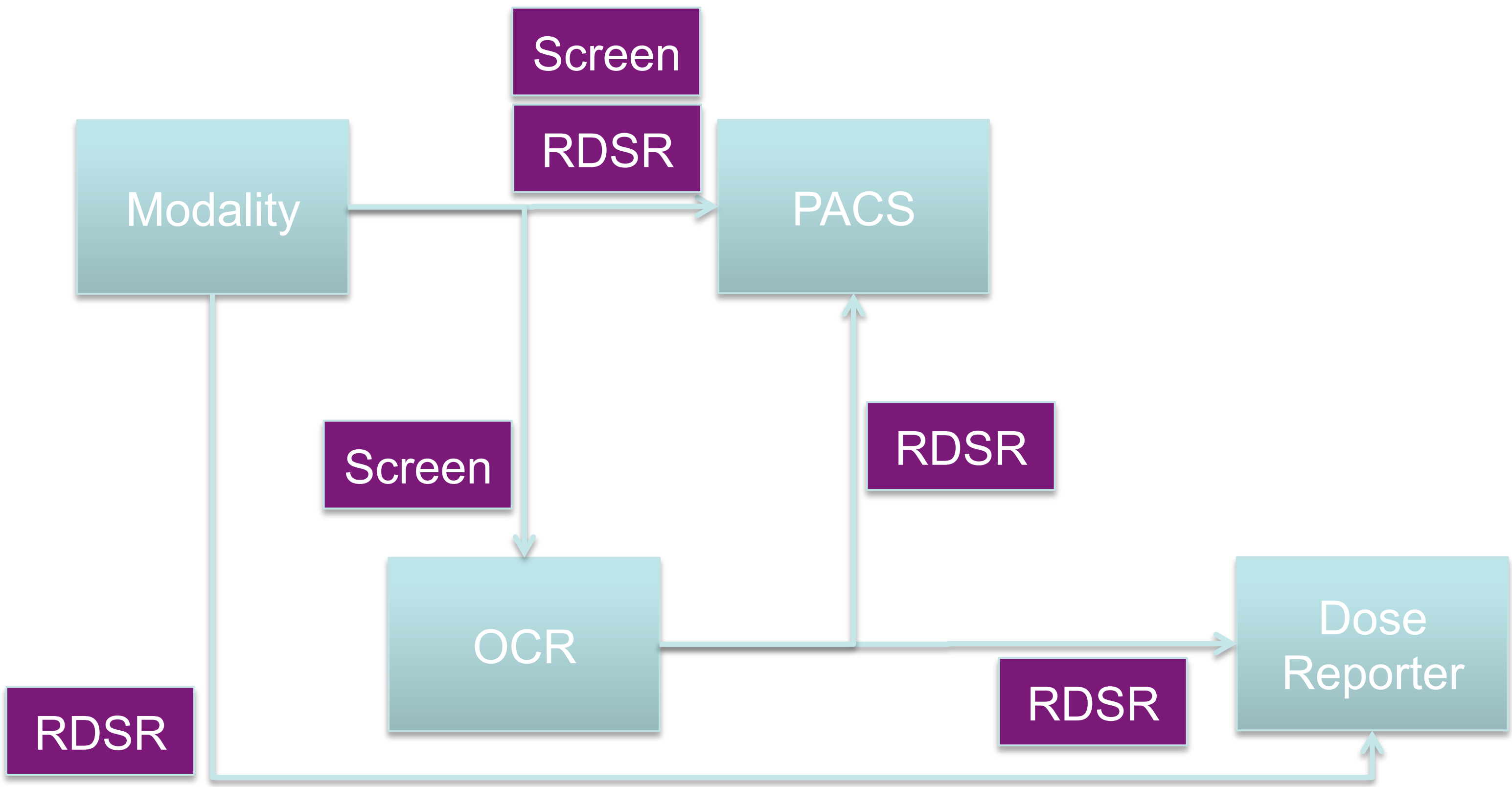
Reporting started						
Dose	2009/08/10 13:03:28	CT	CT HALS/THORAX/ABDOMEN	DLP Total=555.72 mGycm		
	Series=2	Helical	S15.750-I650.250 mm	5.10 mGy	373.00	mGycm BODY32
	Series=5	Helical	S188.000-I105.000 mm	5.10 mGy	182.72	mGycm BODY32
Reporting complete						

Clear

RDSR & OCR Deployment

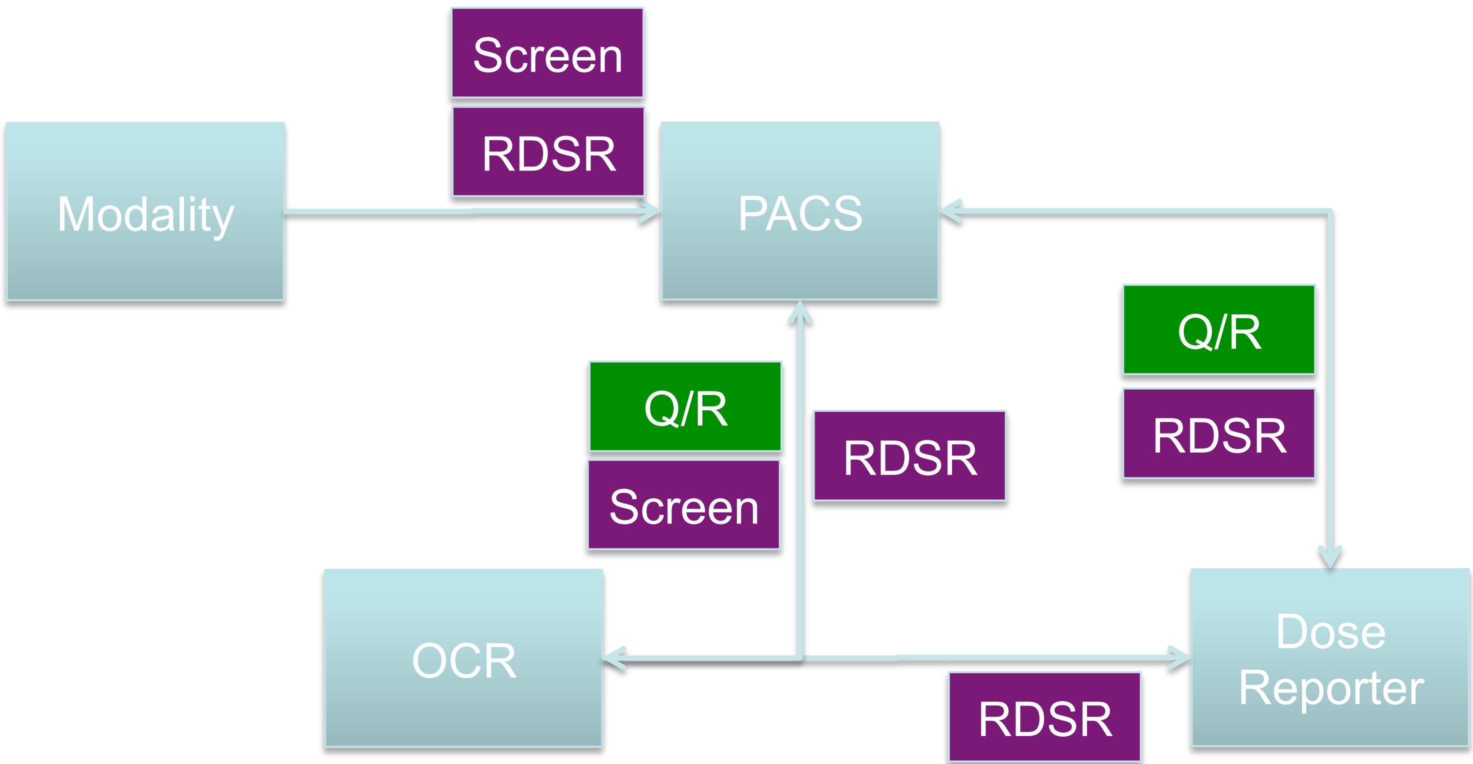


Push Model



Screen
RDSR
Modality
PACS
Screen
RDSR
OCR
Dose Reporter
RDSR
RDSR

Pull Model


Screen
RDSR
Modality
PACS
Q/R
RDSR
Q/R
Screen
RDSR
OCR
Dose Reporter
RDSR

NEMA XR-25 Dose Check

The Association of Electrical and Medical Imaging Equipment Manufacturers

Setting Standards for Excellence

NEMA Standards Publication XR 25-2010

Computed Tomography Dose Check

NEMA XR-25 Dose Check

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

DICOM + XR-25

- **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**

Conclusions

- **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**