

RADIOLOGY RESEARCH

## CT Dose Reporting

Michael Flynn	Henry Ford Health System
Michael McNitt-Gray	UCLS School of Medicine
Richard Morin	Mayo Clinic

### Introduction

- Recent reports have prompted interest in documenting patient exposure from CT examinations in the medical record.
- In this course, we focus on new methods to document CT exposure and explain some of the problems involved in estimating dose for a specific studies.

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### Learning Objectives

- MF** A. DICOM Dose Structured Report.  
B. IHE Radiation Exposure Monitoring.
- RM** C. The ACR Dose Registry project.
- MMG** D. Estimation of Organ doses.  
E. Issues with patient size & sex.

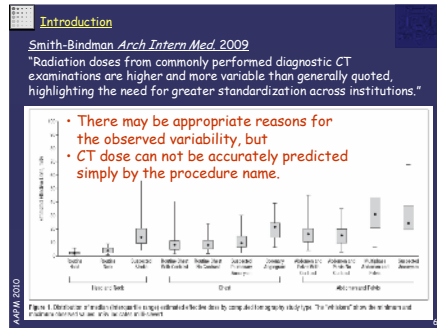
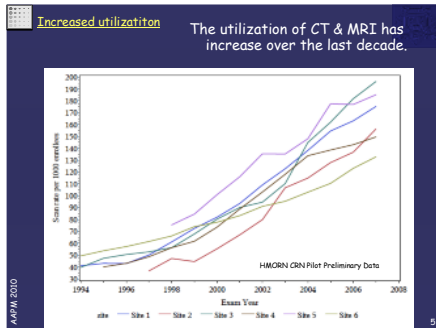
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### Recent Editorials

- Golding, Radiology, June 2010**  
"By any standard, the radiation exposure of the population resulting from computed tomography (CT) in Western medicine is currently a controversy."
- Smith-Bindman, JAMA, June 2010**  
"Consensus is growing that we must ensure that patients undergoing CT receive the minimum radiation dose possible to produce a medical benefit."
- Brenner, JAMA, July 2010**  
"It follows that legislation would also be effective in reducing the current high level of medically unwarranted imaging studies."

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**Estimating Scan exposure from DICOM tags.**

- For archived CT studies, we would like to determine factors influencing radiation exposure to the patient.
- Obtaining this data from DICOM tags is problematic.

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**Image series vs x-ray scan**

- DICOM CT objects were designed to communicate images series.
- Image series that are associated with a new xray scan are not clearly indicated

```
(0008,0008) Image Type
Sr1 - ORIGINAL\PRIMARY\LOCALIZER
Sr2 - ORIGINAL\PRIMARY\AXIAL
Sr3 - DERIVED\SECONDARY\SCREEN SAVE
Sr4 - DERIVED\SECONDARY\REFORMATTED\MIP

(0008,0032) Acquisition Time
Sr1 - 090103 • Localizer scan
Sr2 - 090259 • Axial scan
Sr3 - 090045 • Graphic dose report
Sr4 - 090259 • Reformatted from axial scan
```

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**kV**

- The kV for an identified x-ray scan is the most reliably reported technique factor

```
(0018,0060) KVP
Sr1 - 120
Sr2 - 120
Sr3 - NP
Sr4 - 120
```

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These tag examples are from a 2009 study done on a 16 slice helical scanner

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**Exposure time, current, mA-S**

- mA, time, and mA-S are notorious for being misleading!
- The values reported require knowledge of what the manufacturer reported for a particular model/version.
- No good database exists for scanners in common use.

```
(0018,1150) Exposure Time, mS
Sr2 - (546)
(0018,1151) Xray Tube Current, mA
Sr2 - 100
(0018,1152) Exposure
Sr2 - 4
```

This protocol was set to an effective mA-S of 40

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These tag examples are from a 2009 study done on a 16 slice helical scanner

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**Procedure**

- The performed procedure name may not be reported.
- If reported it does not come from a defined lexicon.
- Protocol names are not the same as procedure names.
- This hinders comparison amongst centers.

```
(0008,1030) Protocol Name
Sr2 - 5.2 LOW DOSE NODULE CHEST
(0008,103e) Series Description
Sr2 - 2.5MM LOW DOSE
```

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These tag examples are from a 2009 study done on a 16 slice helical scanner

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**Pitch for Helical scans**

- Pitch was not reported until recently.
- New tags defined for the enhanced CT object were defined as optional for the original CT object.
- Over the last few years, new scanner software have incorporated these important terms.
- For older studies, a guess must be made.

```
(0018,0022) Scan Options
Sr2 - HELICAL MODE
(0018,9307) Total Collimation
Sr2 - 20
(0018,9307) Spiral Pitch Factor
Sr2 - 1.375
```

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**CTDIvol and DLP**

- CT Dose reports have been incorporated as a graphic image in recent years, but the data is not incorporated as a tag.
- A few centers have attempted Optical Character Recognition (OCR) to extract data.
- Only a few recent device versions include the exposure dose sequence tags.

```
(0040,030e) Exposure Dose Sequence
item 3
...
(0018,9345) 5.094432, CTDIvol
...
```

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These tag examples are from a 2009 study done on a 64 slice spiral scanner

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**DICOM Dose Structure Report.**

- A need exists for a new DICOM object to describe the exposure associated with the x-ray irradiating scans occurring with a CT study.
- The DICOM Dose Structured Report meets this need.
- This is to be communicated separately from the images of the study.

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**C - CT Dose Reporting**

**CT Radiation Dose Reporting (Dose SR)**

- Working Group 21 (CT)
- Supplement 127
- Standard, 2007

"The Computed Tomography X-Ray dose report is based on the SOP class of X-Ray Radiation Dose SR. Specific templates for the recording of the dose and the acquisition parameters in a CT environment have been developed.

The development of the CT Dose Report Template was accomplished by the DICOM WG 21 and by IEC SC62B MT30, which have defined a common set of dose-related information ...

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**C - SR Dose IOD**

**CT SR Dose IOD Modules and Structure**

IE	Module	Reference	Description
Patient	Patient	C.7.1.1	Identifies the patient
	Clinical Trial Subject	C.7.1.3	Identifies the clinical trial subject
Study	General Study	C.7.2.1	Describes the study performed upon patient
	Patient Study	C.7.2.2	Describes information about study
Series	Clinical Trial Study	C.7.2.3	Identifies context of clinical trial
	SR Document Series	C.17.1	Defines attributes of the SR document
Frame of Reference	Clinical Trial Series	C.7.3.2	Identifies context of clinical trial
	Synchronization	C.7.4.2	Synchronization to patient study
Equipment	General Equipment	C.7.5.1	Attributes to identify the equipment
	SR Document General	C.17.2	General context of SR document
Document	SR Document Content	C.17.3	Specifies the attributes contained in the SR
	SOP Common	C.12.1	DICOM basic for definition of object
	CT Accumulated Irradiation Dose Study	template	Accumulated irradiation for an entire examination
	CT Irradiation Event	template	1 to n separate irradiation events

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**C - CT dose content**

- **CT Acquisition Parameters**
  - The tube voltage and the tube current are stated.
  - The effective exposure in mAs is stated.
  - The exposure time and the scanning length are stated.
  - Acquisition parameters related to the volume acquisition are stated (collimation, pitch factor).
- For each CT Acquisition (irradiation event):
  - The CT DIvol and DPL are stated.
  - The corresponding CT DI free air is stated.
  - The effective dose may be stated (optional).
  - The parameters used are stated.
  - The reference values for dose estimation and calculation are stated, e.g. calibration factor, effective dose type

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**IHE - REM**

**IHE**

**IHE Radiology Technical Framework  
Supplement 2007-2008**

**Radiation Exposure Monitoring (REM)  
Integration Profile**

This profile facilitates the collection and distribution of information about estimated patient radiation exposure resulting from imaging procedures.

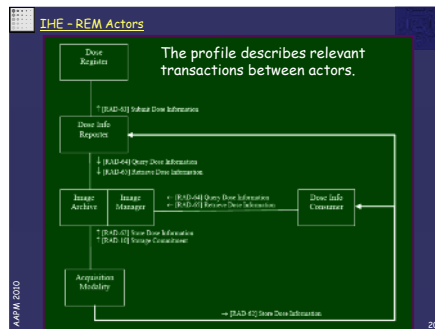
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**IHE - REM Actors**

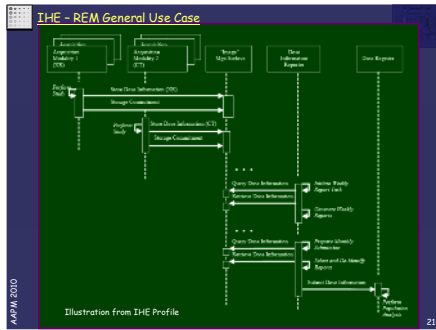
**ACTORS**

- **Acquisition Modality** - <Creates and stores Dose SR.
- **Image Manager/Archive** - <Accepts/Commits dose data and supports Q/R.
- **Dose Information Consumer** - Responsible for supplemental handling of irradiation events, generally on an individual basis, e.g. display, analysis, or further processing.
- **Dose Information Reporter** - Responsible for the aggregation, analysis, reporting and business logic related to irradiation events
- **Dose Register** - Collates information about irradiation events from a number of facilities

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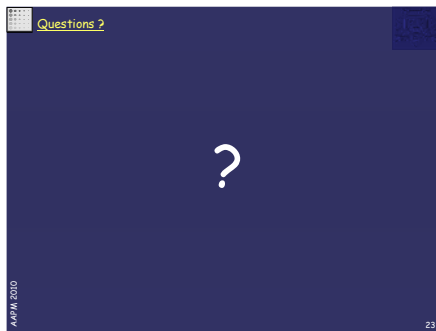
### IHE - REM Connectathon

- Every year, IHE conducts a connectathon to demonstrate vendor implementations of new profiles.
- The results are maintained in public searchable dB.

	Image Manager	Acquisition Authority	Data Information System	Data Information System	Data Engine
JAMA Healthcare	U	*		*	
Alameda College of Dentistry	U		*		*
PH	U		*		
RTS&M	U	*			
BB Healthcare	U	*	*		
Definit, Inc.	U	*	*		
Evans, IR	U	*		*	*
HealthCommunication		*			
EDWARDS Medical Devices	U	*			
ADP/ALCO MEDICAL	U	*			
Beckley Medical JB	U	*			
TILLINGS & A.	U	*	*		
VISAR Technology Transfer Agent	U	*			

[http://sumo.irisa.fr/con\\_result/](http://sumo.irisa.fr/con_result/)

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