



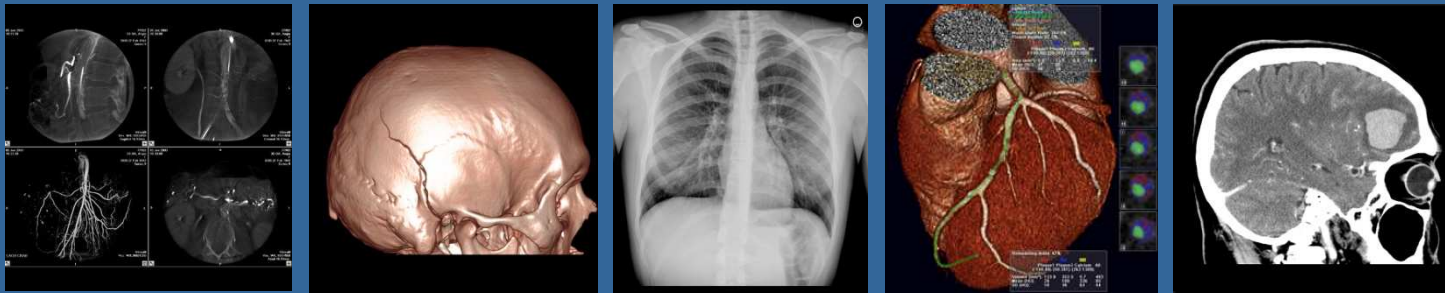
IHE & Radiation Exposure Monitoring

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Motivation

- X-Ray based imaging can provide tremendously useful information



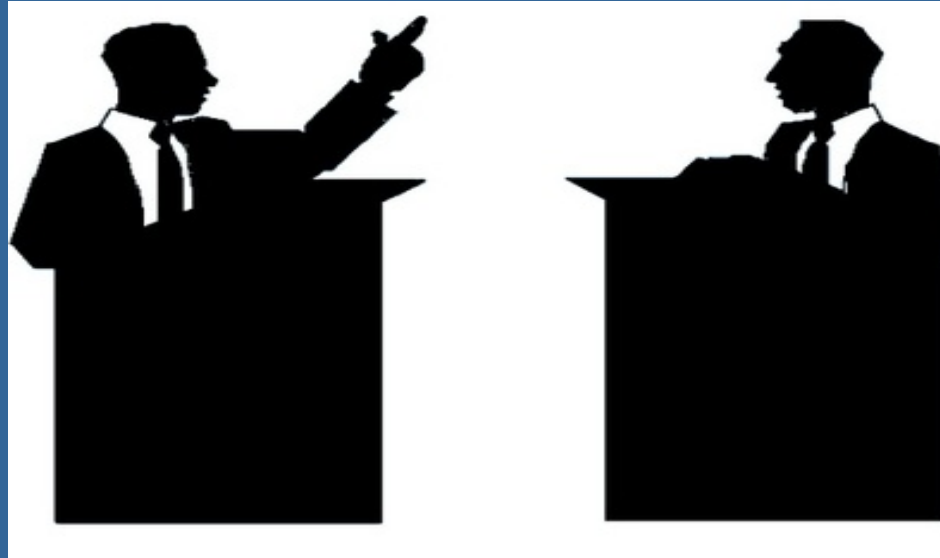
- Patient Dose is an important consideration



- Potential benefit > potential risk
... but risk should be managed responsibly

Why Collect Numbers

*“I think patient
dose is
improving.”*



*“I think it’s
getting
worse.”*

- **Managing in the presence of data is far better and easier than managing in its absence. – Robert Glass**

Why Collect Numbers

- Technology is constantly changing
- Technique is constantly evolving
- Understanding continues to improve

Why Collect Numbers

- **ALARA Guidelines for Physicians**

- (Patient Dose) As Low As Reasonably Achievable

- Patient Dose $< =$ Reasonably Achievable Dose

- $A < = B$

- **Should be routine / automatic / easy**

- **Can we make the data readily available...**

... A New IHE Profile

- What's an IHE Profile?

IHE in One Slide



- **IHE helps vendors implement & test functions that span multiple systems**
- **Profiles are implementation guides**
 - how to use existing standards
 - to address a specific problem scenario
- **Connectathons are test events**
 - managed testing of Profile implementations
- **IHE helps users purchase & integrate multi-system solutions**
 - list required IHE Profile support in RFPs

IHE Connectathon



One Week;
70+ vendors;
350+ engineers;
Thousands
of tests;
Managed
process;
Find & resolve
issues.

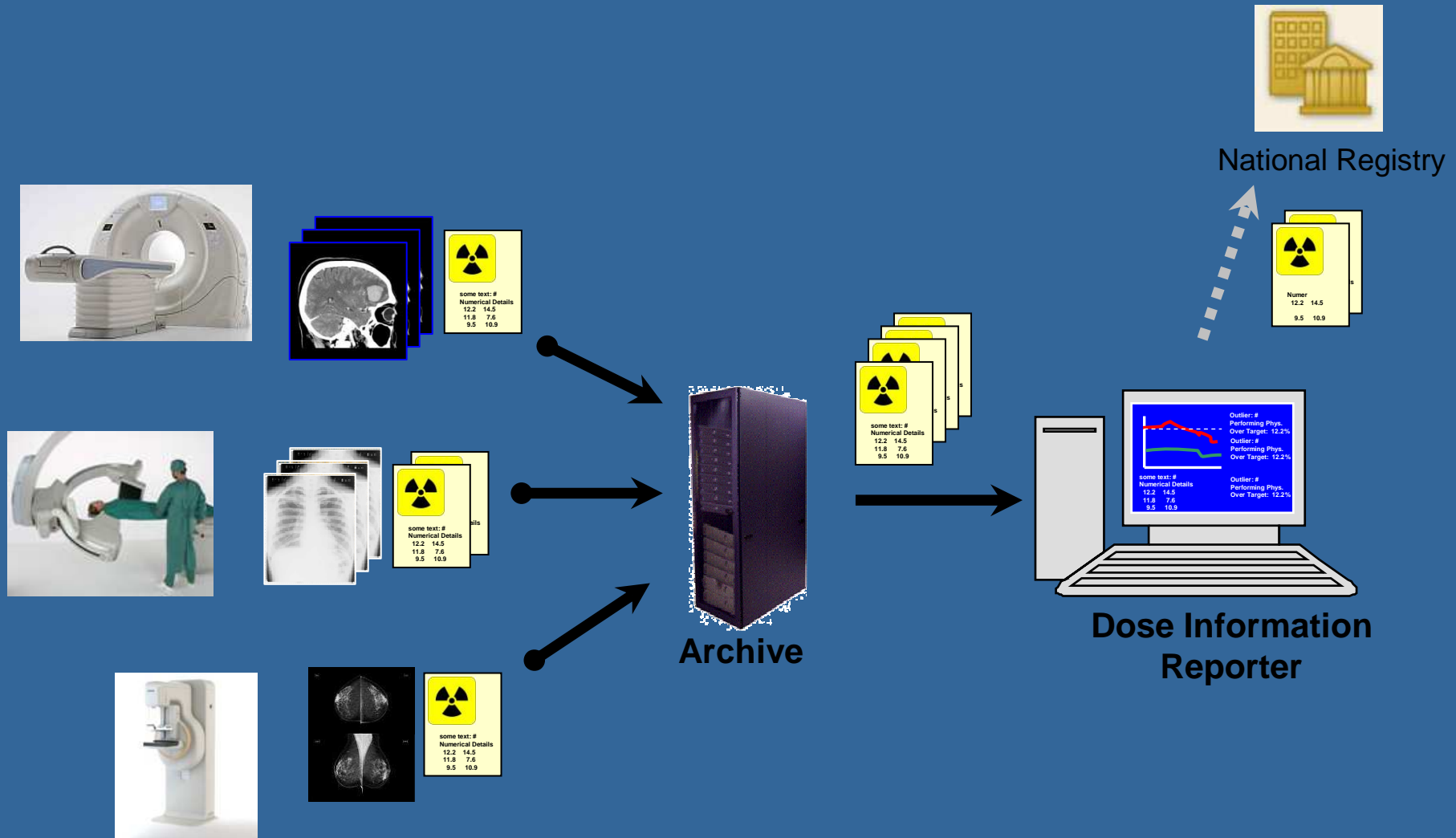
Results @
www.ihe.net

A New IHE Profile

● 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, etc.
- Directly based on DICOM Dose Reports
- Creation, Collection, Distribution, Processing

IHE Radiation Exposure Monitoring Profile



DICOM Dose Reports

- **“SR Objects” – DICOM Structured Reports**
 - Easily ingested (and regurgitated) by PACS
- **Granularity : “Irradiation Event”**
 - + Accumulated Dose over Study, Series
- **Templates:**
 - CT, Projection X-Ray (Mammo, Fluoro)
 - (DR/CR?)
- **Not addressed: NM, RT**

What To Measure

● So many choices...

- Exposure, Dose, Dose Index, Estimated Dose, Effective Dose, Estimated Effective Dose, ...
- $CTDI_w$, $CTDI_{vol}$, $CTDI_{100}$, $CTDI_{freeair}$, ...

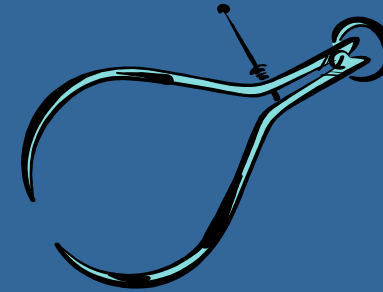
● Solution:

- Collaborated with IEC Subcommittee 62B
- Established a baseline & a pipeline
- Upgrade when necessary

Key Measurements

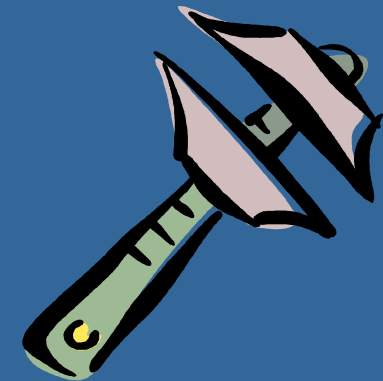
● CT Dose

- DLP, CTDI_{vol}, kVP, mA, sec
- Effective Dose [Optional]
(Reference estimation method)



● Projection X-Ray Dose

- DAP, Dose@RP, kVP, mA, sec
- Fluoro Dose, Fluoro Time



● Mammography Dose

- AGD, Entrance Exposure@RP, kVP, mA, sec
- Compression, Half Value Layer

ftp://medical.nema.org/medical/dicom/2008/08_16pu.pdf

ftp://medical.nema.org/medical/dicom/final/cp874_ft.pdf

Other Details in Dose SR

- Full Patient / Order / Study Details
- Unique ID for each Irradiation Event
- Equipment ID, Ordering Doc, Performing Tech

- Patient Position, Anatomy imaged
- Imaging Geometry (projection)

- Collimation
- X-Ray Filters, Anode Target Material
- Calibration, Phantom, Dosimeter

DICOM SR Template

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-C232G-C32C, SRT, "Procedure Context")	1	U		DCID (10014) Contrast Imaging Technique
6	>	CONTAINS	UIDREF	EV (113769, DCM, "Irradiation Event UID")	1	M		
7	>	CONTAINS	NUM	EV (113821, DCM, "X-ray Filter Aluminium Equivalent")	1	U		Units = EV (mm, UCUM, "mm")
8	>	CONTAINS	CONTAINER	EV (113822, DCM, "CT Acquisition Parameters")	1	M		
9	>>	CONTAINS	NUM	EV (113824, DCM, "Exposure Time")	1	M		Units = EV (s, UCUM, "s")
10	>>	CONTAINS	NUM	EV (113825, DCM, "Scanning Length")	1	M		Units = EV (mm, UCUM, "mm")
11	>>	CONTAINS	NUM	EV (113826, DCM,	1	M		Units = EV (mm, UCUM,

Creating SR Dose Reports

● Modalities

- CT, XA/XRF, X-Ray, Mammography

● “Readers”

- CR, DX, Film Digitizers
- Note challenge if tube and detector don’t talk...

● 3rd Party Workstations

● RIS, PACS

Storing SR Dose Reports

- **Usually stored in the Study folder**
 - Archive, Backup, Reconciliation
 - Query / Retrieve
- **Can be sent to other destinations**

Using SR Dose Reports

Possible applications:

● Radiation QA

- Periodically Query / Retrieve Reports from Archive
- Set policies/standards and flag deviations
- Set goals for improvement and track;
- Implement protocol changes and compare difference in dose

● Patient Impact Evaluation

- e.g. if Patient identified as pregnant post-facto

● Dose Mapping

- Store data in realtime from Modality to Mapping Workstation

Using SR Dose Reports

● National Registries

- Anonymize and submit Dose Reports to Register
- Compile Population Risk Estimations
- Derive Dose Reference Levels
- Provide Site-Site Comparisons

● Individual Dose Record

- Collect Dose Reports over time

● Clinical Trials

- Collect Dose together with Images
- Demonstrate both improved detection & reduced dose

2009 Connectathon Participation

Vendors already testing IHE REM Profile:

- Agfa
- GE
- Krucom
- Siemens
- EDL
- Infimed
- MedicalCommunications
- Softway Medical

Results posted at:

http://ihe.univ-rennes1.fr/con_result/

Take-Away

IHE REM Profile:

- Automates data collection
- Useful component of a site Radiation Safety Program
- Ask about it when purchasing/upgrading
 - Check products IHE Integration Statement
- Discuss your reporting/analysis preferences with your Dose Info Reporting vendor
- Consider legacy system strategies

Questions?

● IHE REM Profile

- www.ihe.net
- www.ihe.net/Technical_Framework/index.cfm#radiology

● Check out other IHE Profiles

- wiki.ihe.net -> Click on “Integration Profiles”

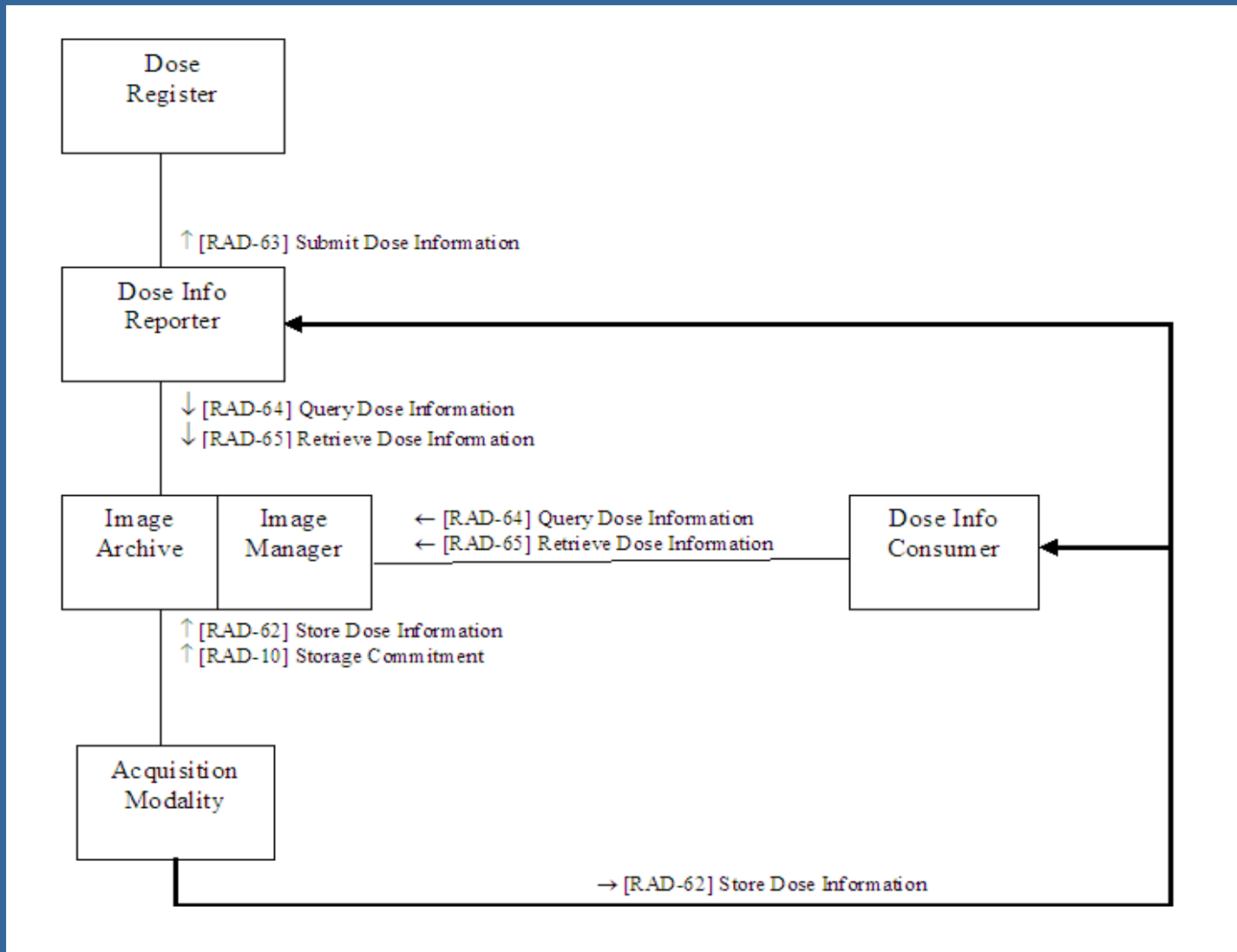
Why not use Image Headers?

- **Mostly Exposure details (for interpretation)**
- **No image; no dose**
 - deleted due to quality / patient motion
- **More images; more dose**
 - extra reconstructions; post-processing
- **Lacks complete dose details**

Why not use MPPS?

- **Modality Performed Procedure Steps**
 - Status messages back to RIS / PACS
- **Transient Information**
 - designed for workflow; not persistent archiving
- **Lacks complete dose details**

REM Profile: Actors & Transactions



The IHE Process

