

THE DICOM 2014 Chengdu Workshop

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Reporting: Presentation & Interpretation

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Reporting: Presentation & Interpretation

- **Introduction**
- **Standards Elements for Building Tools for Reading & Interpretation**
- **IHE Profiles for Interpretation & Reporting**
- **Conclusions**

Introduction

- **Access to Images & Image Related Information - Storage & Retrieval**
- **Display & Presentation of Image Data**
- **Interpretation Results**
- **Report Generation**
- **Putting them all together (the IHE way)**

Access to Images and Image Related Information

- **Retrieval of Images upon Availability**

- Newly Acquired Images
- Prior Images for Comparison
- Evidence Documents

- **Interpretation Worklists for Radiology Staff** sorted by:

- User (assigned Radiologist)
- Modality Type (all CT Exams)
- Specialties (CT Head)
- ...

Description	Tag	Type
Patient's Name	(0010,0010)	R
Patient ID	(0010,0020)	U
Study Date	(0008,0020)	R
Study Time	(0008,0030)	R
Accession Number	(0008,0050)	R
Study ID	(0020,0010)	R
Name of Physician(s) Reading Study	(0008,1060)	O
Modality	(0008,0060)	R

- **Worklist Management - based on:**

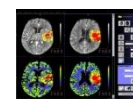
- Application Logic or
- Scheduling Data Provided by RIS/PACS

- **Images Sent to PACS from:**

- Acquisition Modality
- Other Workplaces (e.g. Imaging Centers)
- Imported from brought-in Media



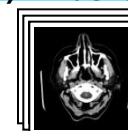
Interpretation
Reviewing
Workstation



Q/R: C-FIND / C-MOVE
New Images

C-FIND/ C-MOVE
Prior Images / Evidences

Image
Management
(PACS)



C-STORE & Storage Commitment
Transfer Images

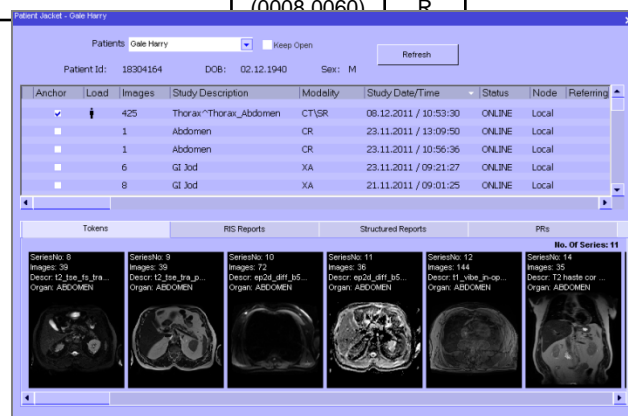


Image
Acquisition
Modality

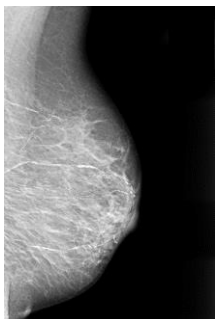


Image Display Consistency - Ensuring Quality for Reviewing & Interpretation

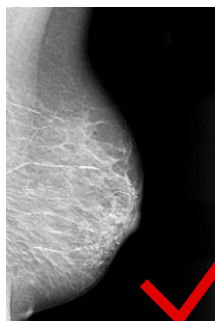
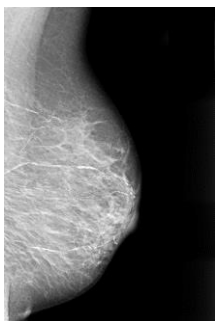
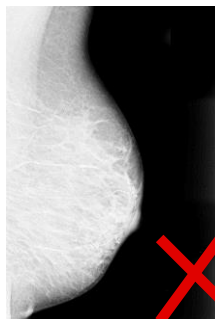
- **Issue #1: Differences in Characteristics of Display Devices**

- ▶ Images produced by same signal have different appearance on different display devices
- ▶ Difference in display luminance → images don't look the same (diagnostic quality impaired)

Display 1



Display 2



- **Grayscale Standard Display Function Standard (GSDF) (DICOM Part 14)**
 - ▶ Standard curve against which display devices can be calibrated (adjust their characteristic curve to the GSDF curve)
 - ▶ GSDF facilitates similarity in (human) grayscale perception and appearance of images between displays of different luminance

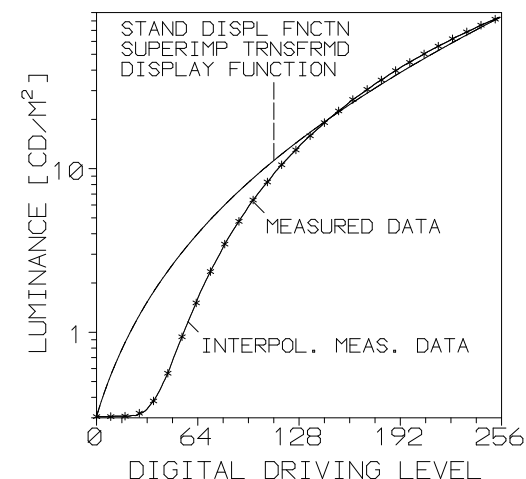
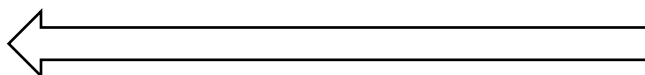


Image Display Consistency - Ensuring Quality for Reviewing & Interpretation

- **Issue #2: Image Display Set-Ups, Transformations and Annotations get Lost when Viewed on Different Displays**

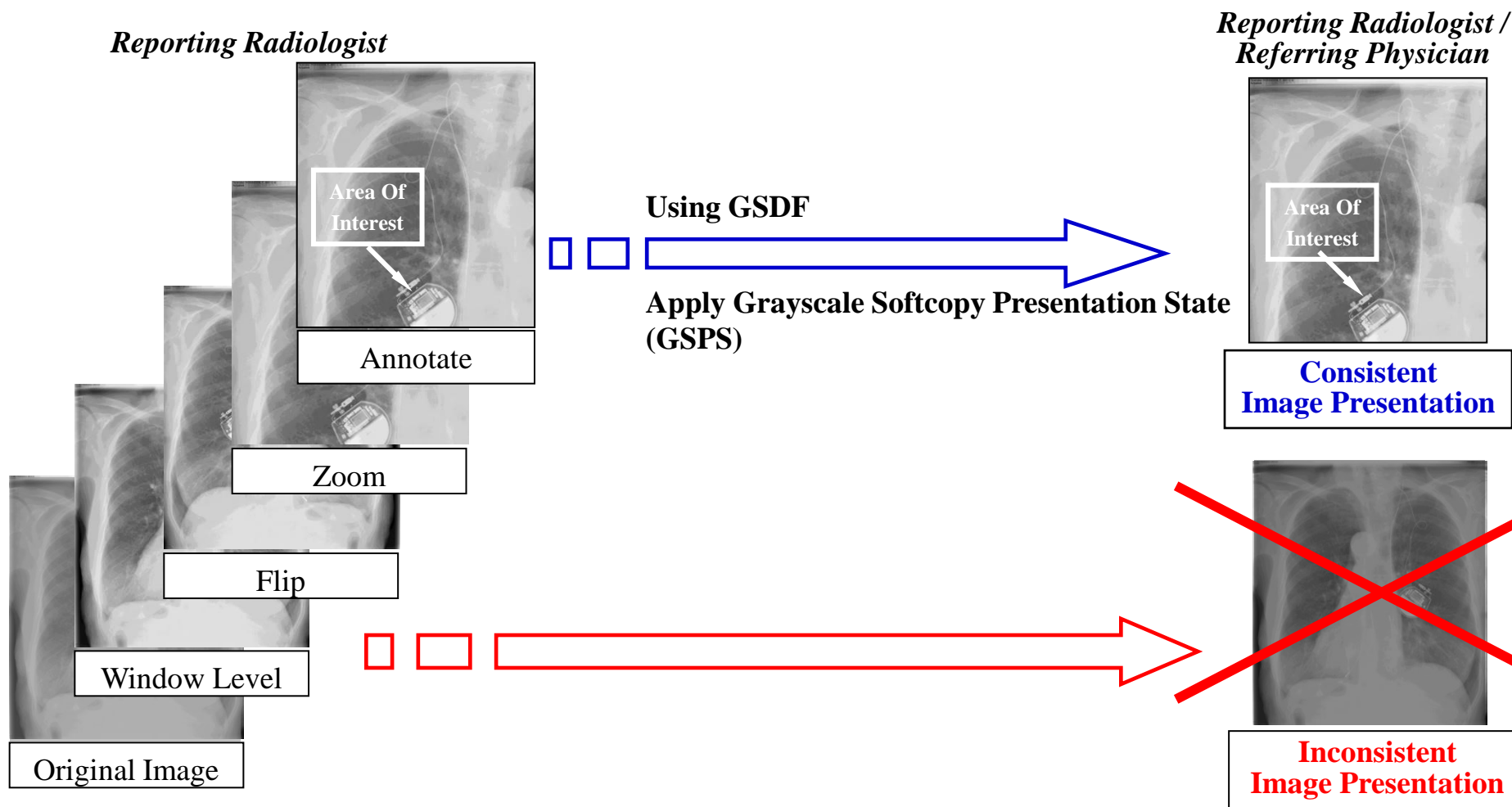
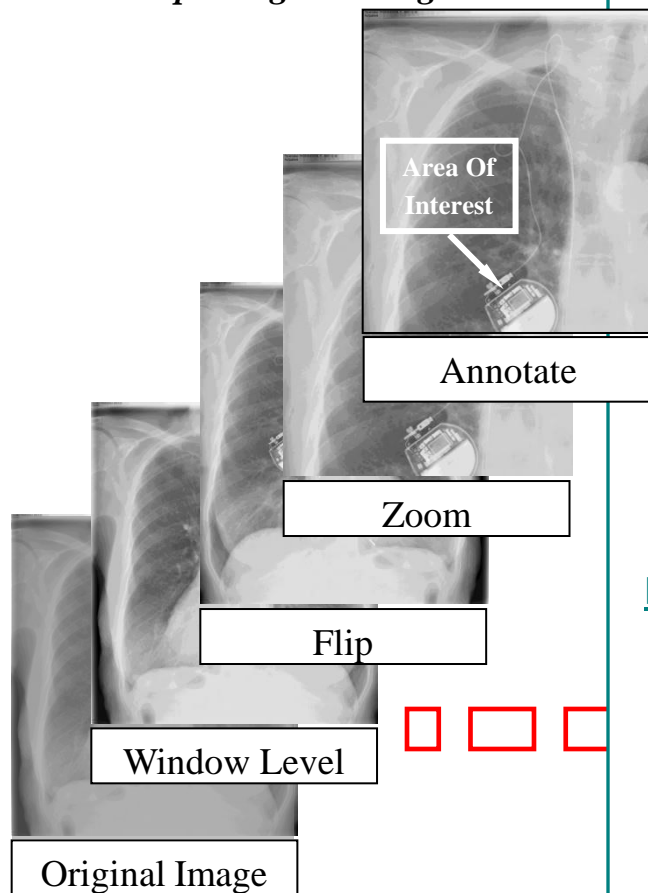


Image Display Consistency - Ensuring Quality for Reviewing & Interpretation

- **Issue #2: Image Display Set-Ups, Transformations and Annotations get Lost when Viewed on Different Displays**

Reporting Radiologist



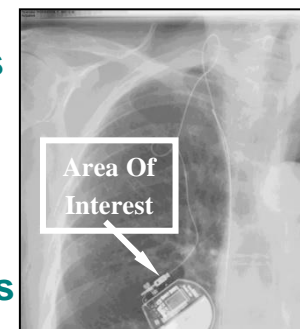
Grayscale Softcopy Presentation State (GSPS)

- ▶ GSPS objects contain only presentation parameters describing how to display images
 - Grayscale Transformation
 - Spatial Transformation
 - Graphics / Annotations
 - Measurements ...
- ▶ Link to one or more Images in Series / Studies
- ▶ Separation of Stored Images from Display Characteristics or Transformations
- ▶ Communication of Display Parameters using regular Storage and Query / Retrieve Services

Benefits

- ▶ Quality & Consistency of Images Preserved for Diagnostic Use - Same Look on all Displays
- ▶ No need to duplicate Images (originals + transformations) - apply Presentation States automatically before the Images Display

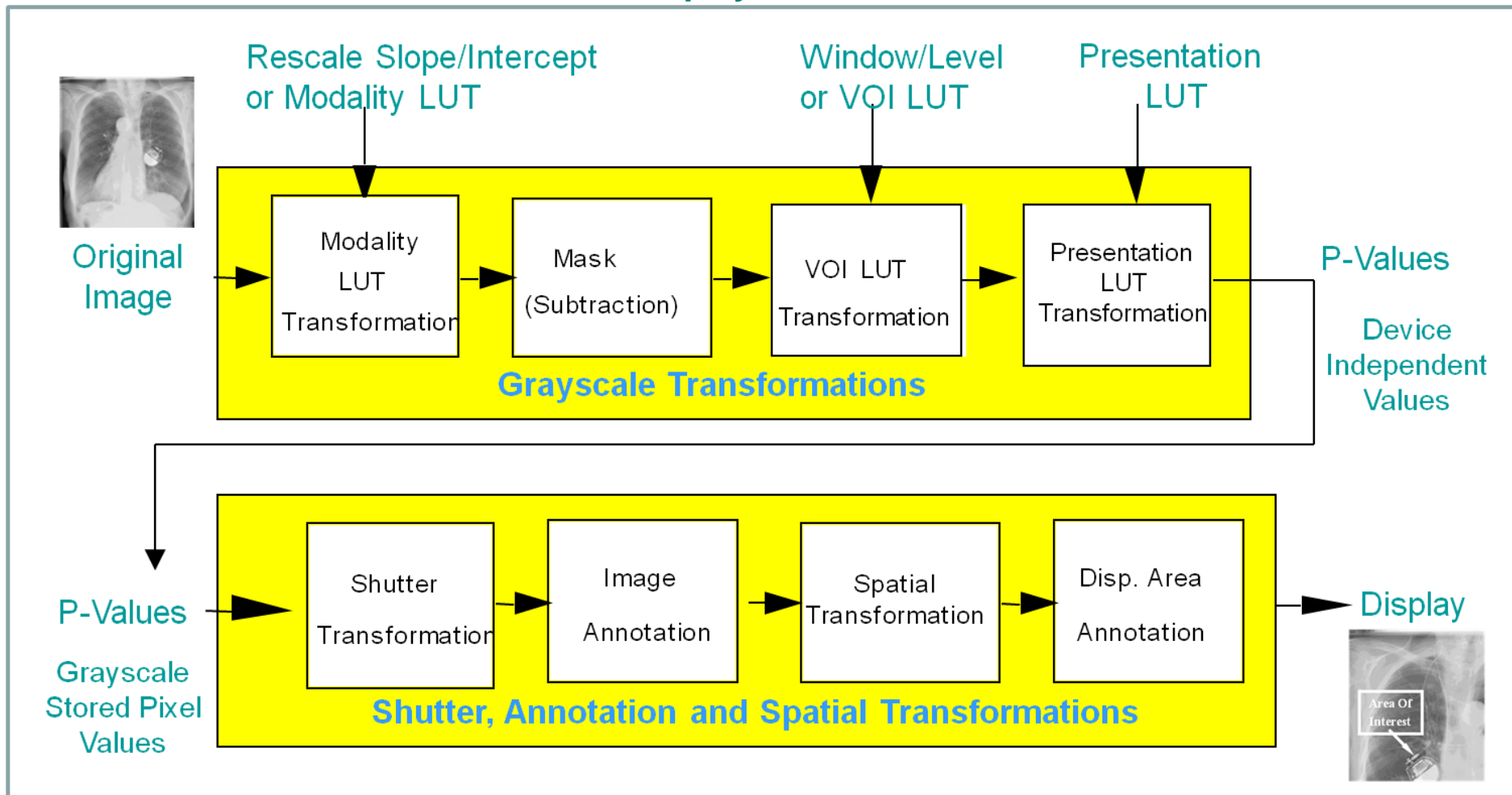
Reporting Radiologist / Referring Physician



Consistent Image Presentation

Image Display Consistency - Ensuring Quality for Reviewing & Interpretation

- **Issue #2: Image Display Set-Ups, Transformations and Annotations get Lost when Viewed on Different Displays**



Creating Evidences - Collecting Information for Reporting

DICOM Structured Reporting (SR)

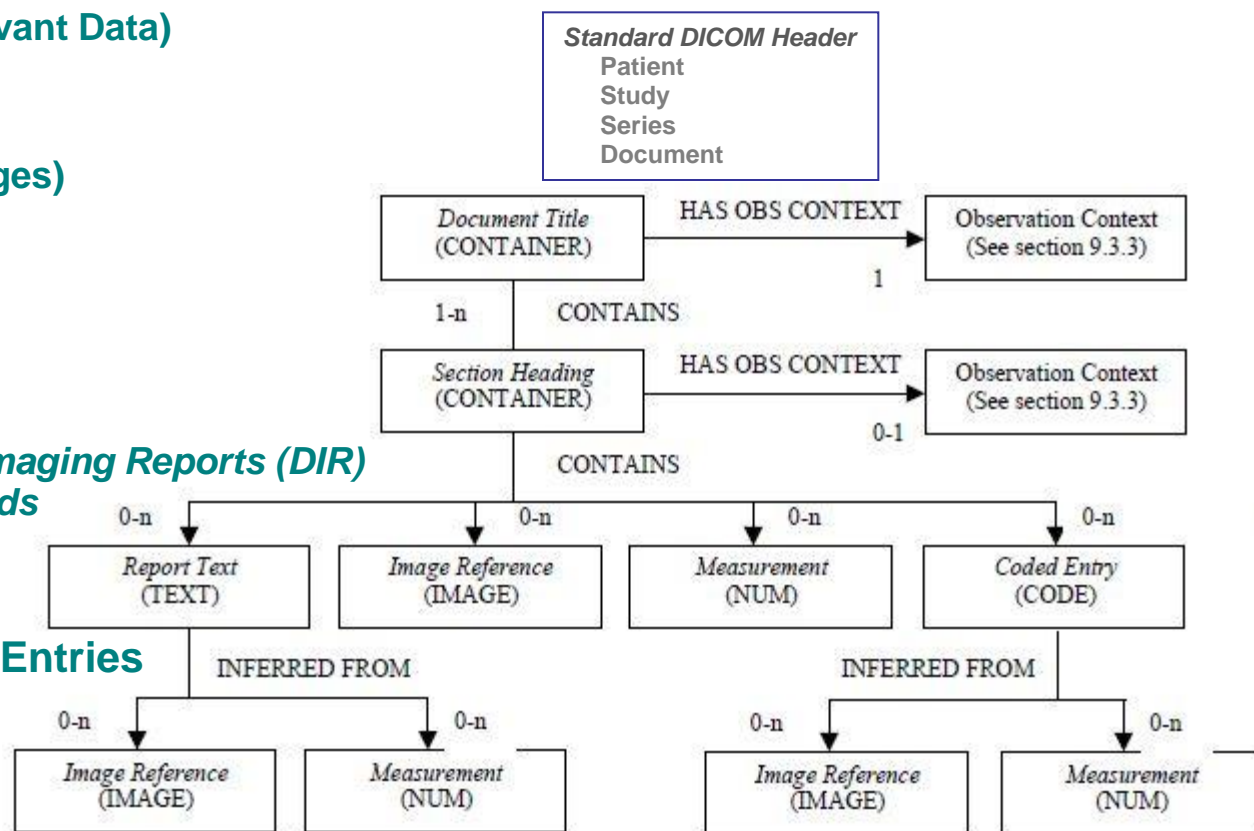
- “Multi-Purpose Tool” for Capturing Image Accompanying Data
- Records of Study Evidences (Findings) made during Image Interpretation

- Observations (Diagnostic Relevant Data)
- Measurements
- Procedure Logs
- Key Object Selection (Key Images)
- Contrast Administration
- Radiation Dose Administration
- CAD Results
- ...

→ *useful Inputs for
Generating (final) Diagnostic Imaging Reports (DIR)
and Creation of Imaging Records*

- DICOM SR Objects are well
Structured & Contain Coded Entries

- Relationships
- Meanings / Semantics
- References to Images or
other Relevant Information



Simple Image and Numeric Report Pattern (from IHE Technical Framework)

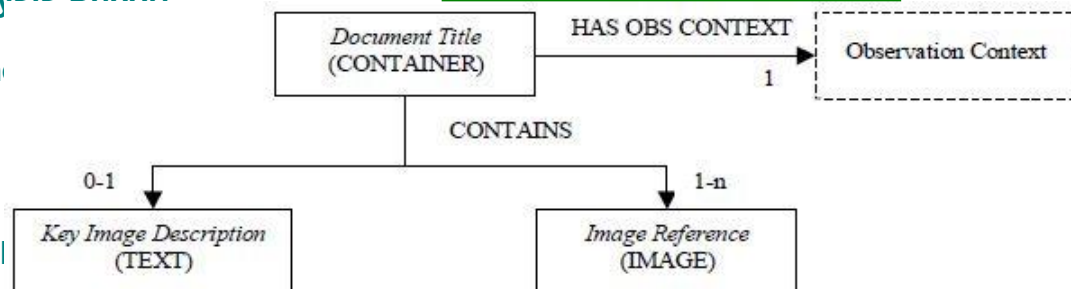
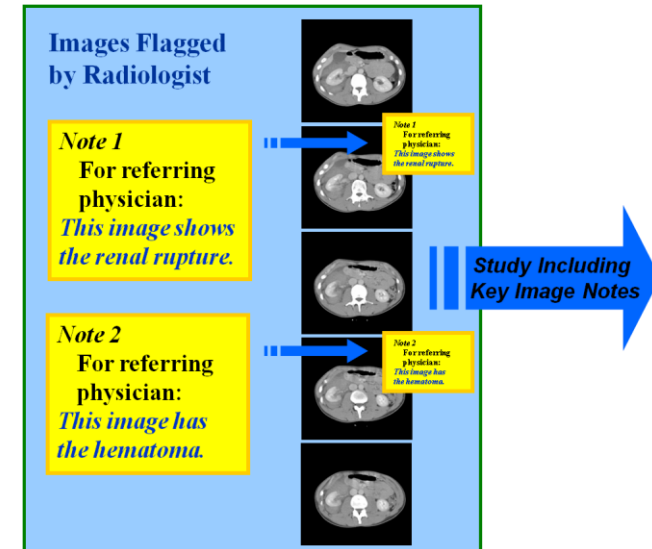
Creating Evidences - Collecting Information for Reporting

- DICOM SR - a Powerful Mechanism with lots of “generic” Flexibility
- Interpreting Applications easily overwhelmed by Diversity / Complexity

- SR Templates - Defining Content Constraints for Specific Document Types (Specialties)

→ *DICOM Standard Part 16: Content Mapping Resource*

- TID 2000 Basic Diagnostic Imaging Report
- TID 2001 Basic Diagnostic Imaging Report Observations
- TID 2002 Report Narrative
- TID 2005 Transcribed Diagnostic Imaging Report
- TID 2010 **Key Object Selection**
- TID 3001 Procedure Log
- TID 3300 Stress Testing Report
- TID 3900 CT/MR Cardiovascular Analysis Report
- TID 4000 Mammography CAD Document
- TID 4200 Breast Imaging Report
- TID 5100 Vascular Ultrasound Report
- TID 10001 Projection X-Ray Radiation |
- TID 10011 CT Radiation Dose

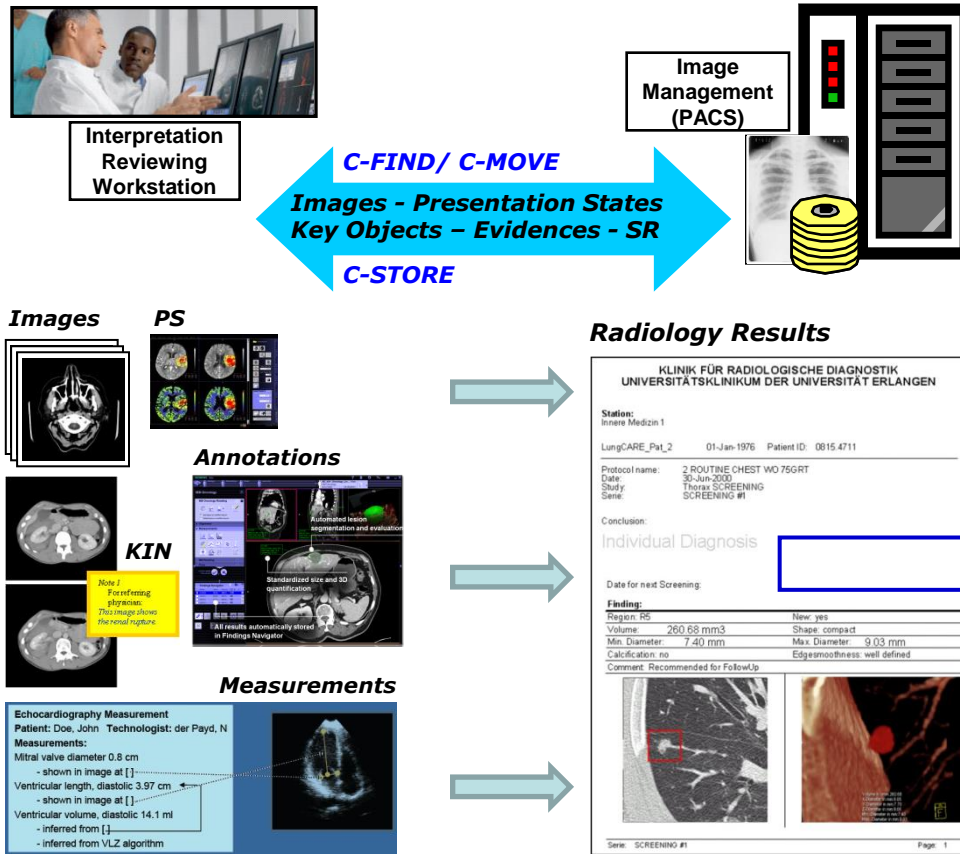


Key Image Note (KIN) Pattern (from IHE Technical Framework)

- SR Objects can be Stored and Retrieved using the same Services as for Images

Report Generation

Assembling DICOM Evidences for Clinical Use



DICOM Standard Objects
→ for "internal" Use / Imaging Records

HL7 CDA-based Standard Documents
→ for wider Distribution / Clinical Context

HL7 CDA Diagnostic Imaging Report

Good Health Clinic Consultation Note

Patient: Henry Levin, the 7th
Birthdate: September 24, 1932
Consultant: Robert Dolin, MD

MRN: 12345
Sex: Male
Created On: April 7, 2000

History of Present Illness

Henry Levin, the 7th is a 67 year old male referred for further asthma management. He was hospitalized twice last year, and already twice this year. He has been able to be weaned off steroids for the past several months.

Past Medical History

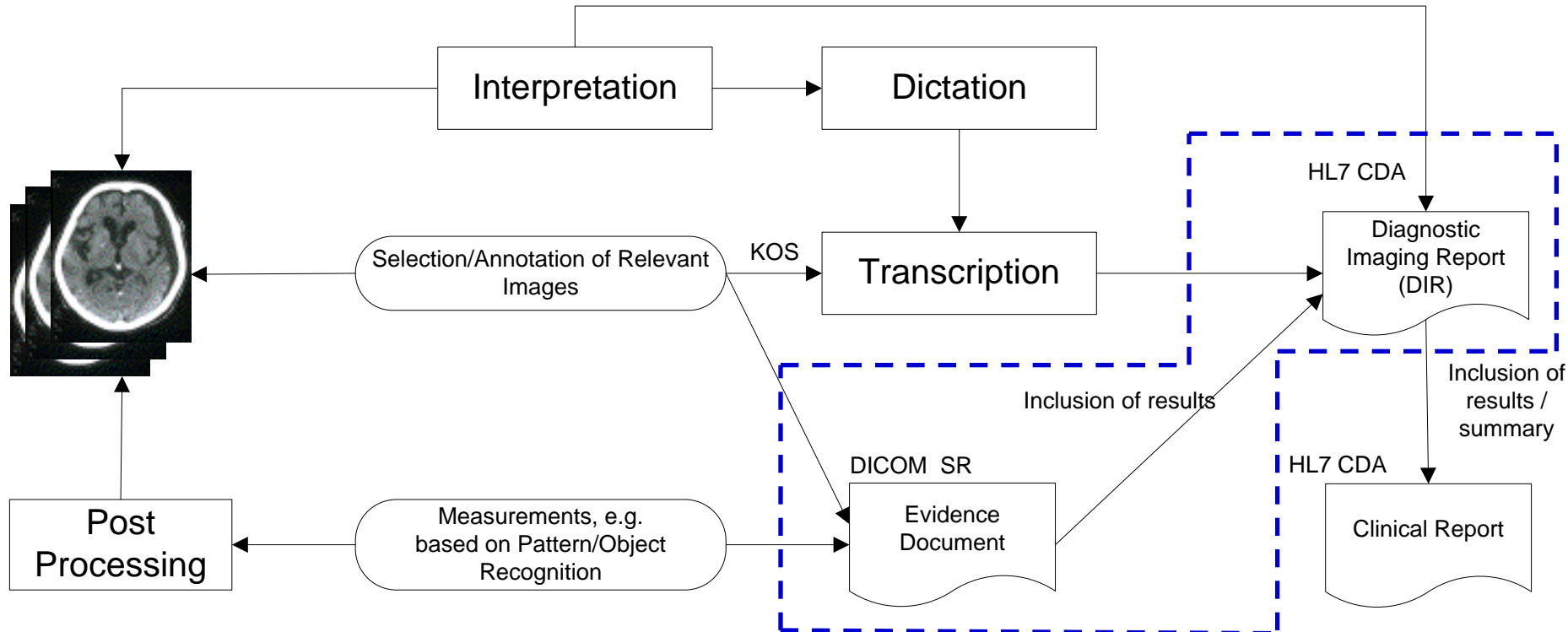
- Asthma
- Hypertension (see HTN.cda for details)
- Osteoarthritis, right knee

Medications

- Theodor 200mg BID
- Proventil inhaler 2puffs QID PRN
- Prednisone 20mg qd

Report Generation

Assembling DICOM Evidences for Clinical Use → DICOM SR / HL7 CDA Transformation



Inclusion of evidence document contents into final diagnostic imaging reports has been addressed in **DICOM Part 20 “Transformation of DICOM to and from HL7 Standards”**, **Annex A “SR Diagnostic Imaging Report Transformation Guide”**

Source: “DICOM & HL7: Integration of Imaging and Information Systems” - Helmut König, MD (2013)

- **IHE:**
Standards Profiling Organization for Advancing Integration in Clinical Practice
- **Interoperability Frameworks for Implementing and Deploying Standards-Based (HL7 & DICOM) Integrated Solutions**
- **IHE Integration Profiles - Address Specific Integration Issues For Radiology:**
 - ▶ **Content Profiles:**
Interoperable Information Objects - exchangeable across systems for display, processing and re-use
 - ▶ **Presentation Profiles:**
Preserving Quality of Image Data - reproducible views across systems / same “look” on any viewing application
 - ▶ **Workflow Profiles:**
Connecting Tasks from one Process Step to the Next Process Step - automating the information flow and relieving users from unnecessary tasks
 - ▶ **Infrastructure Profiles:**
Consistent access to images and reports – network, media, cross-enterprise

Reference to IHE Profiles Descriptions: www.ihe.net/profiles

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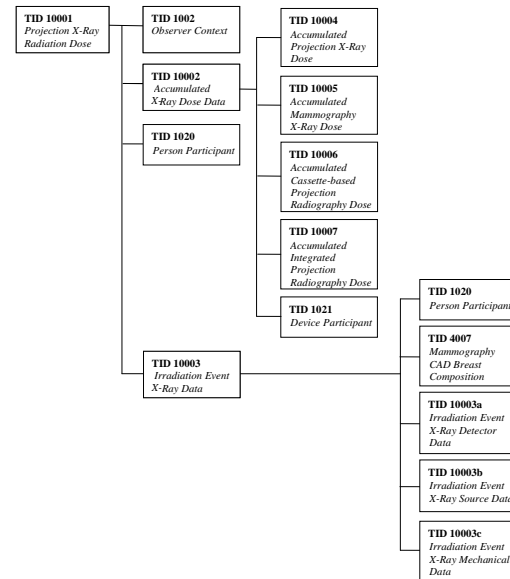
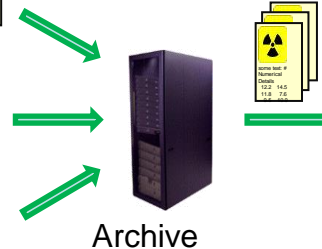
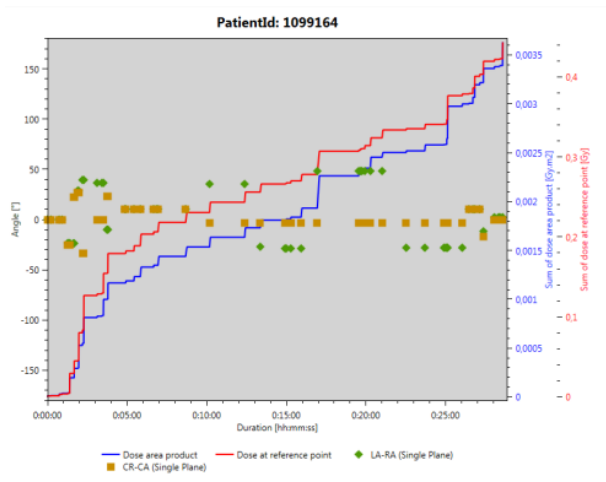
IHE Workflow Profiles

Pertinent to Presentation & Interpretation

DICOMSM
Digital Imaging and Communications in Medicine

• REM Radiation Exposure Monitoring

- ▶ For X-Ray based imaging Patient dose reduction is of significance
- ▶ Integration of systems reporting dose and systems which receive, store or process those reports facilitate automated reporting
- ▶ Using DICOM SR, store, Q/R and FTP
- ▶ Reporting required in parts of U.S. and Europe



National Registry



Source: "Monitoring Radiation Exposure" 2013, O'Donnell, Blendingner

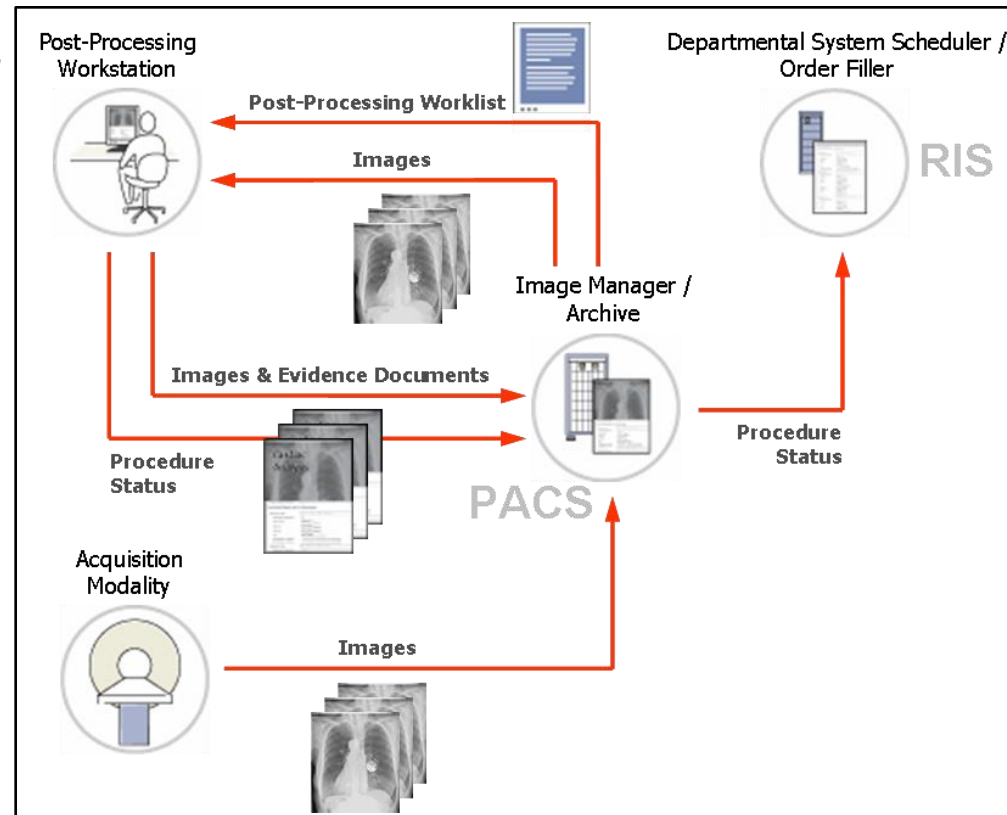
Pertinent to Presentation & Interpretation

- **PAWF Post-Acquisition Workflow (in Trial Implementation)**

- ▶ Managing, organizing and scheduling post-processing tasks in preparation of image interpretation & reporting
- ▶ Monitoring progress and completion of tasks performed during interpretation
- ▶ Worklist Management & Status Report
- + Launching of appropriate applications

- **Reporting Workflow**

- ▶ *in preparation ...*



Conclusions

DICOM Standard Definitions:

- Information Objects

- Images
- Structured Documents
- Display Characteristics
- Presentation Information

and

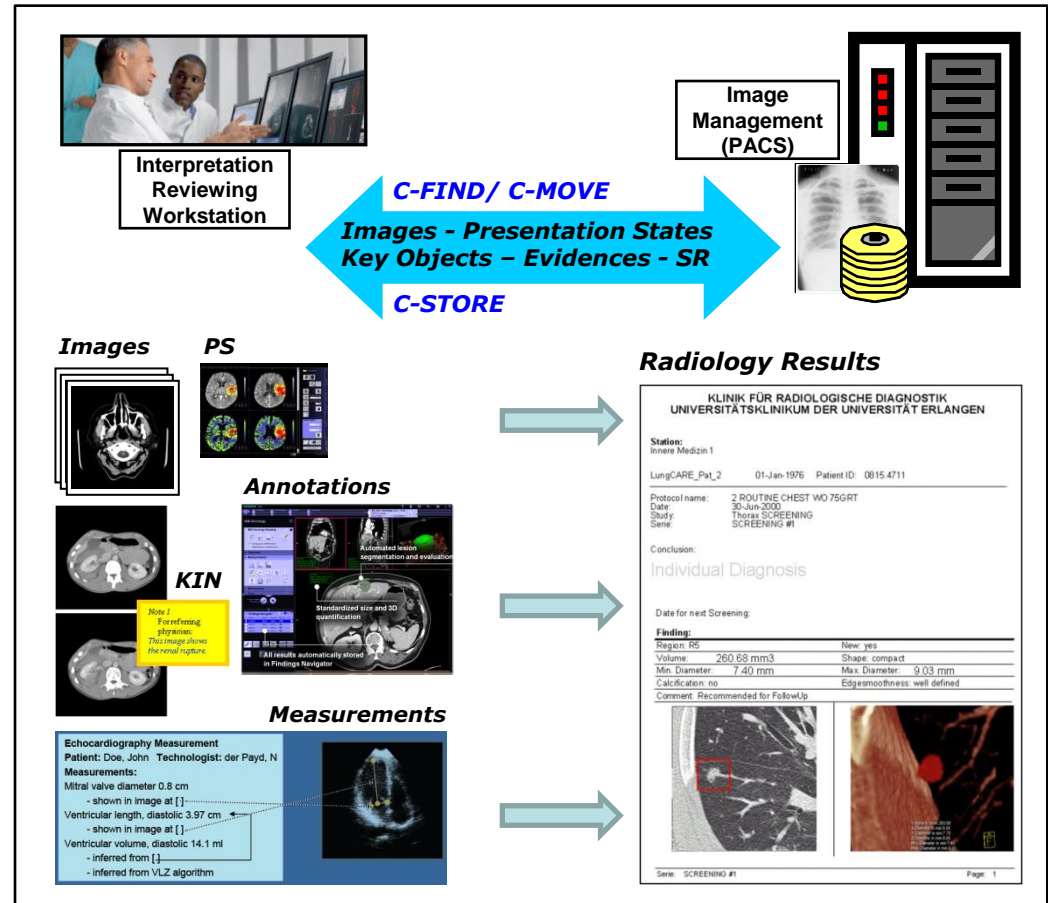
- Services

- Query & Retrieve
- Storage

for

- Exchanging
- Processing
- Presentation and
- Management

of imaging data consistently across multiple applications & systems



References



<http://medical.NEMA.org/DICOM>



<http://www.HL7.org/>



<http://www.IHE.net/>

- Sources: DICOM[®] Standards Publication 2011, © NEMA
- The DICOM Standard is under continuous maintenance, the current official version is available at <http://dicom.nema.org>

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Thank you for your attention !

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Thank you for your attention !