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DICOM
Digital Imaging and Communications in Medicine

Reporting: Presentation & Interpretation

INDIAN INSTITUTE OF SCIENCE
Bangalore, India
भारतीय विज्ञान संस्थान
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Working Group Ten - Strategic Advisory

SIEMENS

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)
  - …
- **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

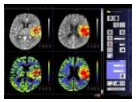
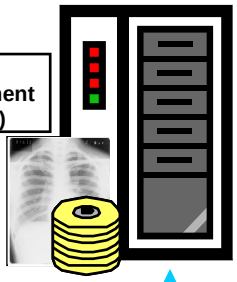
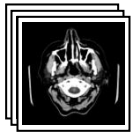


Image Management (PACS)



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

C-FIND/ C-MOVE
Prior Images / Evidences



C-STORE & Storage Commitment
Transfer Images

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

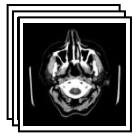
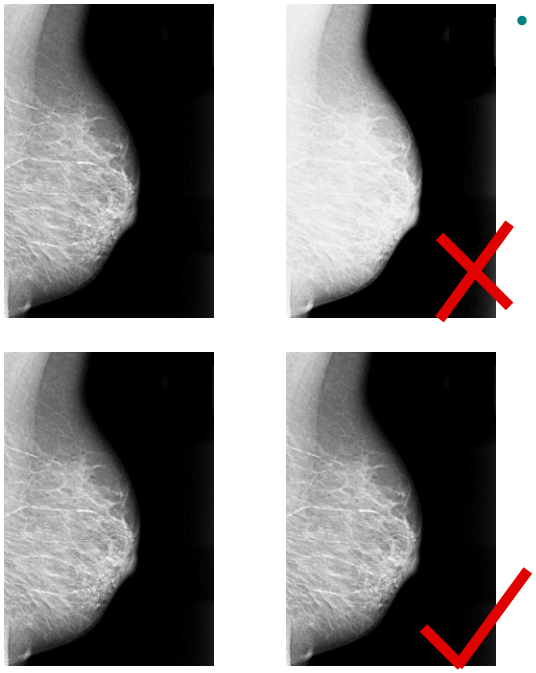


Image Acquisition Modality

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**

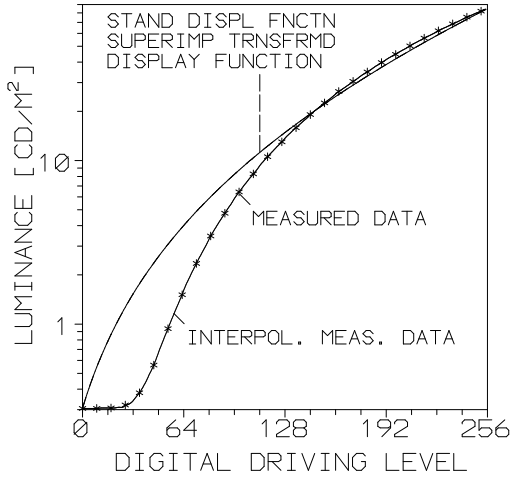


Image Display Consistency - Ensuring Quality for Reviewing & Interpretation

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

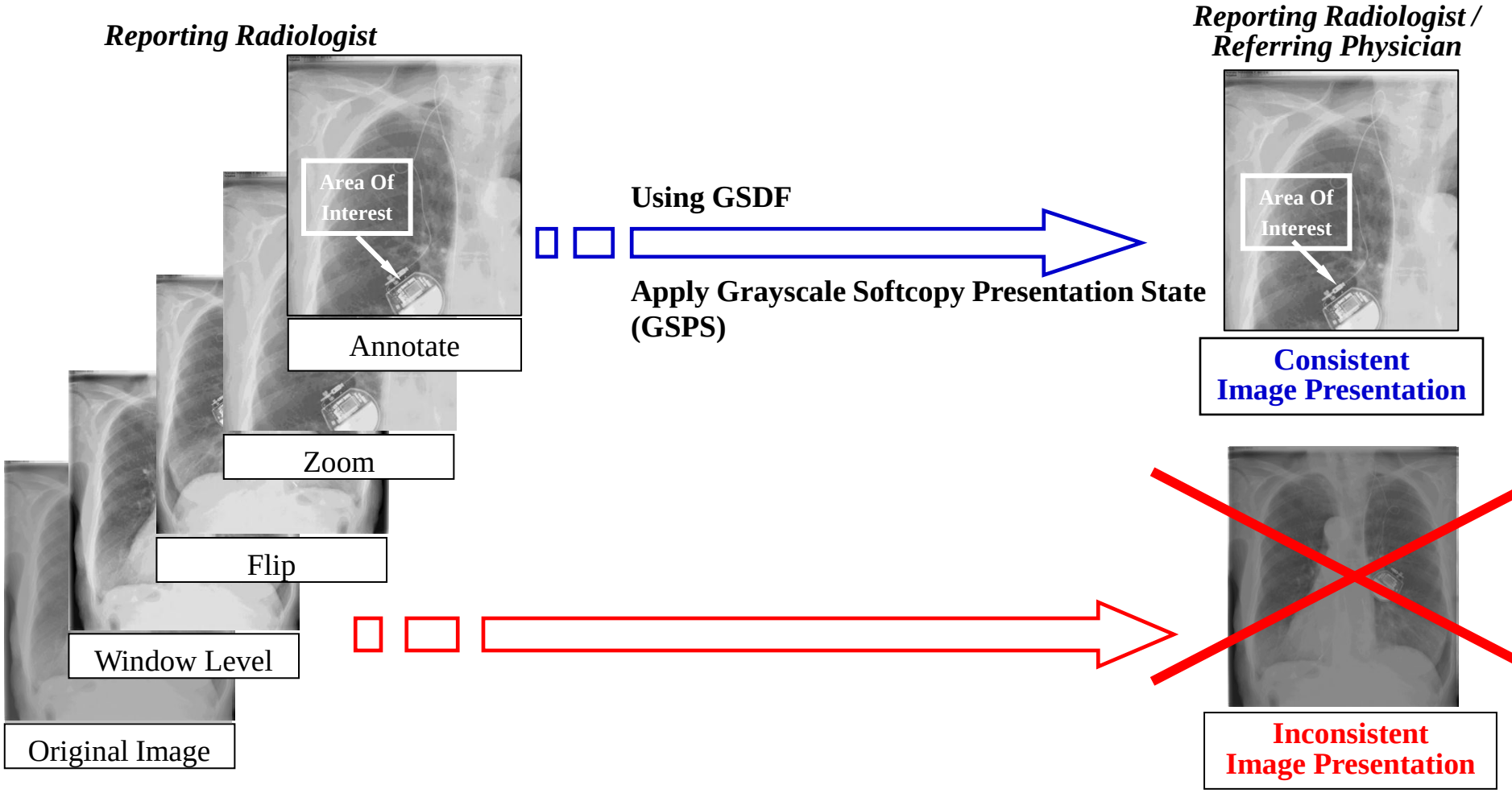
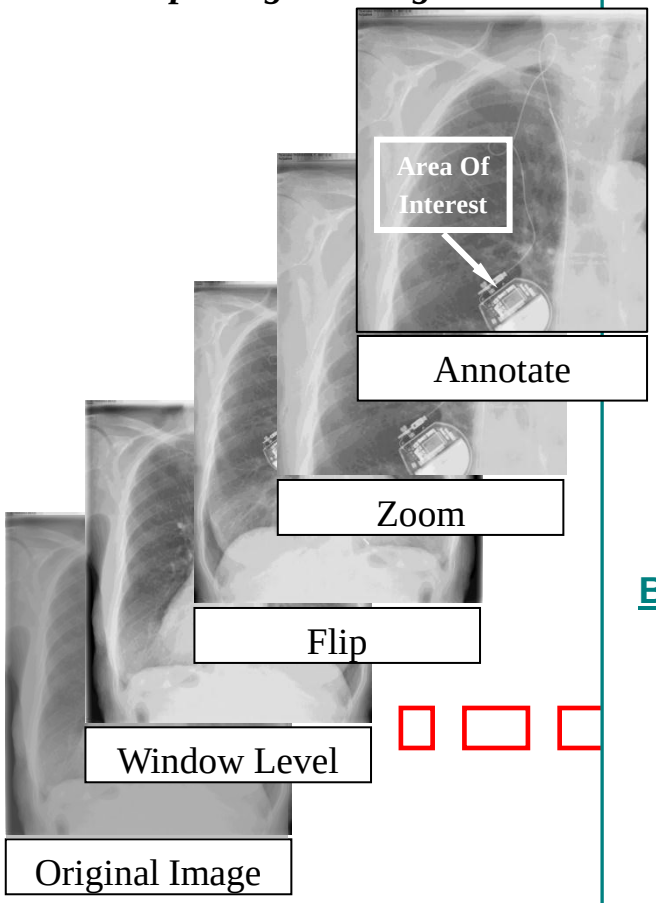


Image Display Consistency - Ensuring Quality for Reviewing & Interpretation

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

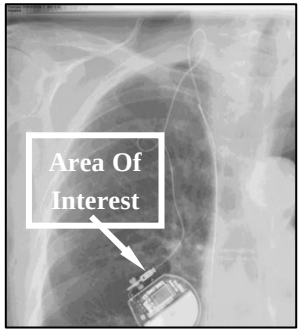
Reporting Radiologist



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

Reporting Radiologist / Referring Physician



Consistent Image Presentation

Benefits

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

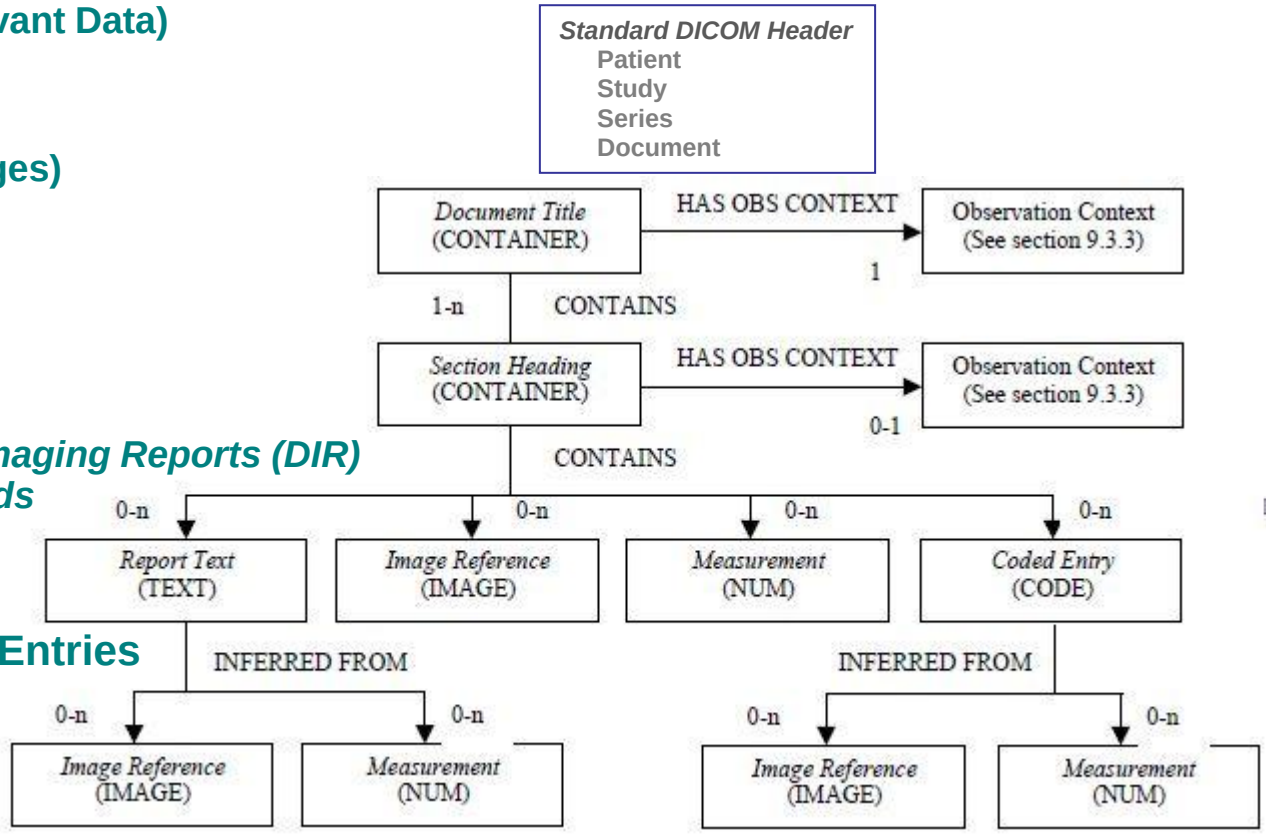
Creating Evidences - Collecting Information for Reporting

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



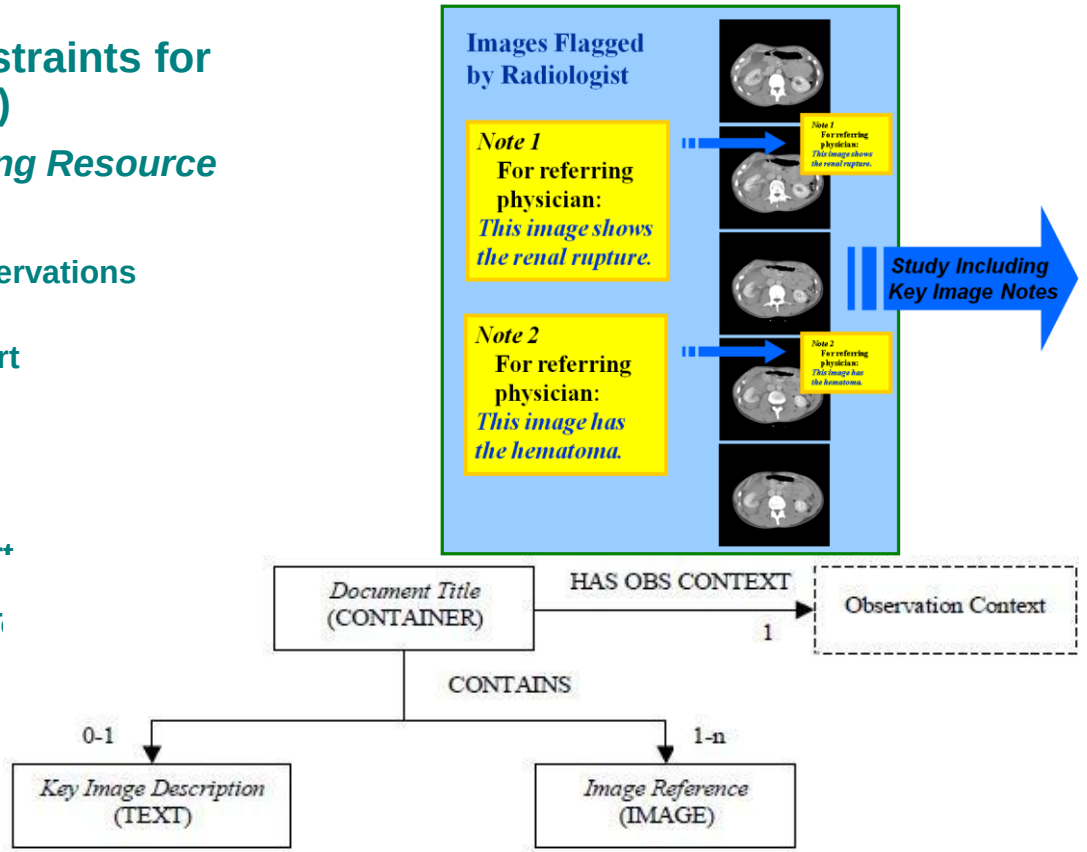
Simple Image and Numeric Report Pattern (from IHE Technical Framework)

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 Root T
  - TID 4200 Breast Imaging Report
  - TID 5100 Vascular Ultrasound Report
  - TID 10001 Projection X-Ray Radiation Dose
  - 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

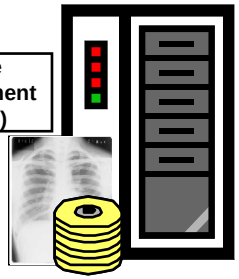
Interpretation Reviewing Workstation

C-FIND/ C-MOVE

Images - Presentation States
Key Objects – Evidences - SR

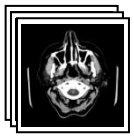
C-STORE

Image Management (PACS)

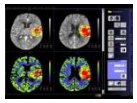


Information System HIS

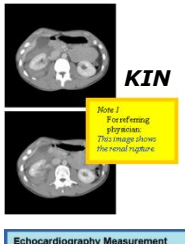
Images



PS

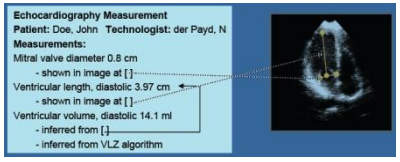


KIN

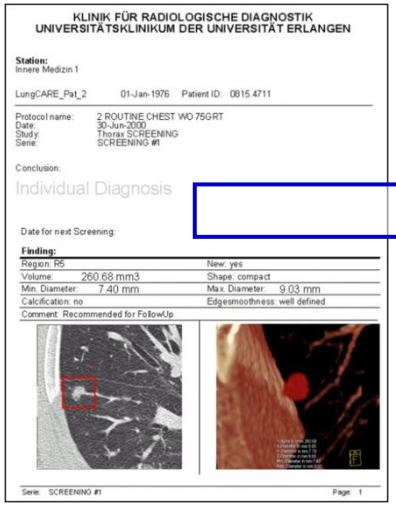


Annotations

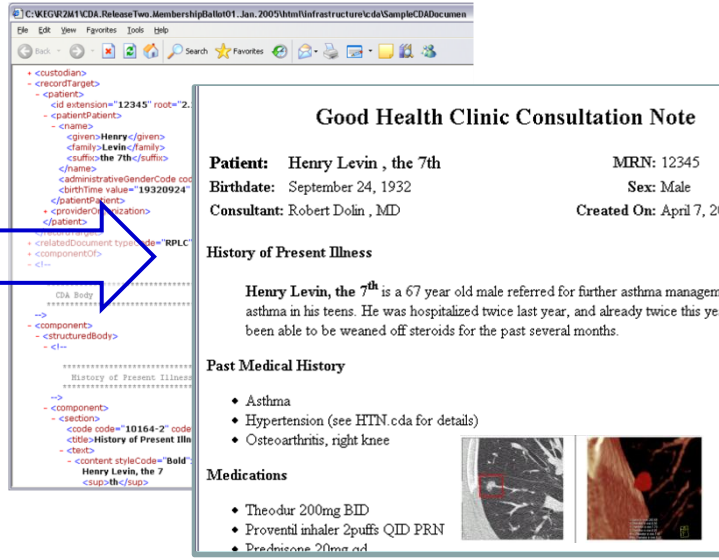
Measurements



Radiology Results



HL7 CDA Diagnostic Imaging Report

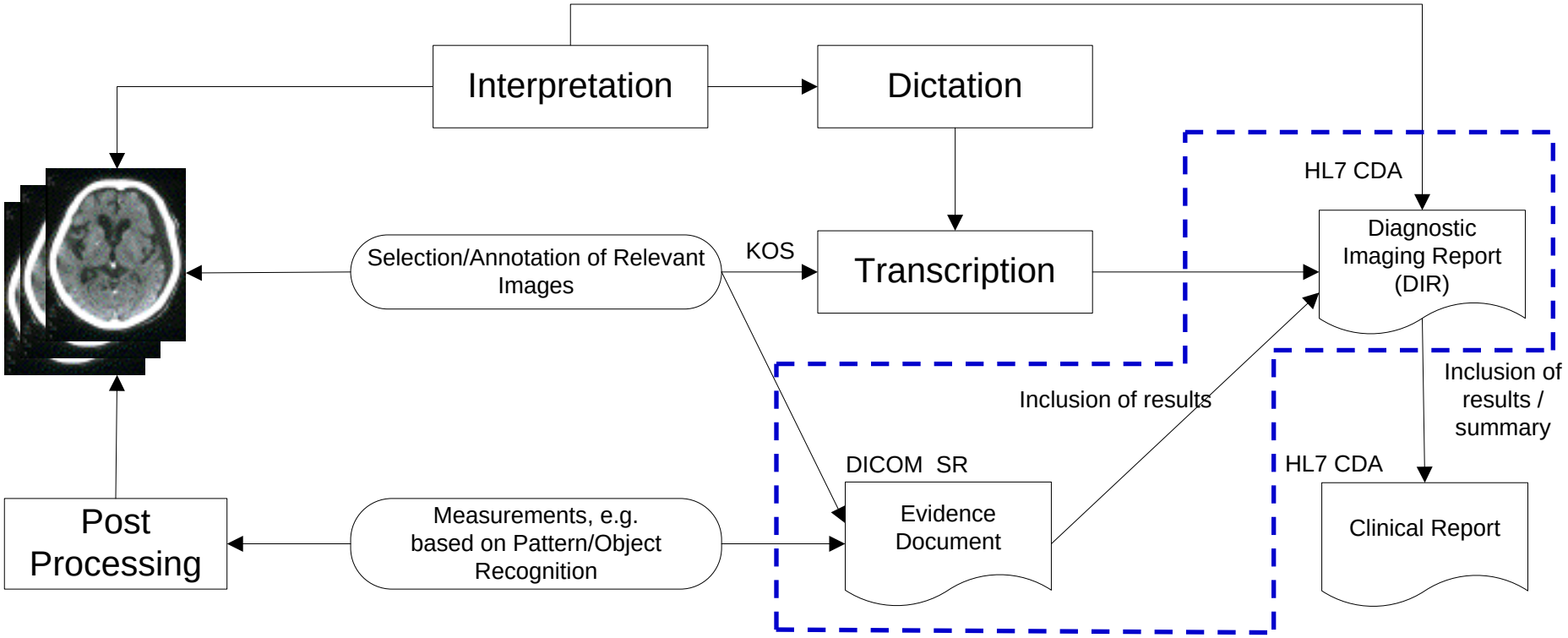


DICOM Standard Objects
→ for "internal" Use / Imaging Records

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

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)

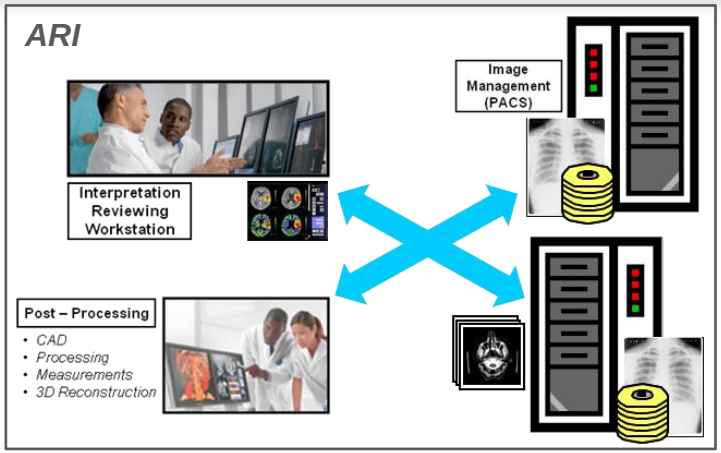
Integrating the Healthcare Enterprise

- **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**
  - **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

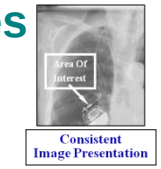
Reference to IHE Profiles Descriptions: www.ihe.net/profiles

Content & Presentation Pertinent to Presentation & Interpretation

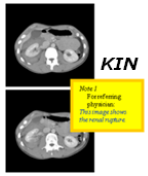
- **ARI** Access to Radiology Information
  - Access & share images, evidences & related data within a (DICOM) Network



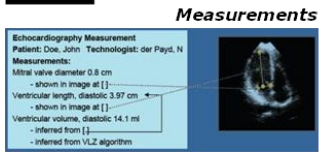
- **CPI** Consistent Presentation of Images
  - Consistent intensity & image transformations across softcopy (& hardcopy) devices



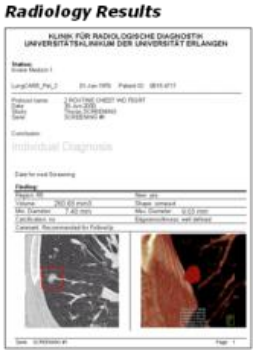
- **KIN** Key Image Notes
  - Mark significant images & add notes e.g. for referring physician, oncologist, surgeon …



- **ED** Evidence Documents
  - Encoding, exchange, management of measurements, procedure logs, CAD results …



- **SINR** Simple Image and Numeric Report
  - Encoding, exchange and management of Radiology Results (image references & numeric data)



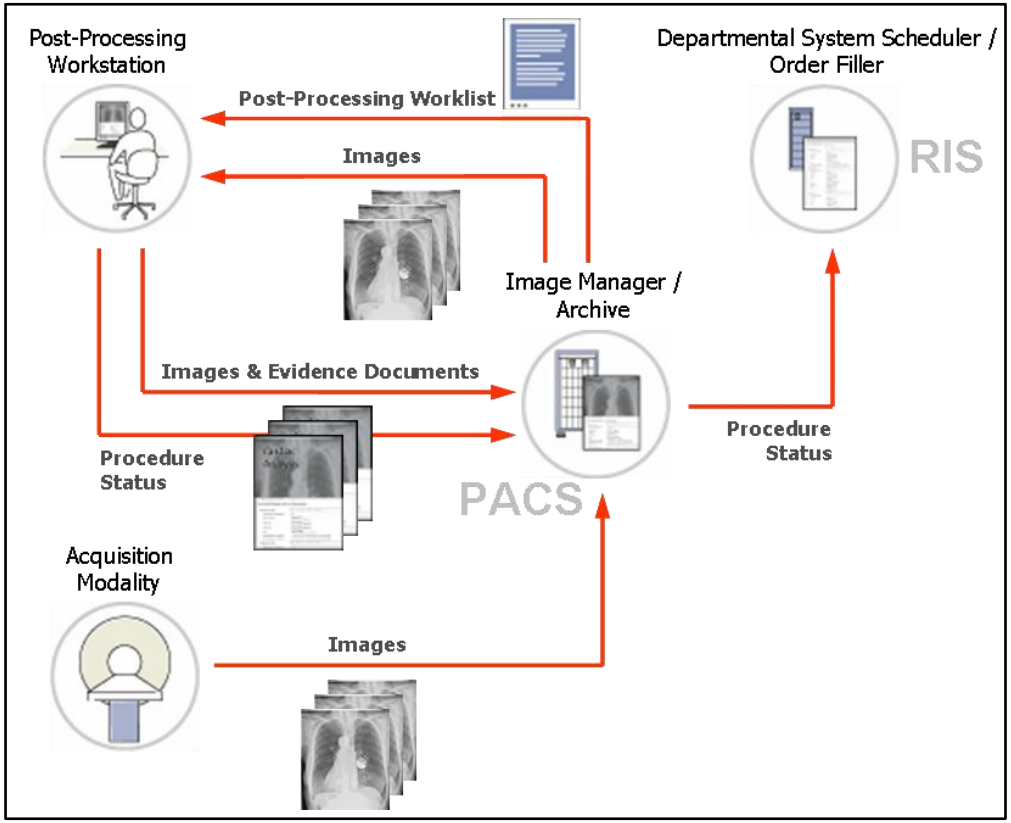
- **MRRT** Management of Radiology Report Templates (in development)
  - Managing a pool of templates with pre-defined structure, content & terminology for Radiologists to re-use (e.g. RSNA Template Library)

IHE Workflow Profiles Pertinent to Presentation & Interpretation

DICOM Digital Imaging and Communications in Medicine

- **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:

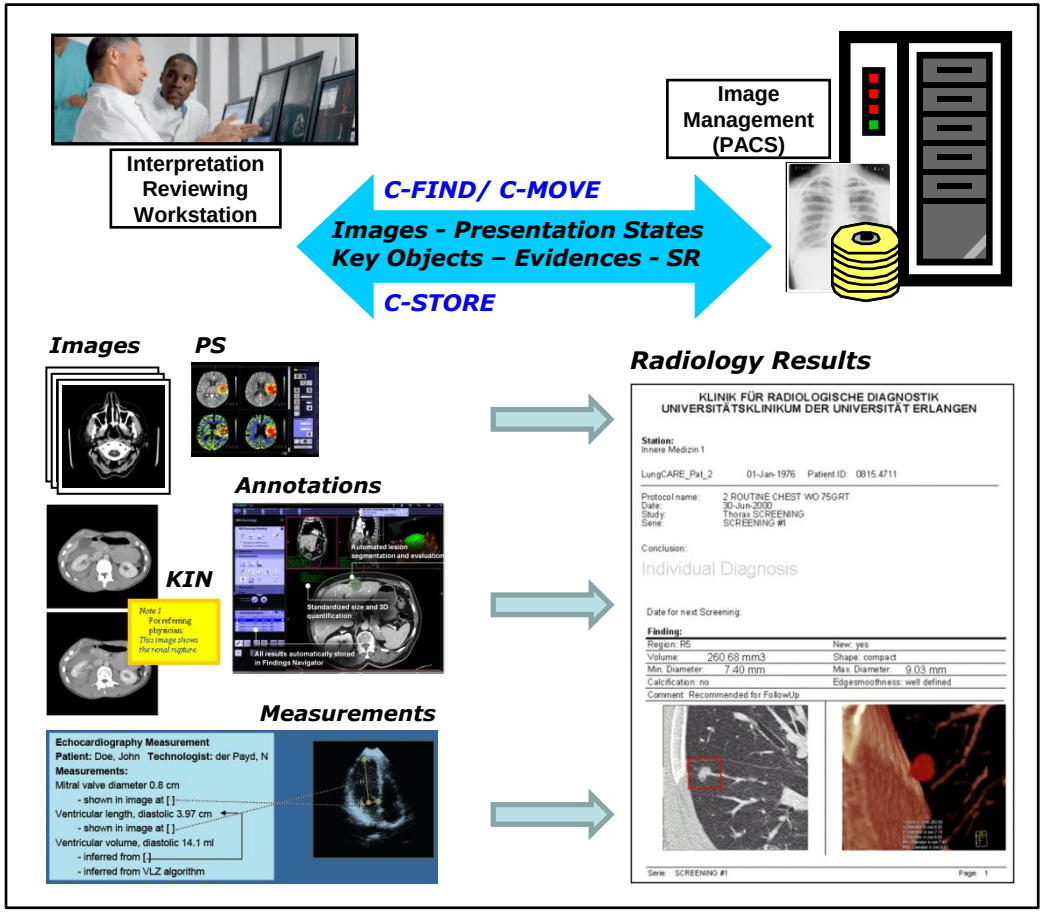
- **Information Objects**
  - Images
  - Structured Documents
  - Display Characteristics
  - Presentation Information

  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 !