Reporting: Presentation & Interpretation

Nikolaus Wirsz, PhD
SIEMENS AG – Healthcare Sector
Program Manager Standards & Interoperability
Erlangen, Germany
Member of the DICOM Standards Committee and Working Group Ten - Strategic Advisory
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
• 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
• Issue #2: Image Display Set-Ups, Transformations and Annotations get Lost when Viewed on Different Displays

Reporting Radiologist

Original Image

Window Level

Flip

Zoom

Annotate

Area Of Interest

Using GSDF

Apply Grayscale Softcopy Presentation State (GSPS)

Reporting Radiologist / Referring Physician

Consistent Image Presentation

Inconsistent 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

  **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 an all Displays
  - No need to duplicate Images (originals + transformations) - apply Presentation States automatically before the Images Display
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
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 Template
    - TID 4200 Breast Imaging Report
    - TID 5100 Vascular Ultrasound Report
    - TID 10001 Projection X-Ray Radiation Dose
    - TID 10011 CT Radiation Dose

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

---

Images Flagged by Radiologist

- **Note 1**
  - For referring physician: This image shows the renal rupture.

- **Note 2**
  - For referring physician: This image has the hematoma.

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

- **Document Title**
  - (CONTAINER)
  - HAS OBS CONTEXT
  - Contains 1-n

- **Key Image Description**
  - (TEXT)

- **Image Reference**
  - (IMAGE)

- Study Including Key Image Notes
Assembling DICOM Evidences for Clinical Use

DICOM Standard Objects → for “internal” Use / Imaging Records

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

Image Management (PACS)

C-FIND / C-MOVE

Images - Presentation States
Key Objects - Evidences - SR

C-STORE

Interpretation
Reviewing Workstation

Information System HIS

HL7 CDA Diagnostic Imaging Report

Good Health Clinic Consultation Note

Patient: Henry Levin , the 7th
Birthdate: September 24, 1932
Sex: Male
Consultant: Robert Dole, MD
Created On: April 7, 2013

History of Present Illness

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

Past Medical History

• Asthma
• Hypertension (see HTP cda for details)
• Osteoarthritis, right knee

Medications

• Theophylline 200mg BID
• Proventil inhaler Spiri QID PRN
• Methylxanthines 30mg od

Images

PS

Annotations

Measurements

Radiology Results

DICOM Standard Objects

→ for “internal” Use / Imaging Records

HL7 CDA-based Standard Documents

→ for wider Distribution / Clinical Context
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
  ► 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)
• **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 ...
DICOM Standard Definitions:

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

- Services
  - Query & Retrieve
  - Storage
  - 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
Nikolaus Wirsz, PhD
SIEMENS AG - Healthcare Sector
Imaging & Therapy Division
Hartmannstr. 16
91052 Erlangen, Germany
nikolaus.wirsz@siemens.com

Thank you for your attention!