Application of DICOM Structured Report

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Dynamic Imaging
DICOM Structured Report

- Encoding for structured observations
  - Universal mechanism
- Generic Applications
  - Basic Text, Enhanced, Comprehensive
- Specialty Applications
  - Key Object Selection
  - CAD, US measurements, ...
  - Patient Relevant Information Query
Encoding of Structured Reports
SR Intent

- Support measurements by imaging devices
- Enable collaborative reporting by any number of persons or devices
  - Enable links to key images
  - Enable links to regions of interest within images and waveforms
  - Template-driven content and structure
Simple Example of SR

- Shows example of simple diagnostic report
- Multi-level structure
- Text, codes, pointers to images
Report of Chest X-Ray (PA and Lateral Views)

Patient Jane Homer
Study # 123456
Recorded by Dr. John Smith

The finding is a mass measuring 1.3 cm in diameter with an infiltrative margination.

The baseline image is shown at (Click to view)

Conclusions
The conclusion is a probable malignancy, inferred from the infiltrative margination of the mass and the appearance shown by the best illustration of findings.

Specific Image Findings
The best illustration of findings is (Click to view)
Chest X-Ray  
has concept modifier Views=PA and Lateral  
Recording Observer=Smith^John^^Dr^  
Study Instance UID ...=1.2.3.4.5.6.7.100  
Patient-Data-Acquisition-Subject=Homer^Jane^^^  
Finding=Mass  
  has properties diameter=1.3 cm  
  has properties margination=infiltrative (1.4.2)  
Baseline Image  ●  
Conclusions  
  conclusion=probable malignancy  
    inferred from 1.4.2  
    inferred from 1.7.1  
Specific Image Findings  
  best illustration of findings(1.7.1)  ●  


Chest X-Ray

*has concept modifier* Views=PA and Lateral

Recording Observer=Smith^John^^Dr^3

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Patient-Data-Acquisition-Subject=Homer^Jane^3

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*has properties* diameter=1.3 cm

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Baseline Image

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conclusion=probable malignancy

inferred from 1.4.2

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best illustration of findings(1.7.1)
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Finding=Mass

\hspace{1cm}

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\hspace{1cm}

has properties margination=infiltrative (1.4.2)

Baseline Image •

Conclusions

\hspace{1cm}

conclusion=probable malignancy

\hspace{1cm}

\hspace{1cm}

inferred from 1.4.2

\hspace{1cm}

\hspace{1cm}

inferred from 1.7.1

Specific Image Findings

\hspace{1cm}

\hspace{1cm}

\hspace{1cm}

\hspace{1cm}

best illustration of findings(1.7.1) •
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*has properties diameter=1.3 cm*

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Baseline Image

Conclusions

conclusion=probable malignancy

inferred from 1.4.2

inferred from 1.7.1

Specific Image Findings

best illustration of findings(1.7.1)
Observation Context
- includes top-level attributes of Composite IOD
- may be attached to root node CONTAINER
- is inherited along by-value relationships
- is not inherited along by-reference relationships
- may be extended (but not replaced) in children
- may be attached to any content item, not just CONTAINER
General Patient Module:

- "Patient Name"="Homer^Jane^^^"
- "Patient ID"="234567"
- "Patient Sex"="F"
- "Patient DOB"="19991109"

General Study Module:

- "Accession Number"="123456"
- "Study ID"="345678"

"Chest X-Ray"

- Context: "Recording Observer"="Smith^John^^Dr^"
- Context: "Study Instance UID ..."="1.2.3.4.5.6.7.100"
- Context: "... Acquisition Subject"="Homer^Jane^^^"
- Contains: "Finding"="Mass"
“Chest X-Ray”

“Recording Observer” = “Smith^John^Dr^”

“Study Instance UID ...” = “1.2.3.4.5.6.7.100”

“... Acquisition Subject” = “Homer^Jane^^^”

“Finding” = “Mass”

“Baseline” = “diameter” = “1.3” “cm”

“margination” = “infiltrative”

“Conclusions”

“conclusion” = “probable malignancy”

“Specific Image Findings”

“best illustration of findings” = “selected”

“Views” = “PA and Lateral”
Obstetric Ultrasound

Mother of Fetus = Homer^Jane^^^

Fetus Identifier = Fetus A

BPD = 27 mm

Gestational Age = 16 weeks

Fetus Identifier = Fetus B

Gestational Age = 16 weeks

BPD = 28 mm
SR Applications
Three Base SR Classes

- Three base SR classes are defined to allow encode any type of structured information:
  - Basic Text SR
  - Enhanced SR
  - Comprehensive SR

- Distinguished by Value Types and Relationships supported
SR Templates

To define appropriate structure for specialized applications, DICOM defines templates.

Templates may be applied to:
- Generic SOP Classes (Basic Text, Enhanced, Comprehensive)
- Specialized SOP Classes (Mammo CAD, Chest CAD)

Templates may be extensible and non-extensible
Legend for templates

Value Types
CONTAINER, NUM, CODE, IMAGE ...

Concept Names and Values of type CODE are triplets
• Code Value
• Coding Scheme Designator
• Code Meaning (actually, just some text to evoke meaning to user)
The document structure depicted in the image is a typical top-level template structure for a medical report. The structure includes:

- **Document Title**: Includes the template specified title, e.g., OB-GYN, Adult Echo, IVUS Ultrasound Vascular, Cath/Hemo...
- **Patient Characteristics**: Contains information about the patient's characteristics.
- **Summary**: Provides an overview of the findings.
- **Findings**: Details the findings of the medical examination.

Other contexts such as procedure details can also be included. The diagram uses a tree-like structure to illustrate the hierarchy and flow of information.
The heading may have semantics shared by children findings

Specific: “Exercise Challenge”
Generic: “Findings”

“Laterality” = “Left”
“Finding Site” = “Cerebral Vessels”
Discrete Numeric Findings

Distributed semantics

CONTAINER Group

has concept modifier

CODE Modifier Concept

contains

NUM Measurement

has concept modifier

CODE Modifier Concept

Diameter, Area, Volume, Blood Velocity, Indices, Ratios, Time Interval …

or pre-coordinated concept: BPD, FL …

Laterality, Finding Site, Anatomic Site Modifier, Cardiac Phase …
Dx Reports

- Based on DICOM SR
- Allows to include without transcription:
  - measurements
  - image links
  - structured content
- Integrated with the imaging workflow
- Friendly to XML implementations
- Easy to export to the EPR (HL7)

### Vessel Section Diameters and Area Measurements

<table>
<thead>
<tr>
<th>Measurement Name</th>
<th>Measurement Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section above Renal Arteries</td>
<td>D1</td>
</tr>
<tr>
<td>Mean Diameter</td>
<td>28.829111 Millimeter</td>
</tr>
<tr>
<td>Short Axis</td>
<td>27.914459 Millimeter</td>
</tr>
<tr>
<td>Long Axis</td>
<td>29.661556 Millimeter</td>
</tr>
<tr>
<td>Area</td>
<td>652.791565 Square Millimeter</td>
</tr>
<tr>
<td>Best Illustration of finding</td>
<td>1.2840.113619.2.80.2161049224.760.1002565988.8</td>
</tr>
<tr>
<td>Best Illustration of finding</td>
<td>1.2840.113619.2.80.2161049224.760.1002565988.8</td>
</tr>
<tr>
<td>Measurement Name</td>
<td>Most Inferior Renal Artery</td>
</tr>
<tr>
<td>Measurement Abbreviation</td>
<td>D2a</td>
</tr>
</tbody>
</table>
Simple Structure

- Minimal Structure: Coded Title and Headings
- Full image links from specific sections of report
- Observation Context (who, what, when) may be section specific
Added Measurements

Simply adds Measurements to Simple Image Reports
Evidence Documents
Evidence Documents

- Measurements and coded data
  - DICOM SR document
- Created by either Acquisition Modality or Workstation
- Produced during acquisition or post-processing workflows
- Interpreted along with the images
Evidence Documents Examples

- Mammography CAD
- Chest CAD
- OB-Gyn Ultrasound Measurements
- Vascular Ultrasound Measurements
- Vascular Intervention Results
- Echocardiography Measurements
Typical Ultrasound SR

- Based on one of generic SR SOP Classes
- Intended to precisely convey measurements and findings, relationships between them
- Each specialized “report” uses its own template
Vascular Content Hierarchy

Document Title
- Vascular Report

Section Heading
- Findings
  - Laterality
  - Topographical Modifier

Group
- Anatomy
  - has concept modifier

Discrete Finding
- Measurement
  - property

Minimum Concepts
Initiated by the desire to have simple Key Image Note

Developed as generic “manifest” – collection of pointers to images (or even specific frames)

Specifies intent of selection, simple textual note

Non-extensible template
for referring physician

Here you can see the renal osteopathy.

For teaching

Fibroosteoclasia
Different notes on different images

- [Note 1] for referring physician
- [Note 2] for referring physician
- [Note 3] for referring physician

Same note on different images

- [Note 4] for referring physician
- [Note 5] for referring physician
- [Note 6] for referring physician
- [Note 7] for referring physician

Here you can see the renal rupture.

Note: This is the hematoma.
Title of KOSD is a Code

The note title defines the semantics of the reason of significance.

Key Image Notes can be queried by code.

The user comments are meant to be informal.

### Codes

<table>
<thead>
<tr>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Of Interest</td>
</tr>
<tr>
<td>Rejected for Quality Reasons</td>
</tr>
<tr>
<td>For Referring Provider</td>
</tr>
<tr>
<td>For Surgery</td>
</tr>
<tr>
<td>For Teaching</td>
</tr>
<tr>
<td>For Conference</td>
</tr>
<tr>
<td>For Therapy</td>
</tr>
<tr>
<td>For Patient</td>
</tr>
<tr>
<td>For Peer Review</td>
</tr>
<tr>
<td>For Research</td>
</tr>
<tr>
<td>Quality Issue</td>
</tr>
<tr>
<td>Reporting</td>
</tr>
</tbody>
</table>
One use of KOSD is to attach « electronic post-it™ » to images to communicate:
- specific examination events
- image quality issues
- consultancy

KOSD can be stored in the archive and later retrieved
Query for SR Content
A simple query that allows retrieve ANY patient information, provided SCP can format it using specified template

Useful for retrieval of relevant information about patient, e.g., from HIS

Intended for use on Modalities and other equipment that is already DICOM enabled
Patient Information Query

- Few matching keys:
  - Patient Name
  - Patient ID
  - Template identifier

- Useful for retrieval of relevant information about patient, e.g., from HIS
Patient Information Query

- Several Template identified for this purpose
  - General Relevant Patient Info
  - Relevant Patient Info for Breast Imaging
Questions?