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

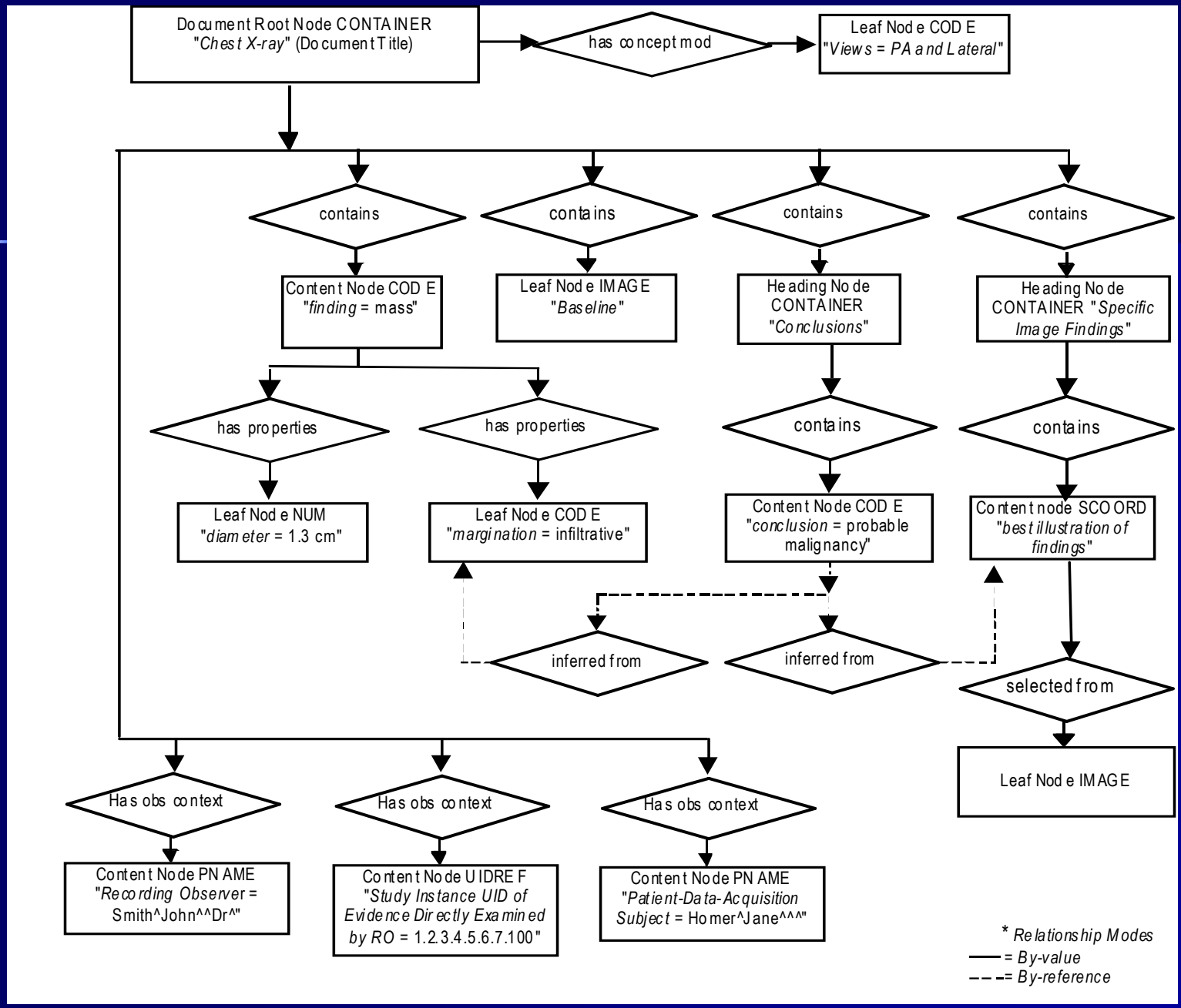
Encoding of Structured Reports

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


Document Root Node CONTAINER
"Chest X-ray" (Document Title)
has concept mod
Leaf Node CODE
"Views = PA and Lateral"
contains
contains
contains
contains
Content Node CODE
"finding = mass"
Leaf Node IMAGE
"Baseline"
Heading Node
CONTAINER
"Conclusions"
Heading Node
CONTAINER "Specific
Image Findings"
has properties
has properties
contains
contains
Leaf Node NUM
"diameter = 1.3 cm"
Leaf Node CODE
"margination = infiltrative"
Content Node CODE
"conclusion = probable
malignancy"
Content node SCOORD
"best illustration of
findings"
inferred from
inferred from
selected from
Leaf Node IMAGE
Has obs context
Has obs context
Has obs context
Content Node PNAME
"Recording Observer =
Smith^John^^Dr^"
Content Node UIDREF
"Study Instance UID of
Evidence Directly Examined
by RO = 1.2.3.4.5.6.7.100"
Content Node PNAME
"Patient-Data-Acquisition
Subject = Homer^Jane^^^"
* Relationship Modes
= By-value
= By-reference

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) •

.

"contains" relationship not shown

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

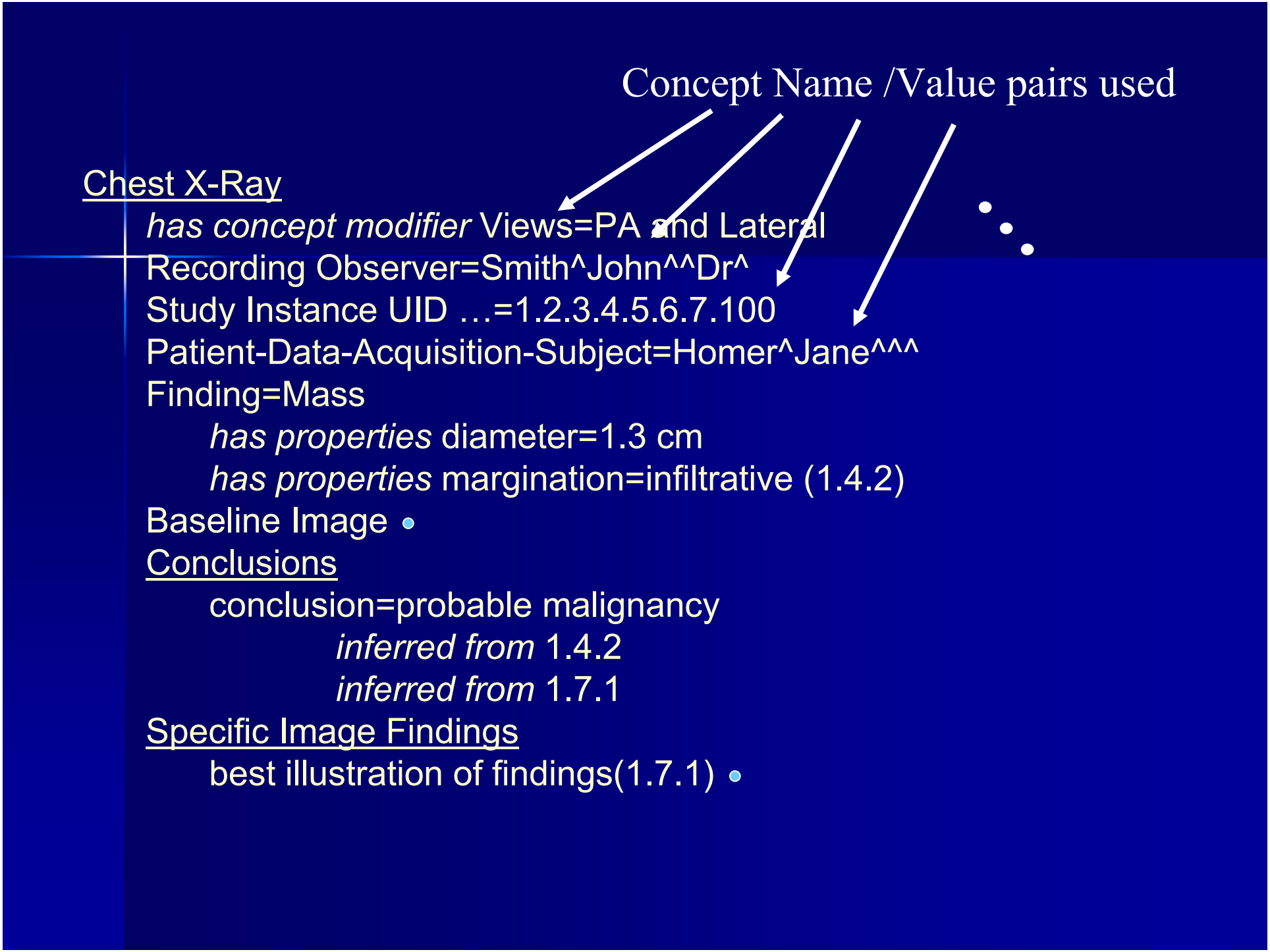
conclusion=probable malignancy

inferred from 1.4.2

inferred from 1.7.1

Specific Image Findings

best illustration of findings(1.7.1)


Concept Name /Value pairs used
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)

Concept Name without a value used as a heading (container)

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) •

Concept Name without a value used as Purpose of Reference for IMAGE, SCOORD

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) •

Inheritance of Context

- 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

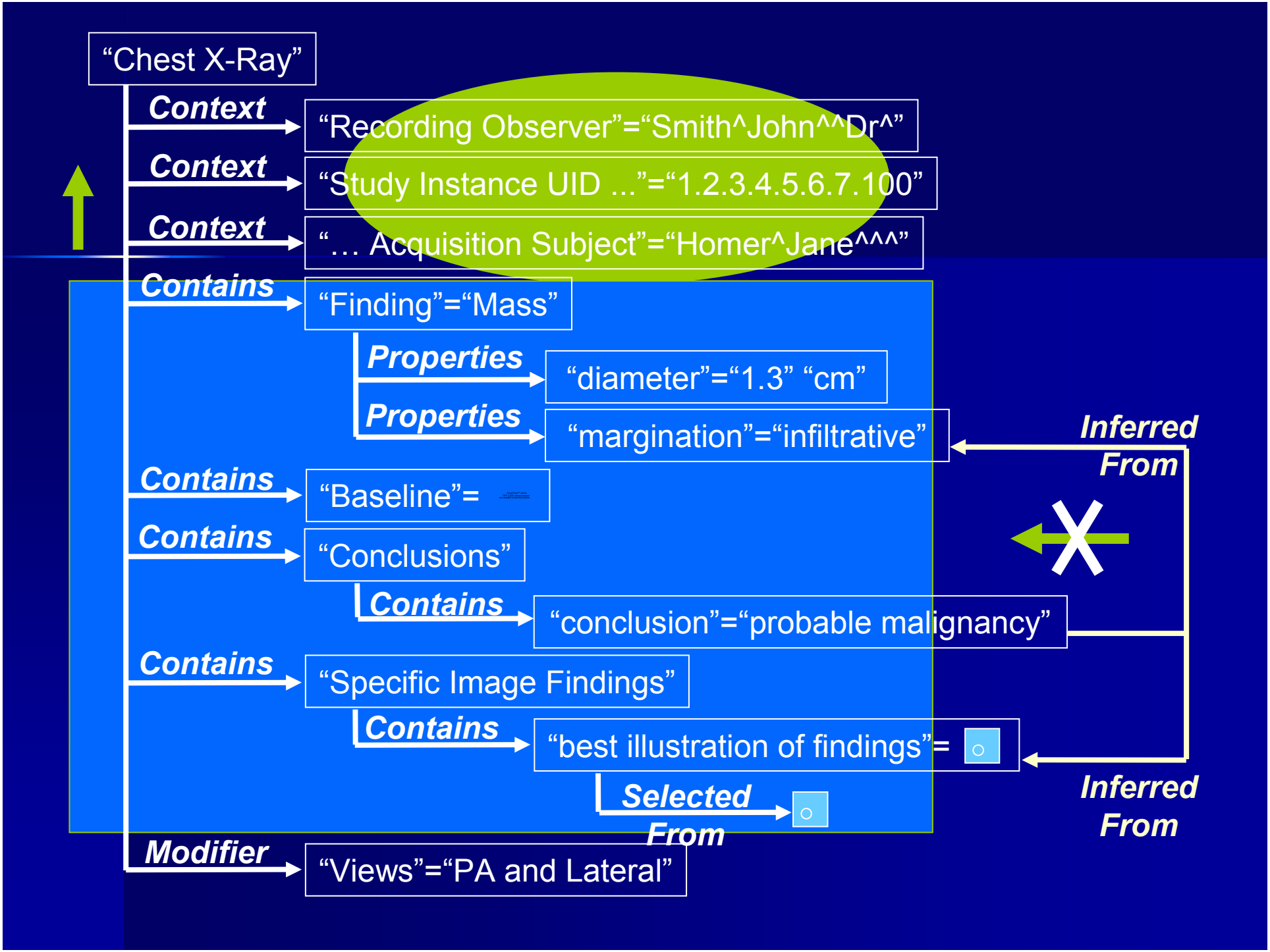
SR Comprehensive SOP Instance

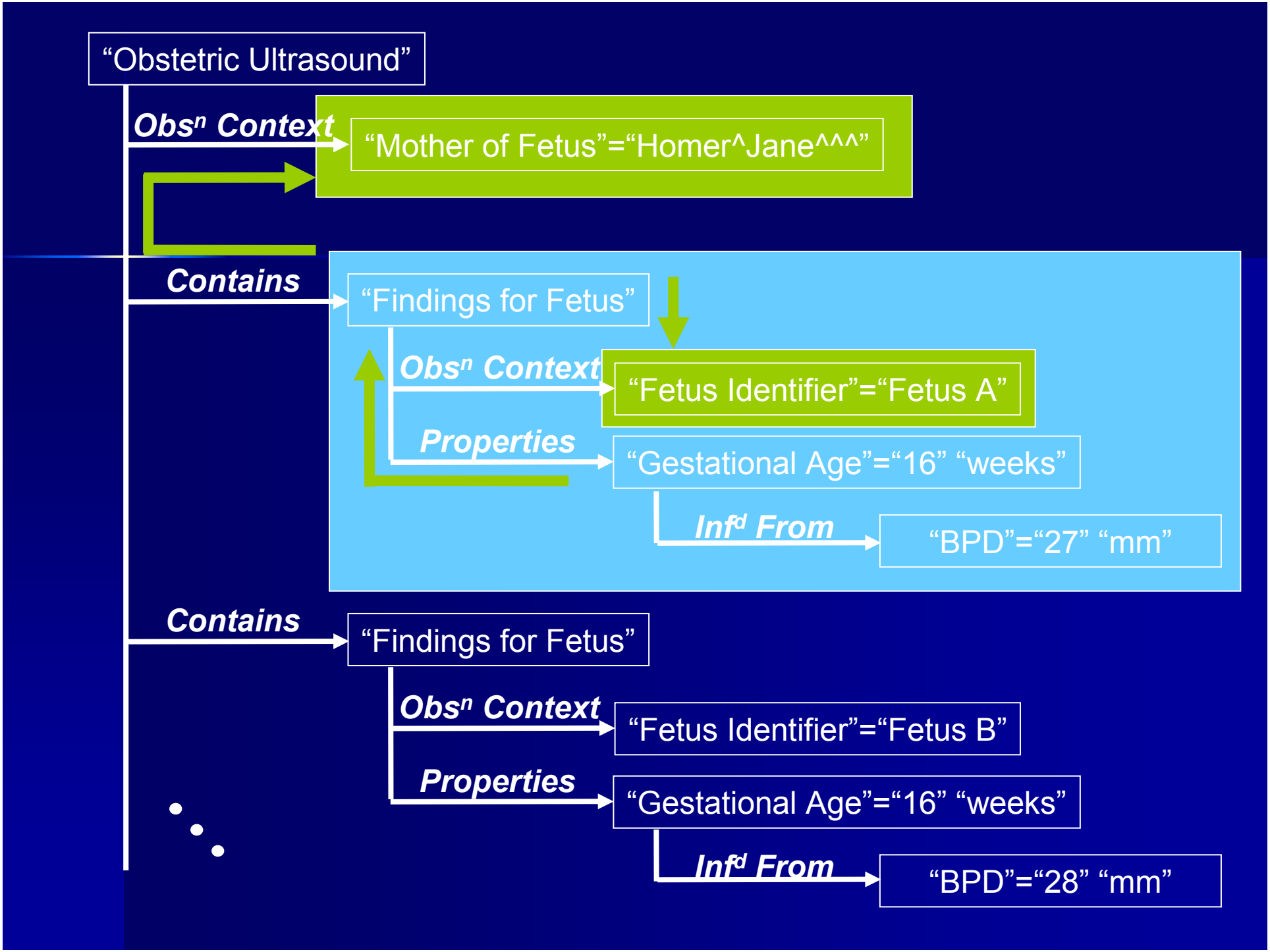
General Patient Module:

"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"
Properties
"diameter"="1.3" "cm"
Properties
"margination"="infiltrative"
Inferred From
Contains
"Baseline"=
Contains
"Conclusions"
Contains
"conclusion"="probable malignancy"
Contains
"Specific Image Findings"
Contains
"best illustration of findings"=
Selected From
Inferred From
Modifier
"Views"="PA and Lateral"


"Obstetric Ultrasound"
Obsn Context
"Mother of Fetus"="Homer^Jane^^^"
Contains
"Findings for Fetus"
Obsn Context
"Fetus Identifier"="Fetus A"
Properties
"Gestational Age"="16" "weeks"
Infd From
"BPD"="27" "mm"
Contains
"Findings for Fetus"
Obsn Context
"Fetus Identifier"="Fetus B"
Properties
"Gestational Age"="16" "weeks"
Infd From
"BPD"="28" "mm"

SR Applications

Three Base SR Classes

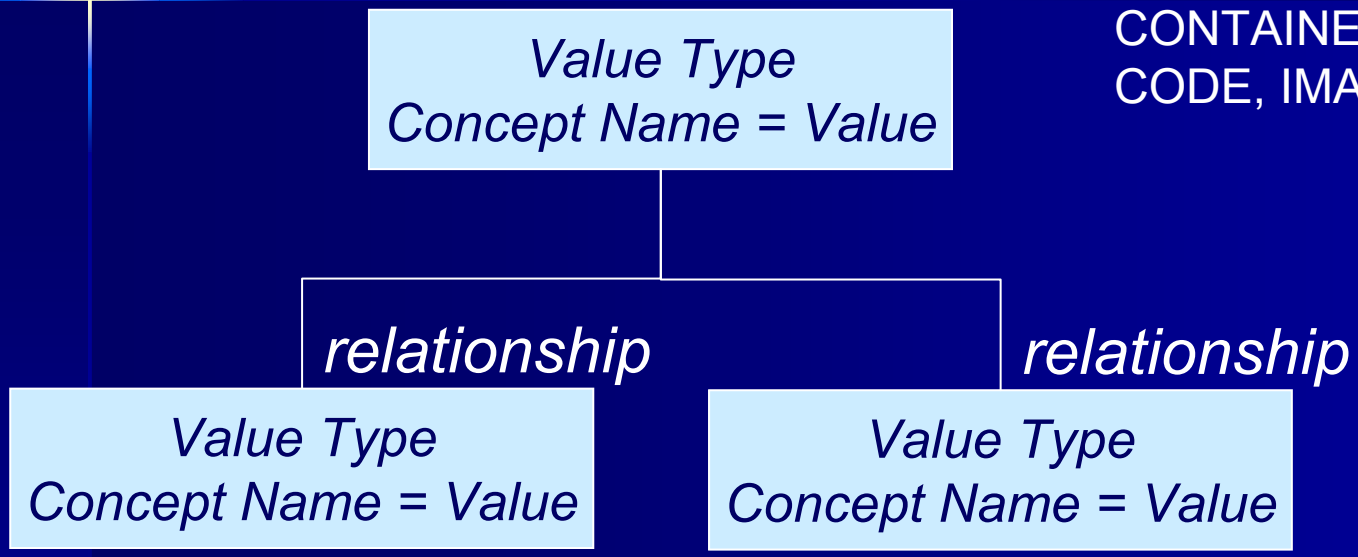
- Three base SR classes are defined to allow encode any type of structured information:
  - Basic Text SR
  - Enhanced SR
  - Comprehensive SR
- Distinguished by Value Types and Relationships supported

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

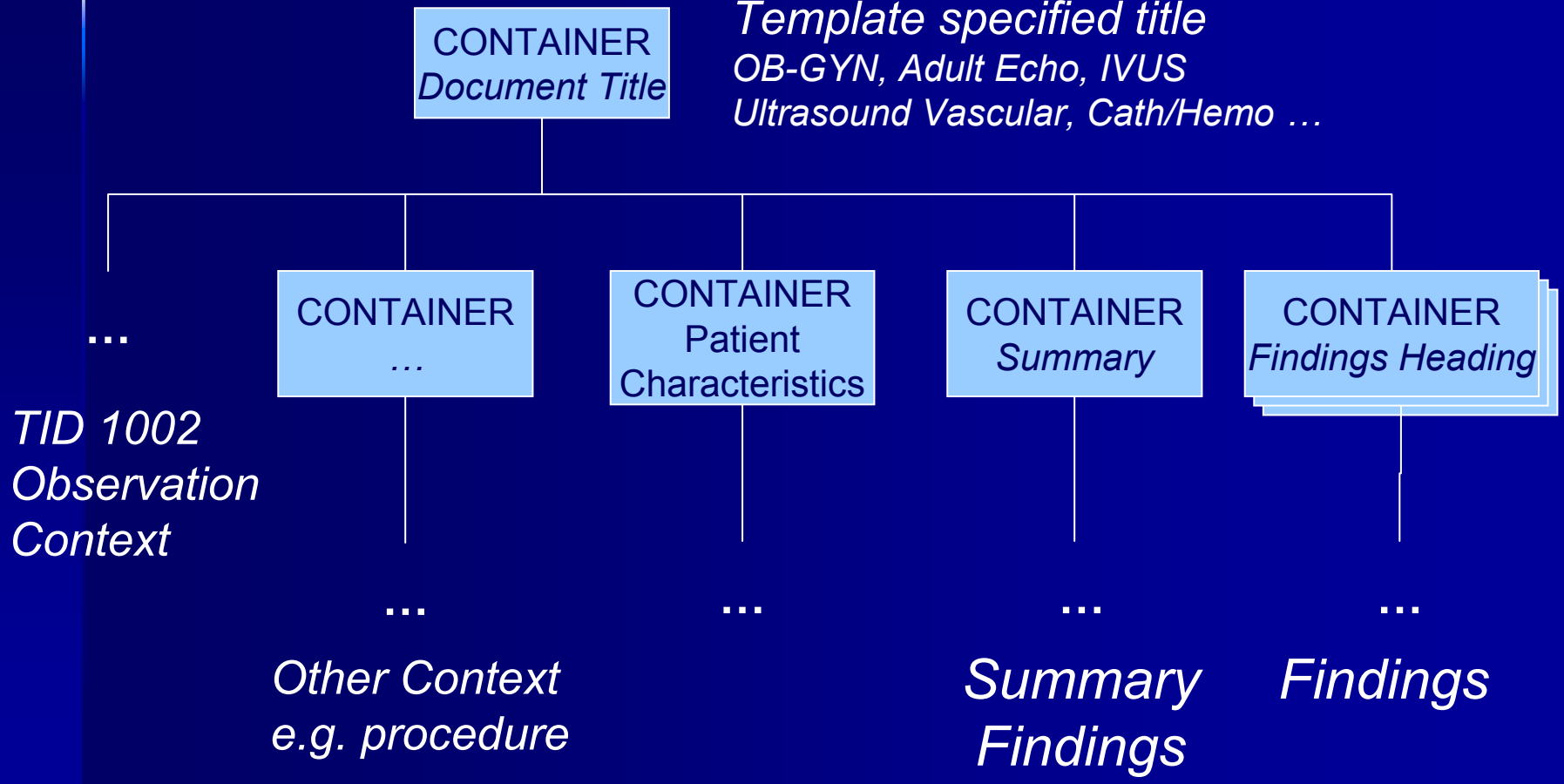
Value Types
CONTAINER, NUM, CODE, IMAGE …



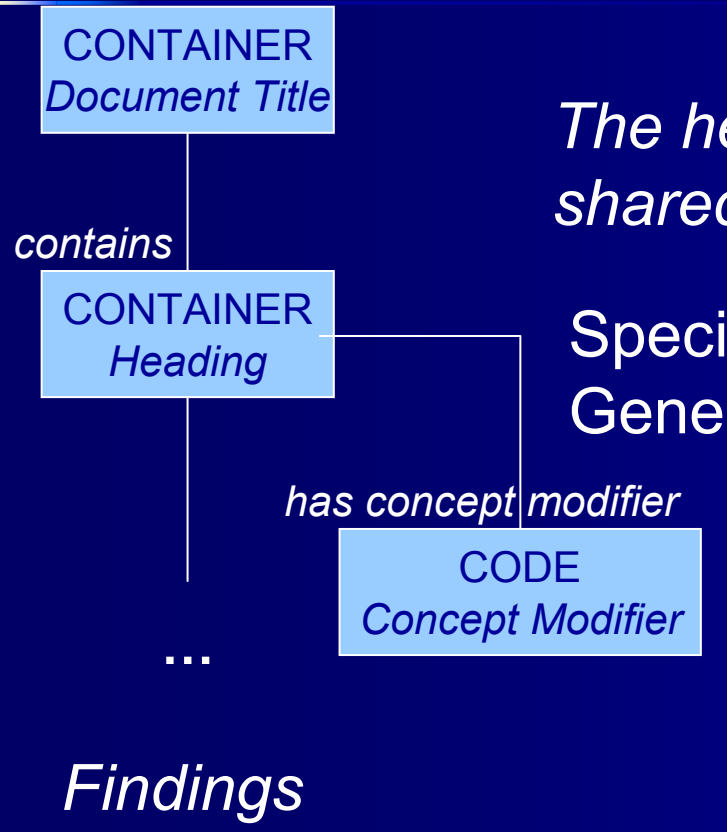
Concept Names and Values of type CODE are triplets

- Code Value
- Coding Scheme Designator
- Code Meaning (*actually, just some text to evoke meaning to user)*

Typical Top Level Template Structure



Document Headings



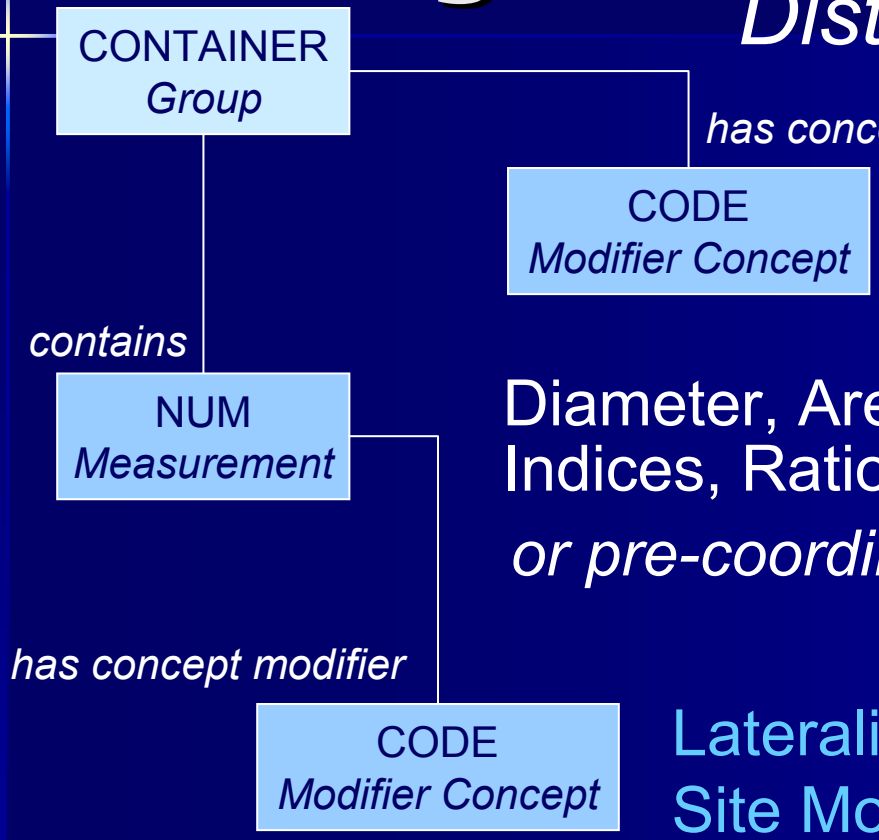
The heading may have semantics shared by children findings

Specific: “Exercise Challenge”
Generic: “Findings”

“Laterality” = “Left”
“Finding Site” =
“Cerebral Vessels”

Discrete Numeric Findings

Distributed semantics



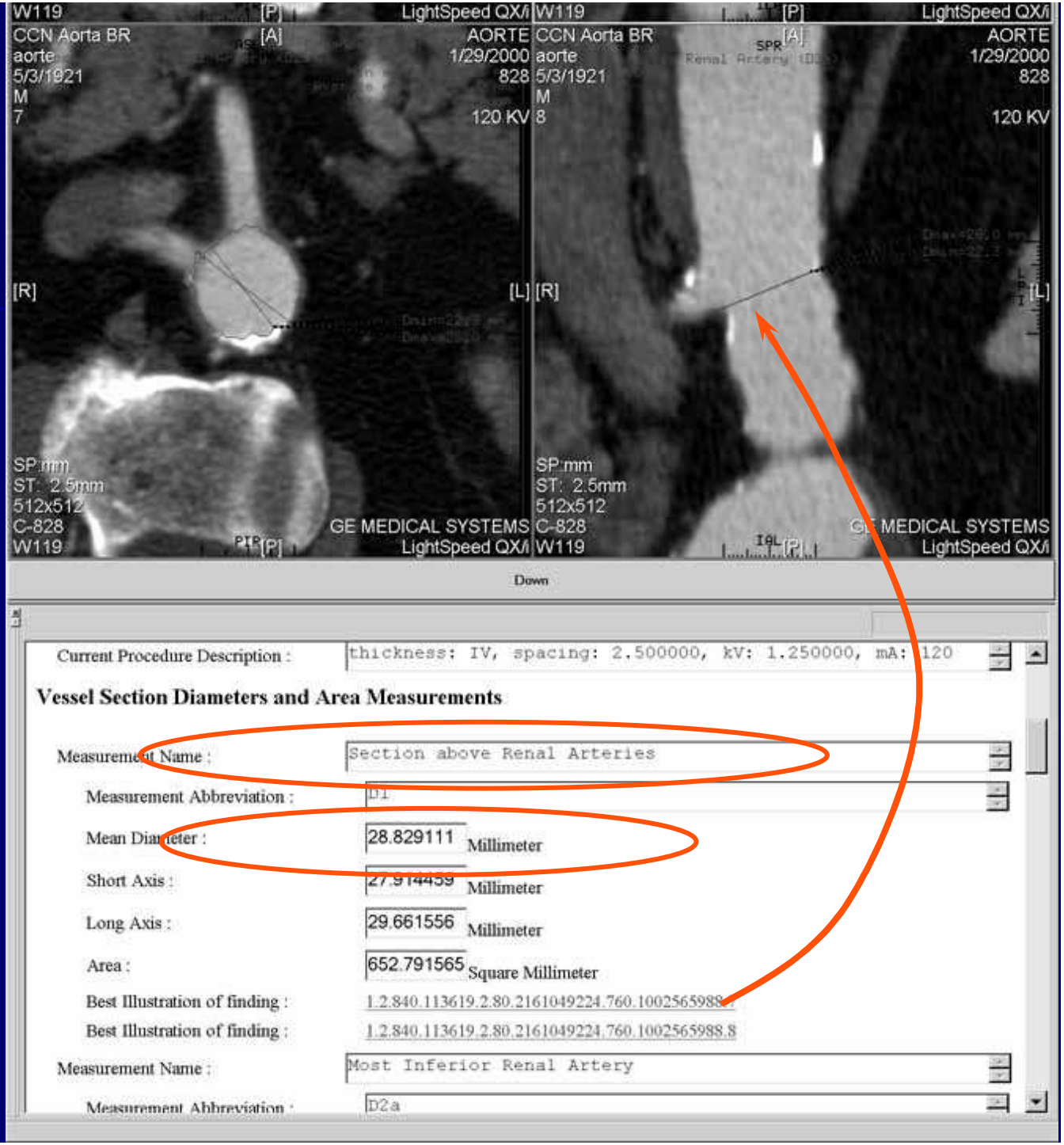
Diameter, Area, Volume, Blood Velocity, Indices, Ratios, Time Interval …

or pre-coordinated concept: BPD, FL …

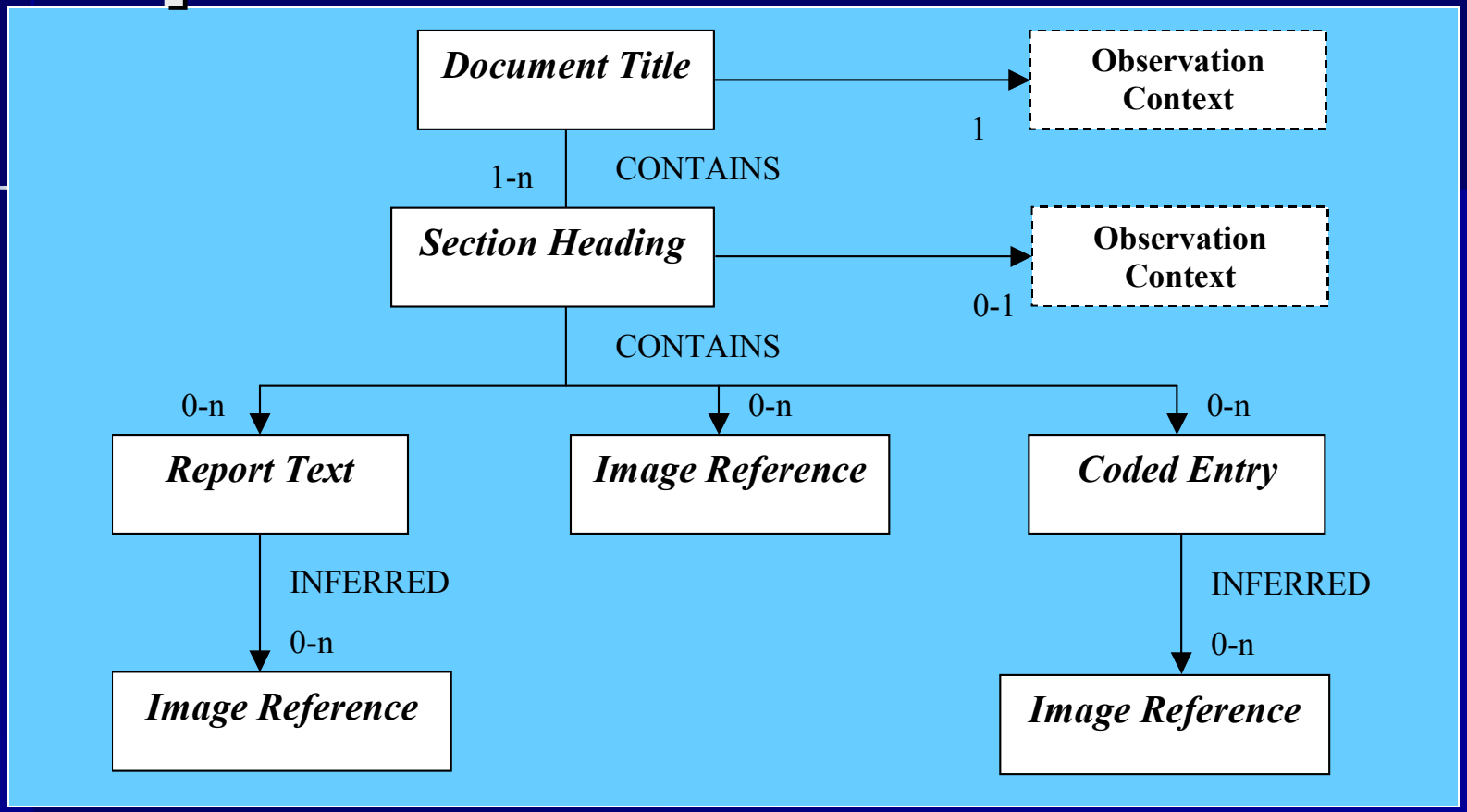
Laterality, Finding Site, Anatomic Site Modifier, Cardiac Phase …

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)

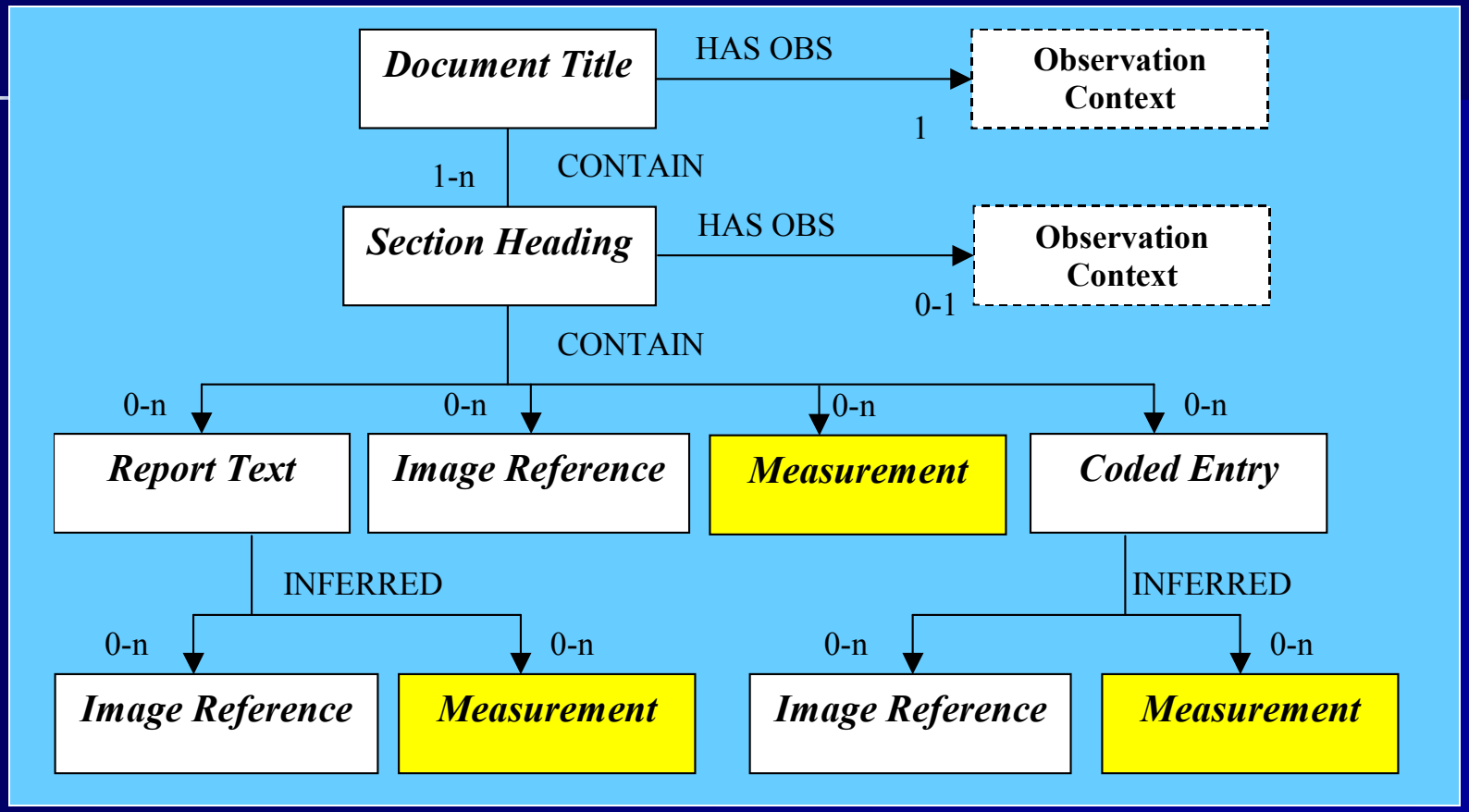


Simple Structure



- 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

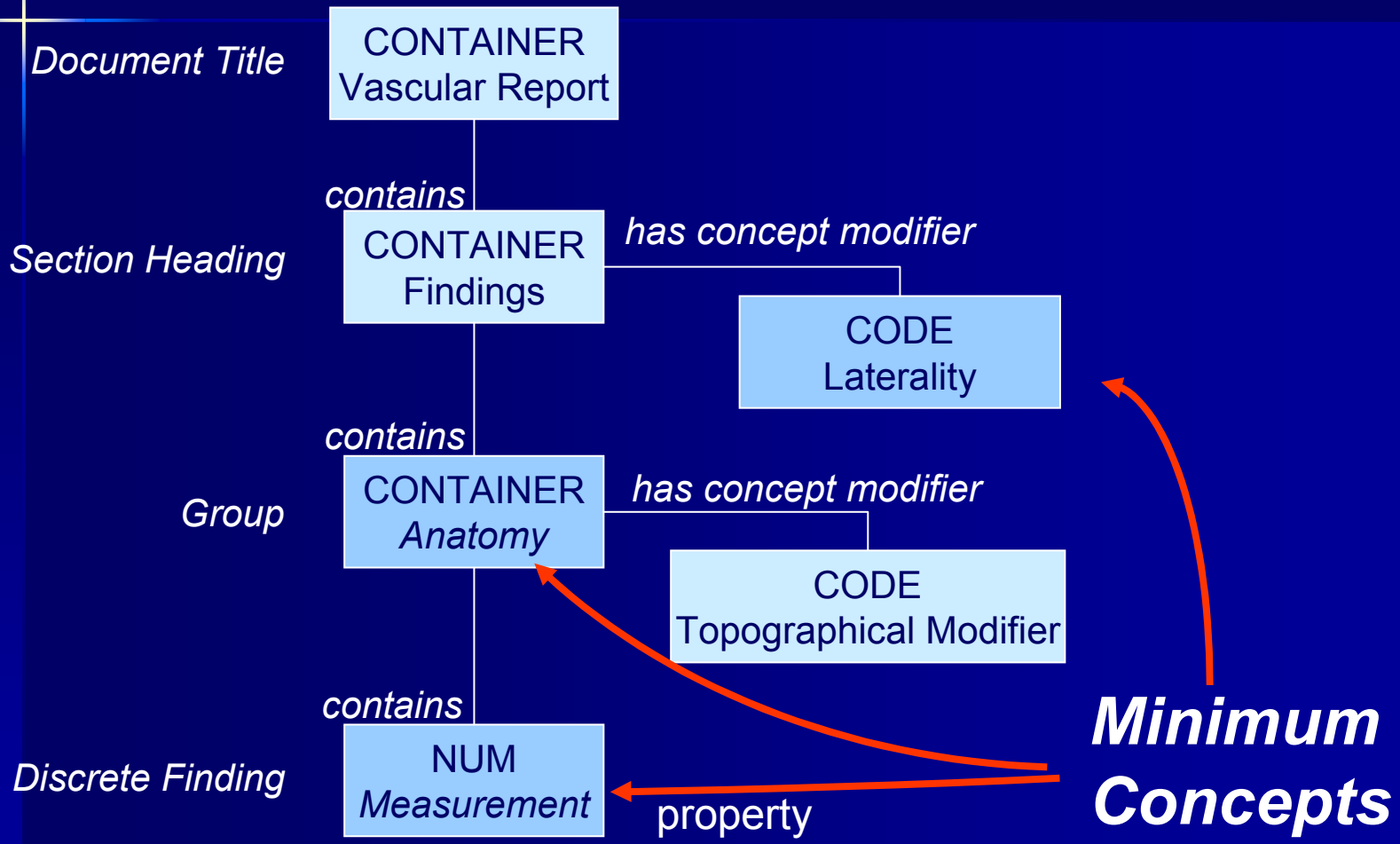
Evidence Documents Examples

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

Typical Ultrasound SR

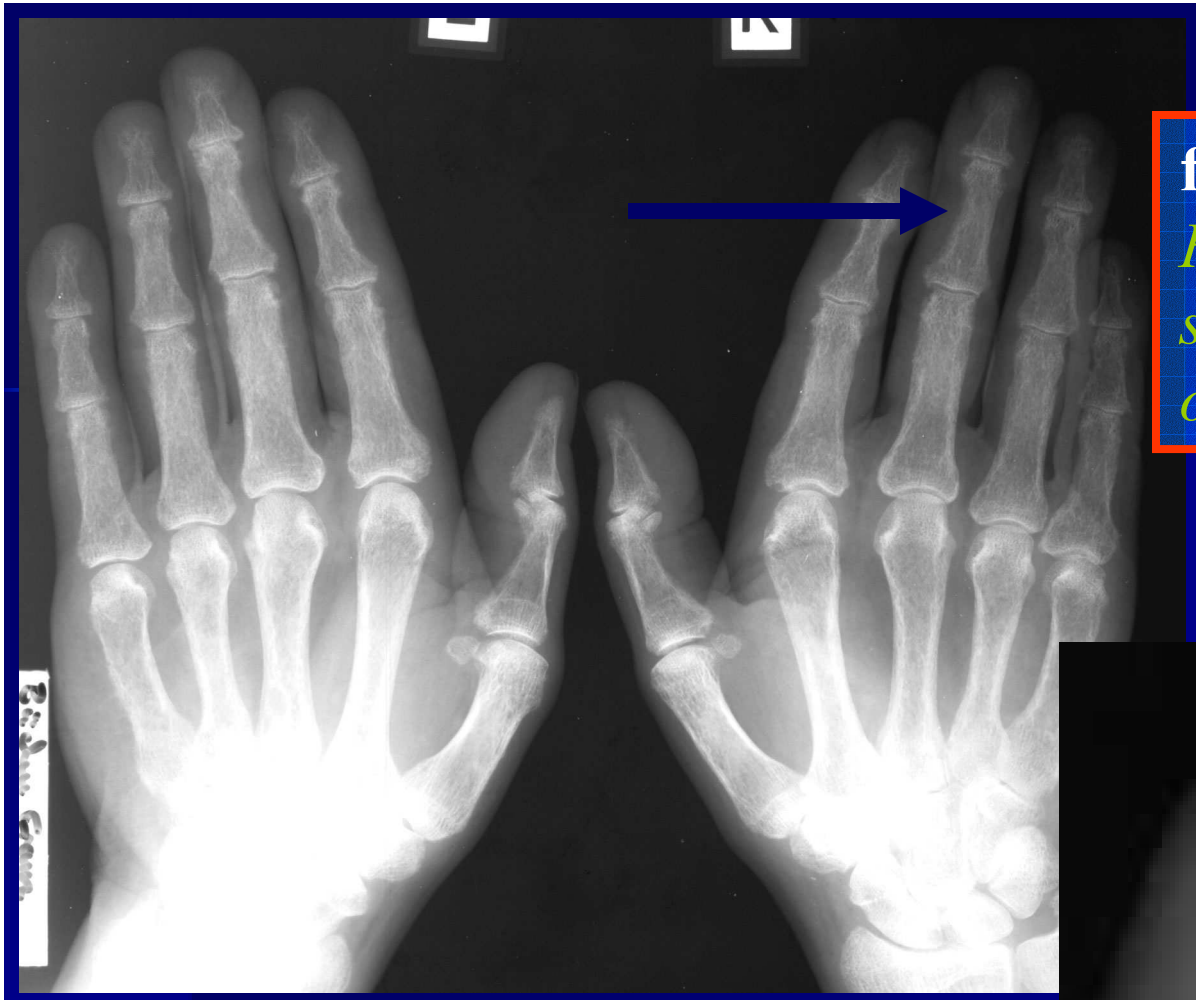
- Based on one of generic SR SOP Classes
- Intended to precisely convey measurements and findings, relationships between them
- Each specialized "report" uses its own template

Vascular Content Hierarchy



Key Object Selection Documents

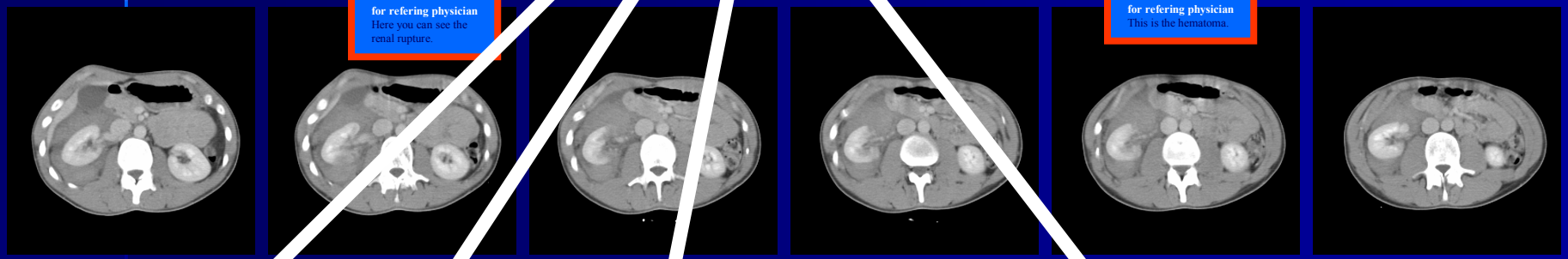
- Initiated by the desire to have simple Key Image Note
- Developed as generic "manifest" – collection of pointers to images (or even specific frames)
- Specifies intent of selection, simple textual note
- Non-extensible template



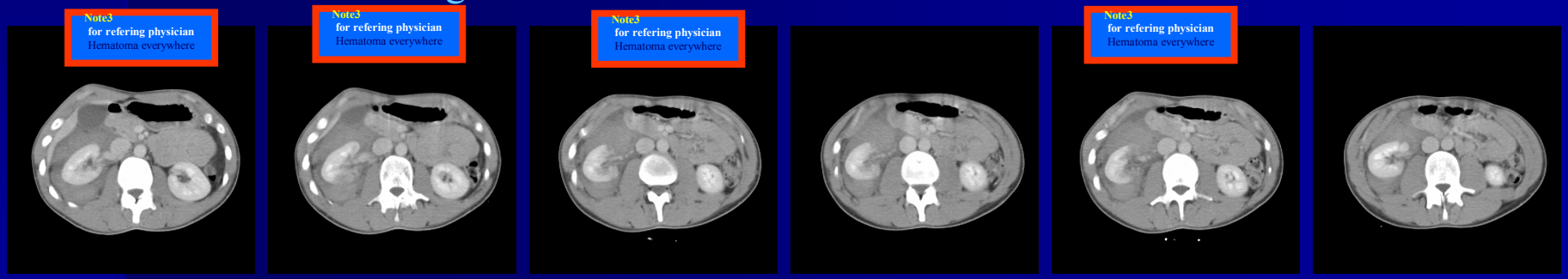
for referring physician
Here you can see the renal osteopathy.

For teaching
Fibroosteoclasia

Different notes on different images



Same note on different images



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.

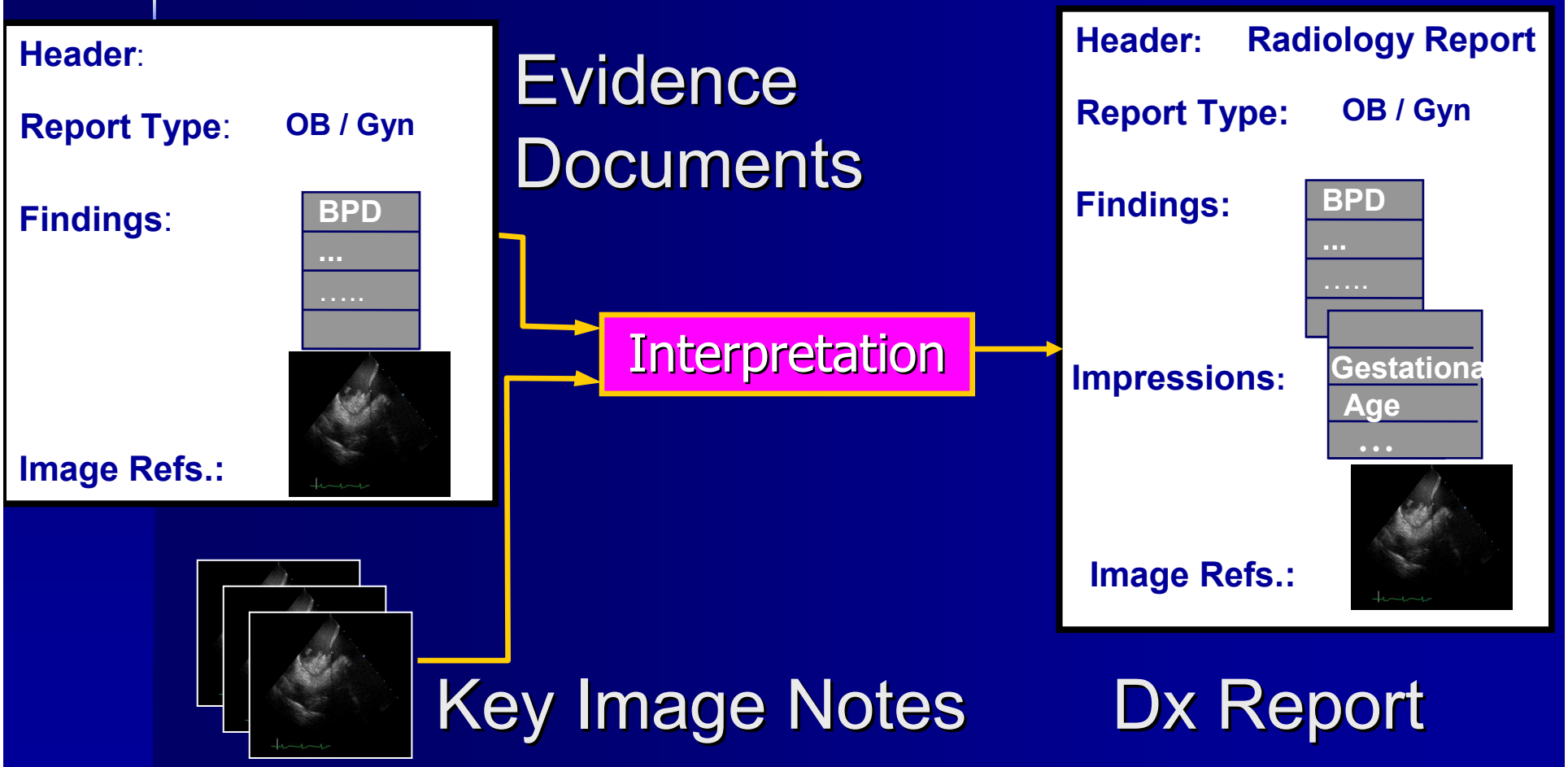
The user comments are meant to be informal.

Codes
Of Interest
Rejected for Quality Reasons
For Referring Provider
For Surgery
For Teaching
For Conference
For Therapy
For Patient
For Peer Review
For Research
Quality Issue
Reporting

Key Image Notes

- 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

Workflow of SR objects



Query for SR Content

Patient Information Query

- 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?