

# Using AMGA to Store and Organise DICOM Structured Reports

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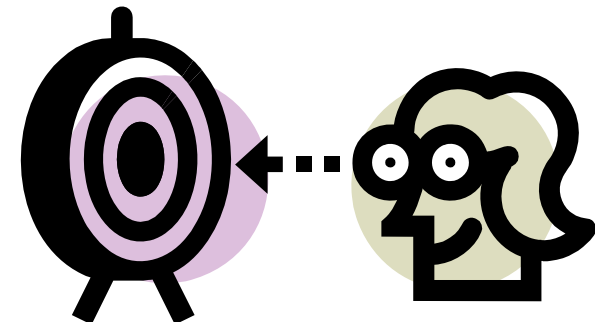
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- Objectives.
- Structured Reporting.
- DICOM-SR and AMGA.
- Future work.



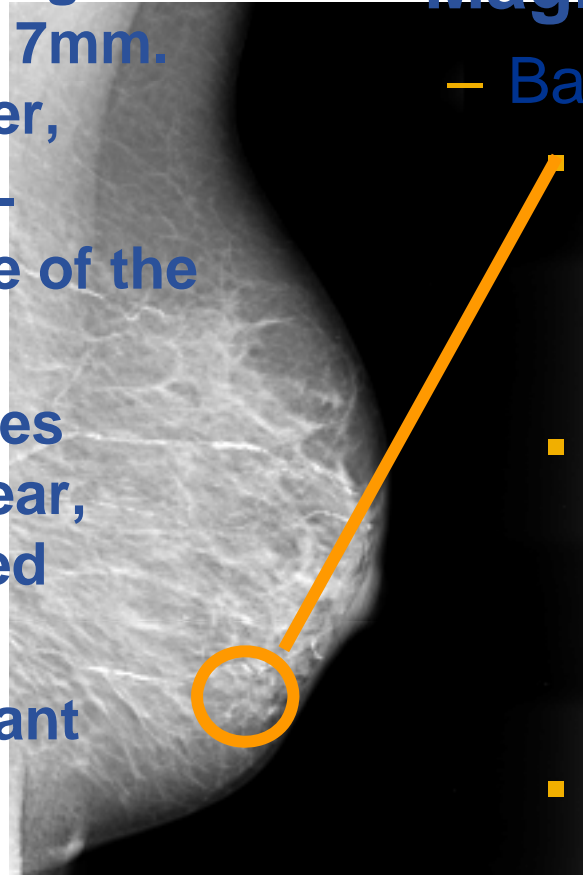
- **Several Components and Middlewares Use Grids to Store and Organise DICOM Images**
  - TRENCADIS, MDM, SRB.
- **An Important Part of the Information is not stored in the Image, but in the Radiology Report.**
  - Structured Reports can be Used to Organise Medical Images Using More Powerful Tools, From the Point of View of the Knowledge.
- **AMGA Can be Used to Represent Knowledge and Ease Querying For Relevant Data.**



- **Digital Report:**
  - Properly Stored and Coded.
  - Fields Agreed by the Community.
  - Standard Lexicon and Semantics.
  - Links to Images, Audio, Measures and Postprocessing Results.
  - Universal Medical Usage.
  - Based on Evidence.
  - Able to Reflect Experimental Results.

Observation of an Irregular Espiculated Mass of 7mm. of Maximum Diameter, Located on the inter-quadrant inferior line of the left breast.

The Lesion Comprises Heterogeneous, Linear, grained and branched Microcalcifications  
Apparently a Malignant Lesion



- **Maglinancy**

- Based on:

- Mass

- *Size: 7mm.*
      - *Shape: Irregular*
      - *Margins: Espiculated*

- Associated

- *Calcification*

- Tipus: Heterogeneous

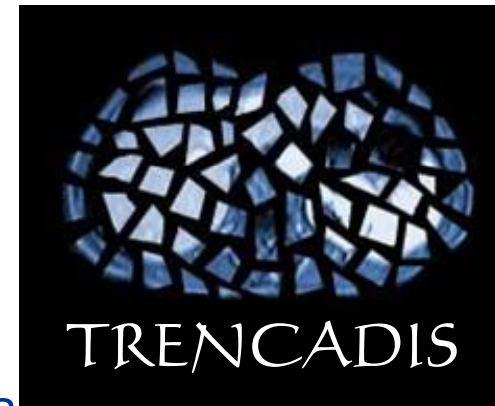
- Tipus: Branched

- Distribution: Grouped.

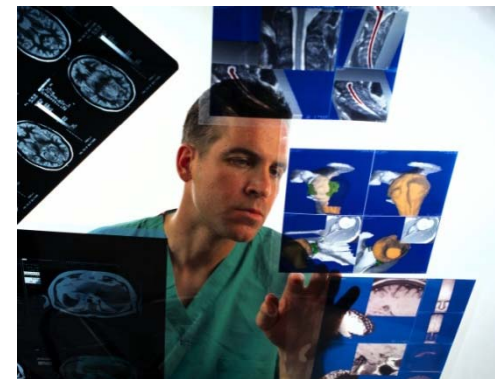
Free Text. There is no Structure Defined and Agreed and not Associated to Images.

Structure and Lexicon Defined And Agreed. Associated to Images.

- **Towards a Grid Environment for Processing and Sharing DICOM Objects**
  - TRENCADIS Aims at the Development of a Middleware to Create Virtual Repositories of DICOM Images and Reports.
  - It Uses a Semantic Model for Organising the Data.
  - Data is Encrypted and Decrypted to Ensure Privacy Protection.
  - High-Performance Services are Included with the System.
  - Architecture Totally Based on WSRF.
- **Objective: Creation of Virtual Shared Repositories of Medical Images.**
  - Complementary to PACS.
  - Intended Mainly for Research and Training.
  - Multicentric and Multiuser.
  - Data to be Shared is Explicitly Selected.
  - Data is Pseudoanonimised Before Entering in the System.



- **DICOM Structured Reporting Defines a DICOM-Compatible Format to Specify Structured Electronic Reports.**
- **DICOM-SR Defines, Through DICOM Information Object Definition (IOD) Data Sets and Information Entity (IE) Data Element Objects, the Way to Specify Concepts and Coding Schemas.**
- **DICOM-SR Defines Three IODs**
  - Basic Text, Enhanced SR, Comprehensive SR.
  - IEs are Structured in a Tree-Shape
- **Each IE a Name / Value Pair, in Which the Name Comprises Three Items: Code Value, Code Schema and Code Meaning.**





- DICOM-SR Does not Define Which Fields Should be Included.
- Templates are Being Provided and Agreed at DICOM
  - A Template is a Tree Structure with a Fixed set of IEs.
  - Defined in the “DICOM Content Mapping Resource” (DCMR) Supplement.
  - DICOM Working Group 15 Provides the Computer-Aided Detection Templates for Mammography (sup. 50), the Chest CAD (sup. 65), Patient History (sup. 75), and Breast Report (sup. 79).
  - Other Templates for catheterization, Ventriculography, Intravascular US, US Obstetrics and Gynecology, Vascular US, Echocardiography, and Fetal and Pediatric Echocardiography.

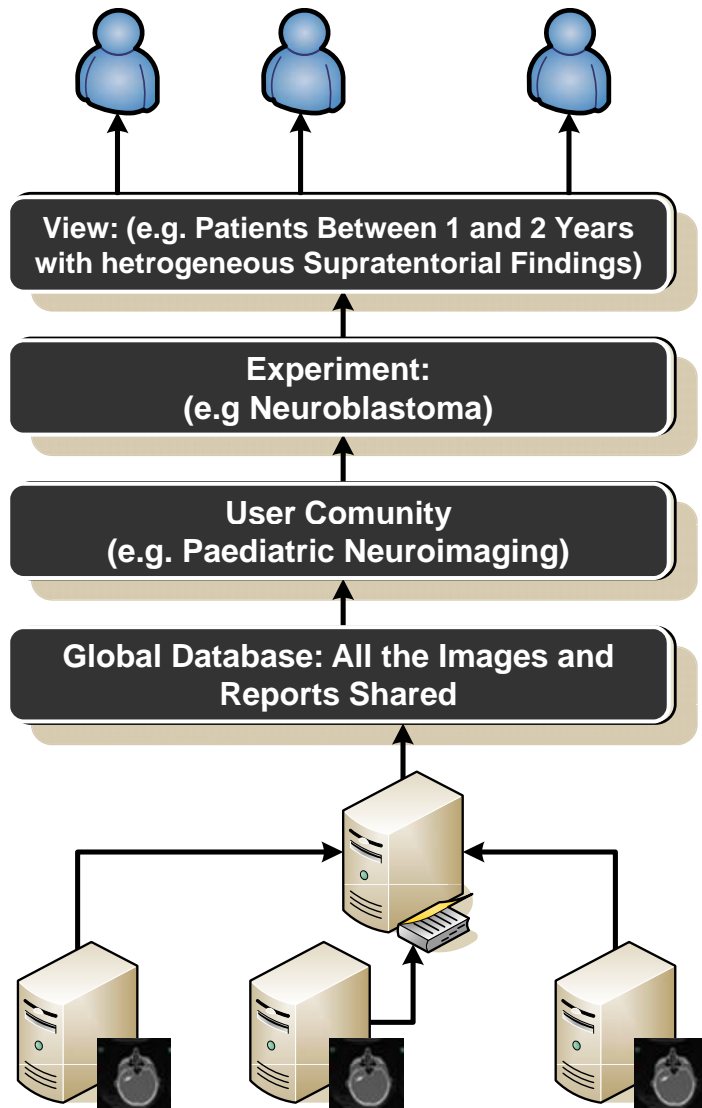
Value Type

TID 2000  
BASIC DIAGNOSTIC IMAGING REPORT

Row number	NL	Ret with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	BCID(7000) Diagnostic Imaging Report Document Titles	1	M		Root node
2	>	HAS CONCEPT MOD	CODE	EV (121058.DCM,"Procedure reported")	1:n	U		
3	>	HAS CONCEPT MOD	INCLUDE	ETID(1204) Language of Context Item and Descendants	1	M		
4	>	HAS CONCEPT MOD	INCLUDE	ETID (1210) Equivalent Meaning of Concept Name	1:n	U		
5	>	HAS OBS CONTEXT	INCLUDE	ETID(1001) Observation Context	1	M		
6	>>	CONTAINS	CONTAINER	BCID(7001) Diagnostic Imaging Report Headings	1:n	U		
7	>>	HAS OBS CONTEXT	INCLUDE	ETID(1001) Observation Context	1	U		
8	>>>	CONTAINS	CODE	BCID(7002) Diagnostic Imaging Report Elements	1:n	U		
9	>>>	INFERRED FROM	INCLUDE	ETID(2001)Basic Diagnostic Imaging Report Classifications	1:n	U		
10	>>>	CONTAINS	TEXT	BCID(7002) Diagnostic Imaging Report Elements	1:n	U		
11	>>>	INFERRED FROM	INCLUDE	ETID(2001)Basic Diagnostic Imaging Report Observations	1:n	U		
12	>>>	CONTAINS	INCLUDE	ETID(2001)Basic Diagnostic Imaging Report Observations	1:n	U		

Nesting Level      Relationship with Parent      Value Multiplicity      Requirement Type





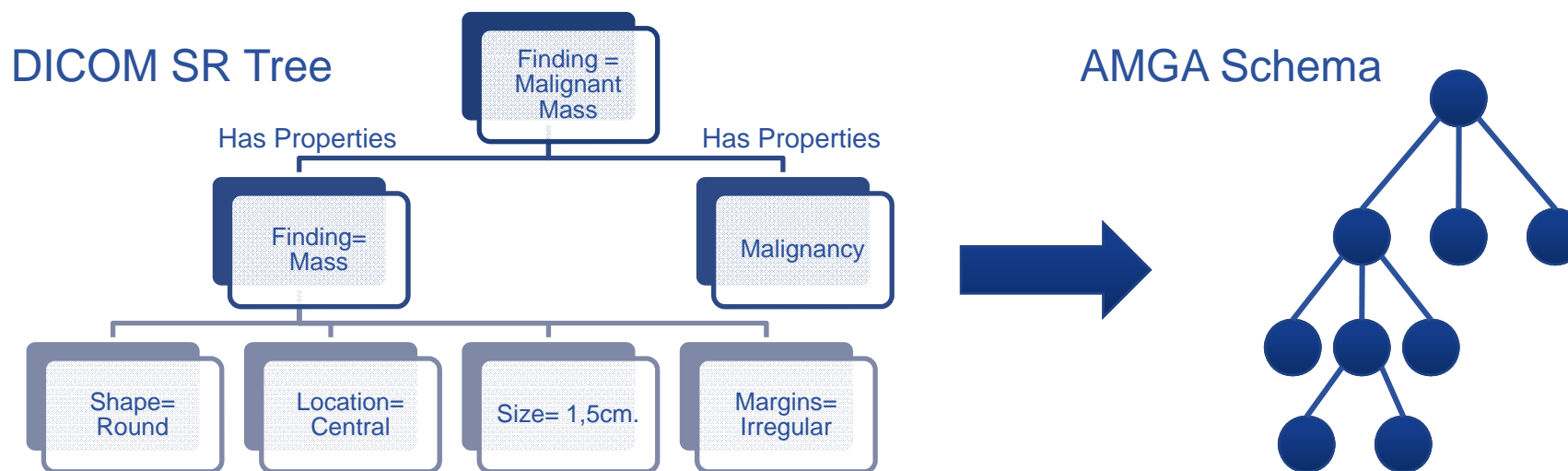
- **Semantic Organisation**

- Users Organise Themselves on Virtual Communities.
- From the Studies Available, Only Those Matching the Selection Criteria of the Virtual Community Profile are Accessible.
- From the Images Available to a Virtual Community, a User Can Create an Experiment with the Studies Matching a Set of Restrictions.
- From this Experiment, More Detailed Views can be Obtained.
- The Criteria for the Selection of the Relevant Information Relies on the DICOM Tags of the Image and the Structured Report.

- **Seven Templates Have Been Generated By the Experts**
  - Report for the Staging of Malignant Liver Neoplasia, Small and Non-Small Cell Lung Cancer and Intraaxial Tumours of Central Nervous System.
  - Follow-up Reports for Liver Metastasis, Lung Carcinoma and Intraaxial Tumours of Central Nervous System.
- **The Reports are Structured and Coded Using the Rules of DICOM-SR.**
- **Standard Coding (Mainly DICOM) Has Been Used When Possible, Following the DICOM-SR Rules To Introduce New Coding Schemas.**
- **The Reports Generate Automatically the TNM Staging Code (From the Radiological Information) in the Cases of Liver and Lung.**

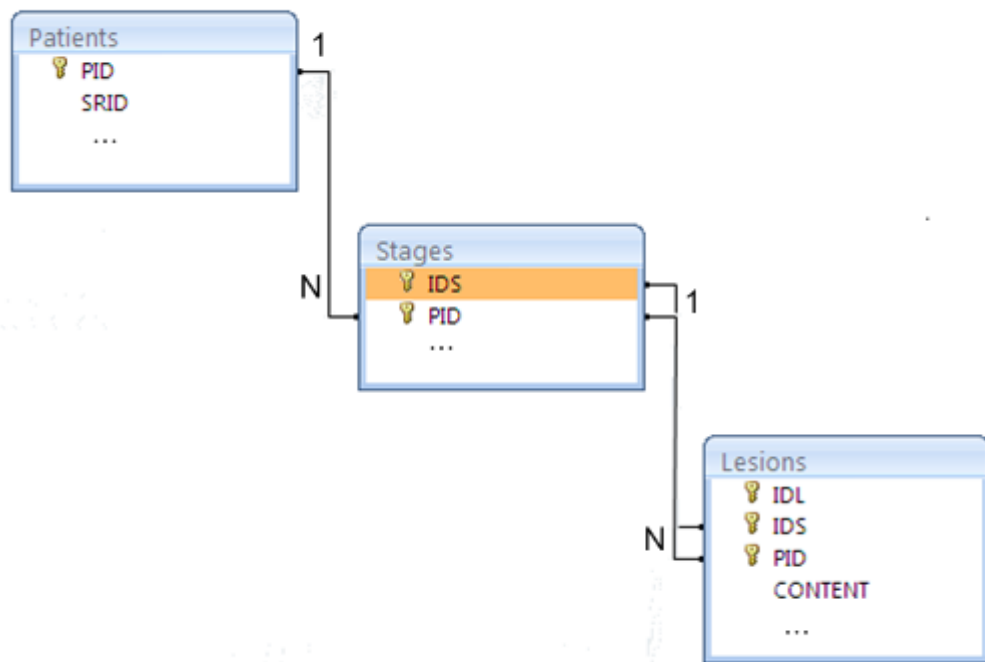


- **A DICOM Study is then a Pair DICOM-SR + DICOM Images.**
  - DICOM Images Could be Huge and Comprise from one to Thousands of Files.
    - SEs are Good Storage Means (Either TRENCADIS DICOM Interaction Components or MDM SRM DICOM).
  - DICOM-SR Require a Relational or Documental Database.
    - AMGA is a Good Candidate to Standardise the Interface.



**Problem:** Retrieve all the ID Reports from the Patients that have a Staging Value of II with an Heterogeneous Secondary Lesion.

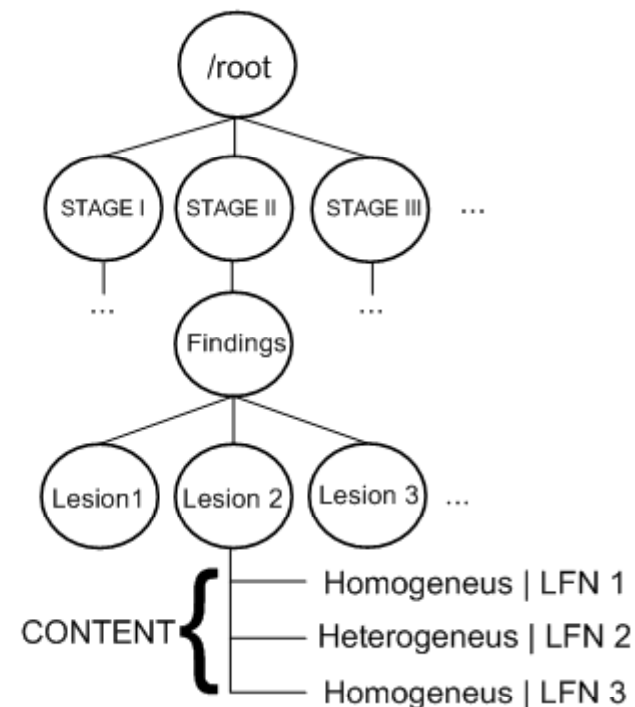
## RELATIONAL DATA ORGANIZATION



```

SELECT Patients.SRID
FROM (Patients INNER JOIN Stages ON Patients.PID =
Stages.PID) INNER JOIN Lesions ON (Stages.PID =
Lesions.PID) AND (Stages.IDS = Lesions.IDS)
WHERE ((Stages.IDS="StagII") AND (Lesions.IDL="2") AND
(Lesions.CONTENT = "Heterogeneous"))
    
```

## AMGA DATA ORGANIZATION



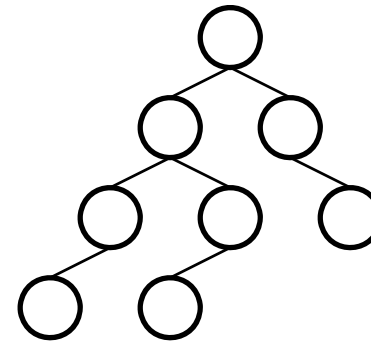
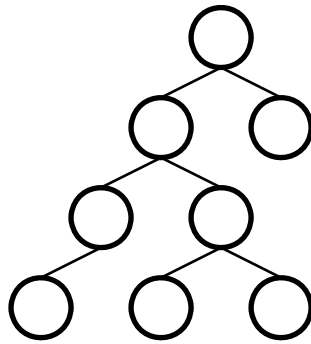
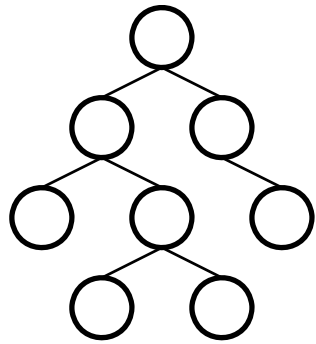
```

Find /root/STAGE_II/Findings/Lesion_2 'like
(CONTENT, "Heterogeneous")'
    
```

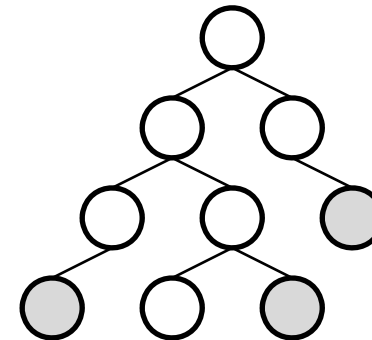
- **Three Tools**
  - Translate a DICOM-SR Template into an AMGA Schema.
  - Insert a DICOM-SR File in an AMGA Database.
  - Retrieve a DICOM-SR File From an AMGA Database.
- **Benefit from the AMGA Features**
  - Security and Authorisation.
  - Replication and Reliability.
  - Efficiency and Performance.
  - Standardisation and Availability of Services.
  - Better Expressivity.



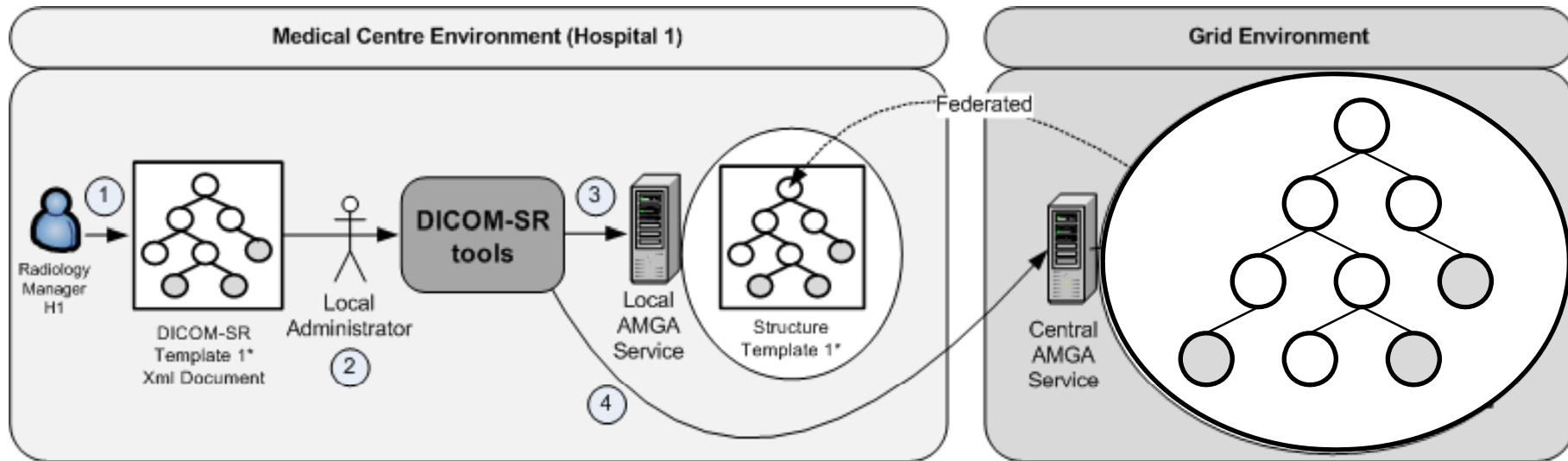
- **Different Hospitals Have Different Templates**

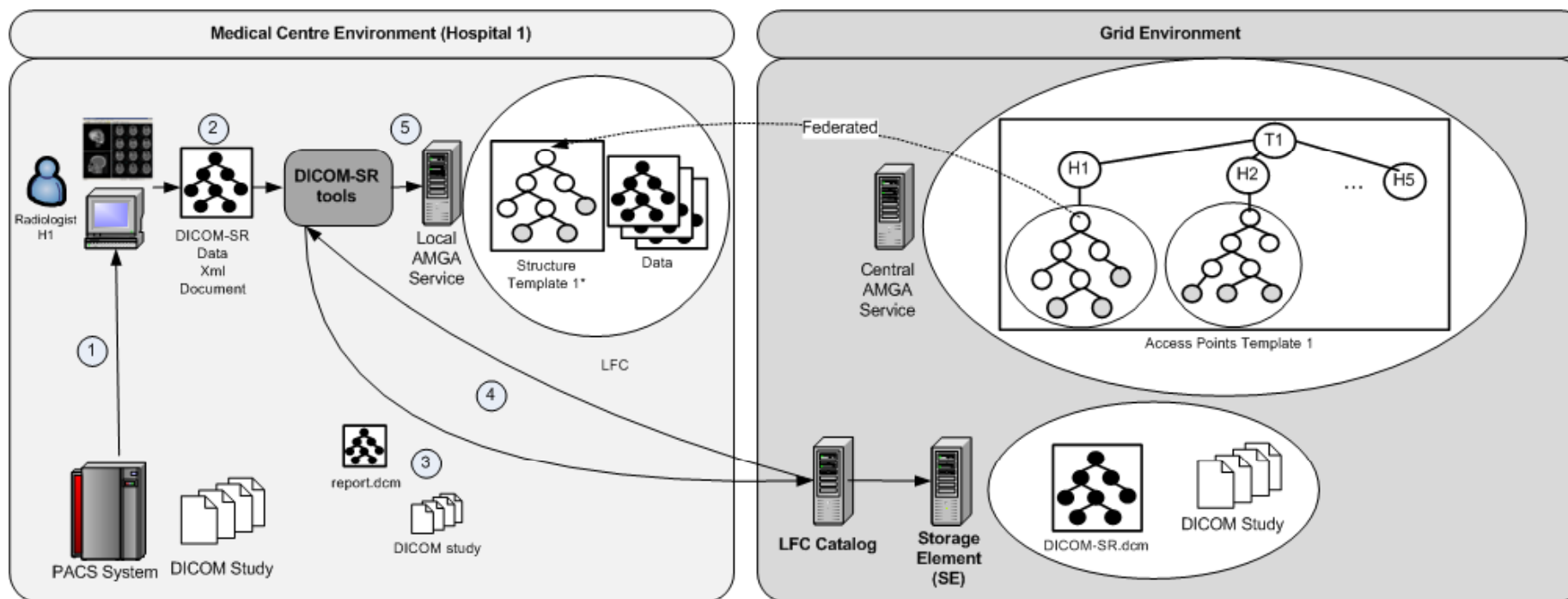


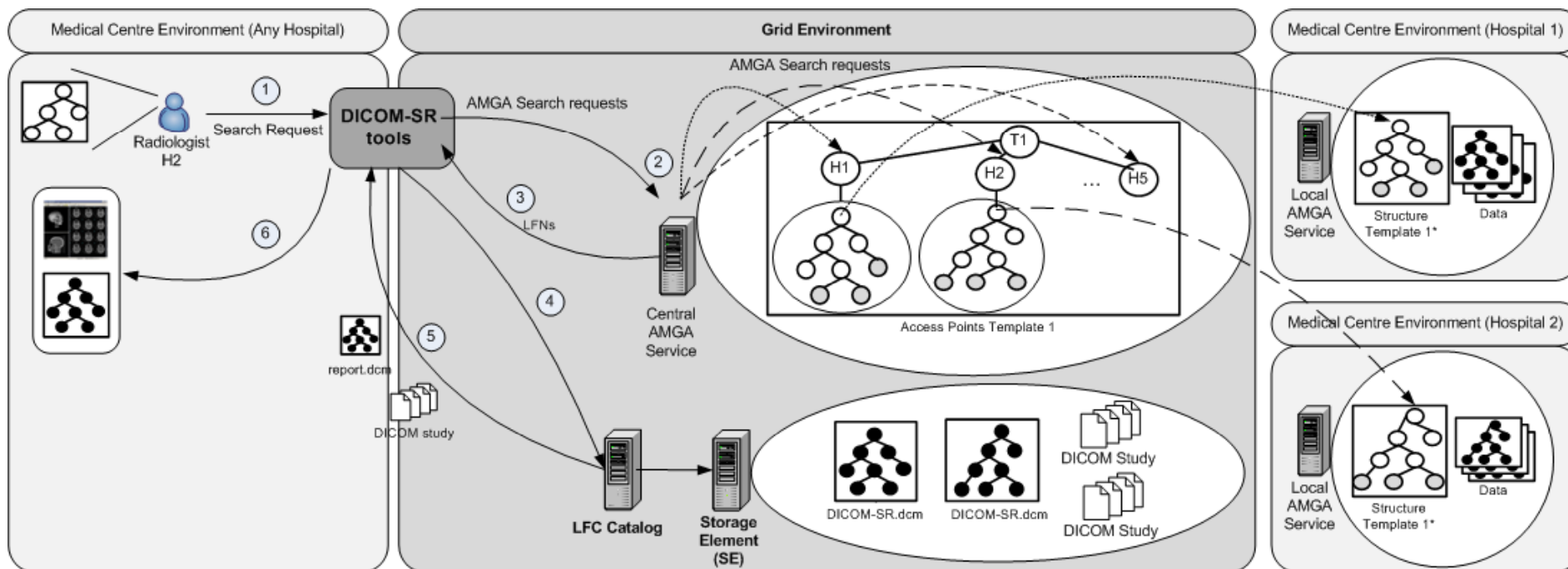
- **But They Can Agree on Basic Items and Codifications.**











- **Implementation of Standardised Supplements such as CAD in Mammography (Sup. 79).**
- **Integration with Grid Medical Imaging Components, such as TRENCADIS.**
- **Performance Evaluation, through Experiment Comparing Relational and Tree-like Searches.**
- **Potential Improvements**
  - Federation of AMGA Branches at a Single Mount Point
    - This would Improve Performing Parallel Searches on a Shared Mount Point.
  - Currently Implemented Through Multiple Distributed Queries in Different AMGA Servers.

- **The use of AMGA Trees Enhances the Expressivity of Metadata when Organising Medical Images by the Content of the Medical Record.**
  - DICOM-SR Structure Fits Well AMGA Tree-Like Organisation.
- **Preliminary Results Show an Acceptable Overhead with Respect to Relational Queries.**
  - Three Components Have Been Developed.
- **AMGA Provides VO-Based Authorisation Management, Replication and Federation.**
- **Usability Could be Improved if Federation Would Include Mounting Multiple Trees in a Single Point.**