



Overview of Tools for Detailed Clinical Models

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Purpose

- This presentation focuses on the tools that are necessary and available to analyze a clinical domain in order to model this for development of information technology in health care.
- And where different types of information technology can work together and exchange information (being interoperable)
- It will be presented based on the example of detailed clinical modeling.



Semantic interoperability

- Functional interoperability – the ability of two or more systems to exchange information (so that it is human readable by the receiver),
- Semantic interoperability – the ability for information shared by systems to be understood at the level of formally defined domain concepts (so that information is computer processable by the receiving system).
- ISO 20514: 2005



Tools for DCM?

- Tools for DCM can be considered a set of software programs that facilitate one or more steps in the DCM development or use.
- Most important: concept representations in different formats
- Tools should work together, or allow moving smoothly from one step to the other, ending with testing of working systems

DCM Tool overview



Phase in DCM	Activity	Tool
Project	Business Modeling	UML
Clinical Content	Information analysis & requirements	Mind map, Office
Formalization	Structure and sort clinical content	DCM pattern in Enterprise Architect
Verification	Professionals review and improve content	CKM, Clinical Templates tool Scotland.
Modeling	Model the structured and verified content	EA DCM pattern, ADL tools, HL7 R-MIM designer, XML editor
Re-use	Transform	Medical Objects EA DCM pattern exports
Functional Design	Compile EHR, message, HIT	EA, Ocean template
Quality and testing	Check quality of models & transforms	HL7 schematron! ADL? EA DCM? Prorec?
Repository	Store and retrieve models etc.	CKM, Clinical Templates tool Scotland



Modeling Maturity

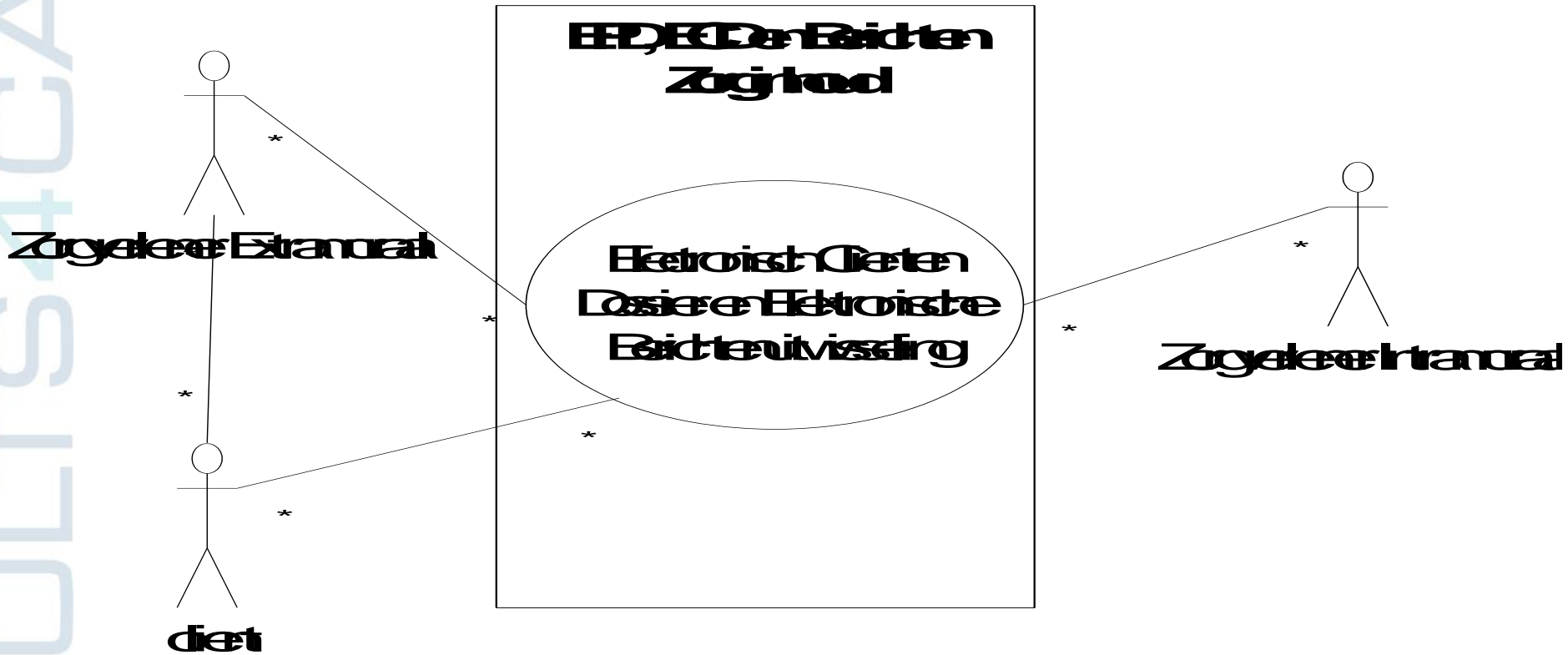
- No specifications
- Textual
- Text with models
- Models with text
- Precise models
- Models only

Source: Warmer J, Kleppe A. The object constraint language: getting your models ready for the MDA. Second Edition. Addison Wesley, 2003



Business modeling

- Purpose: to identify and model the business with respect to
 - Organization
 - Stakeholders
 - Purpose
 - Context
 - Tools: usually word processing and general drawing tools

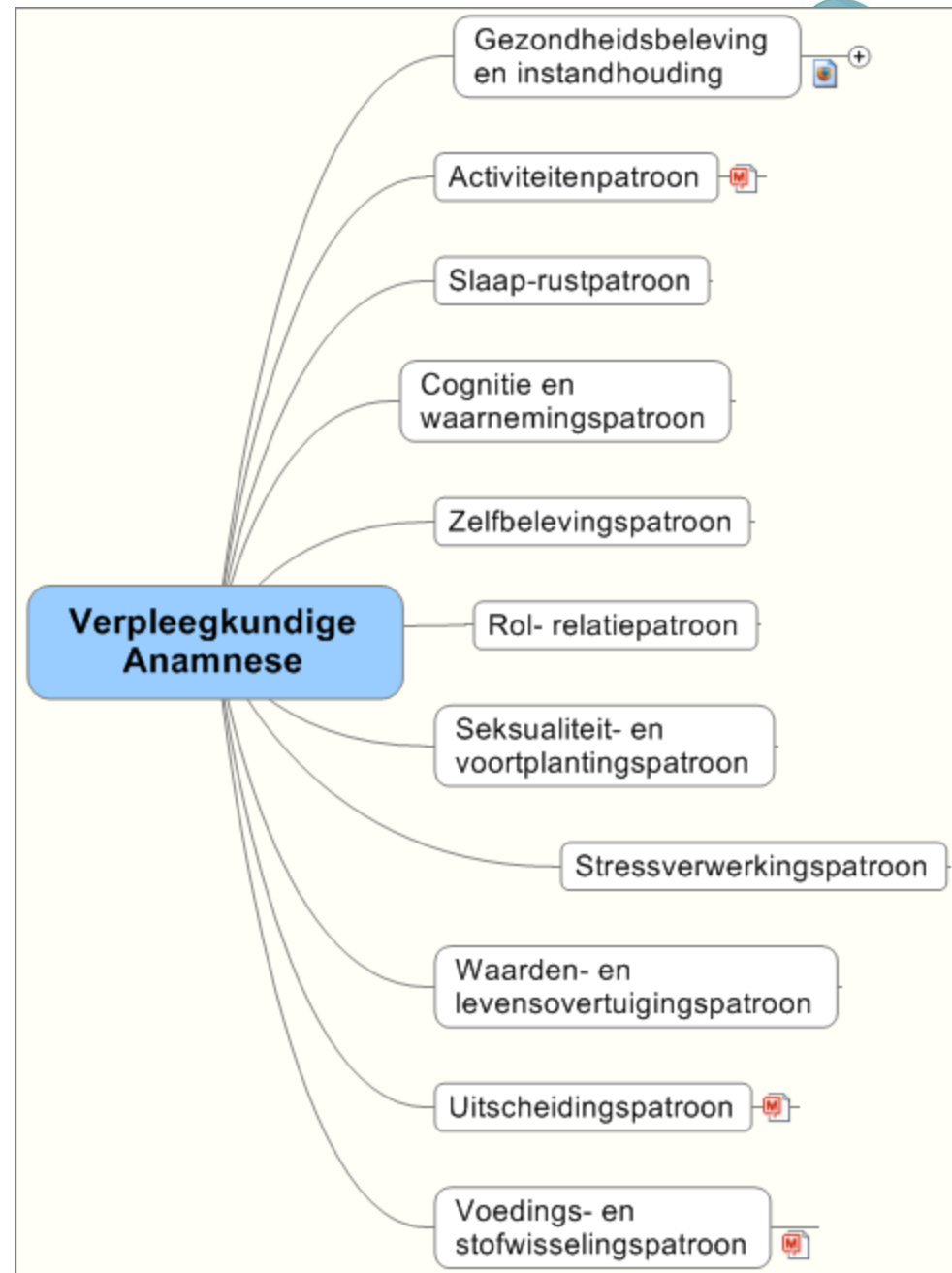


Information analysis



- Analyze data, information, knowledge and represent this in computer files
- Brainstorm and overview:
 - Mindmapping Tools
 - Mindjet Mindmanager Pro
 - RDF
- Data specification tool
 - Mapping table (Basic or Core or Minimal Data Sets)
 - Spreadsheet format (e.g. Excel)
- DCM outline document format
 - Word processor format (e.g. Word)
- Existing forms, questionnaires and assessments
- Existing applications
 - Reverse engineering: several variants
- More?

Mind map



Terminology binding



- Map data and definitions to coding systems
 - Mapping
 - Mapping methoden (face, expert, dissection)
 - GALEN
 - Others?
- Terminology toolkits (multiple!)
 - ETS (enterprise terminology server)
 - Apelon
 - CliniClue Browser -> SNOMED CT
 - Relma-> LOINC
 - ICD-9 of WHO via www.who.int
 - Lexgrid
 - ICD-10 WHO web
 - ICPC
 - Local terminology: data dictionaries



Search

FUNCTIES
STRUCTUUR
ACTIVITEITEN
PARTICIPATIE
EXTERNER FACTO

Top-Level



Hierarchy



Back



Exit

- + B FUNCTIES
- + S ANATOMISCHE EIGENSCHAPPEN
- D ACTIVITEITEN EN PARTICIPATIE
 - + d1 LEREN EN TOEPASSEN VAN KENNIS
 - + d2 ALGEMENE TAKEN EN EISEN
 - d3 COMMUNICATIE
 - + d31-32 COMMUNICEREN - BEGRIJPEN (d310-d329)
 - + d33-34 COMMUNICEREN - ZICH UITEN (d330-d349)
 - + d35-36 CONVERSATIE EN GEBRUIK VAN COMMUNICATIE-APPARATUUR EN -TECHNIEKEN (d350-d369)
 - x d398 Communicatie, anders gespecificeerd
 - x d399 Communicatie, niet gespecificeerd
 - + d4 MOBILITEIT
 - d5 ZELFVERZORGING
 - **d510 Zich wassen**
 - x d5100 Wassen van lichaamsdelen
 - x d5101 Wassen van gehele lichaam
 - x d5102 Zich afdrogen
 - x d5108 Zich wassen, anders gespecificeerd
 - x d5109 Zich wassen, niet gespecificeerd
 - + d520 Verzorgen van lichaamsdelen
 - + d530 Zorgdragen voor toiletgang
 - + d540 Zich kleden
 - x d550 Eten
 - x d560 Drinken
 - + d570 Zorgdragen voor eigen gezondheid
 - x d598 Zelfverzorging, anders gespecificeerd

Geselecteerde codes/rubrieken

Zich wassen

Note

- Wassen en afdrogen van het gehele lichaam, of lichaamsdelen, met gebruik van water en geschikte was- en droogmaterialen of methoden, zoals baden, douchen, wassen van handen en voeten, gezicht en haar, en met een handdoek drogen.

Inclusion

- wassen van lichaamsdelen; wassen van gehele lichaam; zich afdrogen

Exclusion

- verzorgen van lichaamsdelen ([d520](#)); zorgdragen voor toiletgang ([d530](#))

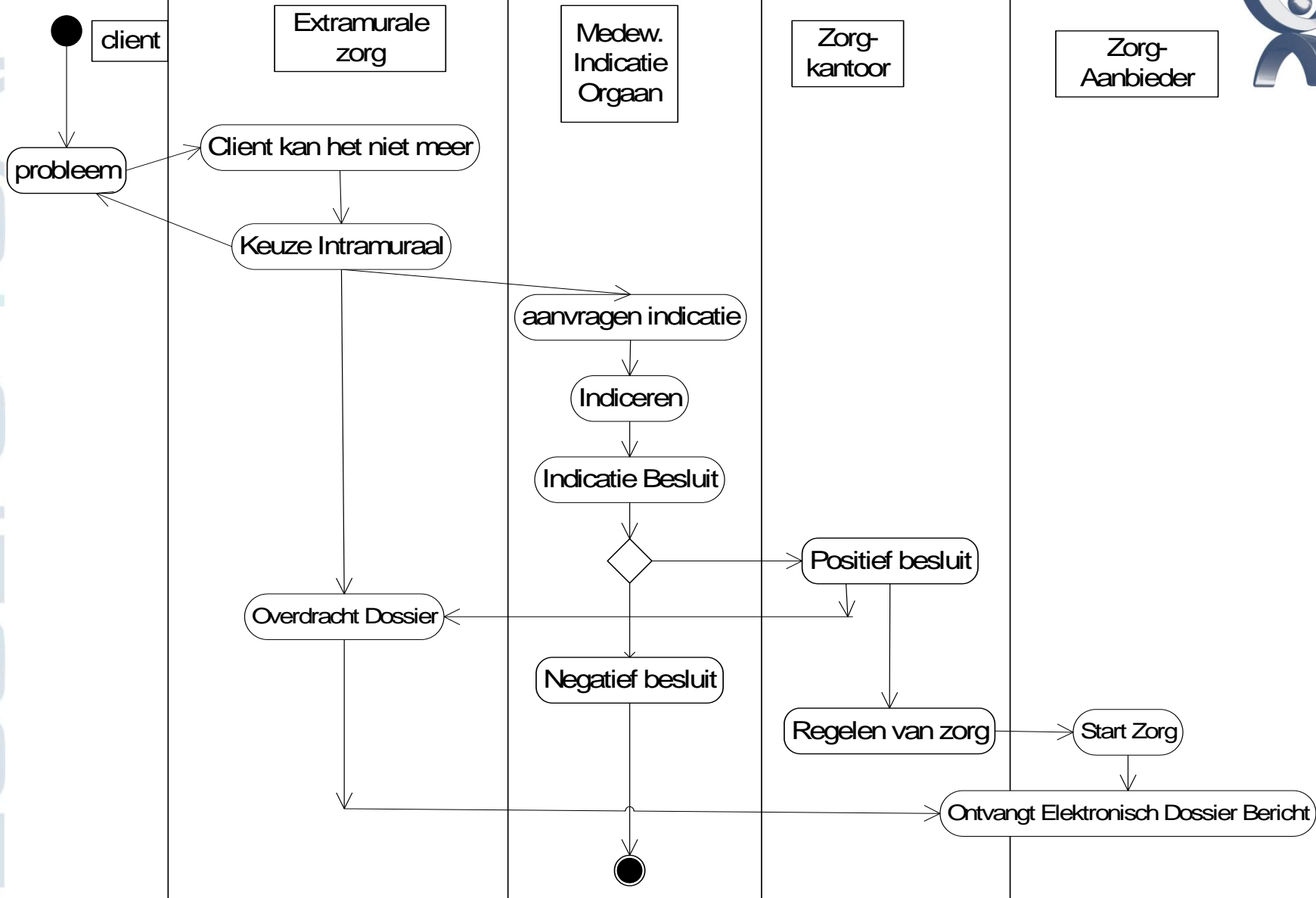
Modifier: Uitvoering en vermogen

- xxx.0 GEEN
beperking/participatieprobleem (geen, afwezig, verwaarloosbaar) 0-4%
- xxx.1 LICHTE
beperking/participatieprobleem (gering, laag) 5-24%
- xxx.2 MATIGE
beperking/participatieprobleem (tamelijk) 25-49%
- xxx.3 ERNSTIGE
beperking/participatieprobleem (hoog, sterk, aanzienlijk) 50-95%
- xxx.4 VOLLEDIGE



Information modeling

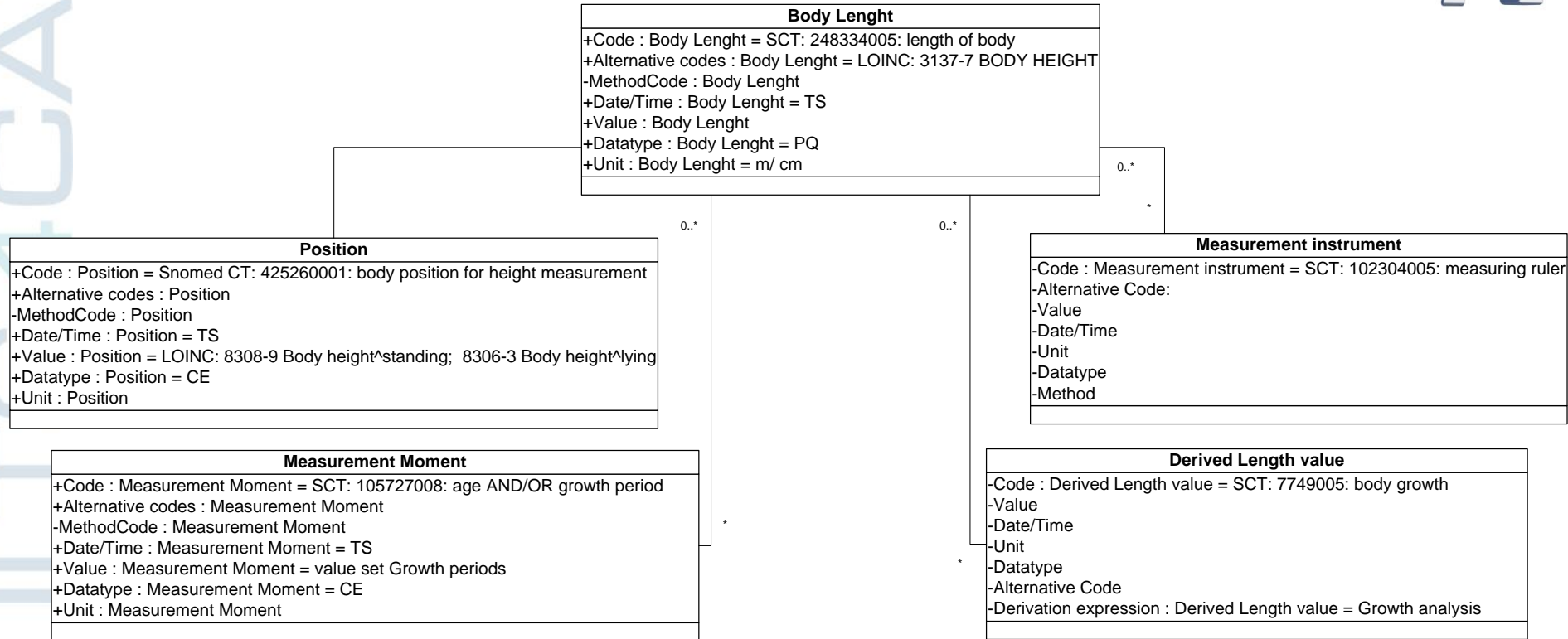
- Dynamic aspects: information management
 - Methods such as the Health Level 7 Development Framework
 - UML model examples activity diagram, interaction diagram, sequence diagram and so on
 - Tools:
 - Enterprise Architect
 - Poseidon
 - MS Visio
 - Etc.





Information modeling

- Structural aspects of data
 - UML
 - Method: Object Orientation / Static Modeling
 - Domain Analysis Model
 - Detailed Clinical Model
 - Tools:
 - Enterprise Architect
 - Open Health Tools SMD (static model designer)
 - IBM Eclipse UML





Verification by care professionals

- Methods:
 - Consensus methods / Delphi method
- Tools:
 - Web based questionnaires
 - Voting systems
- Collaborative work methods
- Tools:
 - OpenEHR Clinical Knowledge Manager
 - Wiki
 - Groove / Sharepoint / Google office
 - Results 4 Care DCM development site 2010



Formalisms

- Necessary, but unavailable?
- Holy Grail?
- Need to have a formalism that allows capturing clinical knowledge and supports different technological developments.



OWL (web ontology language)

- Ontology to structure knowledge
- To combine requirements on concept representations from different techniques to enforce consistency and prevent inconsistencies and errors
- Tools:
 - Protégé
 - Semantic Web

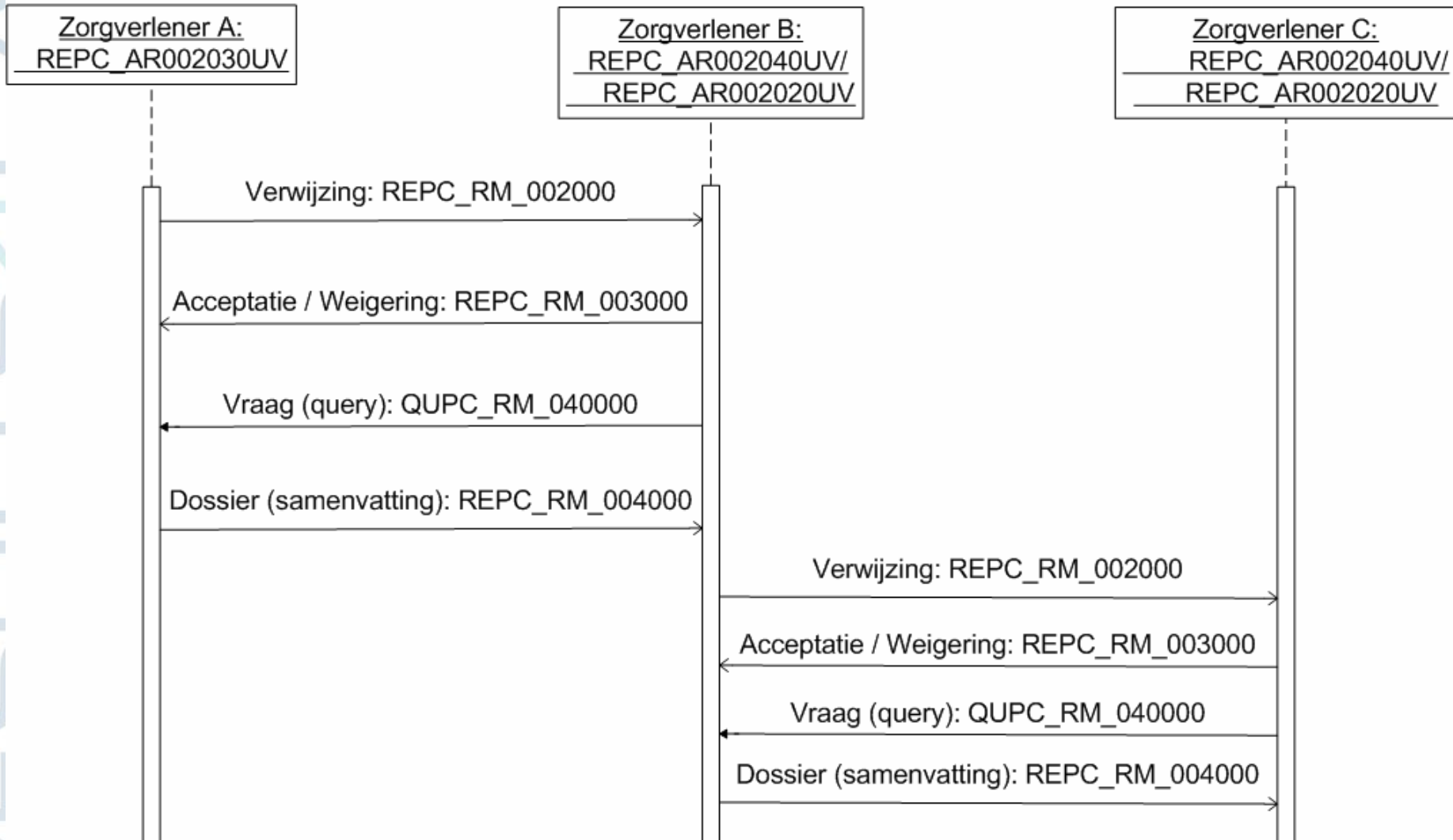
HL7 interoperability paradigm



- HL7 v2
- HL7 v3 & CDA & services
 - Method: constraining models from reference model via domain model to message model:
 - Tools RIM – D-MIM – R-MIM modeling:
 - Visio R-MIM designer
 - XML exports and editors
 - MIF editor & OCL (object constraint language)
 - XMI
 - XSLT
 - (RIM – DIM – CIM – LIM if message independent)



Zorgketen



HL7 application RIMBAA



- HL7 v3 en CDA inspiration source
 - Purpose: to develop a Context Information Model for Service Oriented Architecture SOA (all of health care context included)
 - Tools: RIM – DIM – CIM – LIM if message independent
 - Visio R-MIM designer
 - XML weergave
 - MIF editor & OCL (object constraint language)
 - XMI
 - XSLT



OpenEHR/ ISO/CEN 13606

- Develop clinical content against a reference information model, using archetypes
- Tools:
 - Archetype editor for small items
 - ADL output (Archetype Definition Language)
 - XML output
- Develop forms using archetypes
 - Template editor for complete forms
 - Archetype workbench



Technical validation

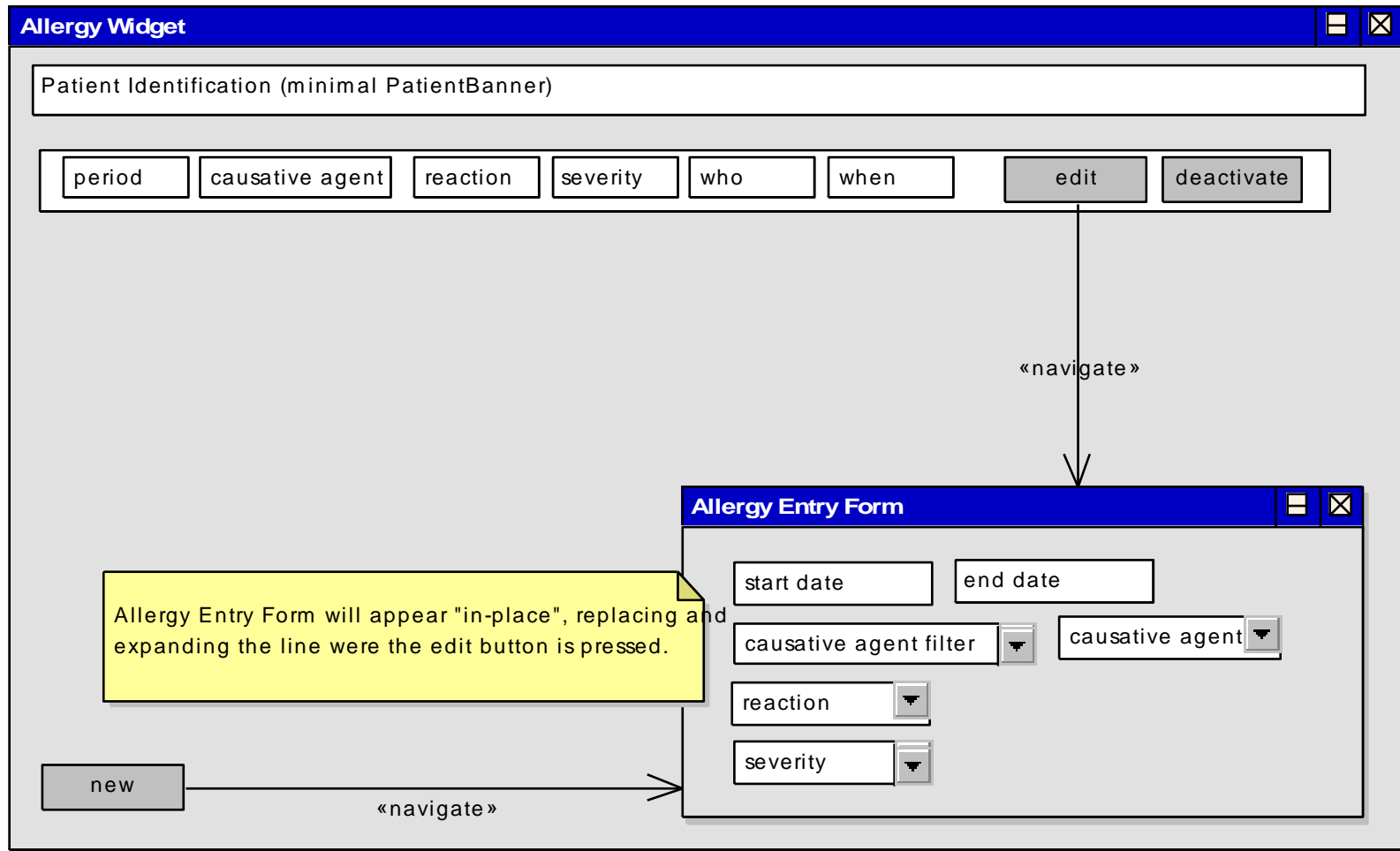
- Purpose: to check if the models work properly in the information technology
- Tools:
 - Validation of XML exchange between systems
 - Schematron
 - Transformations between standards
 - NHS tool XSLT for archetype to HL7 v3 formats vice versa.



User interface

- To develop example screens for the user in which the clinical data are presented and can be used
 - Tools:
 - Archetype editor
 - Template editor
 - MS Infopath
 - MS Excel
 - Rapid Prototyping software
 - Etc.

User Interface DCM based



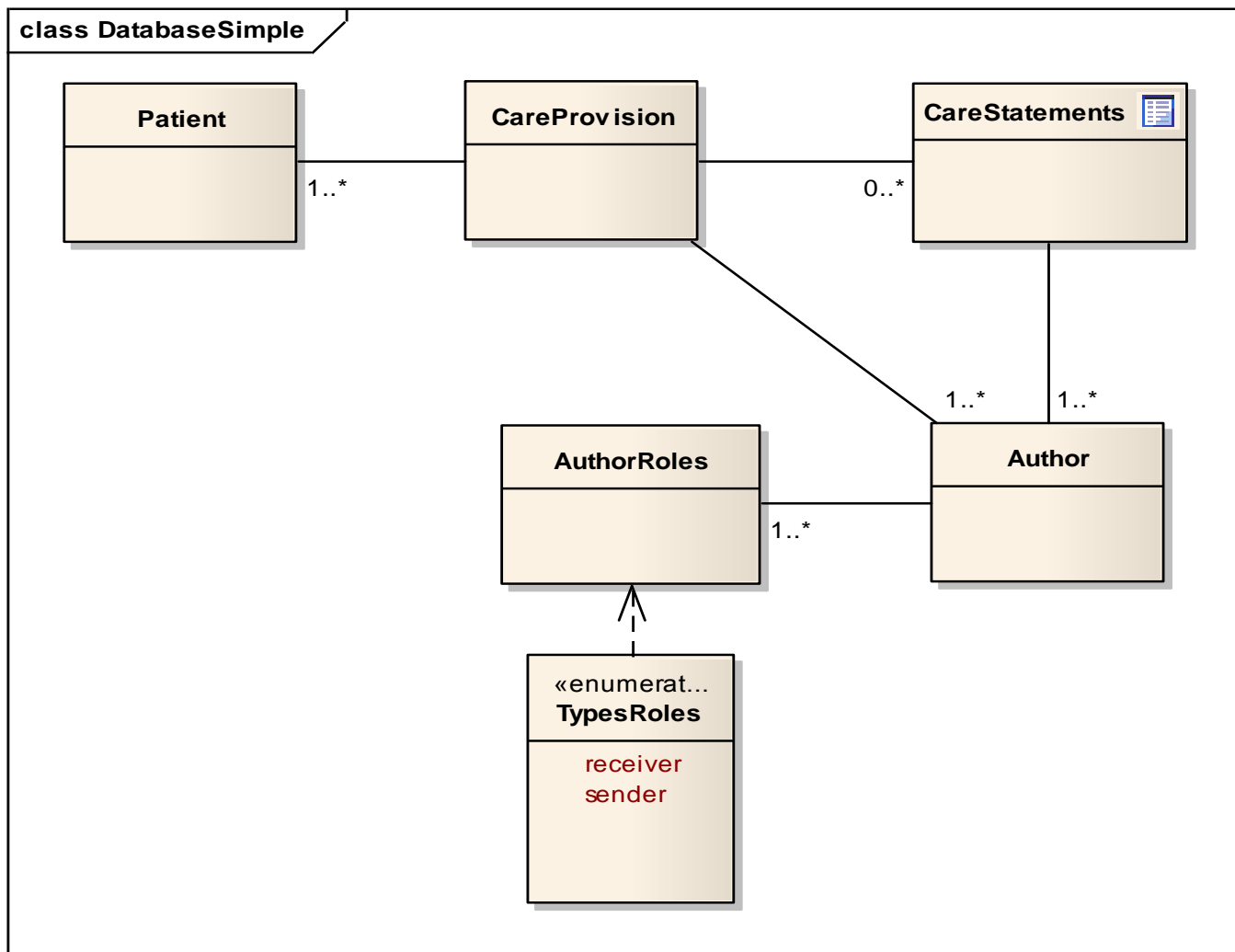


Database Design

- To develop a database that can hold the required clinical data elements, their coding, metadata and others
- Tools:
 - Enterprise Architect
 - HL7 RIMBAA
 - SQL ER (entity relationship)
 - Many others



HL7 RIM based DB





Publication tools

- Purpose: to document the standard and examples
 - Tools:
 - Assigning Artifact id and numbering
 - Assigning index terms
 - Storing in repository
 - Allowing to combine text, tables, graphs etc.
 - Example: HL7 publishing tool
 - OpenEHR repository



Repository / Library

- Purpose: to store, retrieve, manage, maintain and distribute DCM
 - Storing tools, eg database, webforms
 - Indexing to find
 - Apply Version management
 - Use and reuse supporting technology
 - Search engine




Accessing archetypes

14 Archetype(s) found

You can now [narrow](#) or [broaden](#) your search result or start a new [search](#) .

Search	Query
Search 1	Any term = 'blood'

Blood glucose

Archetype ID	openEHR-EHR-OBSERVATION.laboratory-glucose.v1
Description	The concentration of glucose in the blood
EHR class	Observation
Health Area	Patient recording
Purpose	Biochemical investigation
Language	German English
Data source	Pathology episode
Country	Australia
Links	
Parent Archetype	openEHR-EHR-OBSERVATION.laboratory.v1
HTML	openEHR-EHR-OBSERVATION.laboratory-glucose.v1.html
ADL	openEHR-EHR-OBSERVATION.laboratory-glucose.v1.adl
	openEHR-EHR-OBSERVATION.laboratory-glucose.v1.mm

Blood gas assessment

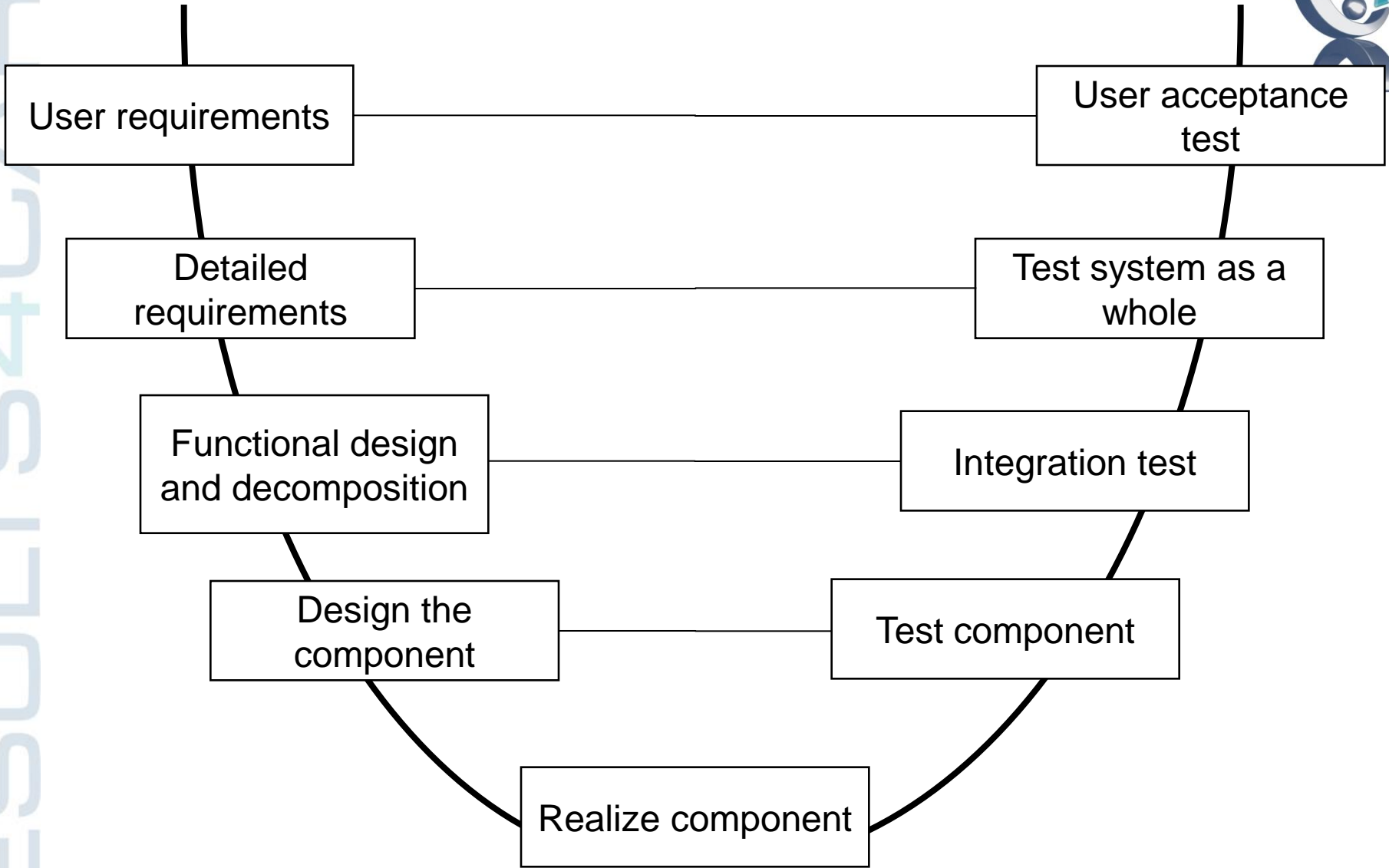
Archetype ID	openEHR-EHR-OBSERVATION.blood_gases.v1
Description	The assessment of blood gas concentrations and acid-base balance in blood

Repositories of repositories: where to find what is out there
Garde S, Workshop on Care Information Models post Medinfo 2007, Brisbane



Test tools

- To test the models and their functioning in systems
- To test the exchange of information: is it really semantic interoperable?
 - Tools:
 - Schematron to some extend
 - To be developed
- ISO standard on test design



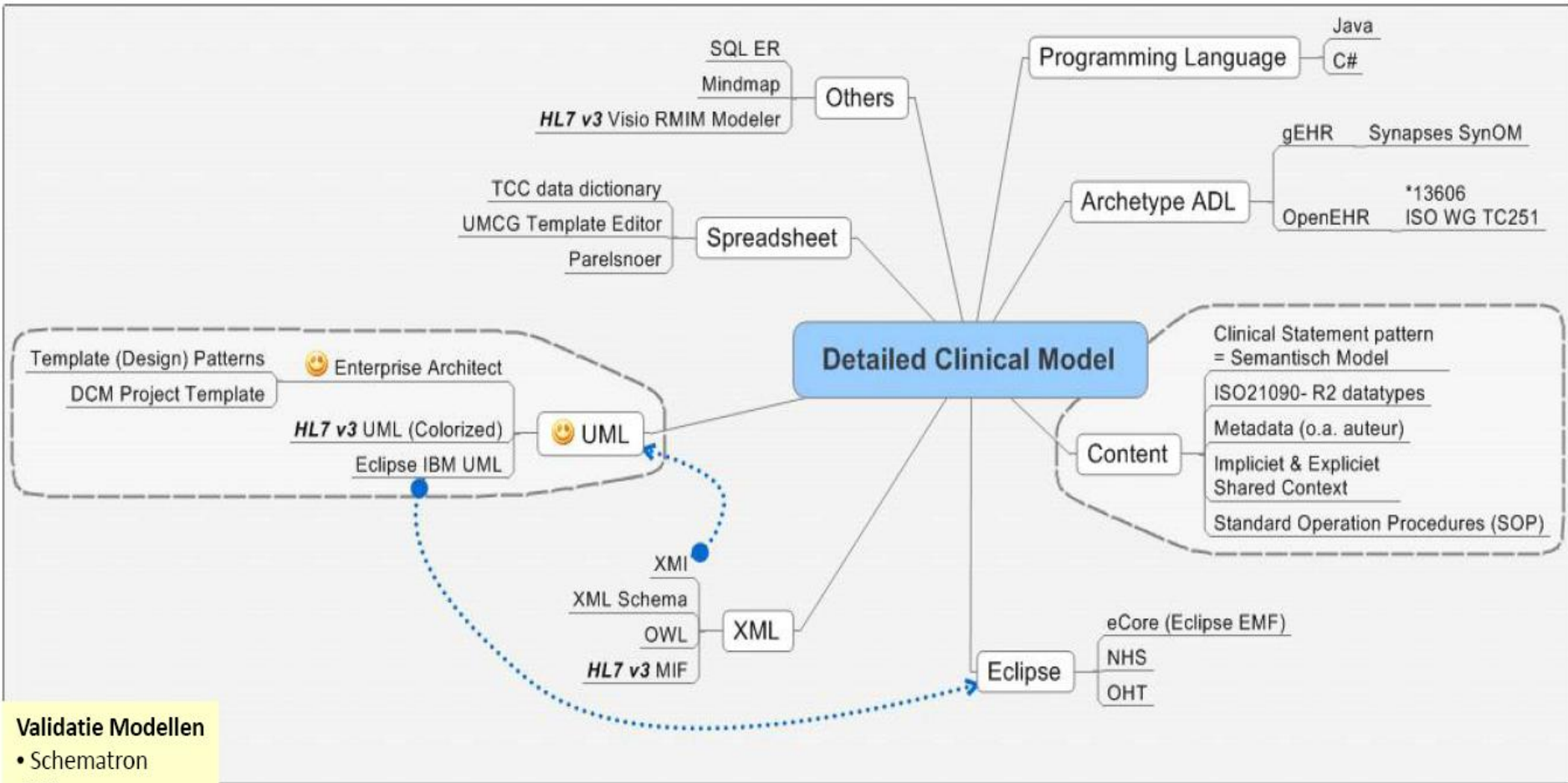


Soon...

- Traceable to Functional Models (EHR-S FM)
- UML Profile (MDG Technology)
 - Templates, Patterns, Stereotypes, Datatypes
- Validation of the Models
 - professional, EA using Conformance Statements, and in a running system Schematron
- Manuals / How-to's
- Repository with rtf, xmi, hl7 xml, archetype, etc.
- Wireframes



Modelling and transforms



- Validatie Modellen**
- Schematron
 - OCL
 - Prog. Language



Conclusions

- Capturing and Organizing clinical content
- Business modeling
- Information modeling
- Terminology modeling
- Transformations
- Storage and retrieval
- Maintenance
- Testing
- All require tools that can work together



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