

Use of GELLO v.1.x, GLIF 3.5, SNOMED-CT and EN 13606 archetypes



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Japanese introduction



皆様、おはようございます・こんにちは。ピータースコットと申します。本日は、この会議で話す機会をいただきありがとうございます。京都はとてもいい都市ですね。私の子供達は、オーストラリアで一年生から日本語を勉強しておりまして、私も彼らを励まそうと、日本語の勉強を始めました。今日はこの場をお借りして皆様の失礼にならないように、せめて挨拶だけでも日本語でさせていただきたいと思えます。

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ありがとう。

Good morning. My name is Peter Scott. I am very pleased to be speaking to you at this conference. Kyoto is well worth visiting.



Japanese introduction

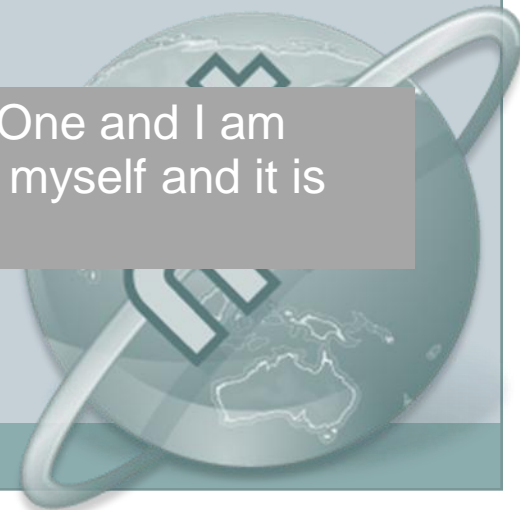


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ありがとう。

My children learn Japanese at school in Australia from Year One and I am trying to encourage them by learning some Japanese words myself and it is great to be able to say "Hello" to you.



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ありがとう。

I work with a small and innovative health information technology company known as “Medical Objects”.



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ありがとう。

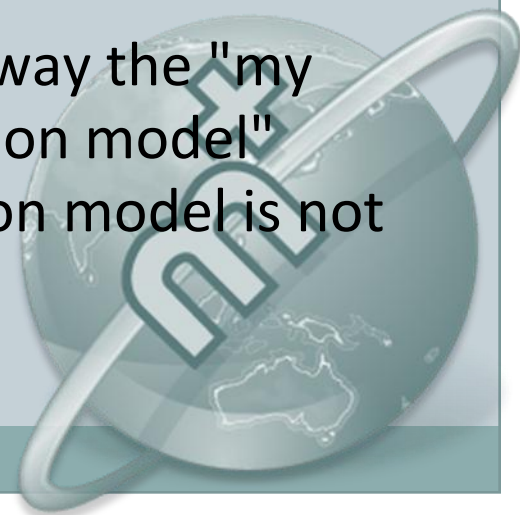
Today I will be telling you about how we have combined existing standards in a harmonious way to produce real software used every day by real doctors and staff. We have produced some software tools to enable this software development.



Some main points



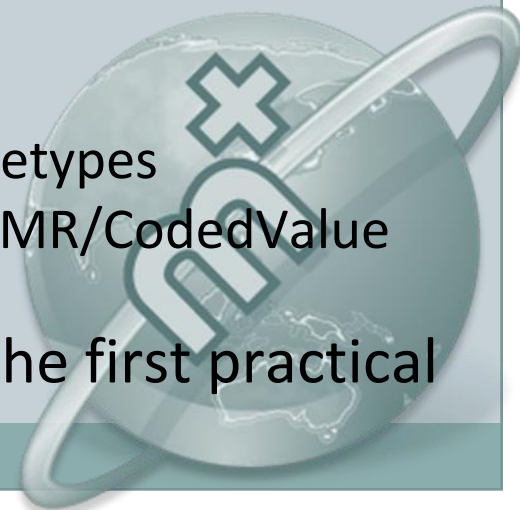
1. Standards integration achieves real implementations even in v.2 environments like Australia
2. A GELLO v.1.x parser/interpreter/engine can be used to:
 - a) enable decision criteria in GLIF
 - b) 'script' queries and processing on retrieved EHR data as well as SNOMED-CT knowledge and LOINC information space.
3. GELLO 1.1 is coming up for ballot – please take an interest
4. A virtual medical record (vMR) helps abstract away the "my information model is better than your information model" problem as well as the "my *reference* information model is not fully RIM compliant" problem.



Medical-Objects' HL7 GELLO v.1.0 projects



- Projects – 1. CDS for lymphoma 2. Setup of a small pathology laboratory
- GLIF was used for the former. Both used EN 13606 archetypes converted into a form accessible from the vMR.
- Decision was made to use GELLO encoded logic.
- GELLO v. 1 features
 - HL7/ANSI standard
 - OCL derived, but extended for health informatics functionality
 - Rich querying facilities.
 - Strongly typed, Object oriented, Declarative
 - vMR - Integrates well with HL7 and EN 13606 archetypes
 - Support for SNOMED-CT, LOINC, ICD-10 through vMR/CodedValue and more-so with CTS
- Implemented what we believe to be some of the first practical implementations of GELLO v.1 worldwide.



Rector's Model of models

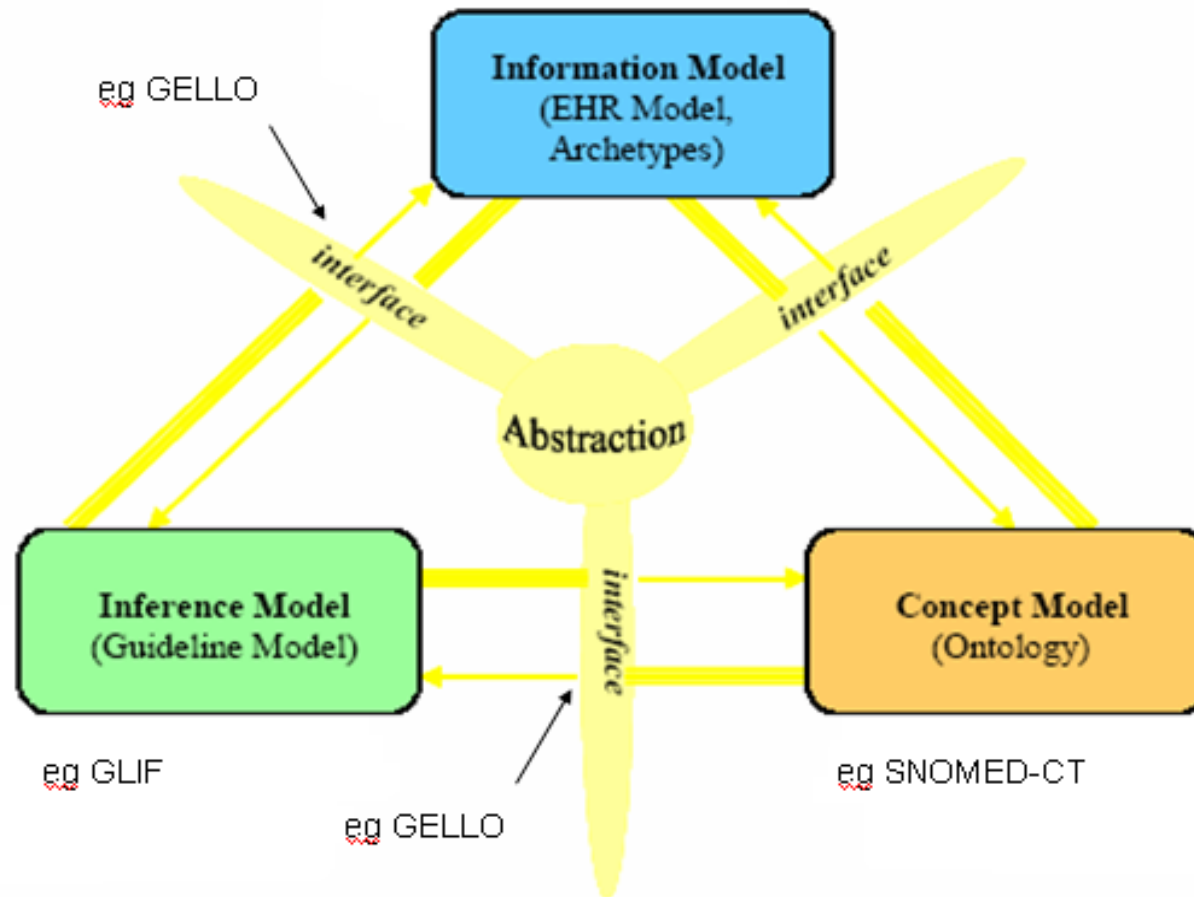


Diagram modified from Alan Rector's "Model of models" found at:

Rector A, Taweel A, Rogers J, (2004) Models and Inference methods for Clinical Systems: A Principled Approach, Proceedings of [MedInfo 2004](#)

Working with GELLO



- We completed the adaption of GLIF to the GELLO language
- We used EN 13606 archetypes as data structures within the GLIF and as the basis for templates. The templates are GELLO enabled.
- Peter Tattam and Andrew McIntyre improved GELLO spec's BNF, and built some tools (all available to informatics colleagues for playing and comments):
 - GELLO authoring tool and parser/interpreter
 - GLIF authoring tool and editor
 - SNOMED-CT server and
 - CEN 13606 Template editor



ISO/CEN13606 Part 2



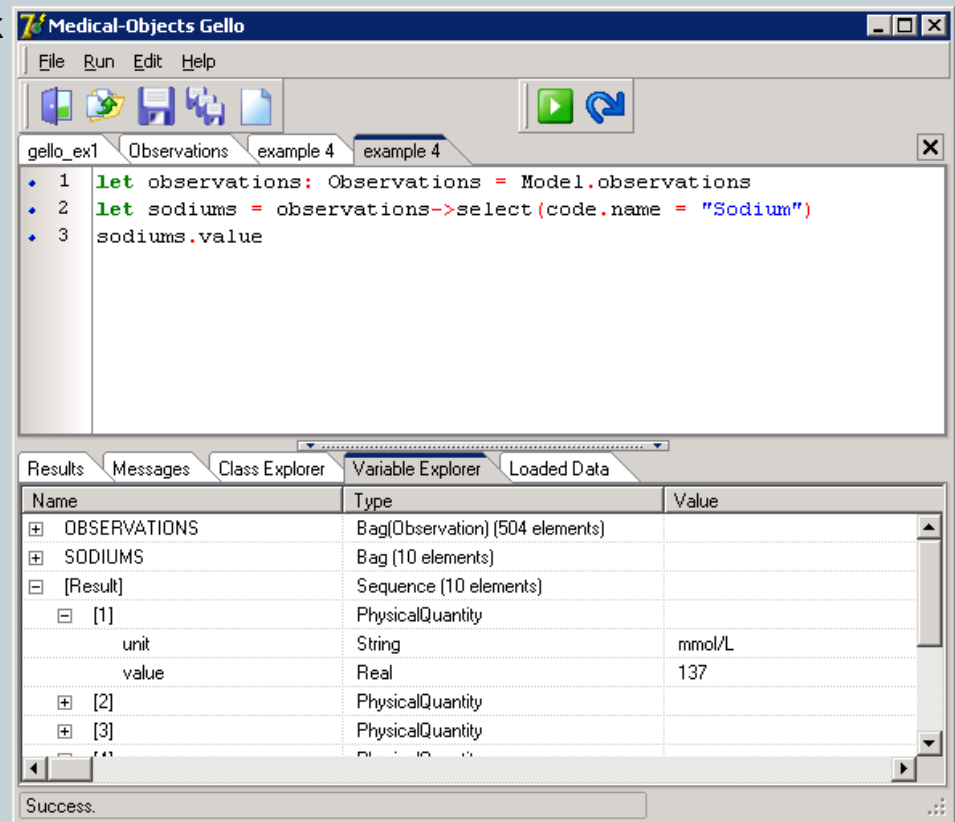
- About complex information to be communicated
- Extract -> Folder -> Composition ->(Section) -> Entry ->(Cluster) -> Element

Table 1 — Main hierarchy components of the EHR Extract Reference Model

EHR HIERARCHY COMPONENT	DESCRIPTION	EXAMPLES
EHR_EXTRACT	The top-level container of part or all of the EHR of a single subject of care, for communication between an EHR Provider system and an EHR Recipient.	(Not applicable)
FOLDER	The high level organisation within an EHR, dividing it into compartments relating to care provided for a single condition, by a clinical team or institution, or over a fixed time period such as an episode of care.	Diabetes care, Schizophrenia, Cholecystectomy, Paediatrics, St Mungo's Hospital, GP Folder, Episodes 2000-2001, Italy.
COMPOSITION	The set of information committed to one EHR by one agent, as a result of a single clinical encounter or record documentation session.	Progress note, Laboratory test result form, Radiology report, Referral letter, Clinic visit, Clinic letter, Discharge summary, Functional health assessment, Diabetes review.
SECTION	EHR data within a COMPOSITION that belongs under one clinical heading, usually reflecting the flow of information gathering during a clinical encounter, or structured for the benefit of future human readership.	Reason for encounter, Past history, Family history, Allergy information, Subjective symptoms, Objective findings, Analysis, Plan, Treatment, Diet, Posture, Abdominal examination, Retinal examination.
ENTRY	The information recorded in an EHR as a result of one clinical action, one observation, one clinical interpretation, or an intention. This is also known as a clinical statement.	A symptom, an observation, one test result, a prescribed drug, an allergy reaction, a diagnosis, a differential diagnosis, a differential white cell count, blood pressure measurement.
CLUSTER	The means of organising nested multi-part data structures such as time series, and to represent the columns of a table.	Audiogram results, electro-encephalogram interpretation, weighted differential diagnoses.
ELEMENT	The leaf node of the EHR hierarchy, containing a single data value.	Systolic blood pressure, heart rate, drug name, symptom, body weight.

Embedded GELLO v.1.x

- Embedded component within a GLIF and Archetypes framework.
- Developed using a LALR(1) parser framework in conjunction with a Delphi Object Pascal HL7 framework.
- It is interpretive in nature.
- Gello expressions are compiled at run time and stored as an internal object oriented expression tree.
- Execution speed is facilitated by the use of object oriented techniques.
- There is no “byte code” to execute, all calls are made natively to the HL7 framework.
- GELLO expressions can be implemented using an embedded IDE called “Mowgli”.
- Library facilities have been developed whereby frequently used GELLO expressions can be run indirectly from within another GELLO expression
- This library now has a syntax checker for whole library



The screenshot shows the 'Medical-Objects Gello' application window. The main editor displays three lines of GELLO code:

```
1 let observations: Observations = Model.observations
2 let sodiums = observations->select(code.name = "Sodium")
3 sodiums.value
```

Below the editor is a 'Variable Explorer' tab showing the results of the execution. The table below represents the data shown in the explorer:

Name	Type	Value
⊕ OBSERVATIONS	Bag(Observation) (504 elements)	
⊕ SODIUMS	Bag (10 elements)	
⊖ [Result]	Sequence (10 elements)	
⊖ [1]	PhysicalQuantity	
unit	String	mmol/L
value	Real	137
⊕ [2]	PhysicalQuantity	
⊕ [3]	PhysicalQuantity	
⊕ [4]	PhysicalQuantity	

The status bar at the bottom indicates 'Success.'

a GELLO v.1.x example



```
let a:integer = 1  
let b:integer = 2
```

```
a+b
```



a GELLO v.1.x example



```
let a:integer = 1    Let Statement  
let b:integer = 2    Let Statement
```

Outer Expression

(In)

```
a+b    Inner Expression
```



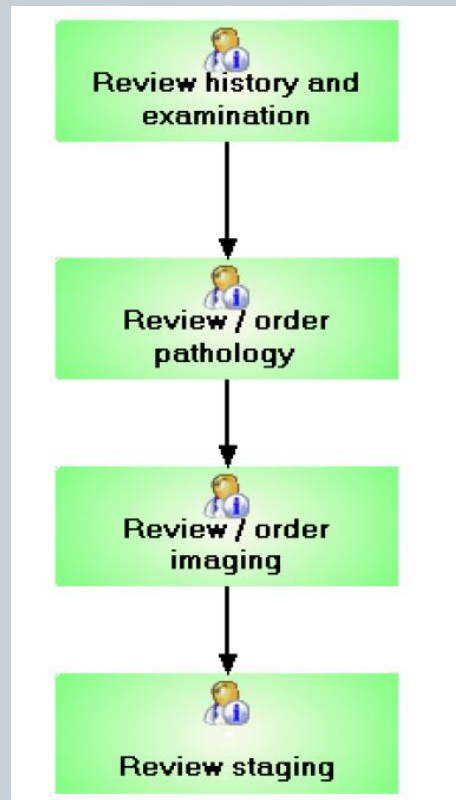
GLIF 3



➤ States



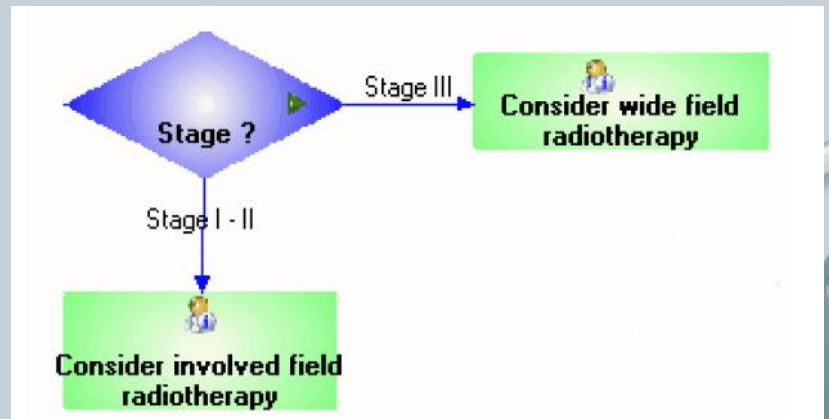
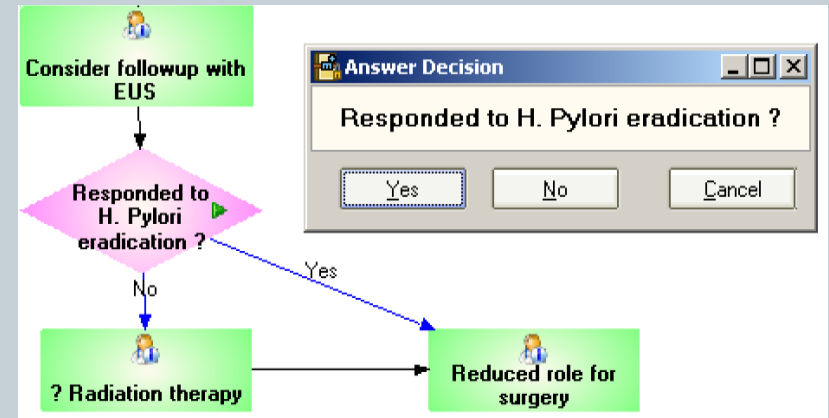
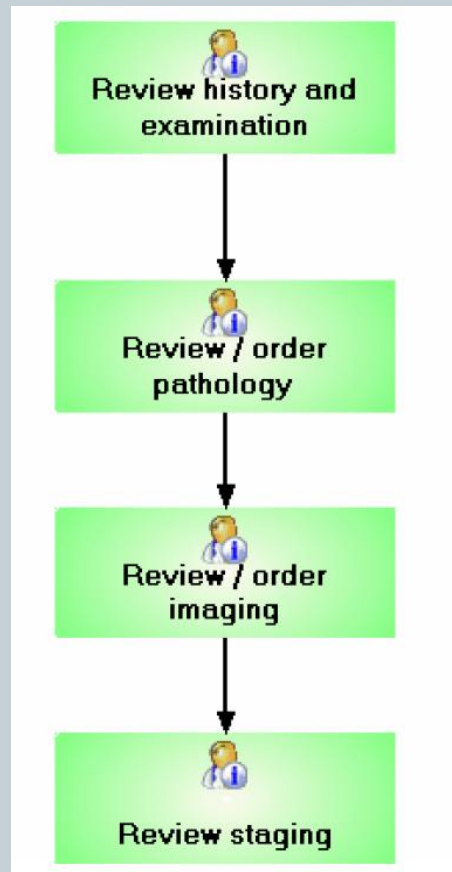
➤ Action steps



GLIF



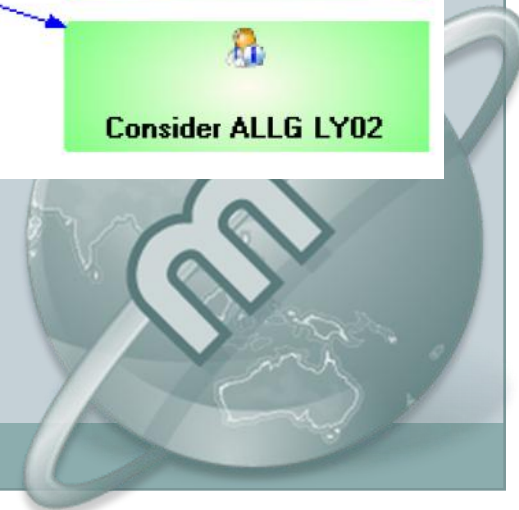
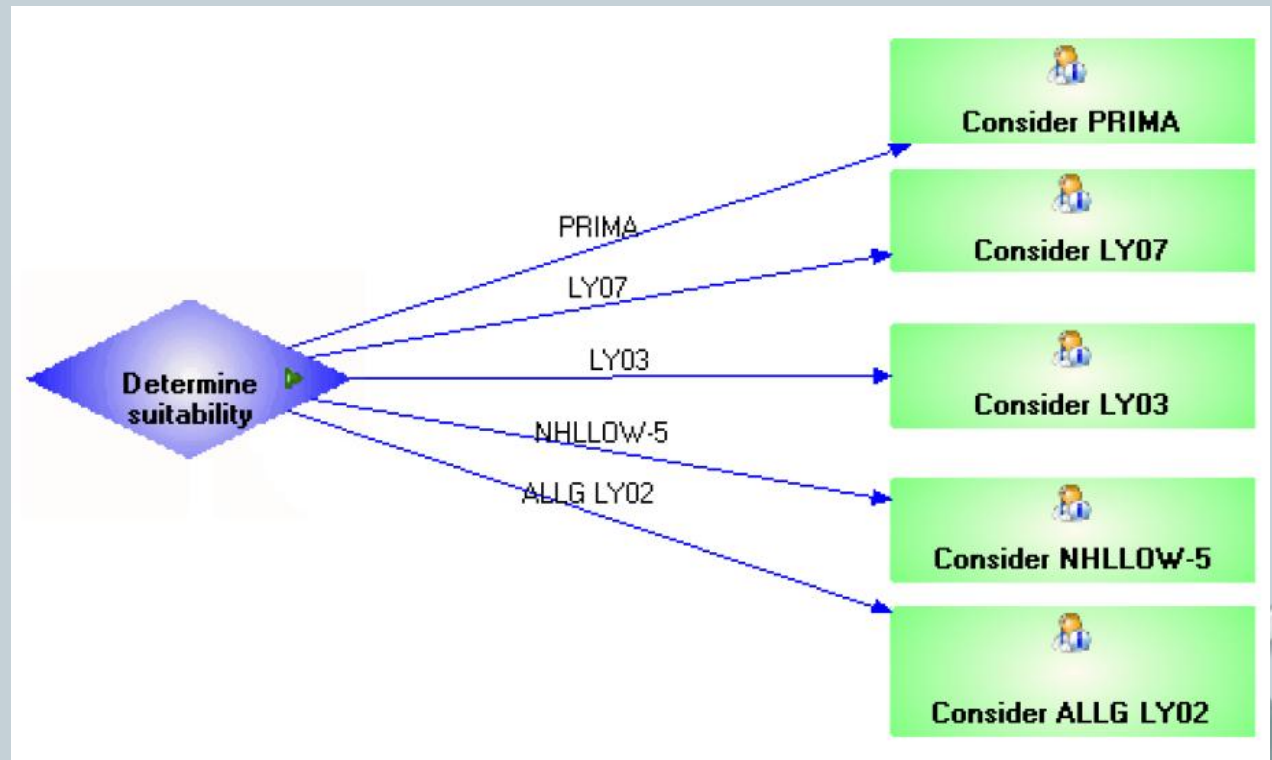
- States
- Action steps
- Decision steps
 - Conditional
 - User driven
 - automated



GLIF

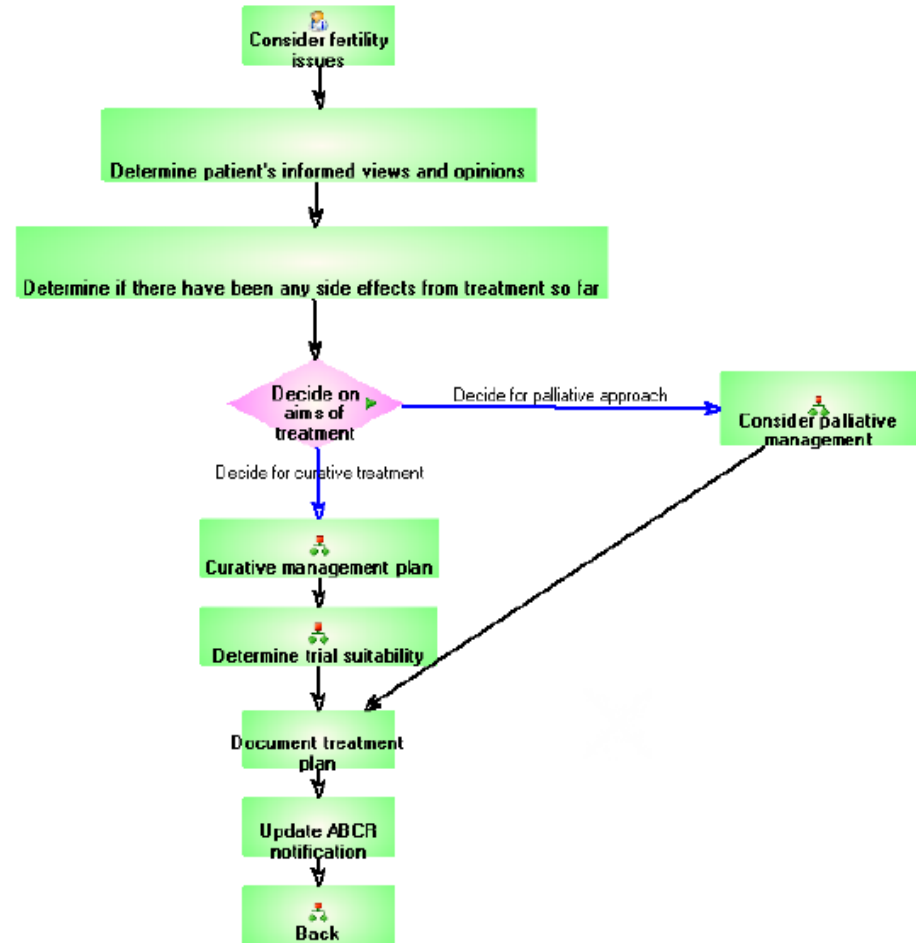


- States
- Action steps
- Decision steps
 - Conditional
 - User driven
 - automated
- Branched



Treatment planning

- Links
- Subguidelines
- Keywords
- Hints
- Sync nodes
- Didactics
 - Text
 - HTML



Fertility

Treatment with chemotherapy or pelvic irradiation may lead to infertility and, given the long life expectancy following successful treatment and young age at which many patients present, it is crucial to address reproductive issues before treatment planning commences, except in cases where emergency treatment is required. Where relevant, that is, when treatment carries a significant risk of affecting reproductive function, referral for harvesting and storage of sperm should be made and appropriate specialist consultations arranged to discuss preservation of fertility in female patients. Ovarian transposition may be considered if pelvic radiotherapy is planned, but results of this procedure are variable.

Rector's Model of models

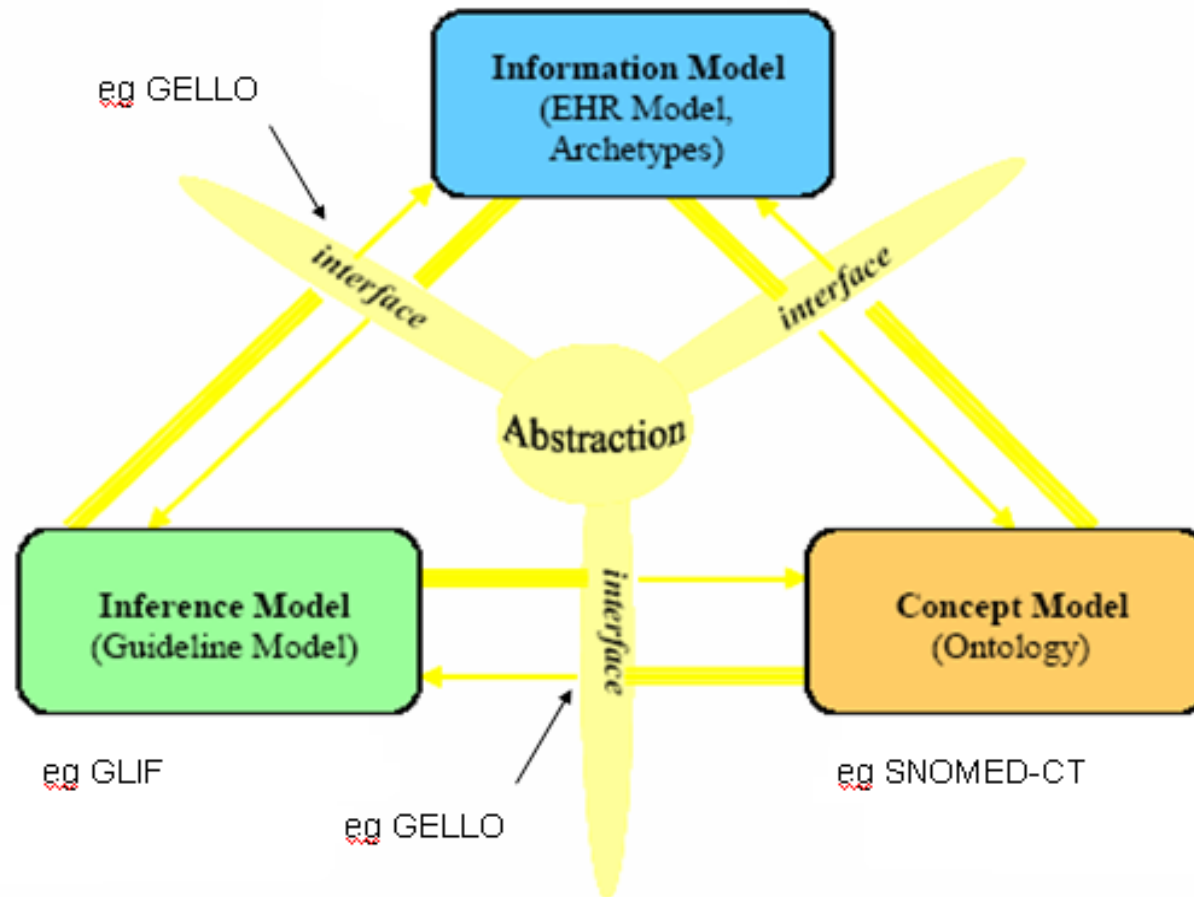


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Query on the Information Model



```
// most recent platelets observation as a physical  
quantity:
```

```
let plateletsCode: CodedValue =  
Factory.CodedValue('777-3', 'LN')  
let platelets_obs = observation->select(code =  
plateletsCode) ->sortBy(absolutetime) ->last()  
  
platelets_obs.value
```



Rector's Model of models

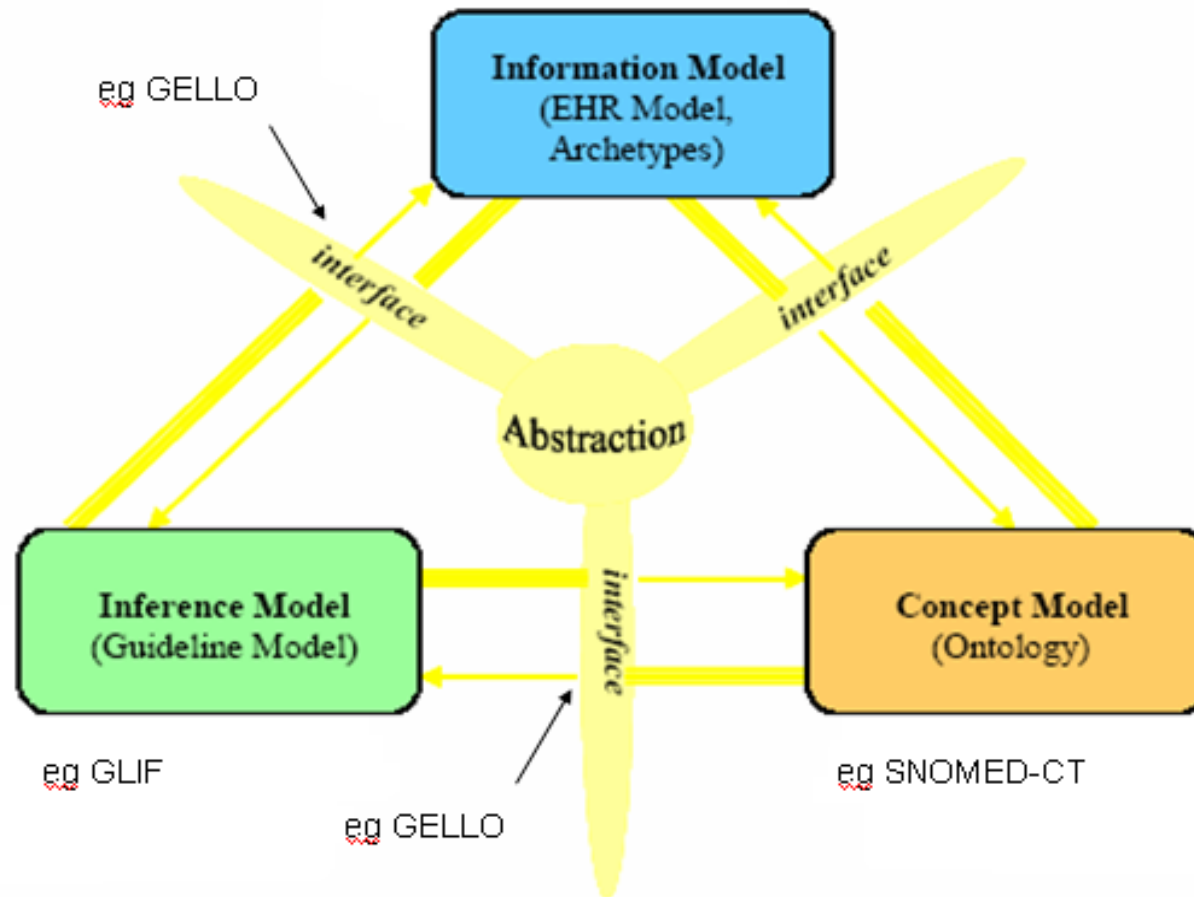


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Query on the Concept Model



```
Let o:observation = parameter[1]
Let OpenAbdominal:CodedValue = Factory.CodedValue('108189003','SNOMED-CT')
Let SnomedTerm:CodedValue =
  if o.isdefined() then
    o.find_observation('1.1.1').Value.asType(CodedValue)
  else
    Factory.CodedValue('64572001','SNOMED-CT')
  endif
Let CholeIsAbdoOperation: Boolean = SnomedTerm.implies(OpenAbdominal)

CholeIsAbdoOperation
```



Demonstration video



[GLIF Editor](#)

[Pathology archetype](#)



Demonstration videos



Live demo of gello leveraging SNOMED-CT knowledge

[SNOMEDValidate.html](#)



Show me your CDA ?



- Medical Objects is open to using CDA R2 as an alternative persistence format/document however CDA not in use in Australia
- By exposing v.2 data as a v.3 vMR any transition to CDA should not affect the logic involved in decision support.
- EN13606 extract archetype standard is not *openEHR*. We feel it should be considered and harmonized as a template candidate.

