



Solor

Solor Master Presentation

A Collection of Presentation-Ready Slides

Table of Contents

This master deck contains selected slides from the following presentations that have been reformatted for the Solor PPT template:

1. FHA Learning Series #1 (Jan 18, 2018)
2. FHA Learning Series #2 (May 17, 2018)
3. HSPC 17th General Meeting (July 31, 2018)
4. FDA SHIELD Presentation (Dec 11, 2018)
5. AMIA ANF Presentation (Nov 16, 2018)
6. HL7 ANF Presentation (Jan 15, 2019)
7. Grades, Scales, Stages, and Scores Findings and Issues (Jan 15, 2019)
8. MIDI & Use of Solor (Jan 24, 2019)

Semantic Interoperability

The Promise of Health IT



Improve the **quality** and **safety** of health-care



Measure the **cost** and **quality of services**



Integrate multiple providers across organizations in a continuum of care



Integrate high-quality decision support into the clinical workflow across the continuum of care

The Promise of Health IT Depends on Interoperability

The Promise of Health IT



Improve the **quality** and **safety** of health-care



Measure the **cost** and **quality of services**



Integrate multiple providers across organizations in a continuum of care



Integrate high-quality decision support into the clinical workflow across the continuum of care

Encoded data is the foundation needed to deliver The Promise!



Types of Interoperability

- **Foundational**

- Data exchange from one system to another

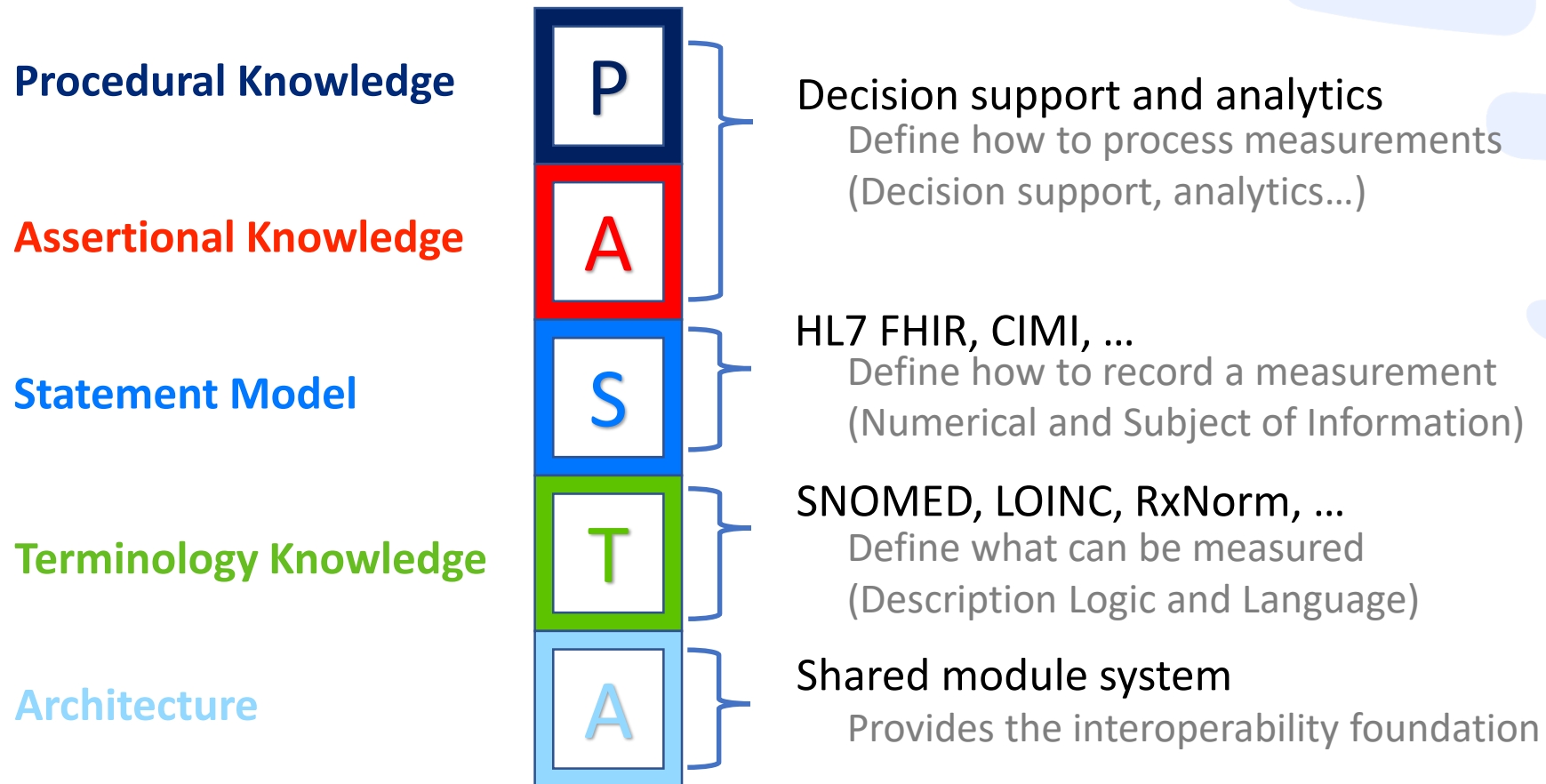
- **Structural**

- The syntax of the data exchange at the data format/field level

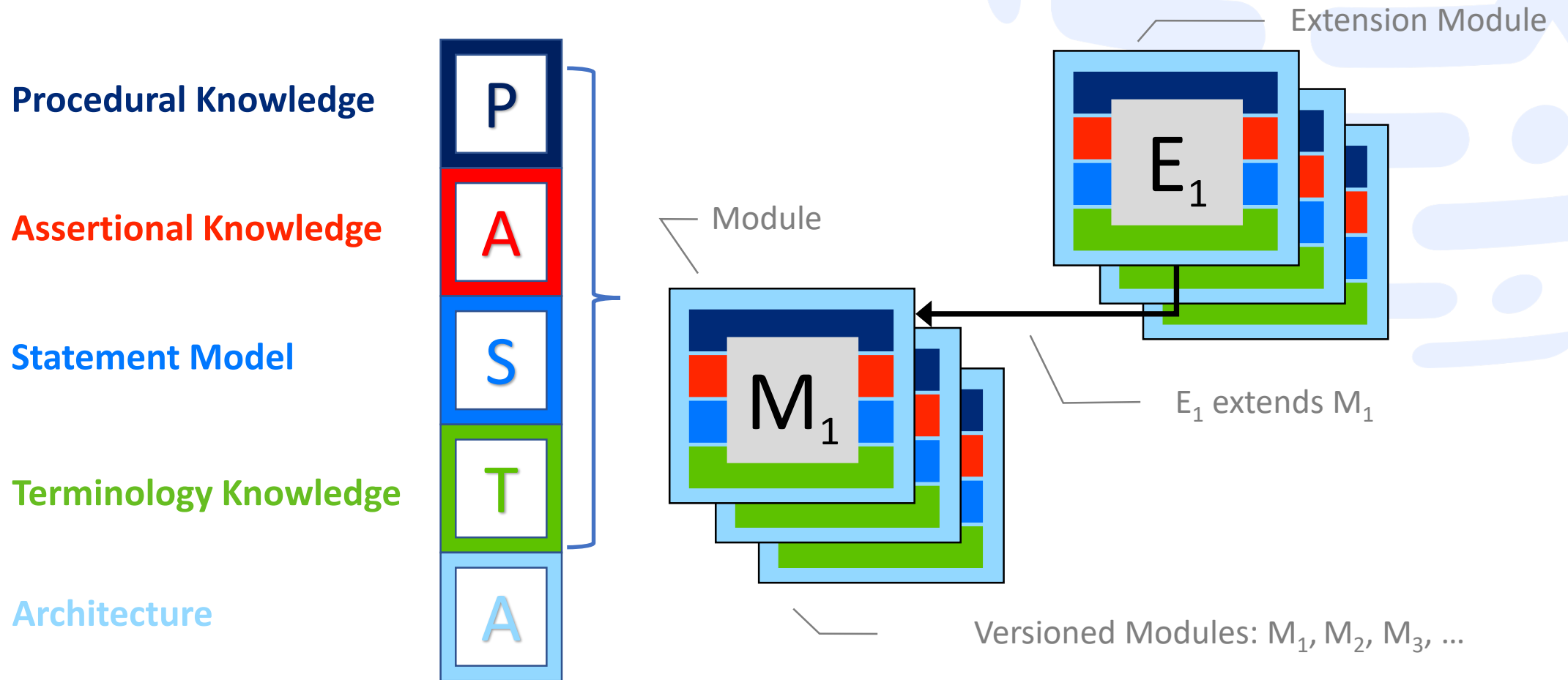
- **Semantic**

- The exchange of information in a way that the receiving system can **interpret the data**

Architectural Separation of Concerns



Semantic Interoperability Architecture



What is Separation of Concerns?

- An architectural design principle whereby a system is divided into distinct sections, such that each section addresses a separate concern
- When concerns are well-separated, individual sections can be reused, as well as developed and updated independently
- Each architectural layer addresses separate concerns
- Defining what is being measured is a separate concern from representation of the results of a measurement

What are the Implications of Separation of Concerns?



Statement layer: *Recording* measurement

- Quantitative measurement
- Existential measurement



Language and Definitional layers: Defining *what* is measured

- Dot-blot hemorrhage of the retina
- Type 1 diabetes



Measurement of absence needs to be removed from Solor sources to allow layers to address separate concerns

Where We Are Today



Today's Challenges

- Mapping is always **out of date**
- Internal curation of local terminology is **not scalable**
- Potential **information loss** at each transformation
- Unnecessary **complexity**
- Patient safety is **compromised**

Administrative Data Standards

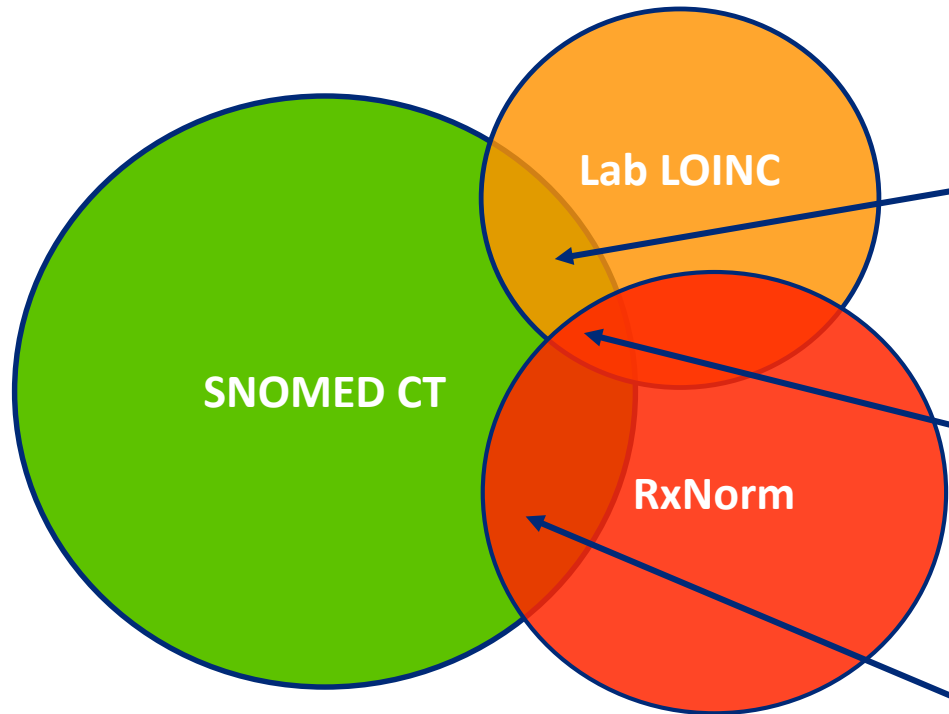
- Content is not driven by implementation needs
- Insufficient detail for a clinical care

Clinical Data Standards

- Lack coherence
- Submission process does not meet operational needs

Every System is Different!

Overlap in Content

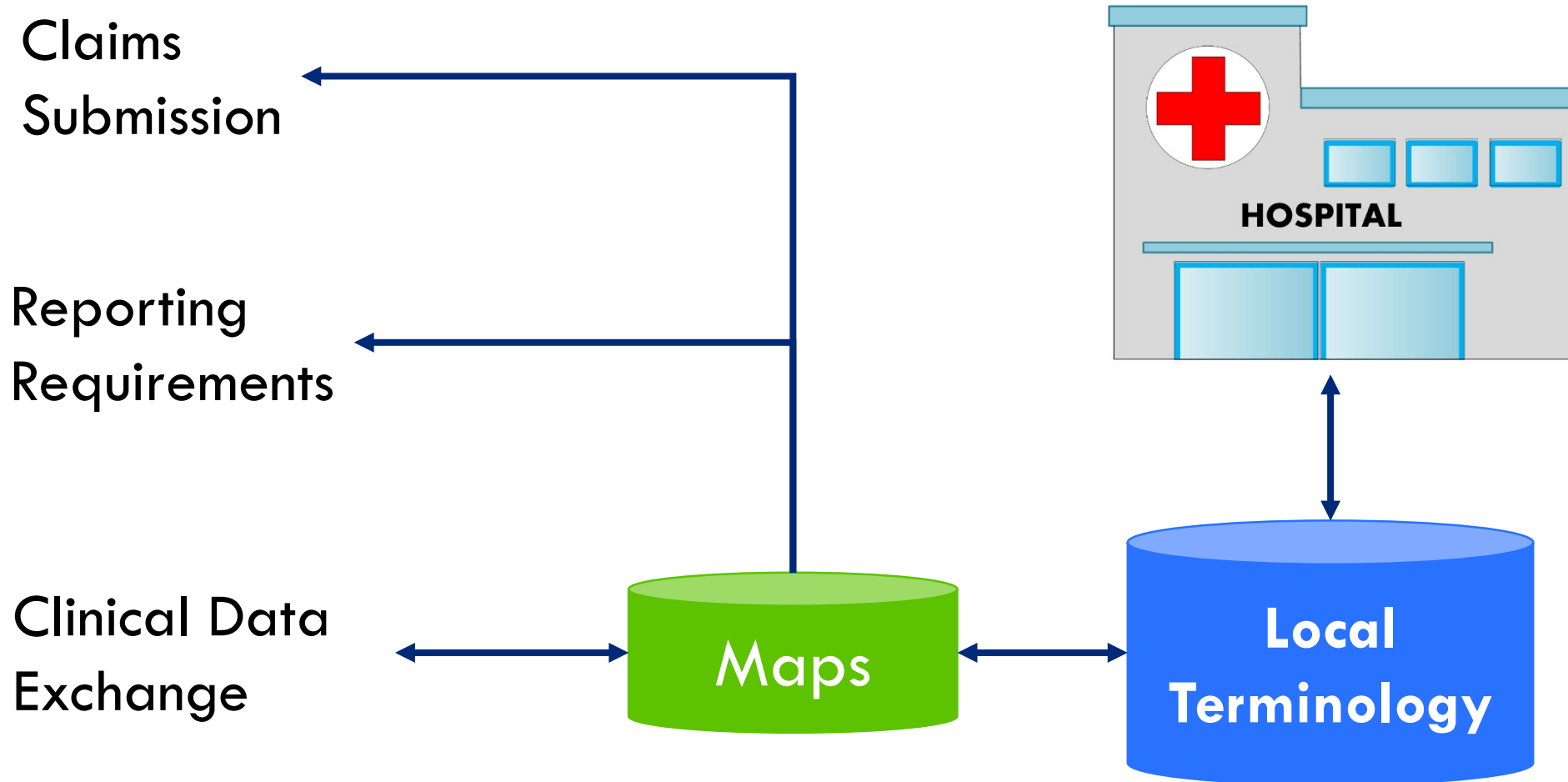


SNOMED CT	LOINC
LOINC: Gentamicin is a component of laboratory tests	
SNOMED: Gentamicin is a component of laboratory tests	

SNOMED CT	LOINC	RxNorm
LOINC: Gentamicin is a component		
SNOMED: Gentamicin is a substance		
RxNorm: Gentamicin is an ingredient		

SNOMED CT	RxNorm
SNOMED: Gentamicin is a PRODUCT	
SNOMED: Gentamicin 0.3% preservative-free eye drops	
RxNorm: Gentamicin sulfate 0.3% Ophthalmic Solution	
RxNorm: Gentamicin is a PRODUCT	

Mapping-based Implementation



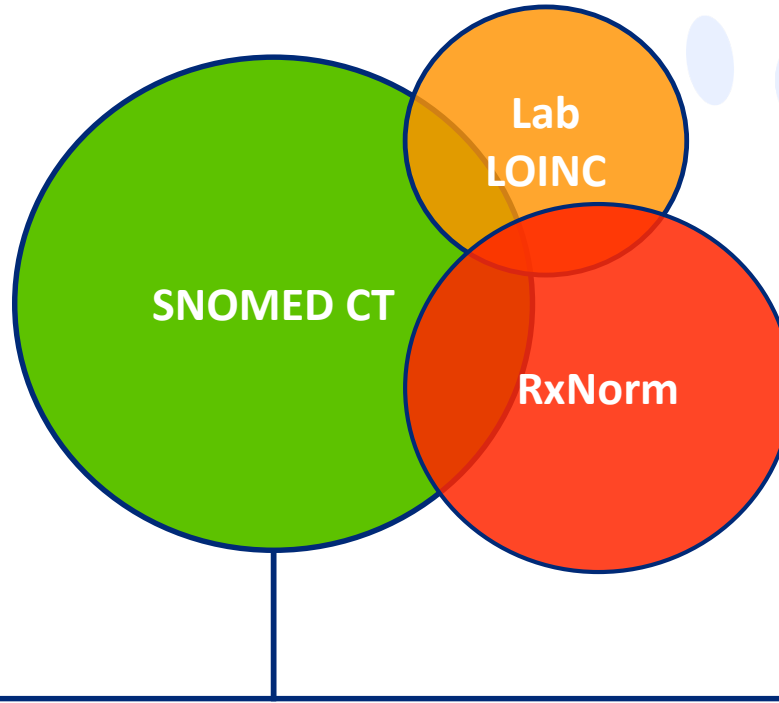
SNOMED Mapping Example

Organization A
Local **code**: 12345
Infiltrating ductal carcinoma of lower inner quadrant of breast

Provider A
SNOMED Code:
408643008
Infiltrating ductal carcinoma of breast



Lose location of the carcinoma



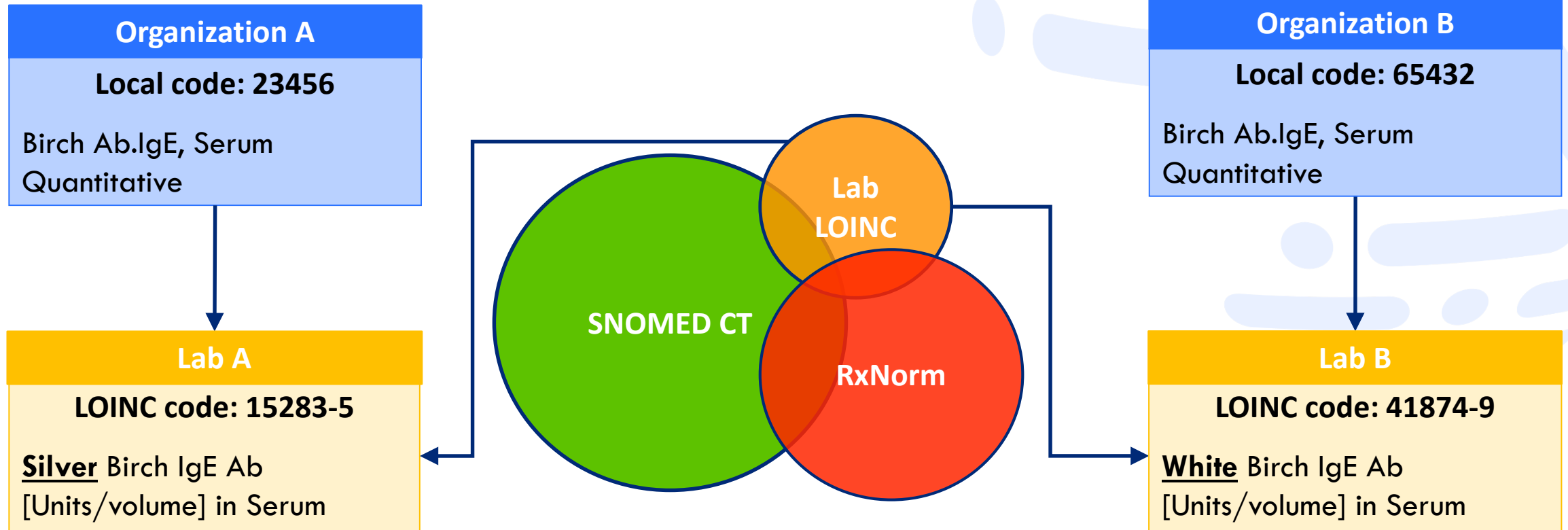
Organization B
Local **code**: 54321
Infiltrating ductal carcinoma of lower inner quadrant of breast

Provider B
SNOMED Code: 373080008
Malignant neoplasm of lower inner quadrant of breast



Lose morphology of the carcinoma

LOINC Mapping Example



 Mapping can add false information

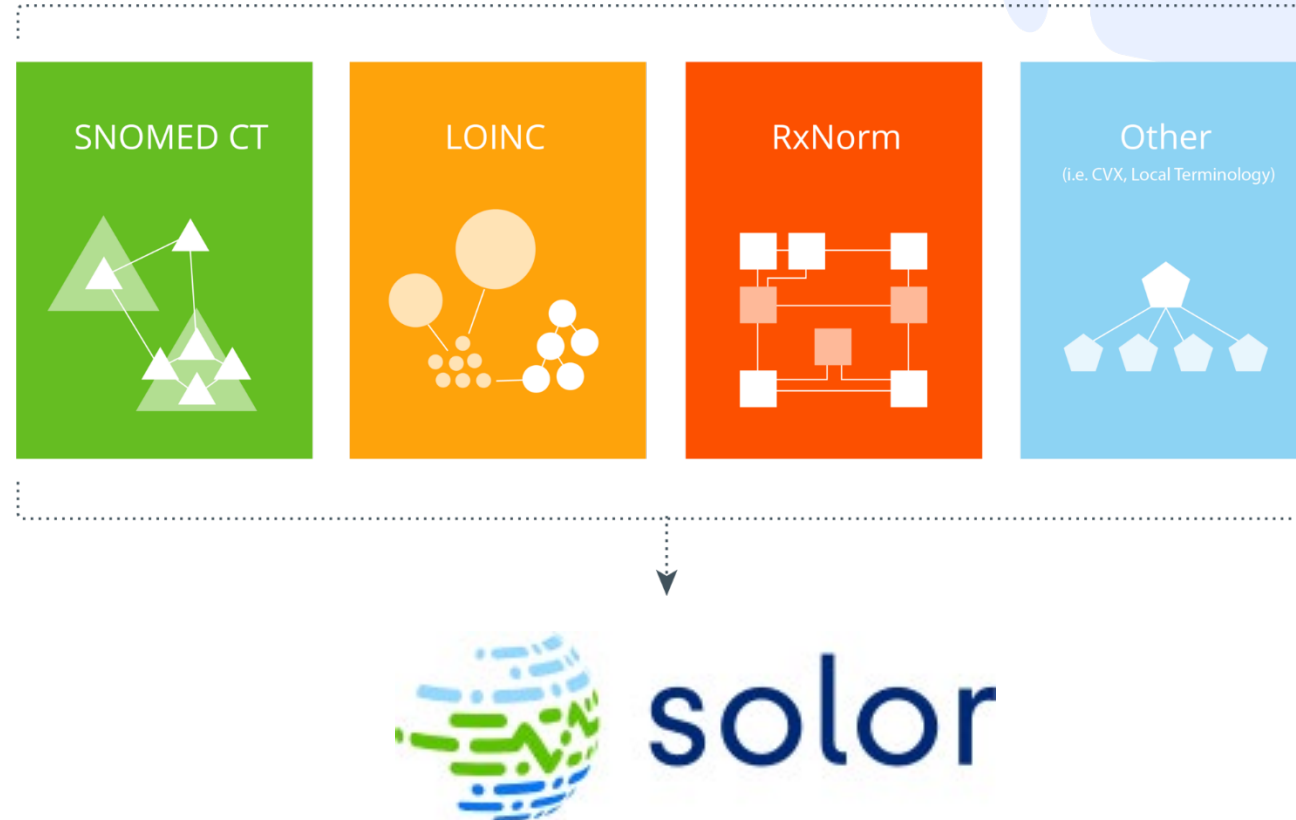


Enabling Semantic Interoperability

- ✓ **Standardize the Standards**
 - Standardize the encoded data model
 - Standardize the extension model
- ✓ **Meet Operational Needs**
 - Enable sharing of extensions
 - Open-extensions
 - Proprietary-extensions
- ✓ **Evolve Existing Systems**
 - SNOMED, LOINC, RxNorm and other terminologies

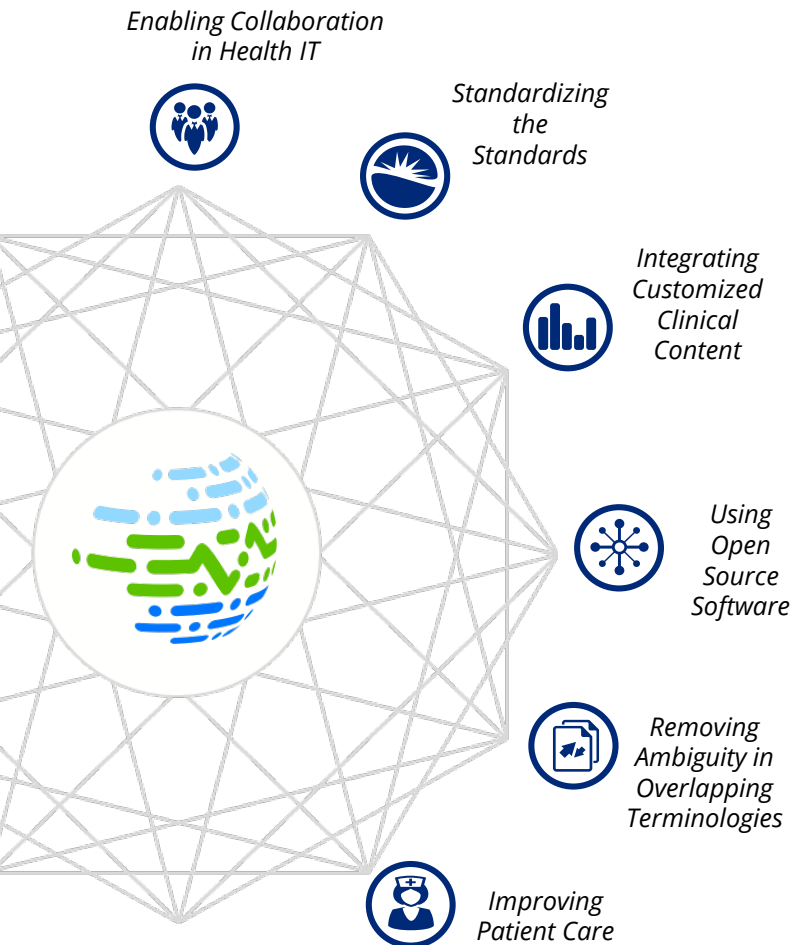
Introduction to Solor

What is Solor?



Integration of terminology in a common model

Solor at a Glance



Solor provides an open source ecosystem to assimilate disparate health standards into a consistent representation.

Solor awarded the FedHealthIT 2018 Innovation Award

June 2018

Dr. Keith Campbell selected for the OSEHRA Lifetime Achievement Award

July 2018

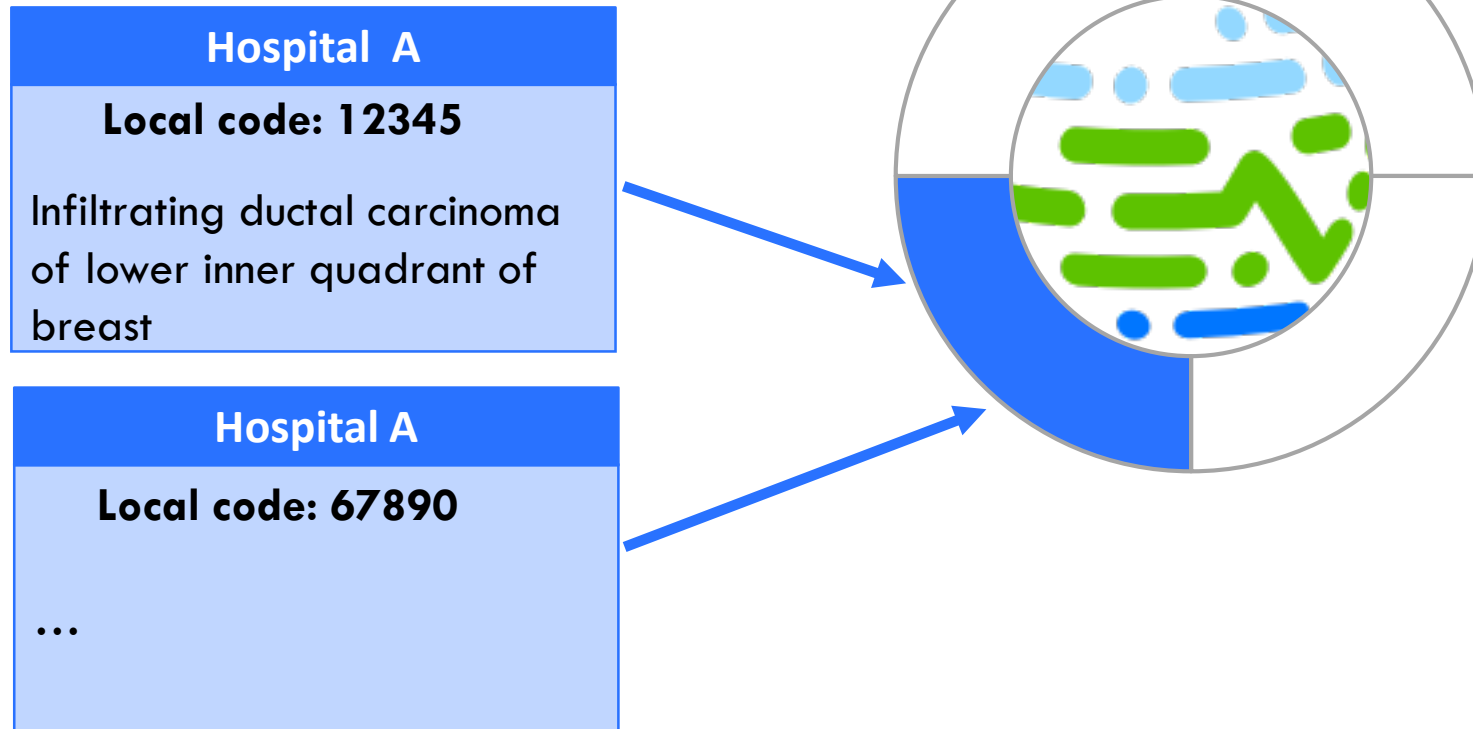
HSPC highlighted Solor as mission critical at the HSPC 17th General Meeting

July 2018

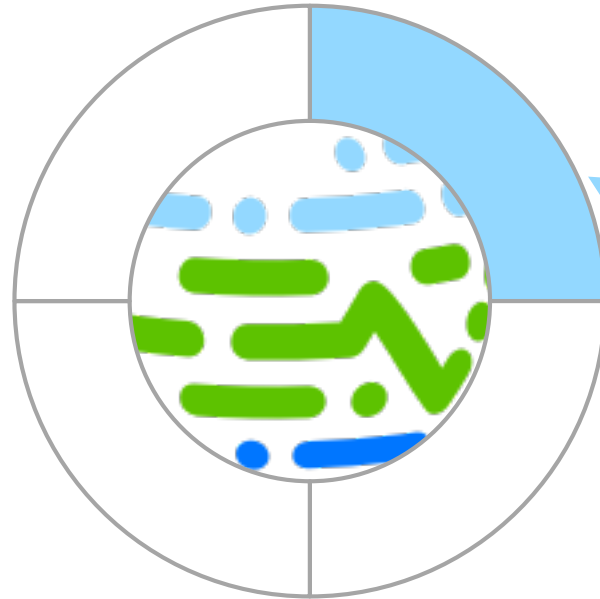
An Example of a Solor Extension

Hospital A Creates Solor Extension

Localization of clinical data representation is very common



Medical Practice Creates Solor Extension



Each localization of clinical data representation is different

Medical Practice

Local code: 54321

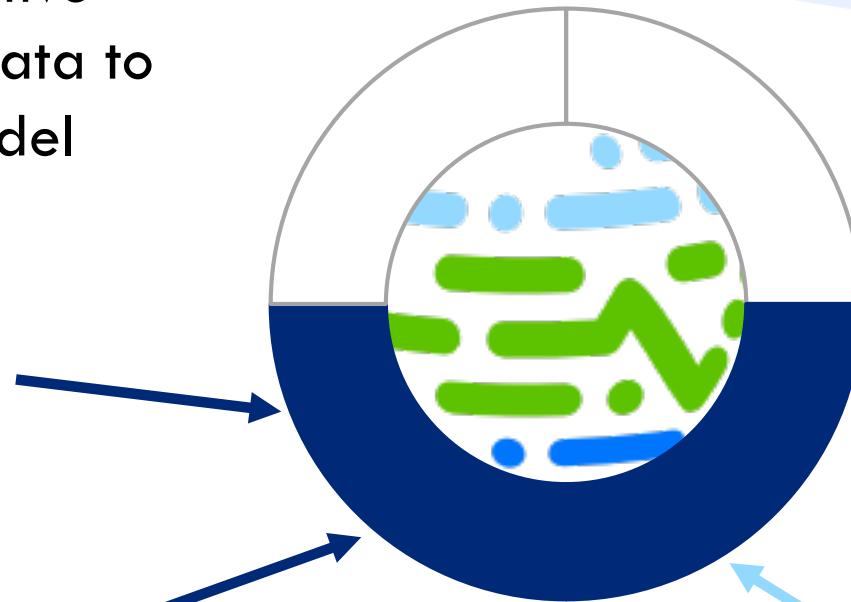
Infiltrating ductal carcinoma of lower inner quadrant of breast

Shared Solor Extension

Solor allows local and native representations of clinical data to co-exist in a common model

Hospital A
Local code: 12345
Infiltrating ductal carcinoma of lower inner quadrant of breast

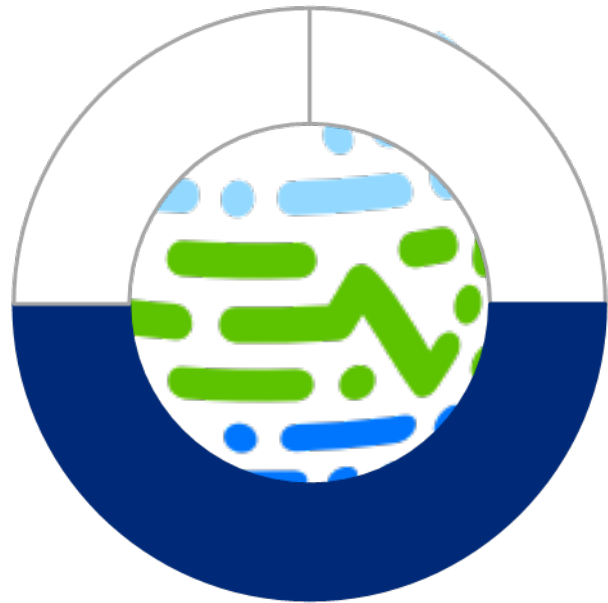
Hospital A
Local code: 67854
...



Searches for concept in shared Solor extension

Medical Practice
Infiltrating ductal carcinoma of lower inner quadrant of breast

Content Contributed to the Standard



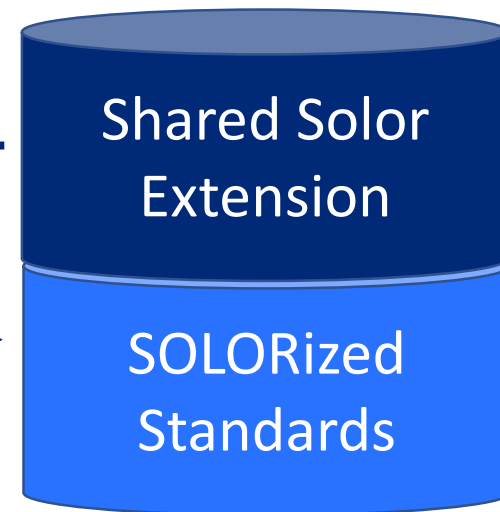
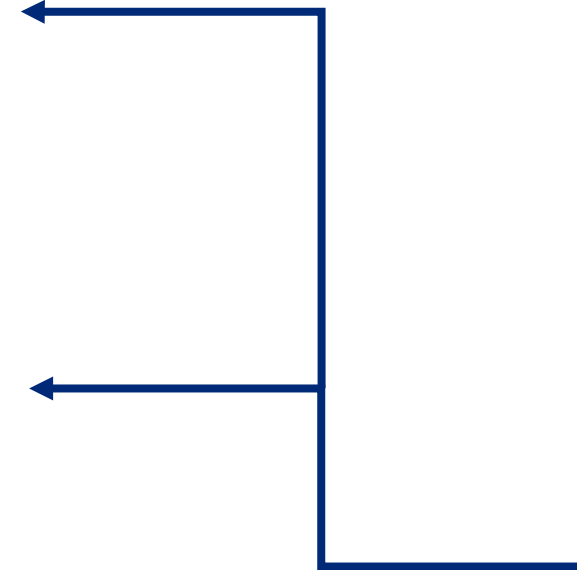
New concepts in extensions
can be contributed back

Solor Implementation

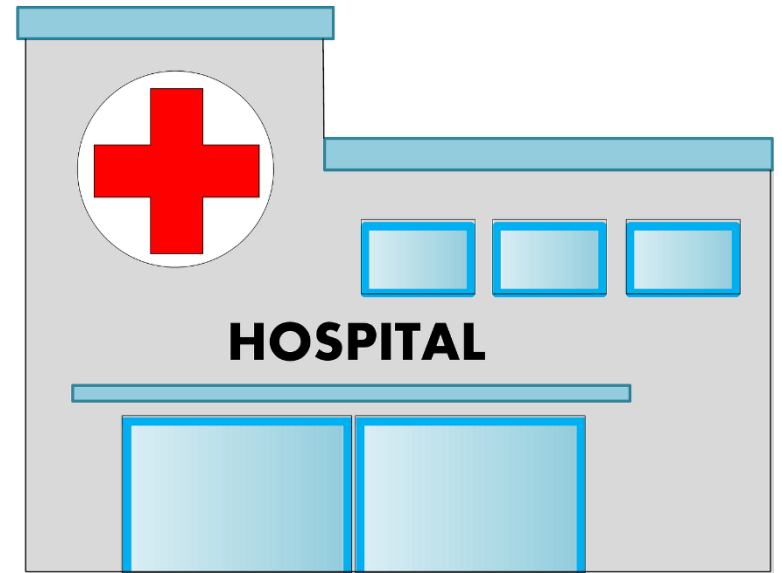
Claims
Submission

Reporting
Requirements

Clinical Data
Exchange

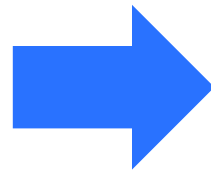


Local
Enhancement



Solor is a Way to Transition

“Interoperability of Today”



Interoperability of the Future

- Big bang switch won't work
- Need to support current systems while evolving to native interoperability

Simplifies Systems

By simplifying content management, Solor makes:

- Implementation easier for business owners and safer for patients
- Management of change easier for business owners and safer for patients

Solor Content Improvements

Need for Consistent Representation



Statement model separates concerns (FHIR, CIMI, etc.)

- Measurement supports existential and quantitative results
- Tractable computation, good separation of concerns



Negation in definitional layer causes confusion and delay

- Wrong semantics
- Intractable computation
- Poor separation of concerns

Current inconsistencies require us to identify — and provide solutions for — inconsistent content.

Content Selection and Review

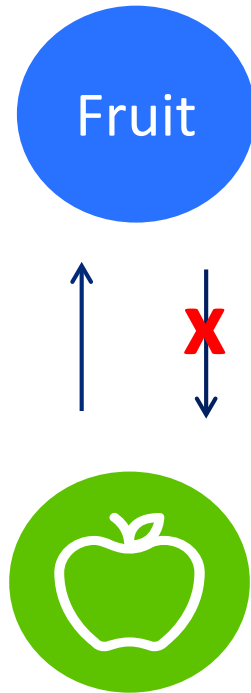
Selection

- Negation (no speech)
- Subject is not patient (father smokes)
- Compound observations (nausea and vomiting)
- 50,000 concepts selected

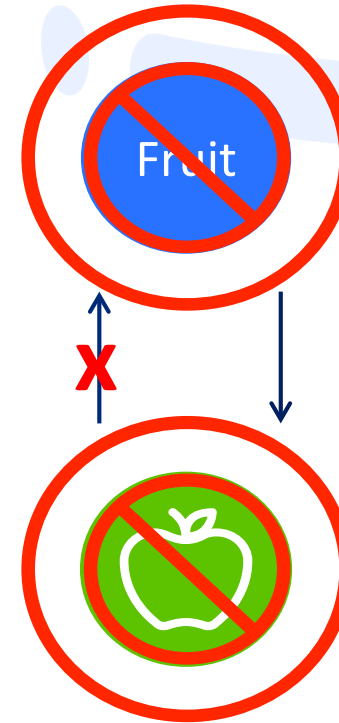
Review Process

- Two independent reviewers
- Disagreements were analyzed and resolved
- 10% sample for each topic reviewed twice

Negation



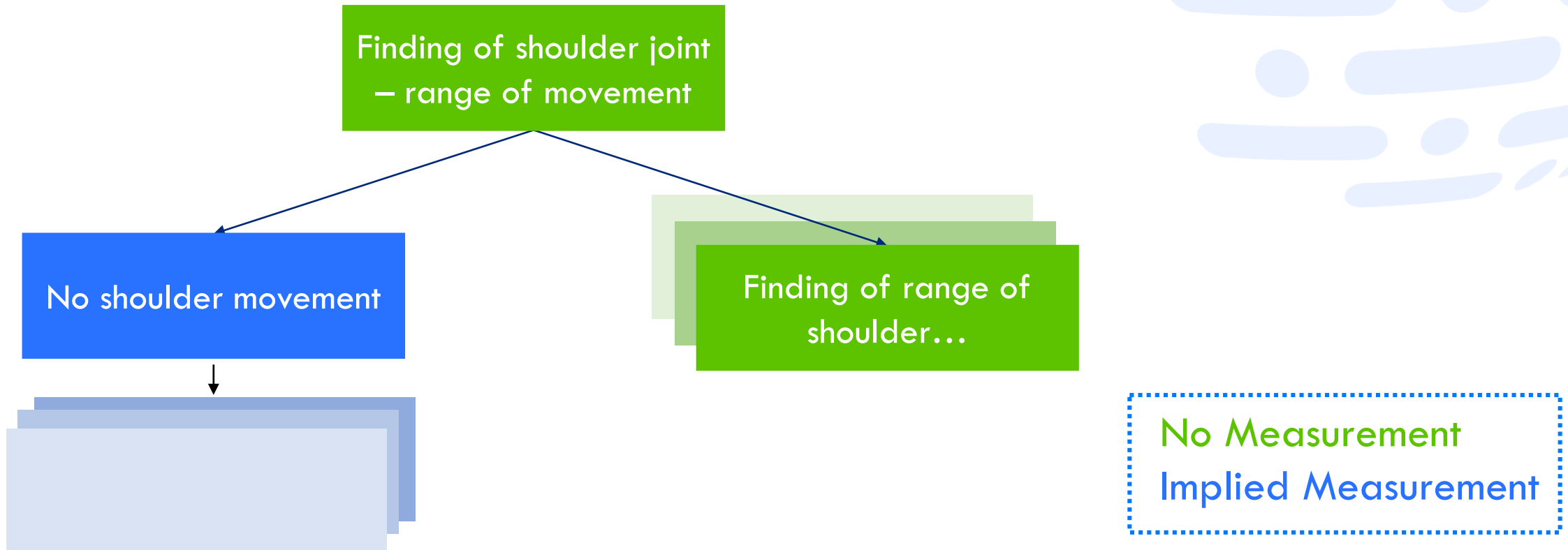
Having an "Apple" = Having a "Fruit"
Having a "Fruit" \neq Having an "Apple"



Having "No Fruit" = Having "No Apple"
Having "No Apple" \neq Having "No Fruit"

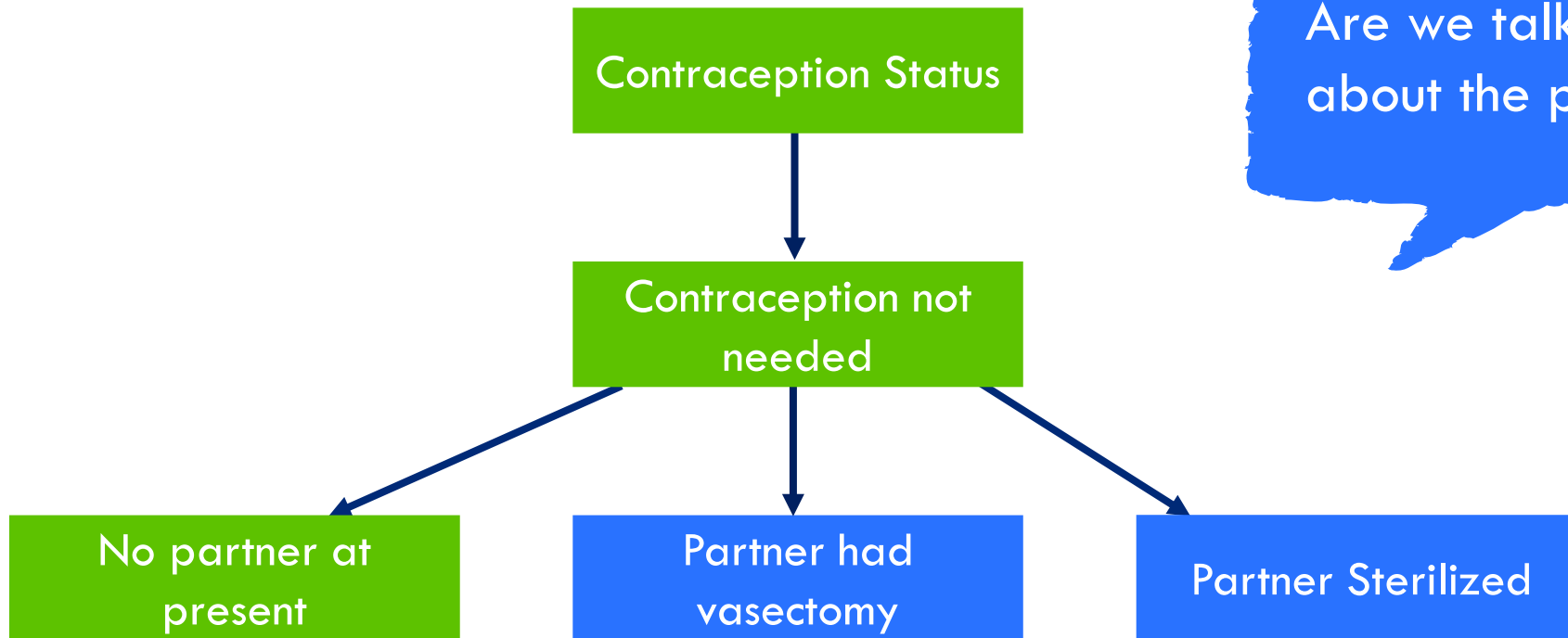
SNOMED Negation Example

What does “no shoulder joint movement” mean?



Patient is Not Subject of Record

Results in an inconsistent view of concepts applying only to the patient.

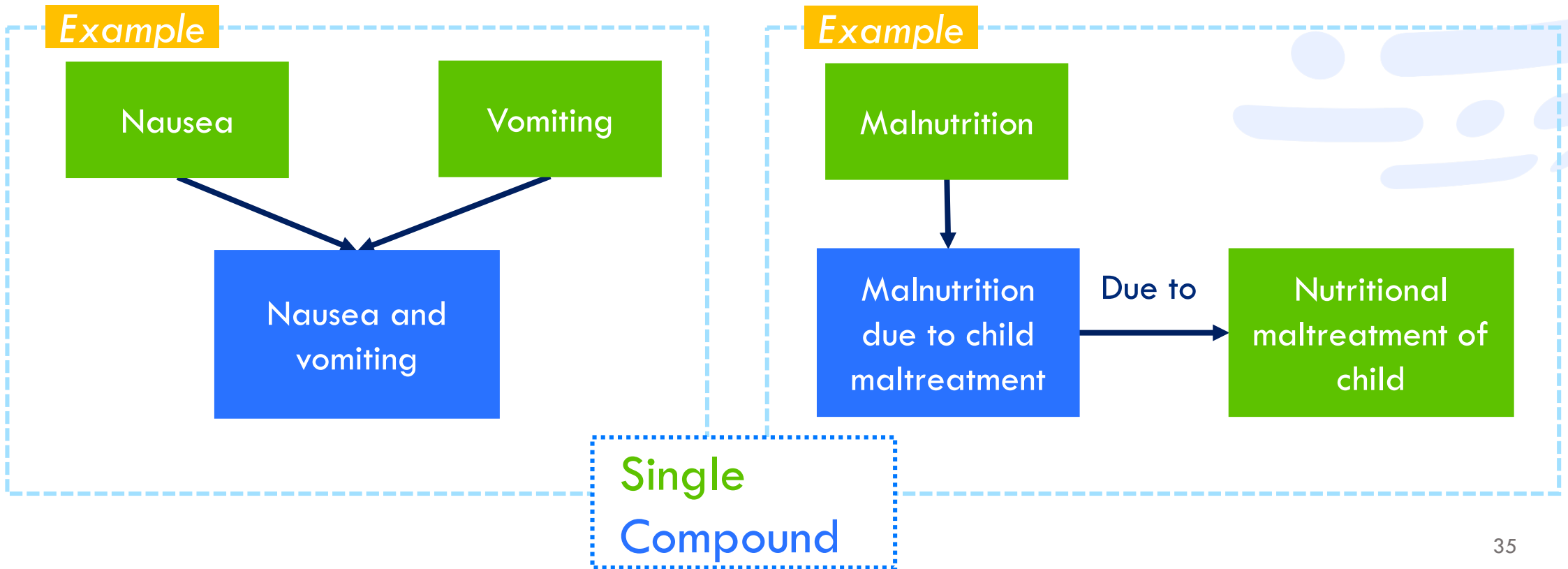


Are we talking about the patient?

Patient
Not Patient

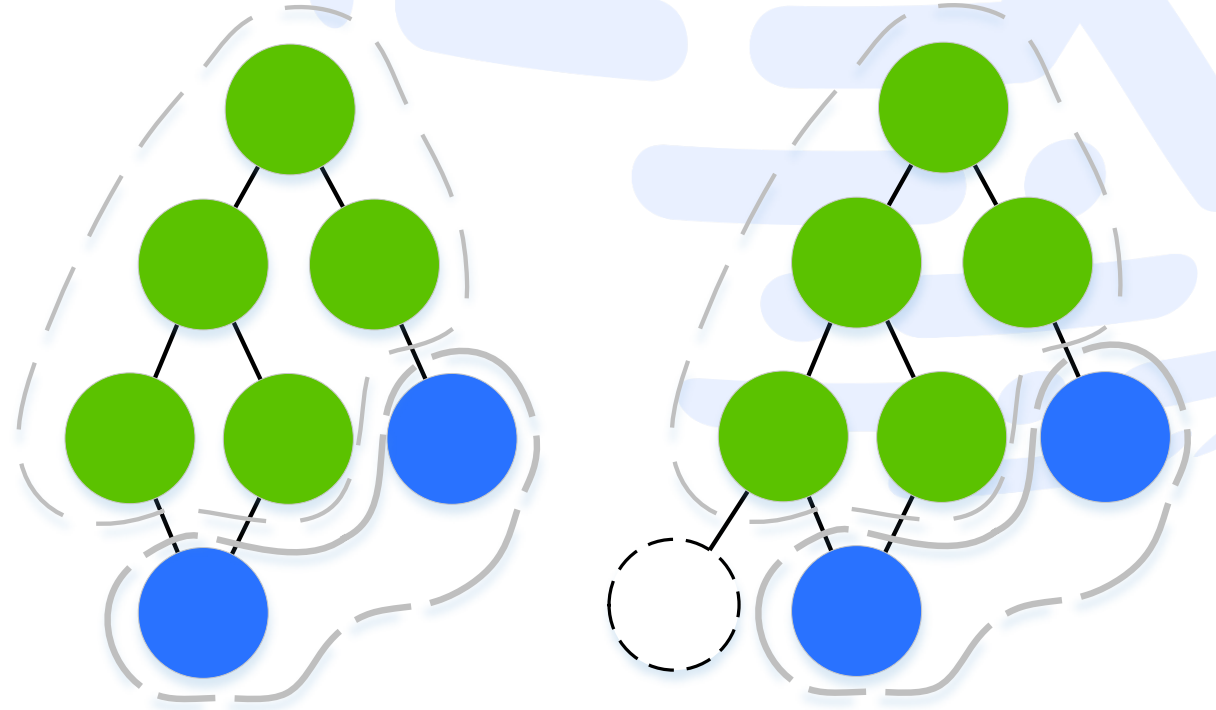
Compound Observations

- ☰ Concepts observations are those that involve a combination of more than one observation.
- ☑ Combining multiple concepts into one can cause modeling issues that affect retrieval.



RefSets Represent Results

- Support integrated queries
- Provide a consistent method for content update and maintenance
- Provide a better alternative to spreadsheets



Is Not [Topic]

Is [Topic]

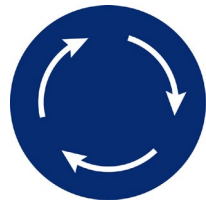
New Concept

Solor Release Files of SNOMED CT Improvements

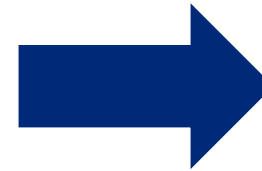
Extract, Transform, and Load



SNOMED
Release Files








Solor Release
Files



Solor Viewer

Solor Assemblage View

 ▼ Negated assemblage 4,707 semantics						
Colu...				author time	module path	+
	MBR	Negated assemblage Brain stem contusion without open intracranial wound AND with prolonged loss of consciousness (more than 24 hours) AND return to pre-existing conscious level		Deloitte User 2017-06-30 0...	Deloitte Hea... Developmen...	^
	MBR	Negated assemblage Open wound of nape of neck without complication		Deloitte User 2017-06-30 0...	Deloitte Hea... Developmen...	
	MBR	Negated assemblage No diagnosis on Axis II		Deloitte User 2017-06-30 0...	Deloitte Hea... Developmen...	
	MBR	Negated assemblage Failure to maintain weight		Deloitte User 2017-06-30 0...	Deloitte Hea... Developmen...	

Concept View of Assemblage Member

The screenshot shows a software interface for viewing a concept. The top bar contains window titles: '+', 'empty', and 'No shoulder movement x'. Below this is a search bar with a magnifying glass icon and the text 'No shoulder movement (finding)'. To the right of the search bar is a 'Focus' toggle set to 'ON'. Below the search bar is a tree view with a 'History' toggle set to 'OFF'. The tree view shows a concept 'CON' with a count of 6. Below the concept are several extensions:

Extension Type	Description	Count
REF	SNOMED legacy implication Sufficient concept definition	6
STR	SCTID 304298000	6
MBR	Negated assemblage Member	4
MBR	Not compound assemblage Member	4
MBR	Patient is subject assemblage Member	4

A red bracket groups the three MBR extensions. A blue dashed box highlights the text: 'Concept is a member of these assemblages'.

Solor Content Integration

LOINC Improvements



Better integration through improved description logic



OWL EL++ with concrete domains

- Multiple sufficient sets
- Support for numeric values and ranges



Compatible with SNOMED's stated future direction

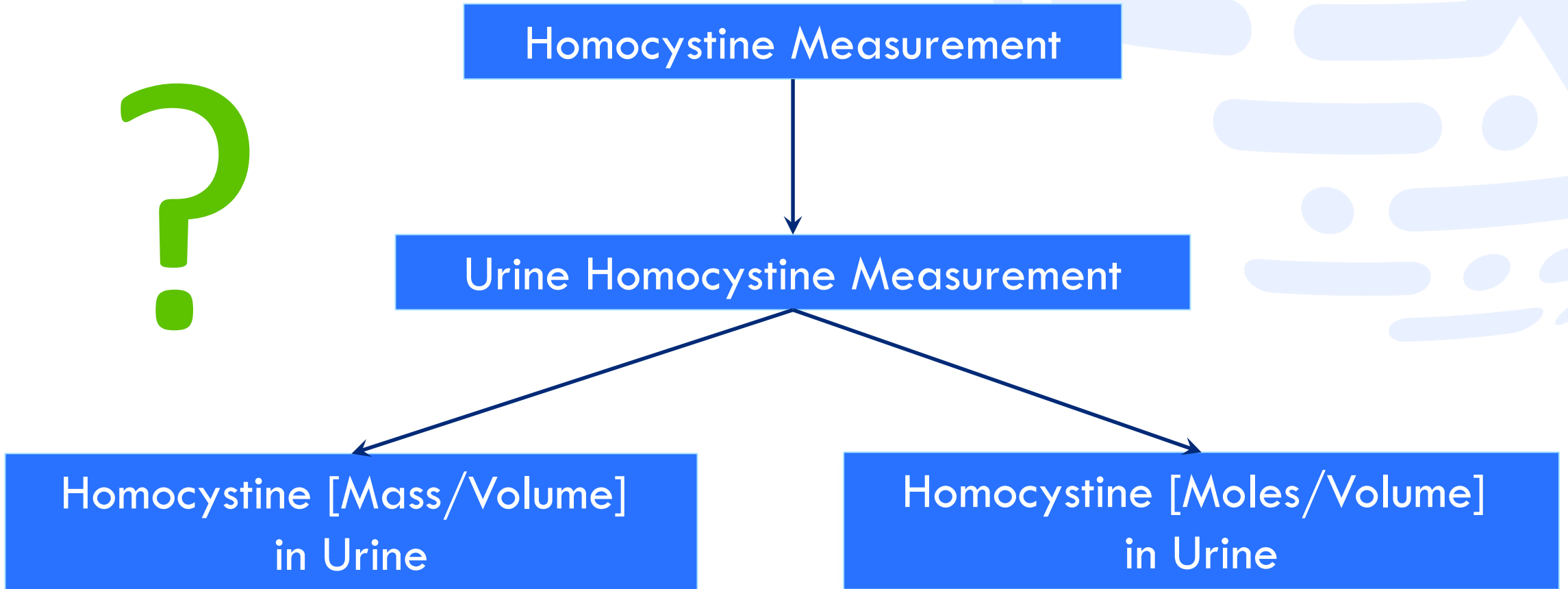
+urine +homocystine

Result
Urine homocystine measurement
Urine homocystine level
Urine homocystine measurement (procedure)
Homocystine [Presence] in Urine
Homocystine [Mass/volume] in Urine
Homocystine [Moles/volume] in Urine
Homocystine Free [Moles/volume] in Urine

SNOMED Concepts

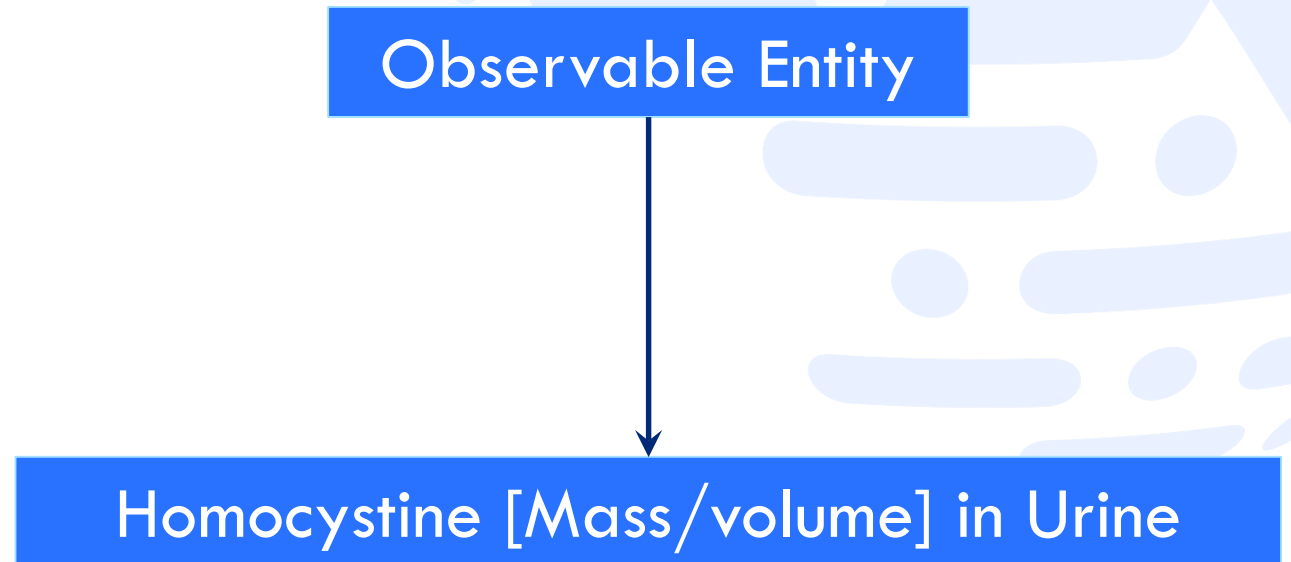
LOINC Concepts

Taxonomy



... Not Quite

- ▼ ○ Homocystine measurement
 - ⬆️ Plasma homocystine measurement
 - ⬆️ Serum homocystine measurement
 - 🏠 Procedure
 - 🔄 Procedure by method
 - 🔄 Evaluation procedure
 - 🔄 Measurement
 - 🔄 Measurement of substance
 - 🔄 Measurement of substance in specimen
 - ⬆️ Measurement of amino acid
 - ⬆️ Evaluation of urine specimen
 - 🔄 Measurement of amino acid in urine
 - 🔄 Urine homocystine measurement



SNOMED ↔ LOINC

▶ **FQN** Urine homocystine measurement (procedure)

2 Aa

▶ **SYN** Urine homocystine measurement

2 Aa

▶ **SYN** Urine homocystine level

2 Aa

DEF Sufficient →

1 ⚙

And →

Some Role group →

And →

Some Component →

Homocystine

Some Role group →

And →

Some Method →

Measurement - action

Some Role group →

And →

Some Has specimen →

Urine specimen

Measurement of amino acid in urine

Homocystine measurement

▶ **FQN** Homocystine Free [Moles/volume] in Urine

1 Aa

▶ **SYN** Homocystine.free Ur-sCnc

1 Aa

DEF Necessary →

3 ⚙

And →

Phenomenon

Sufficient →

And →

Some Role group →

And →

Some Time aspect →

Single point in time

Some Role group →

And →

Some Direct site →

Urine specimen

Some Role group →

And →

Some Component →

Free homocystine

Some Role group →

And →

Some Property type →

Substance concentration

Some Role group →

And →

Some Scale type →

Quantitative

Some Role group →

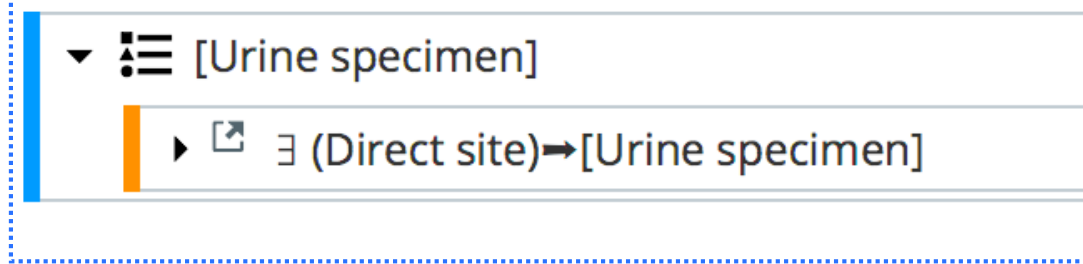
And →

Some Inheres in →

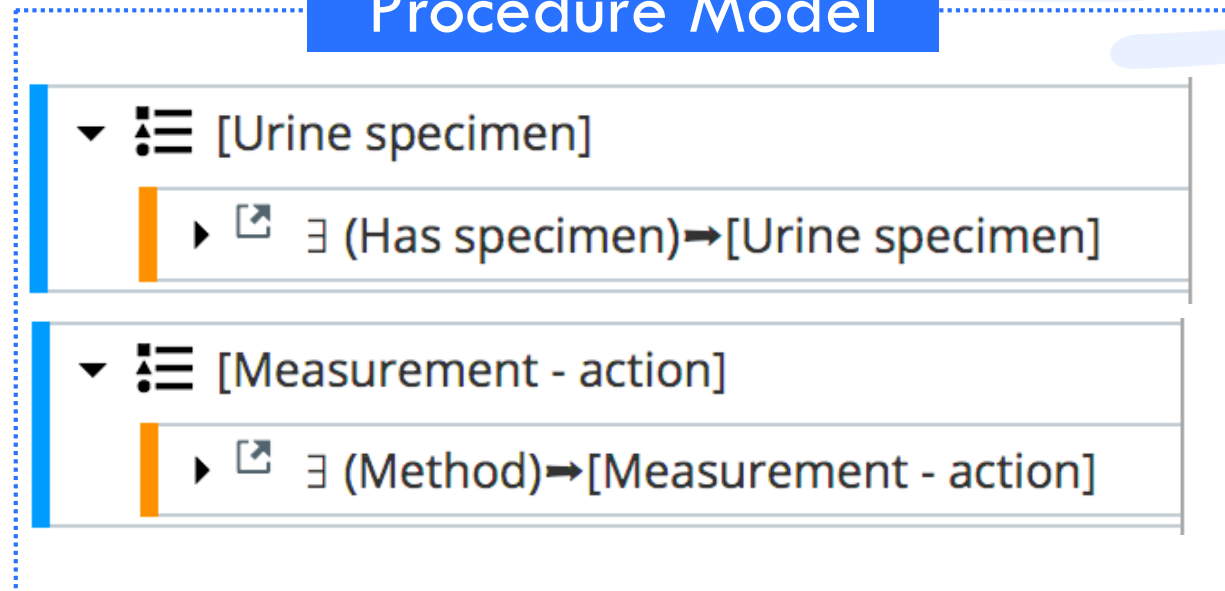
Urine

Minor Model Differences

Observation Model



Procedure Model






Multiple Sufficient Sets

- ▼ ○ Sufficient set: Hcys Ur-mCnc
 - 📄 Observation
 - ▶ 📄 [Homocysteine]
 - ▶ 📄 [Mass concentration]
 - ▶ 📄 [Quantitative]
 - ▶ 📄 [Single point in time]
 - ▶ 📄 [Urine specimen]
 - ▶ 📄 [Urine]


- ▼ ○ Sufficient set: Hcys Ur-mCnc
 - 📄 Procedure
 - ▶ 📄 [Homocysteine]
 - ▶ 📄 [Mass concentration]
 - ▶ 📄 [Measurement - action]
 - ▶ 📄 [Quantitative]
 - ▶ 📄 [Single point in time]
 - ▶ 📄 [Urine specimen]
 - ▶ 📄 [Urine]



Organizing Concepts, Classification

▼  Necessary set: Hcys Ur-mCnc






  Homocysteine measurement














  Homocysteine observation

  Inheres in Urine observation

  Quantitative measurement of amino acid in urine

New Taxonomy

- ▼  Necessary set: Hcys Ur-mCnc
 -  Homocysteine measurement
 -  Homocysteine observation
 -  Inheres in Urine observation
 -  Quantitative measurement of amino acid in urine

-  Inheres in Urine observation (OP)
 -  Observation (SOLOR)
 -  Substance observation (OP)
 -  Amino acid observation (OP)
 -  Homocysteine observation (OP)
 -  Procedure (SOLOR)
 -  Procedure by method (procedure)
 -  Evaluation procedure (procedure)
 -  Measurement procedure (procedure)
 -  Measurement of substance (procedure)
 -  Measurement of amino acid (procedure)
 -  Homocysteine measurement (procedure)
-  Homocysteine [Mass/volume] in Urine

Why Does this Matter?



The ability to find all equivalent concepts is:



- Necessary for decision support
- A patient safety issue




If not done properly in the defining taxonomy:

- Each decision support rule has to take into account all the different ways to represent the same thing
- Redundant effort at best
- Greater opportunity for omissions that may result in patient harm

RxNorm Integration

  **Product containing aspirin (medicinal product)**

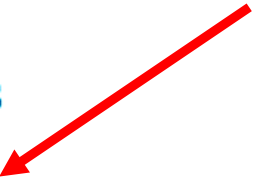
 **Expand All**

CON

9 Active in SNOMED CT® core modules on Development path

Extensions:

REF	SNOMED legacy implication
9	Necessary but not sufficient concept definition
STR	SCTID
9	7947003
STR	RxNorm CUI
3	1191

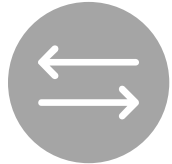


RxNorm – Update



SNOMED is working to finalize an International Drug Model

- Participation from NLM, NHS, Australia, others
- Due out this year



RxNorm may align with this model

- Example of collaborative contribution
- Don't want to reinvent the wheel

Solor & SHIELD

A Common Mission

To develop, harmonize and implement semantic interoperability standards in order to protect and promote public health by:

- Improving support for clinical decisions
- Reducing burdens to the healthcare ecosystem
- Promoting the development of innovative solutions to public health challenges

Solor achieves semantic interoperability by integrating disparate health standards into a common model.

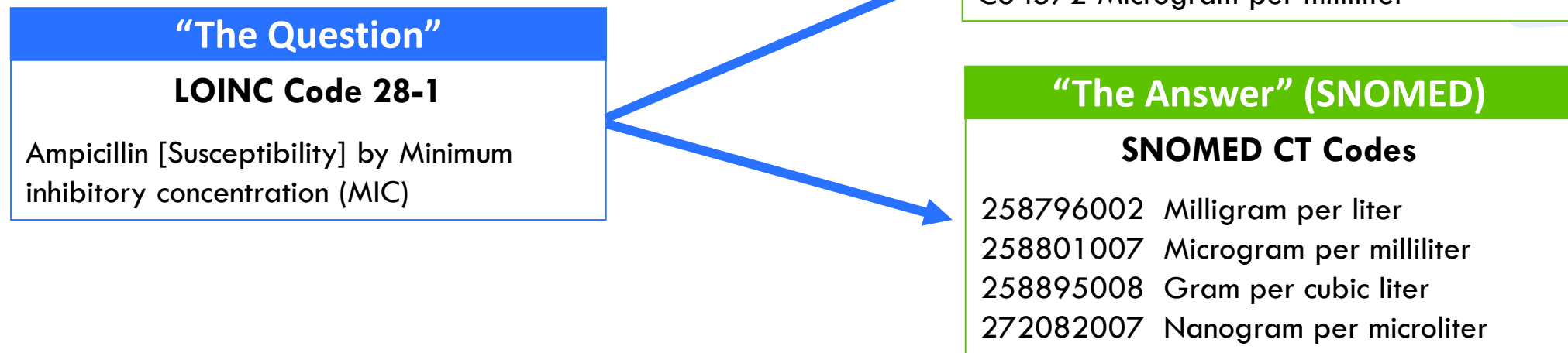


LOINC to IVD (LIVD)

- *In vitro* diagnostics (IVDs) products are intended for use in diagnosis of disease or other conditions
- Fundamentally, IVDs ask a '**question**' of a specimen taken from a human body (e.g. LOINC)
- The result that follows is the '**answer**' to that question (e.g. SNOMED CT, UCUM)
- Each individual device is '**who's asking**' (e.g. Unique Device Identifiers)

LIVD Example

- A particular IVD may measure the **Minimum Inhibitory Concentration (MIC)** of Ampicillin that will inhibit the growth of a microorganism after incubation. The **unit of measure for MIC is microgram/milliliter**.
- The MIC test result and the units of measure are mapped to LIVD:



Managing LIVD Today

Example of LIVD Mapping










LIVD Table Format: IVD Test Transmission Codes

IVD Test Result				
Vendor Specimen Description	Vendor Result Description	Vendor Reference	Vendor Comment	LOINC Code
MIC	µg/ml	--		28-1
serum plasma	pmol/l	--	FT3	83126-3
serum plasma	pg/ml	--	FT3	83127-1

UCUM_Code	SCT_Code	UCUM_term
C64387	414719002	Millimole per Liter
C64572	258796002	Milligram per liter
C64572	258801007	Microgram per milliliter
C64572	258895008	Gram per cubic liter
C64572	272082007	Nanogram per microliter

Managing LIVD with Solor

Solor & SNOMED CT Taxonomy

- ▼  SOLOR concept
 - ▶  Metadata
- ▼  SNOMED CT Concept
 - ▶  Body structure
 - ▶  Clinical finding
 - ▶  Environment or geographical location
 - ▶  Event
 - ▶  Observable entity
 - ▶  Organism

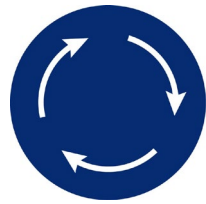
Proposed LIVD Integration

- Solor concept
 - Metadata
 - SNOMED CT Concept
 - LIVD
 - LOINC (28-1)
 - UCUM value (C64572)
 - SNOMED CT value (258796002)
 - SNOMED CT value (258801007)
 - SNOMED CT value (258895008)
 - SNOMED CT value (272082007)

Integration into a Common Model



SHIELD
LIVD Specifications



LIVD Solor
Extension



Solor
Ecosystem

Knowledge Management Environment

- We are currently developing a knowledge management environment that could potentially be used to integrate LIVD specifications

Screenshot of Current Version
(subject to change)

The screenshot displays the SOLOR interface with the following components:

- Taxonomy Panel (Left):** Shows a hierarchical tree of concepts. The 'Alzheimer's disease' category is expanded, and its sub-entities 'ABCA7' and 'ACE' are highlighted with a red box. Below them, two Clinvar variants are listed: 'Clinvar Variant NM_000789.3(ACE):c.*185G>A' and 'Clinvar Variant NM_000789.3(ACE):c.*319A>G'.
- Main Panel (Center):** Displays details for the selected variant 'Clinvar Variant NM_000789.3(ACE):c.*185G>A'. It includes sections for 'CON' (Contraindication), 'EXTENSIONS' (listing STR variants), 'DEF' (Definition), and 'AXIOMS' (listing necessary sets).
- Activities Panel (Right):** Shows a search bar with 'ACE' and a list of results, including various Clinvar variants such as 'Clinvar Variant NM_000789.3(ACE):c.3836G>A' and 'Clinvar Variant NM_000789.3(ACE):c.*334G>A'.

Continued Collaboration

We are looking for your feedback on the following topics:

- How we can work together going forward
- Understand your requirements and any pain points you have experienced
- Define a process of transforming LIVD data into SOLOR's common model
- Manage data within a common model
- Provide Solor/Knowledge Management Environment documentation

Discussion with SHIELD Working Group

Solor & ANF

The Promise of Health IT



Improve the **quality** and **safety** of health-care



Measure the **cost** and **quality of services**



Integrate multiple providers across organizations in a continuum of care



Integrate high-quality decision support into the clinical workflow across the continuum of care

Encoded data is the foundation needed to deliver The Promise!

Has the The Promise of Health IT Been Delivered?

- ✓ Improve the quality and safety of health-care*
- ? Measure the cost and quality of services
- ✗ Integrate multiple providers across organizations in a continuum of care
- ✗ Integrate high-quality decision support into the clinical workflows in the continuum of care

Analyzing encoded data is necessary to deliver the promise...

*Many quality and safety improvement opportunities still exist.

Analysis Normal Form (ANF)

ANF is a simple statement model.

Statement	
Narrative	Right Radial Pulse observed to be 100 bpm on 4/23/2018 9:15 am PST
Topic	[pulse rate]-(location)->[right radial artery]
Subject of info	Subject of Record
Statement time	4/23/2018 9:15 am PST
Performance/ Request Circumstance	100 BPM

Why Solor & ANF

- **Integrated terminology: Solor**
 - Provide integrated content in a standardized way
 - Open up the silos and integrate
 - Reduce complexity
- **Statement model: CIMI ANF and Iseosemantic equivalents**
 - Need to be able to express clinical concepts precisely
 - Need to “know” equivalence among clinical concepts
 - Need to be able to error check complex representations at scale

ANF is about Statements

Procedural Knowledge

P

Assertional Knowledge

A

Statement Model

S

Terminology Knowledge

T

Architecture

A

- ANF assumes coherence of language and definitional layers
- ANF assumes a clean separation between the statement layer and the definitional and language layers

ANF Principles

- Don't create a thousand models if one (or two) will do
- Ensure that the statement representation is:
 - Reproducible
 - Scalable
- **Simplicity**
- **Reusability**
- **Use case driven**
- Immutability
- No False Dichotomies

Clinical Input Form

- Clinicians typically enter information into an EHR in a certain *manner*: *the clinical input form (CIF)*
- The CIF is not a literal “form.” It refers to the *manner* in which information is presented to the clinicians and how they enter the data, e.g.:
 - by constraining the information to allow only certain values to be entered, such as through a drop-down list or radio button
 - breaking up large chunks of related information into smaller parts like in medication orders

ANF vs CIF

- The way information is presented to clinicians should be most efficient for the clinicians to use (CIF)
- What is an efficient way for clinicians to select and enter data may not be the most efficient way for data analysts to use when they are querying data
- For this, the data is normalized using the *analysis normal form (ANF)* and stored in a database.

ANF Types

- Performance of action, may include
 - passive observation of a phenomenon related to patients and their health status or family history, and
 - active interventions, such as providing education or administering medications
- Request for action, may include
 - Procedure orders, consultation with other providers, or active interventions
- Both are statements with topics

Major model components

- Topic
 - WHAT is being observed or requested
- Circumstances
 - **HOW, WHY** and **WHEN** a requested or performed action will be or was carried out
- What, when, where, why, and how are concerns of the statement model

ANF Structure

ClinicalStatement	
getStatementTime()	Measure
getStatementId()	UUID
getSubjectOfRecordId()	UUID
getStatementAuthors()	List<? extends Participant>
getSubjectOfInformation()	LogicalExpression
getStatementType()	LogicalExpression
getTopic()	LogicalExpression
getCircumstance()	Circumstance
getStatementAssociations()	List<StatementAssociation>

StatementAssociation	
getAssociationSemantic()	LogicalExpression
getAssociatedStatementId()	UUID

Participant	
getParticipantRole()	LogicalExpression

IdentifiedParticipant	
getParticipantId()	UUID

PerformanceCircumstance	
getResult()	Result
getPerformanceParticipants()	List<IdentifiedParticipant>

Circumstance	
getTiming()	Measure
getPurposeList()	List<LogicalExpression>

RequestCircumstance	
getConditionalTriggers()	List<ClinicalStatement>
getRequestedParticipants()	List<? extends Participant>
getPriority()	LogicalExpression
getRepetitions()	List<Repetition>
getRequestedResult()	Result

UnstructuredCircumstance	
getUnstructuredText()	String

Interval	
getLowerBound()	float
getUpperBound()	float
includeLowerBound()	boolean
includeUpperBound()	boolean

Measure	
getResolution()	Optional<Float>
getMeasureSemantic()	LogicalExpression

Result	
--------	--

ObservationResult	
getHealthRisk()	Optional<LogicalExpression>
getNormalRange()	Optional<Interval>

InterventionResult	
getStatus()	LogicalExpression

Repetition	
getPeriodStart()	Measure
getPeriodDuration()	Measure
getEventFrequency()	Interval
getEventSeparation()	Measure
getEventDuration()	Optional<Measure>

Statement

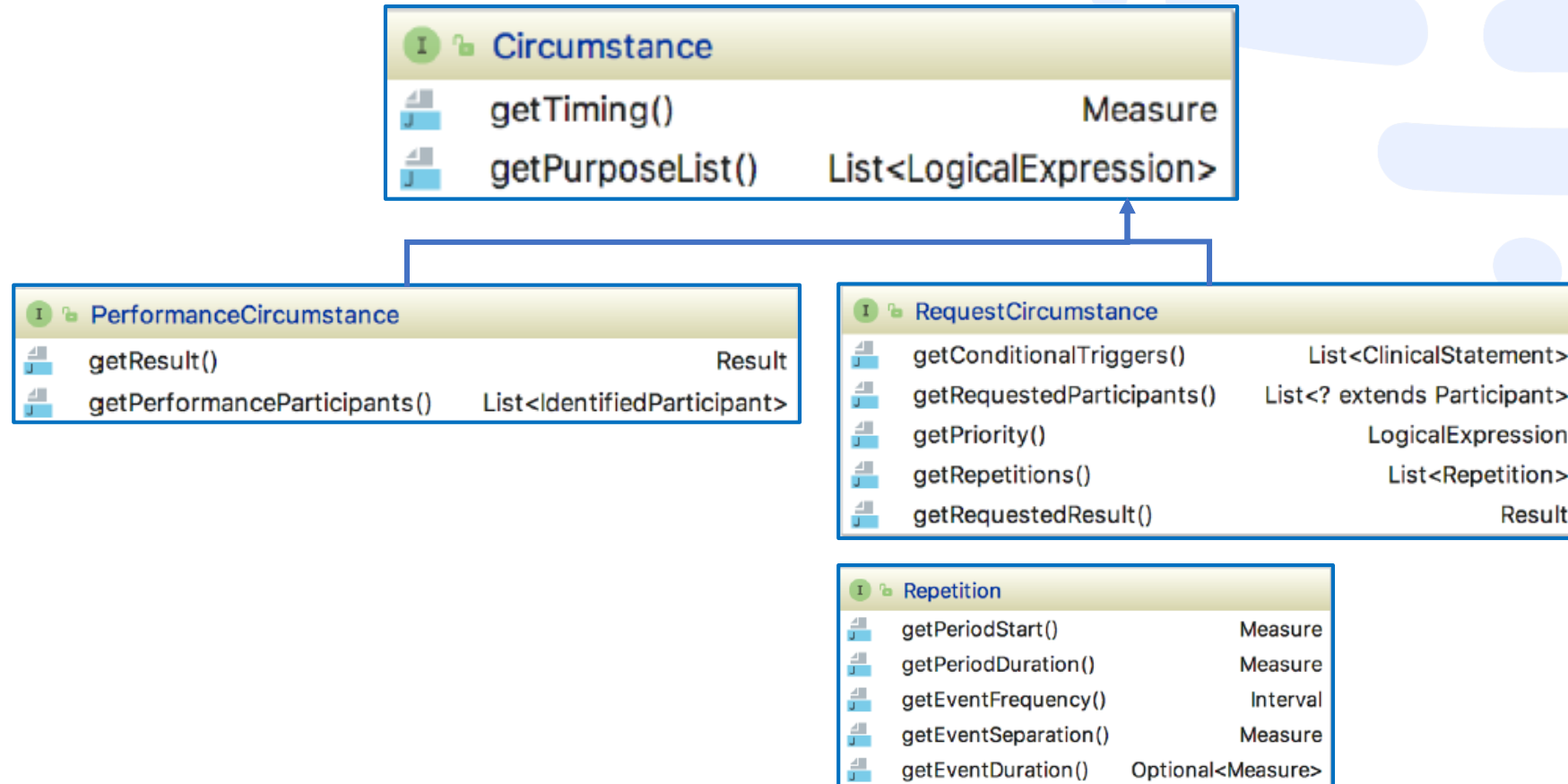
ClinicalStatement	
getStatementTime()	Measure
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getStatementAuthors()	List<? extends Participant>
getSubjectOfInformation()	LogicalExpression
getStatementType()	LogicalExpression
getTopic()	LogicalExpression
getCircumstance()	Circumstance
getStatementAssociations()	List<StatementAssociation>

Who

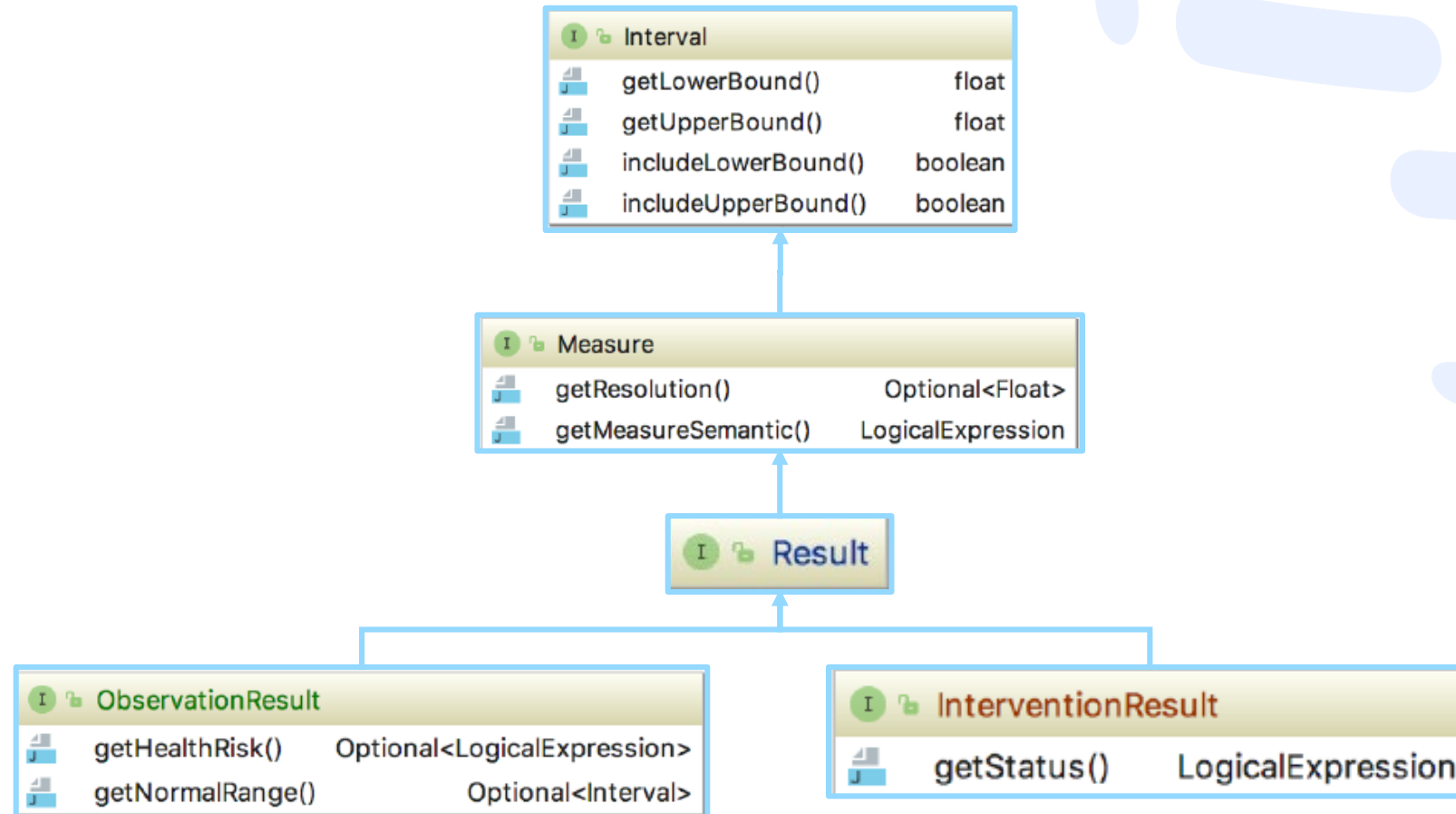
What

How

Circumstance



Measurement



Request for Action

Instance Request	X-ray cervical spine anteroposterior (AP) and lateral neck pain
purpose	[386053000 Evaluation procedure (procedure)] ->(363702006 Has focus (attribute))->[81680005 Neck pain (finding)]

Evolution

- ***In the beginning was the word...***

- ...which complicated things right away

- ...searching for true “meaning” and detecting false dichotomies was a big part of the work

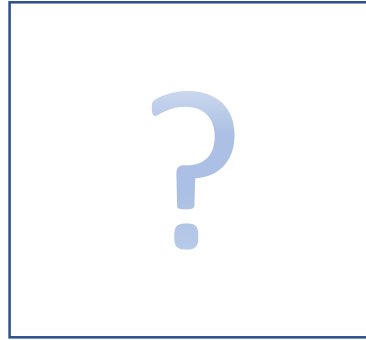
- ***Let there be light...***

- ...in its youth, ANF was very heavy on topic types and “circumstances” – now it matured to be very light

Evolution

Example

- Prerequisite
- Precondition
- Technique



“Measurement of systolic blood pressure on right brachial artery, using adult BP cuff, patient in sitting position for at least 5 minutes”



Evolution

- There is still work to do
- Not all Instance Requests can be fully modeled...yet

Methylprednisolone 4 mg tablet oral by taper: take 6 tablets at once on day 1; on day 2 take one tablet before breakfast, one after lunch, one after dinner, and two at bedtime; on day 3 take one tablet before breakfast, one after lunch, one after dinner, and one at bedtime; on day 4 take one tablet before breakfast, one after lunch, and one at bedtime; on day 5 take one tablet before breakfast and one at bedtime; and on day 6 take one tablet before breakfast. 21 tablets 0 refills

Discussion

Words are the beginning
of all misunderstandings.

- Oscar Wilde

Grades, Scales, Stages, and Scores Findings and Issues

Symmetry Modeling

- In some areas of SNOMED CT, concepts exist, which should be modeled in a “symmetrical” way
- We define “symmetrical” as being modeled following a consistent pattern
- Concepts, that are “suspects” for potentially not being modeled symmetrically include:
 - Inverse concepts
 - Concepts, that are modeled with more than one of the same attribute, but with different values
 - Parent concepts of Leaf Nodes
 - Concepts to which Grades, Scales, Stages or Scores are applied

Symmetry Criteria

- We considered modeling “symmetrical” if the concepts:
 - Which are considered opposites of each other (inverse concepts)
 - Exist in SNOMED and
 - Reside in the correct hierarchy under the correct parent concept
 - Which are not modeled with more than one of the same attribute, but with different values (e.g. a clinical course that is both acute and chronic)
 - Which are parent concepts of a Leaf Node and have all the correct Leaf concepts
 - Which are Grades, Scales, Stages, and Scores, where all concepts existed and were consistently modeled

Inverse Concepts

- Concepts should have an opposing concept
- If the opposing concept does not exist, it is considered “asymmetric”

Concept ID	FSN
8587003	Congenital diverticulum of colon (disorder) ⇒ Acquired diverticulum of colon (disorder)
8656007	Total traumatic cataract (disorder) ⇒ Total non-traumatic cataract (disorder)
9027003	Normal pulmonary arterial wedge pressure (finding) ⇒ Abnormal pulmonary arterial wedge pressure (finding)
21370008	Tenotomy of abductor of hip, open (procedure) ⇒ Tenotomy of abductor of hip, closed (procedure)

Inverse Concepts (cont.)

- Opposing concepts should reside in the correct hierarchy under the correct parent
- This does not always mean they have to reside under the same proximal parent

Example:

268163008 | Congenital ptosis (disorder) |

Proximal parent: 91158006 | Congenital anomaly of eyelid (disorder) |

271429007 | Acquired ptosis of eyelid (disorder) |

Proximal parent: 11934000 | Ptosis of eyelid (disorder) |

- If the opposing concept does not reside in the correct hierarchy and the correct parent, it is considered “asymmetric”

Attribute Modeling

- If a concept is modeled with more than one of the same attributes, but with different values, it is considered “asymmetric”

The screenshot displays the 'Concept Details' page for 'Acute polyarticular juvenile rheumatoid arthritis (disorder)'. The page includes a navigation bar with tabs for Summary, Details, Diagram, Expression, Refsets, Members, and References. The 'Parents' section lists three parent concepts: Acute arthritis (disorder), Acute polyarthritis (disorder), and Juvenile rheumatoid arthritis (disorder). The main content area is divided into two columns. The left column shows the concept name, SCTID (75822003), and its English names. The right column lists attributes and their values. A red box highlights the 'Clinical course' attribute, which has two distinct values: 'Chronic' and 'Sudden onset AND/OR short duration'. Other attributes include 'Occurrence' (Childhood), 'Associated morphology' (Acute inflammation and Chronic inflammatory morphology), and 'Finding site' (Joint structure). The 'Children' section at the bottom indicates zero children.

Concept Details

Summary | **Details** | Diagram | Expression | Refsets | Members | References

Parents

- ▶ Acute arthritis (disorder)
- ▶ Acute polyarthritis (disorder)
- ▶ Juvenile rheumatoid arthritis (disorder)

Acute polyarticular juvenile rheumatoid arthritis (disorder) ☆

SCTID: 75822003

75822003 | Acute polyarticular juvenile rheumatoid arthritis (disorder) |

- en Acute polyarticular juvenile rheumatoid arthritis
- en Acute juvenile rheumatoid arthritis
- en Acute polyarticular juvenile rheumatoid arthritis (disorder)

Attributes:

- Occurrence → Childhood
- Clinical course → Chronic
- Clinical course → Sudden onset AND/OR short duration
- Associated morphology → Acute inflammation
- Finding site → Joint structure
- Associated morphology → Chronic inflammatory morphology
- Finding site → Joint structure

Children (0)

No children

Leaf Node Parents

- Parent concepts of a Leaf Node should have the correct Leaf concepts

The screenshot displays the 'Concept Details' page for 'Pneumocholecystitis (disorder)'. The page is divided into several sections:

- Parents:** A list of parent concepts: Cholecystitis (disorder) and Infectious disease (disorder).
- Concept Details:** A blue box containing the concept name, SCTID (95558008), and a list of related concepts: Pneumocholecystitis, Emphysematous cholecystitis, Gaseous pericholecystitis, Gaseous cholecystitis, and Pneumocholecystitis (disorder).
- Associated Concepts:** A light blue box showing relationships: Pathological process → Infectious process, Causative agent → Superkingdom Bacteria, Associated morphology → Emphysema, Finding site → Gallbladder structure, and Finding site → Gallbladder structure, Associated morphology → Inflammation.
- Children (1):** A list of child concepts: Acute emphysematous cholecystitis (disorder).

Leaf Node Parents (cont.)

- Parent concepts of a Leaf Node that do not have the correct Leaf concepts are considered “asymmetric”

The screenshot displays a medical ontology interface. On the left, a blue card represents the leaf node 'Congenital clubnail (disorder)'. It includes a menu icon, a star icon, and a share icon. The text on the card reads: 'Congenital clubnail (disorder)', 'SCTID: 64596006', '64596006 | Congenital clubnail (disorder) |', and two language codes: 'en Congenital clubnail' and 'en Congenital clubnail (disorder)'. To the right of this card is a light blue box containing two white boxes with relationship information: 'Associated morphology → Clubbing' and 'Finding site → Nail structure' in the top box; and 'Occurrence → Congenital Associated morphology → Developmental anomaly' and 'Finding site → Nail structure' in the bottom box. Below these elements, a red-bordered box highlights the 'Children (1)' section, which contains a blue line, a menu icon, and the text 'Congenital club finger (disorder)'. The background of the slide features abstract blue brushstrokes.

Grades, Scales, Stages, and Scores

- This part of the “Symmetry” work is exploratory in nature
- The goal was to identify patterns of concepts, where Grades, Scales, Stages, or Scores are applied and examined, if they are applied in a consistent way
- We identified and examined a sample of concepts

Grades, Scales, Stages, and Scores (cont.)

- We reviewed Stage, Scales, and Grades to ensure that:
 - All are concepts related to a Stage, Scale, or Grade are present
 - All appropriate concepts exist in the Finding and Disorder hierarchies
 - Were modeled consistently

Grades, Scales, Stages, and Scores (cont.)

Examples:

Summary | Details | Diagram | Expression | Refsets | Members | References

Parents

Stated Inferred

- ▶ Histological grade finding (finding)

Moderately differentiated histological grade finding (finding) ☆

SCTID: 373377004

373377004 | Moderately differentiated histological grade finding (finding) |

en Moderately differentiated histological grade finding (finding)

en Moderately differentiated histological grade finding

Interprets → Histopathology test

Associated morphology → Lesion

Interprets → Lesion observable

Children (4)

- G2 grade (finding)
- G2: 6-50% non-squamous solid growth (finding)
- G2: Moderately differentiated (50-95% gland forming) (finding)
- G2: Nuclei slightly irregular, approximately 15 μ; nucleoli evident (finding)

Summary | Details | Diagram | Expression | Refsets | Members | References

Parents

Stated Inferred

- ▶ Heart failure (disorder)
- ▶ Systolic dysfunction (finding)

Systolic heart failure (disorder) ☆

SCTID: 417996009

417996009 | Systolic heart failure (disorder) |

en Systolic heart failure (disorder)

en Systolic heart failure

Finding site → Heart structure

Has interpretation → Abnormal

Interprets → Cardiovascular function




Children (5)

- ▶ Acute systolic heart failure (disorder)
- ▶ Chronic systolic heart failure (disorder)
- ▶ Systolic heart failure stage B (disorder)
- ▶ Systolic heart failure stage C (disorder)
- Systolic heart failure stage D (disorder)

Review Findings

1. Naming Inconsistencies

- Scale and Score are used interchangeably



 Glasgow coma scale, 4 (finding)  

SCTID: 112110007

112110007 | Glasgow coma scale, 4 (finding) |

en Glasgow coma scale, 4
en Glasgow coma scale, 4 (finding)

Finding site → Brain structure
Interprets → Glasgow coma score

 Glasgow coma score finding (finding)  


SCTID: 386560004

386560004 | Glasgow coma score finding (finding) |

en Glasgow coma score finding (finding)
en Glasgow coma score finding
en Glasgow coma score

Finding site → Brain structure
Interprets → Glasgow coma score

Children (13)

-  Glasgow coma scale, 10 (finding)
-  Glasgow coma scale, 11 (finding)

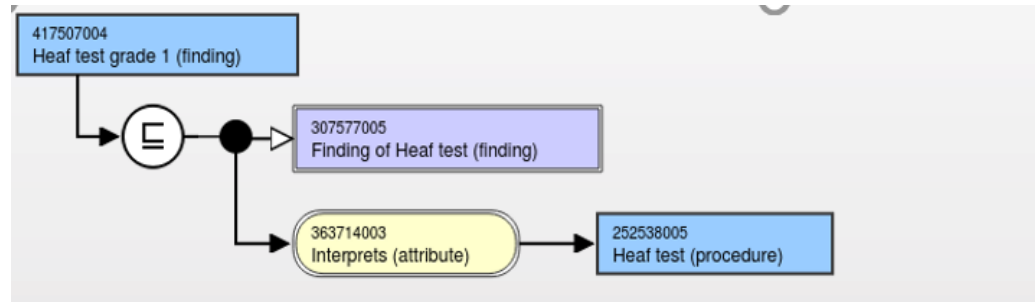
Review Findings (cont.)

- 2. Grades, Scales, and Stages without corresponding findings/disorders:
- 762993000 | Assessment using Morse Fall Scale (procedure) does not have a corresponding finding pertaining to Morse Fall Scale
 - 426938003 | Morse falls risk assessment (assessment scale) |
 - 718584002 | Morse Falls Risk Assessment score (observable entity) | also exist.
- 277459008 | Daumas-Duport grading system (staging scale) | has no corresponding concepts in Procedures, Observables, or Findings/Disorders

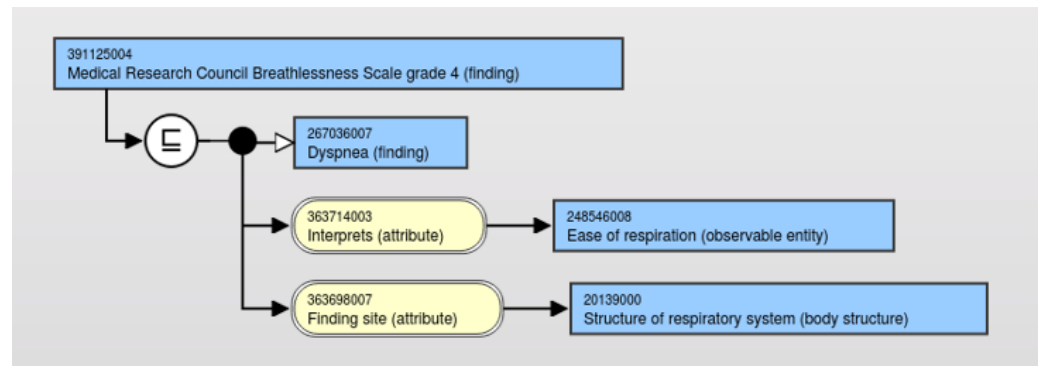
Review Findings (cont.)

3. Interprets procedure vs. observable

- Interpret = Procedure (42 concepts)



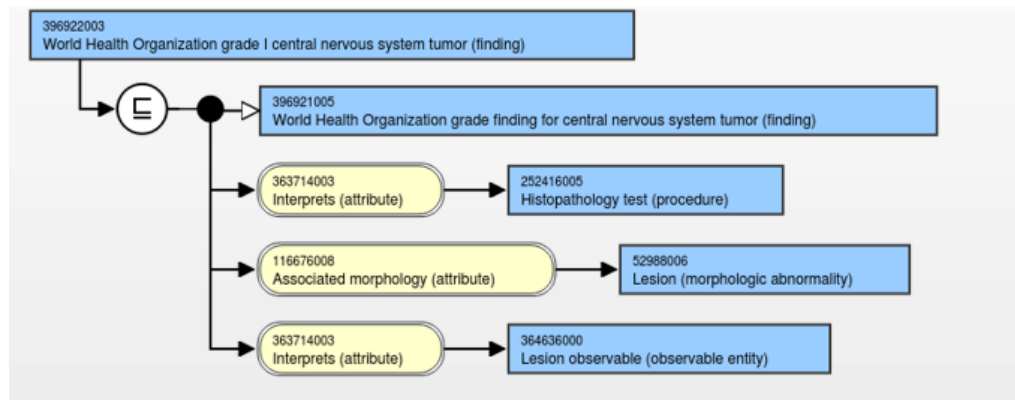
- Interprets = Observable (352 concepts)



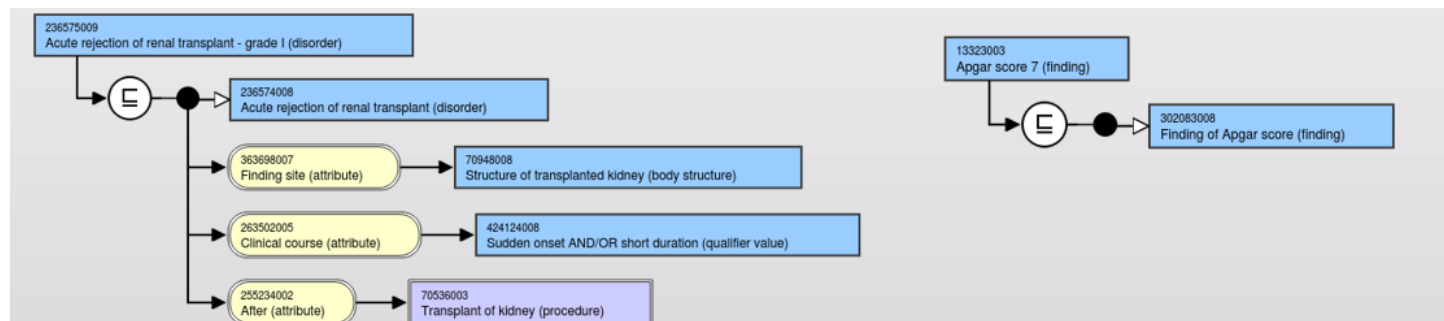
Review Findings (cont.)

4. “Interprets” both or missing concepts

- Interprets both Observable and Procedure (41 concepts)



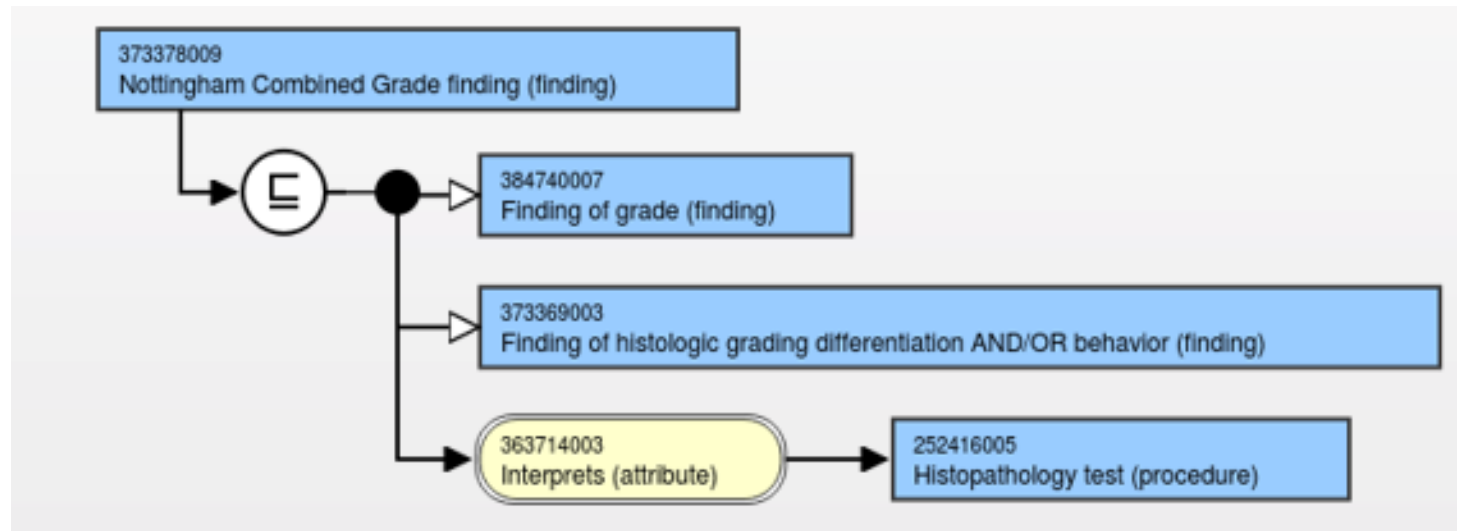
- Interprets missing (400 concepts)



Review Findings (cont.)

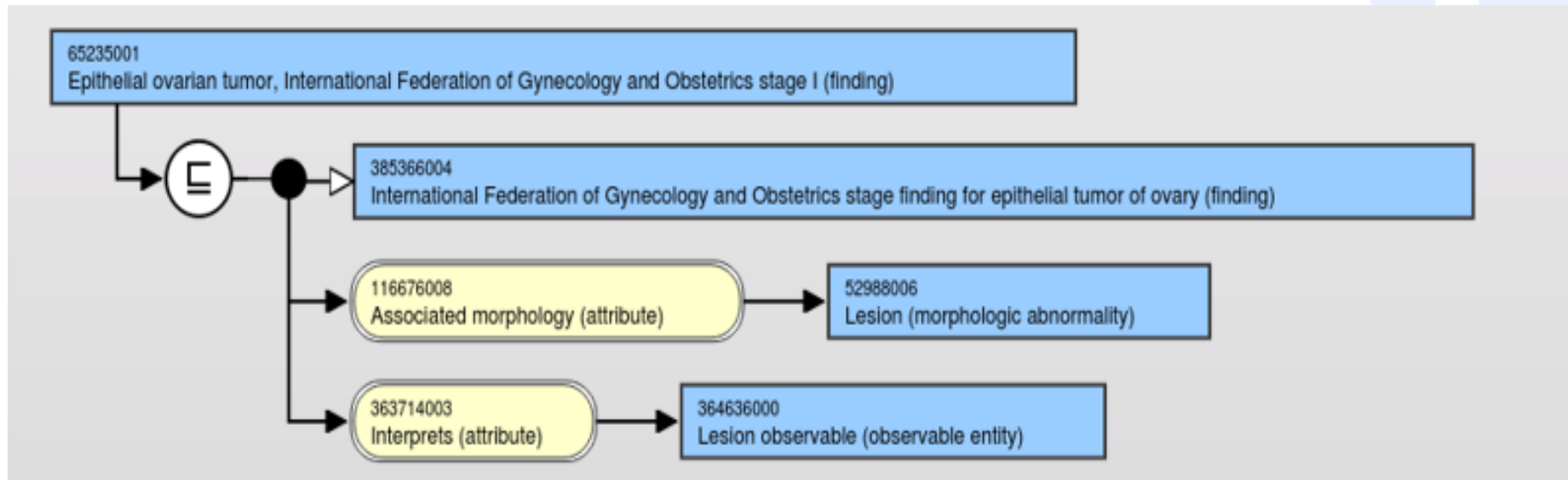
5. “Interprets” uses less specific values

- Concept uses generic Procedure but a specific Observable exists
 - 372276001 | Nottingham Combined Grade (observable entity) |



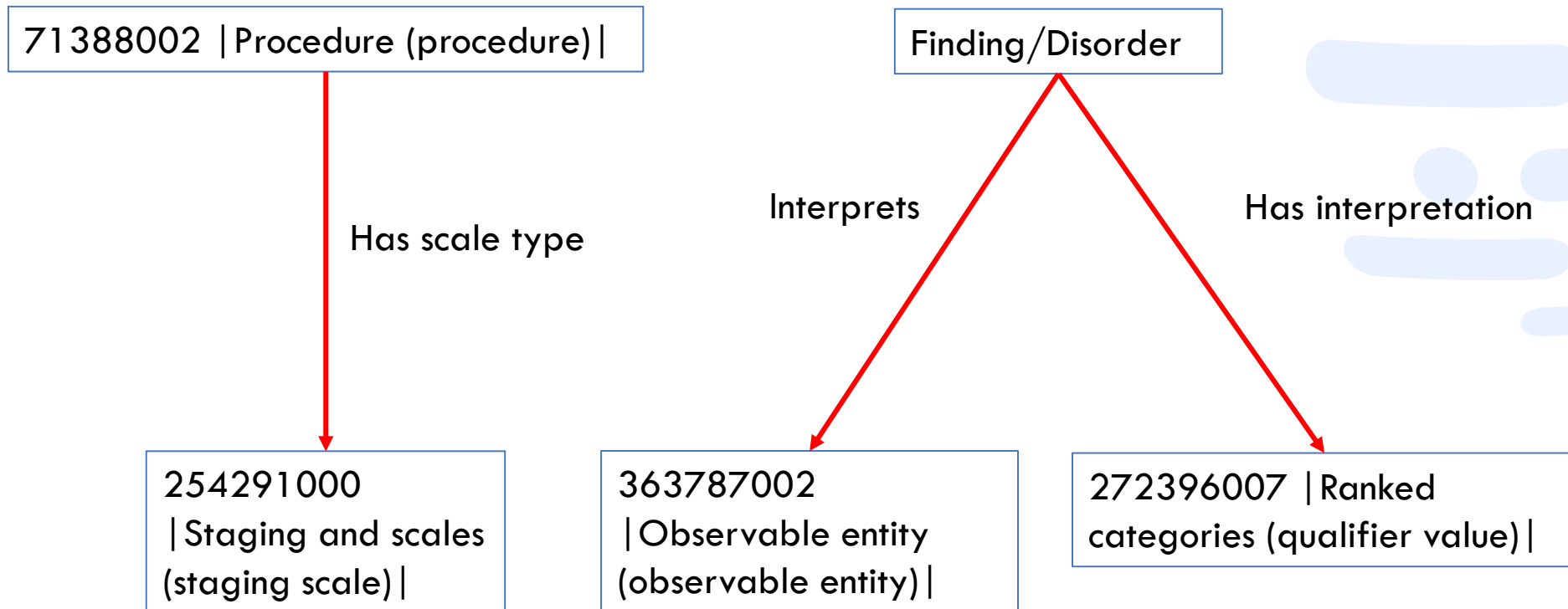
Review Findings (cont.)

- Concept uses a generic Observable when a more specific one exists
 - 385363007 | International Federation of Gynecology and Obstetrics ovarian tumor stage (observable entity) |



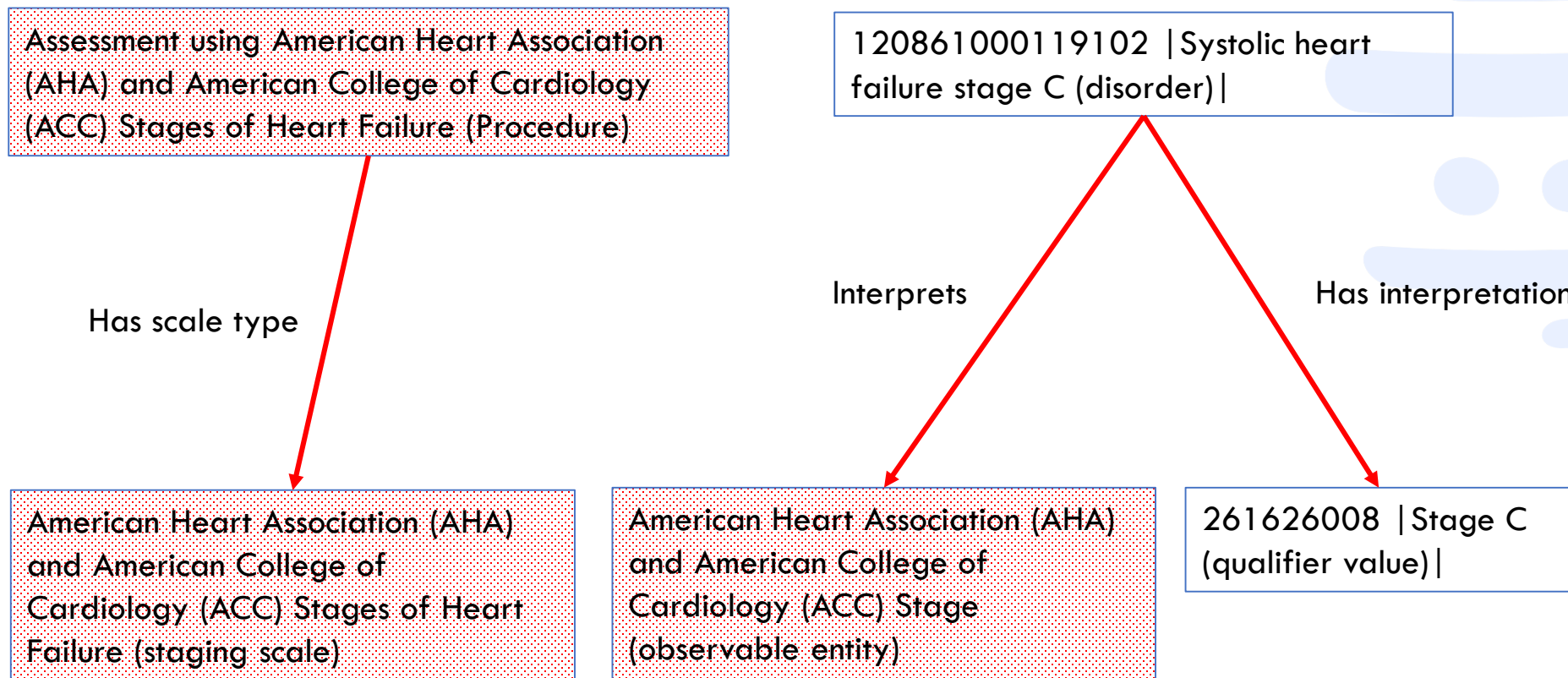
Options For Remodeling

Option 1



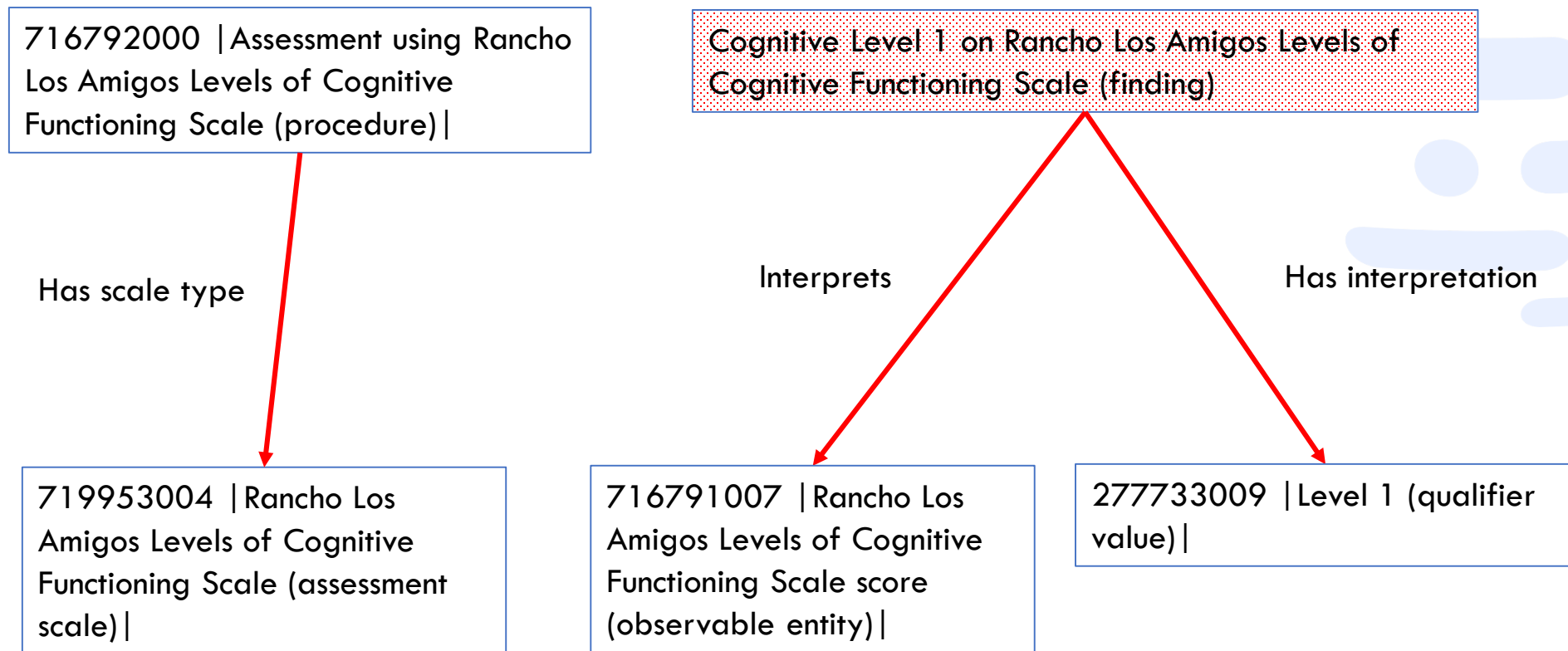
Options For Remodeling (cont.)

Option 1 – Example A



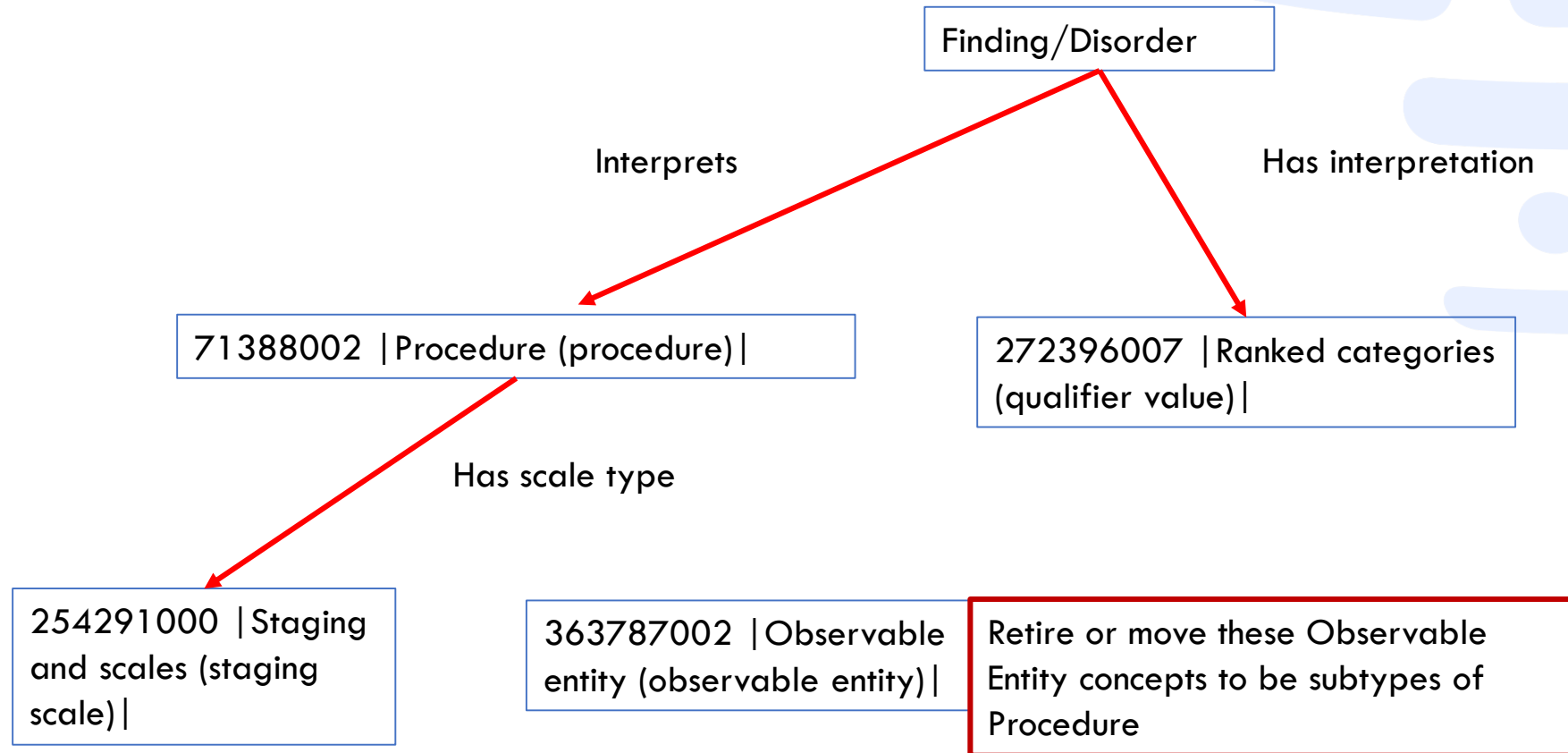
Options For Remodeling (cont.)

Option 1 – Example B



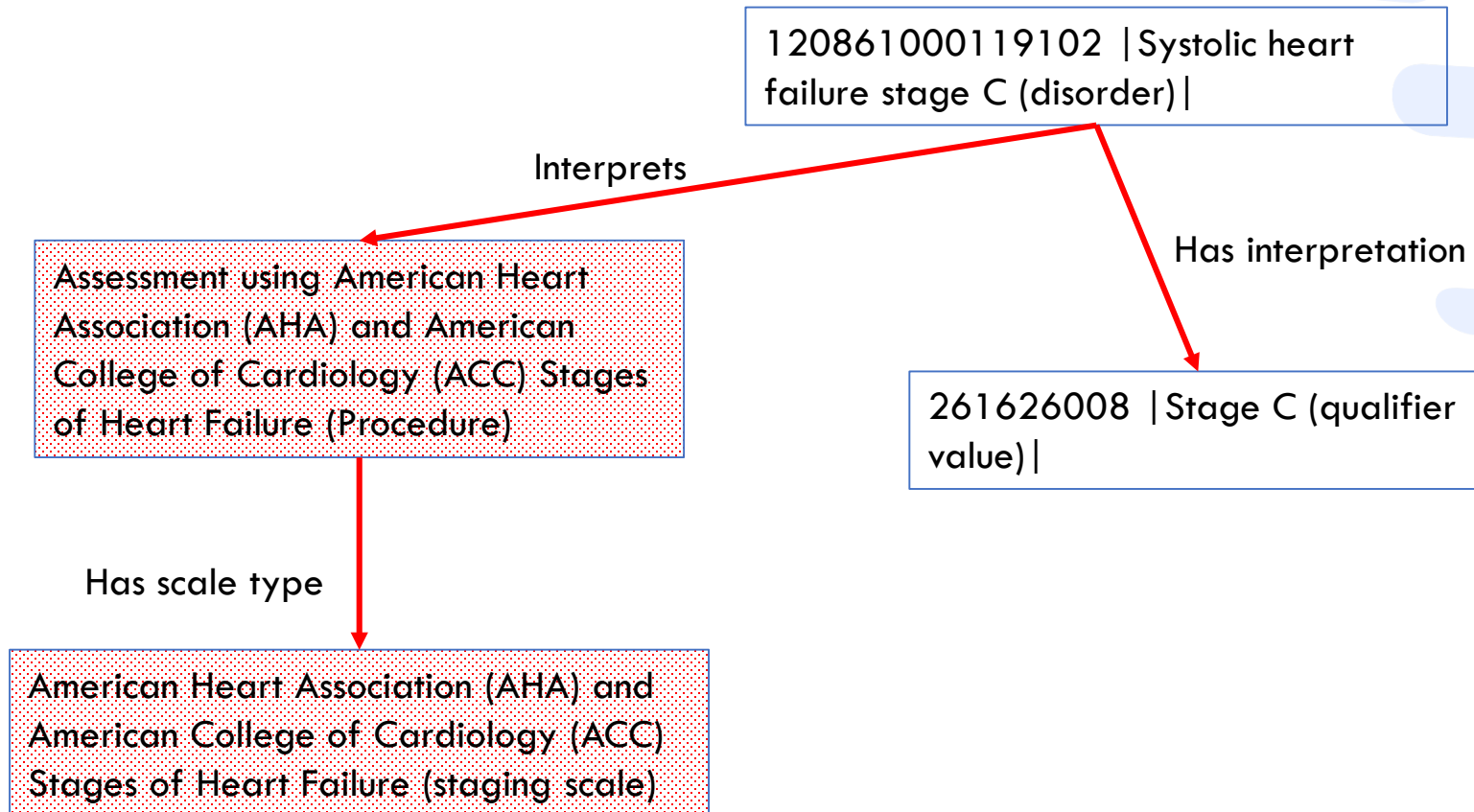
Options For Remodeling (cont.)

Option 2



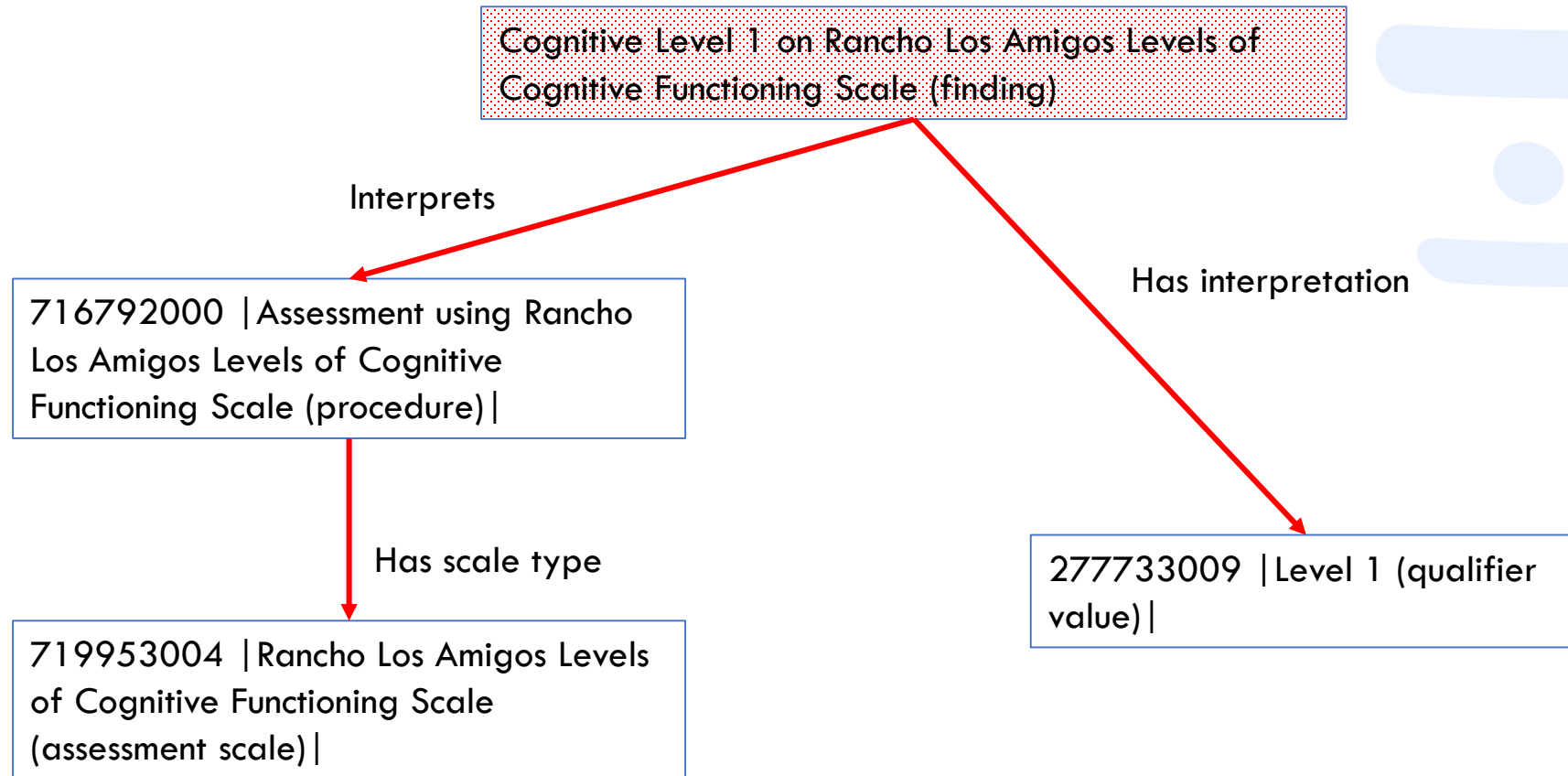
Options For Remodeling (cont.)

Option 2 – Example A



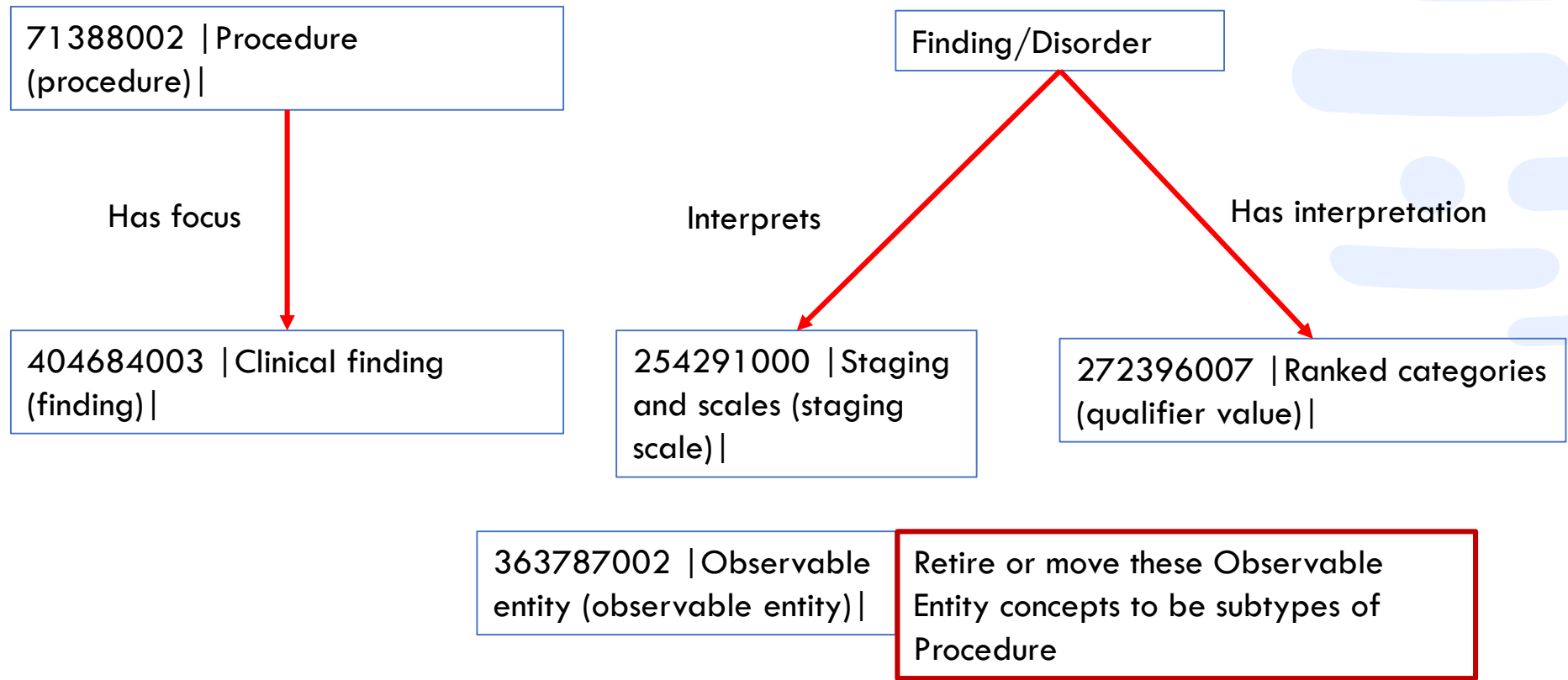
Options For Remodeling (cont.)

Option 2 – Example B



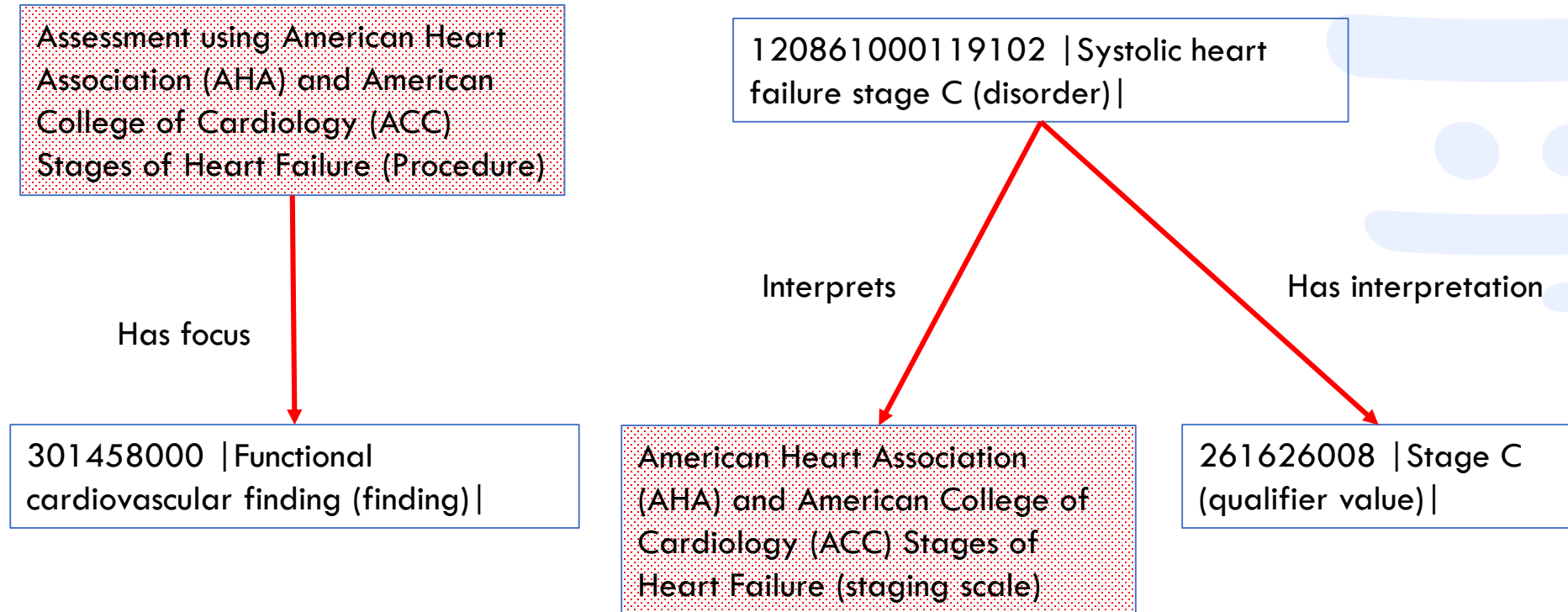
Options For Remodeling (cont.)

Option 3



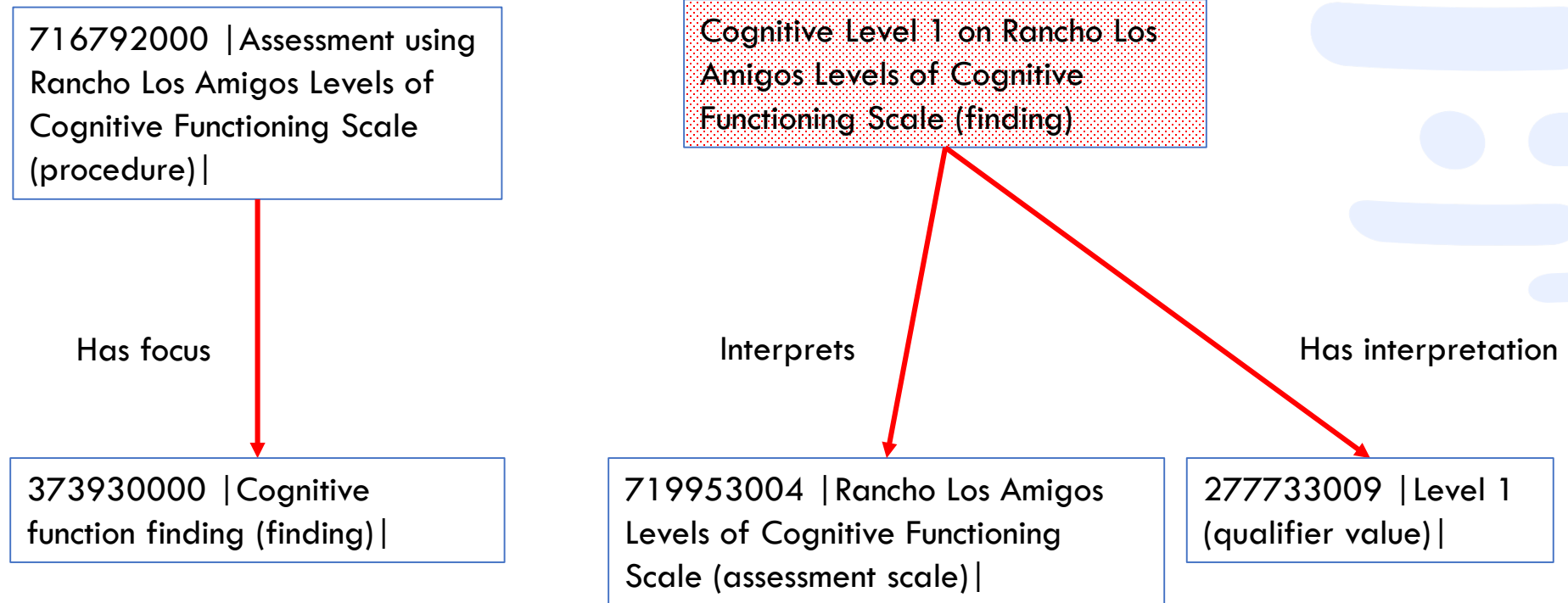
Options For Remodeling (cont.)

Option 3 – Example A



Options For Remodeling (cont.)

Option 3 – Example B



Recommendations

- Option #3 can be accomplished without the addition of new concept model attributes
- It would require the addition of 254291000 | Staging and scales (staging scale) | as an allowable value for Interprets.
- A large number of Observables would need to be retired or made a subtype of Procedures.

Discussion

How to Represent Grade/Score/Scale Values ?

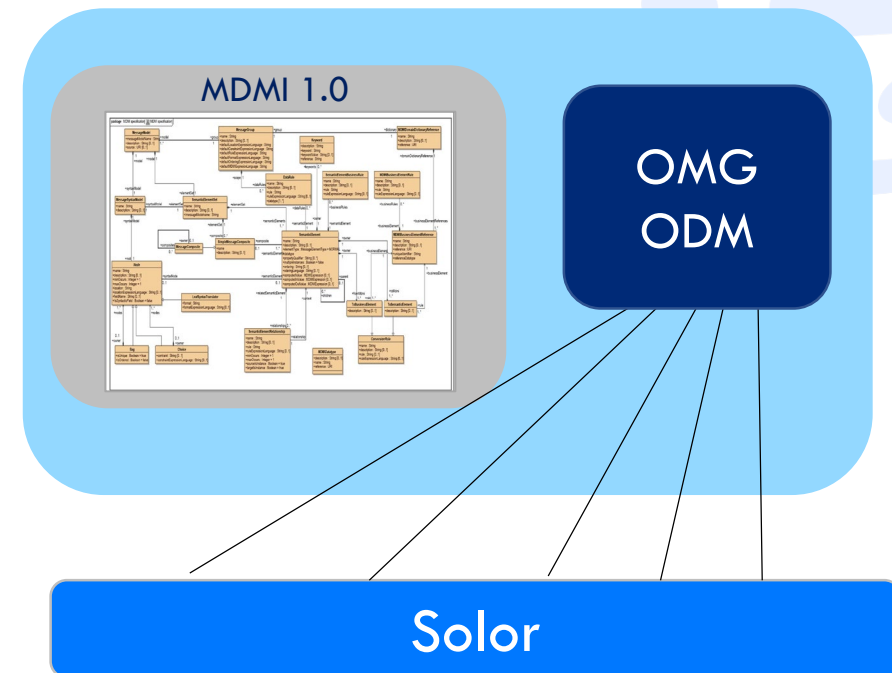
- Numeric Values
 - 401323002 | Borg Breathlessness Score: 0.5 very, very slight (just noticeable) (finding) |
- Alpha-Numeric Values
 - 735623008 | Grade A2 albuminuria (disorder) |
- Range of Scores
 - 369776000 | Gleason Score 5-6: Moderately differentiated (finding) |
- Some Values are expressed with their scale
 - 33013007 | Gleason grade score 8 out of 10 (finding) |

MDMI

MDMI 2.0

The plan for MDMI 2.0 is to use Solor as the Reference Model to add Semantic Concepts for each Business Element in the SEER to provide a unique, post-coordinated description.

- The business elements in MDMI 2.0 will have post-coordinated concepts linked to the semantic concepts in Solor.
- Solor provides a harmonized understanding of many industry standard healthcare ontologies & terminologies.



Summary

- MDMI and Solor are complementary.
- MDMI would like to use Solor as the Reference Model for meaning.
- Filling the gap in the Information Architecture will continue to reveal new opportunities to drive best practices and clinical workflow across the entire continuum of care, integrating multiple providers working in independent systems.

Get Started with Solor

Get Involved

- Solor project information on HSPC Confluence
 - <https://healthservices.atlassian.net/wiki/spaces/Solor/overview>
- Sources for Documentation and Tools
 - KOMET – <https://github.com/OSEHRA/komet>
 - ISAAC – <https://github.com/OSEHRA/ISAAC>
- Solor JIRAs
 - <https://healthservices.atlassian.net/projects/SOL/summary>
 - <https://healthservices.atlassian.net/projects/SIK/summary>
- Solor Website
 - <http://solor.io>
 - <http://solor.io/blog/>
- Solor Viewer App and User Guide
 - Navigate to **Learn More** section of <http://solor.io>



Thank You!

- Attendees
- Healthcare Services Platform Consortium (HSPC)
- Veterans Health Administration (VHA)
- Intermountain Health
- PenRad
- Book Zurman
- Cognitive
- Deloitte
- Sujanski & Associates
- TermMed
- CSIRO
- Amplified
- VetsEZ
- Federal Health Architecture (FHA)