



solor

SHIELD - IVD Semantic Interoperability Working Group

Keith E. Campbell M.D. PhD

Raja Cholan MS

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<http://www.solor.io>

Getting Started

Our presentation of SOLOR at 2nd HSPC meeting in August 2018 raised public interest in our work and our **vision for semantic interoperability**.

Our goal during this presentation is to:

- Introduce you to SOLOR
- Show how we can help SHIELD
- Receive your feedback on how we can improve our tooling to meet your needs

Semantic Interoperability

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.

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**

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- Mapping is always **out of date**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

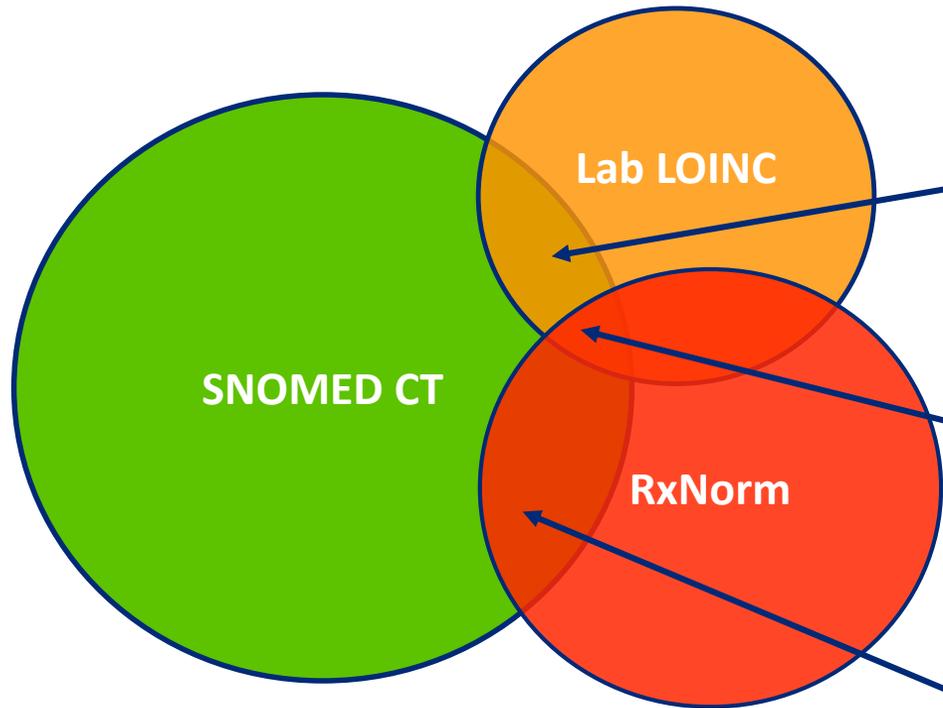
- Content is not driven by implementation needs
- Insufficient detail for a clinical care

Clinical Data Standards

- Lack coherence
- Submission process does not meet operational needs

Every System is Different!

Overlap in Content

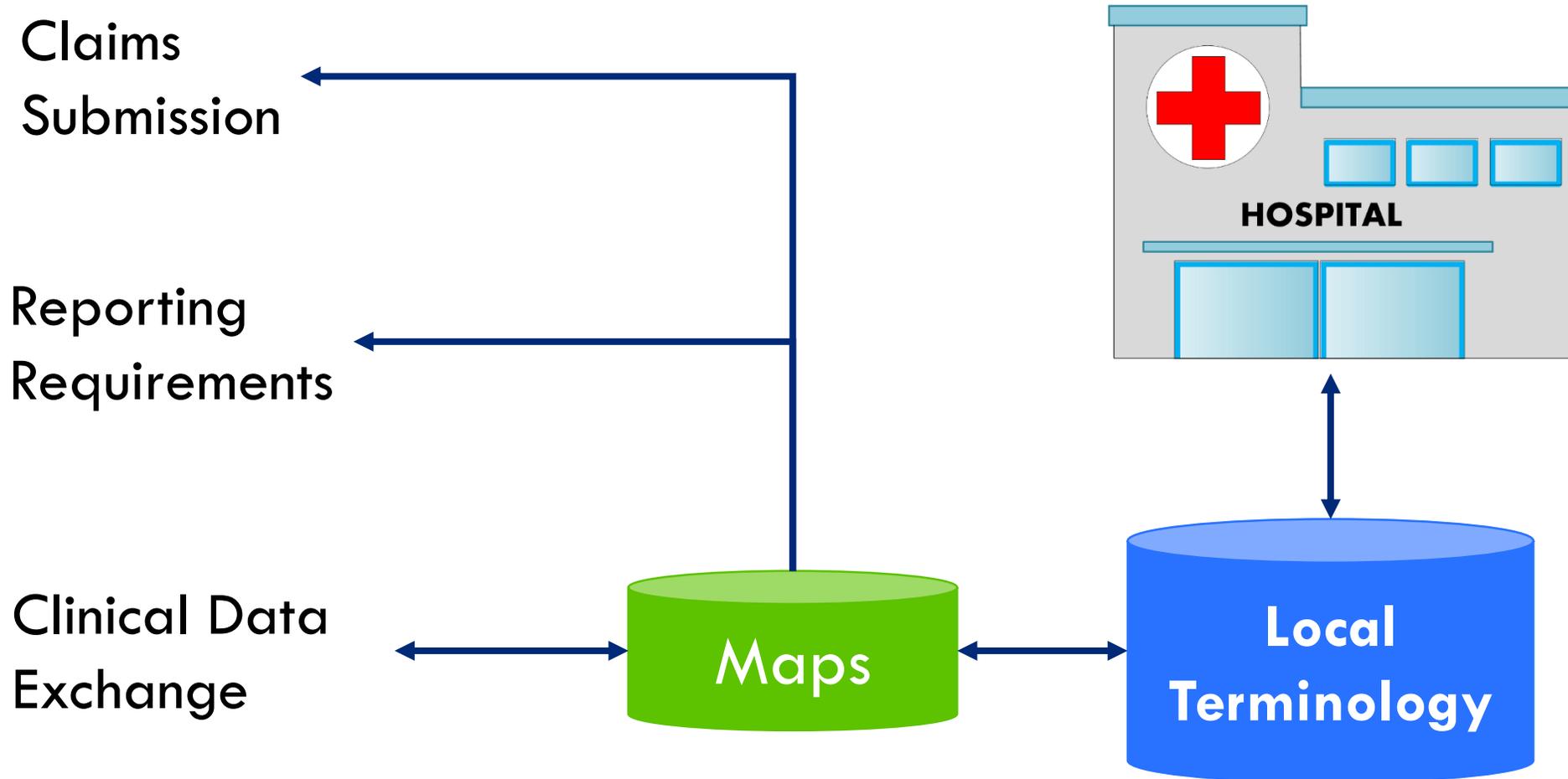


SNOMED CT	LOINC
LOINC: Gentamicin is a component of laboratory tests	
SNOMED: Gentamicin is a component of laboratory tests	

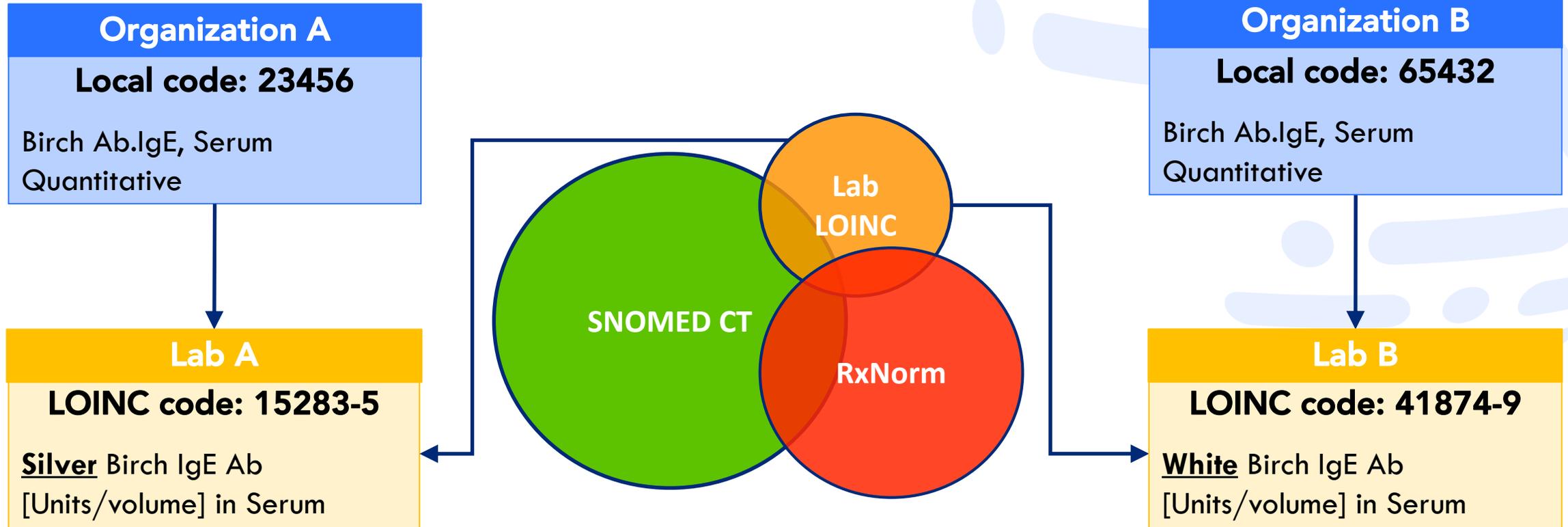
SNOMED CT	LOINC	RxNorm
LOINC: Gentamicin is a component		
SNOMED: Gentamicin is a substance		
RxNorm: Gentamicin is an ingredient		

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



LOINC Mapping Example



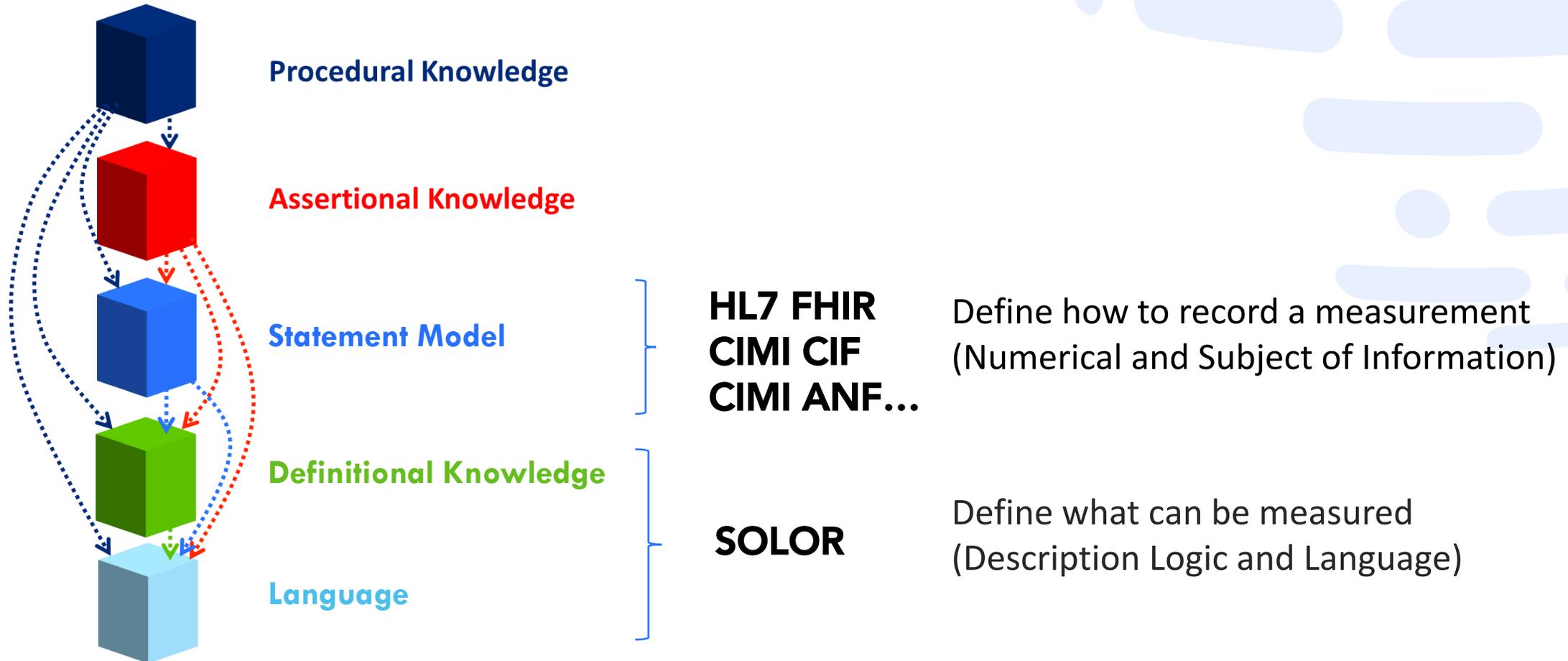
 Mapping can add false information

Enabling Semantic Interoperability

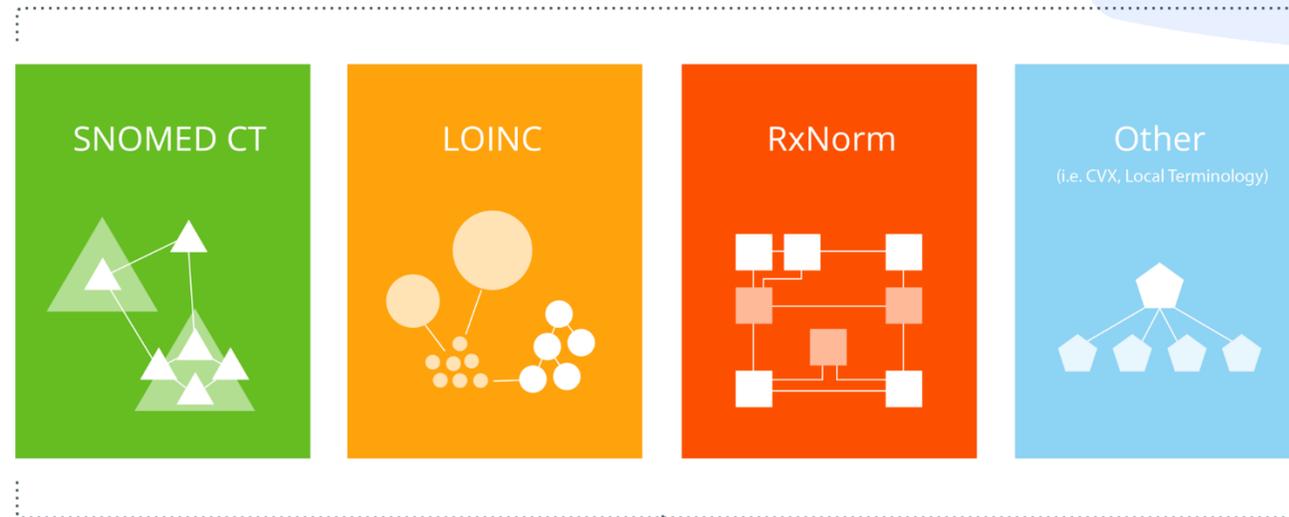
- ✓ **Standardize the Standards**
 - Standardize the encoded data model
 - Standardize the extension model
- ✓ **Meet Operational Needs**
 - Enable sharing of extensions
 - Open-extensions
 - Proprietary-extensions
- ✓ **Evolve Existing Systems**
 - SNOMED, LOINC, RxNorm and other terminologies

Introduction to SOLOR

Architectural Layers for Separation of Concerns



What is the **System Of LO**gical Representation (SOLOR)?



Integration of terminology in a common model

Architectural Separation of Concerns



Measurement is a concern of the statement model

- Quantitative measurement
- Existential measurement



Defining what is measured is a concern for SOLOR

- Dot-blot hemorrhage of the retina
- Pressure ulcer on the left olecranon process
- Type 1 diabetes

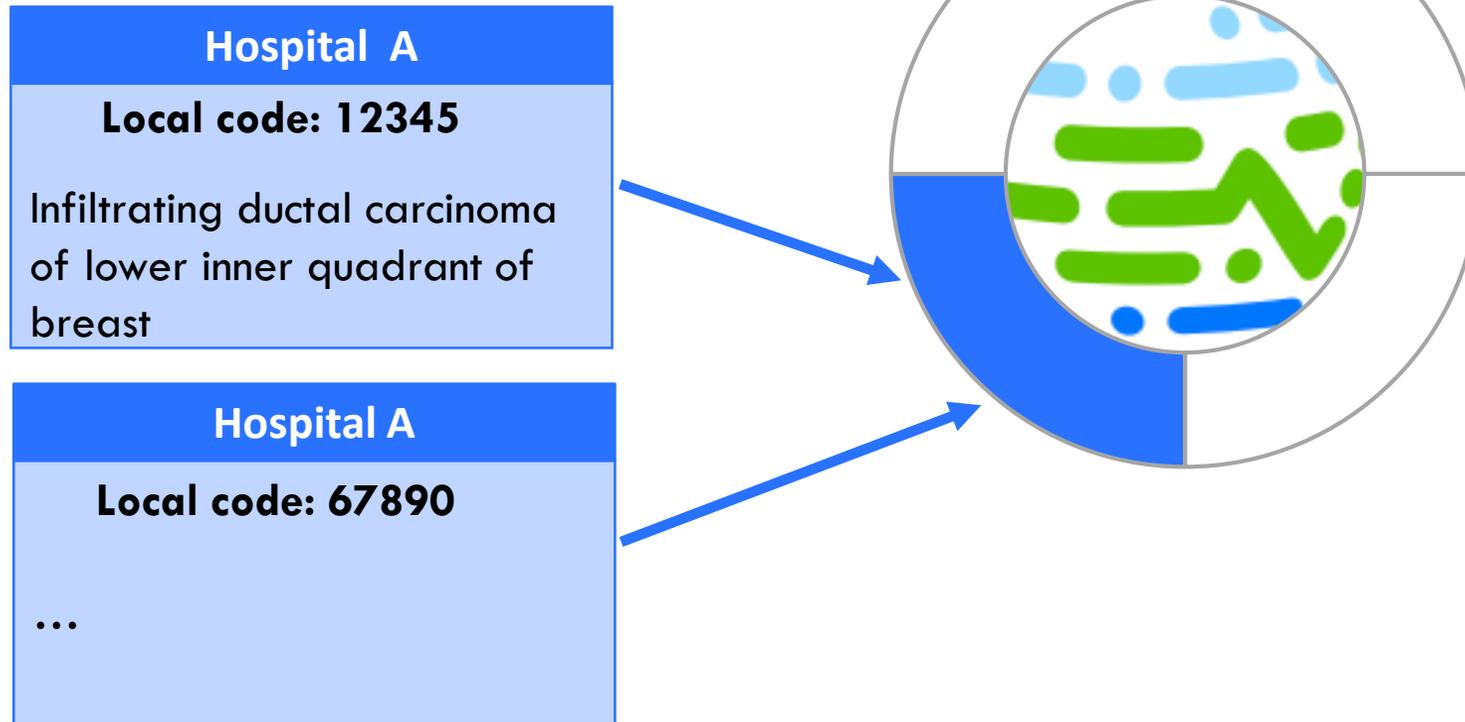


Measurement of absence needs to be removed from SOLOR sources to allow layers to address separate concerns

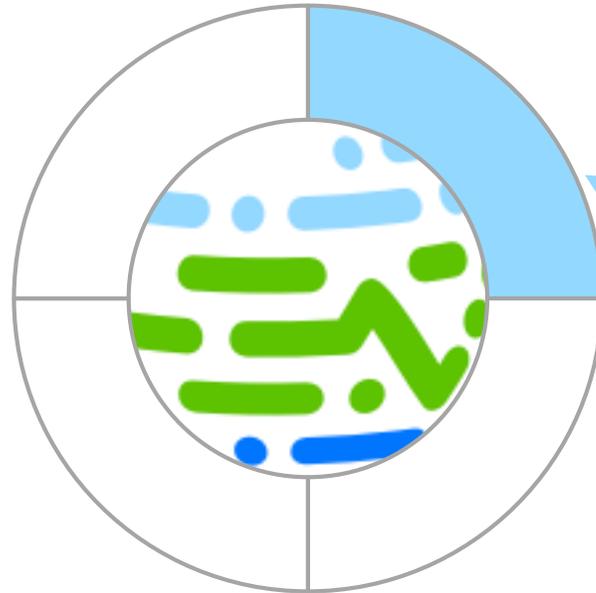
An Example of a SOLOR Extension

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

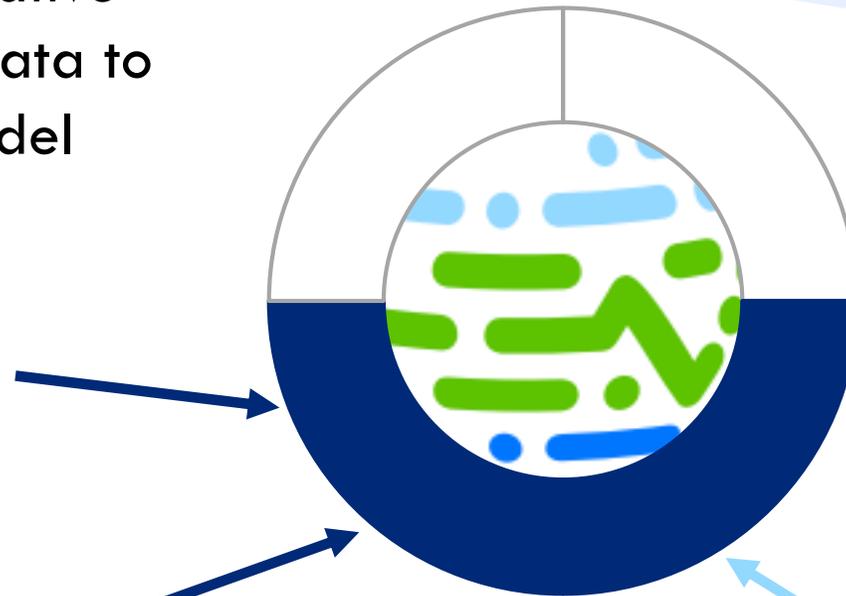
Infiltrating ductal carcinoma of lower inner quadrant of breast

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

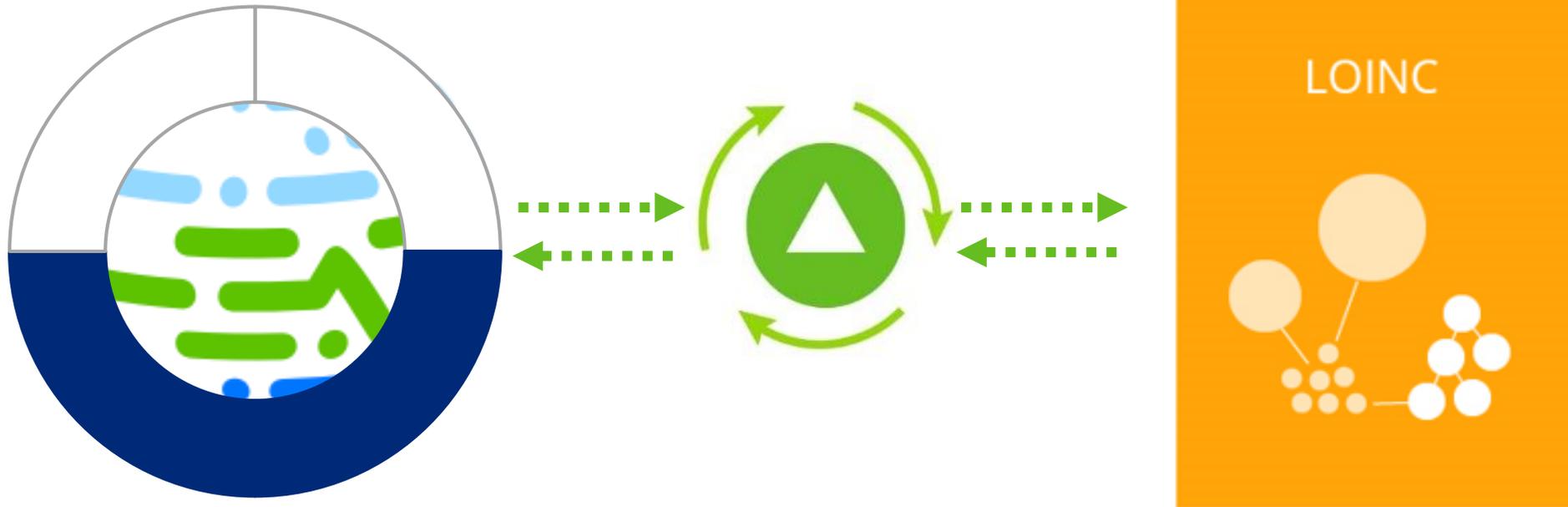
Hospital A
Local code: 67854
...



Searches for concept in shared SOLOR extension

Medical Practice
Infiltrating ductal carcinoma of lower inner quadrant of breast

Content Contributed to the Standard



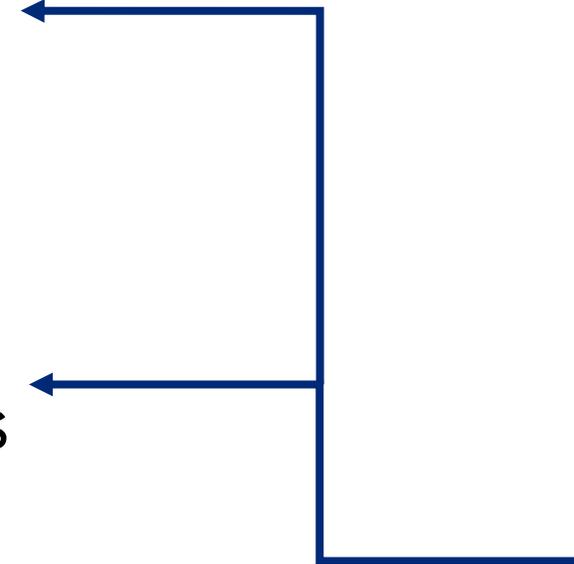
New concepts in extensions
can be contributed back

SOLOR Implementation

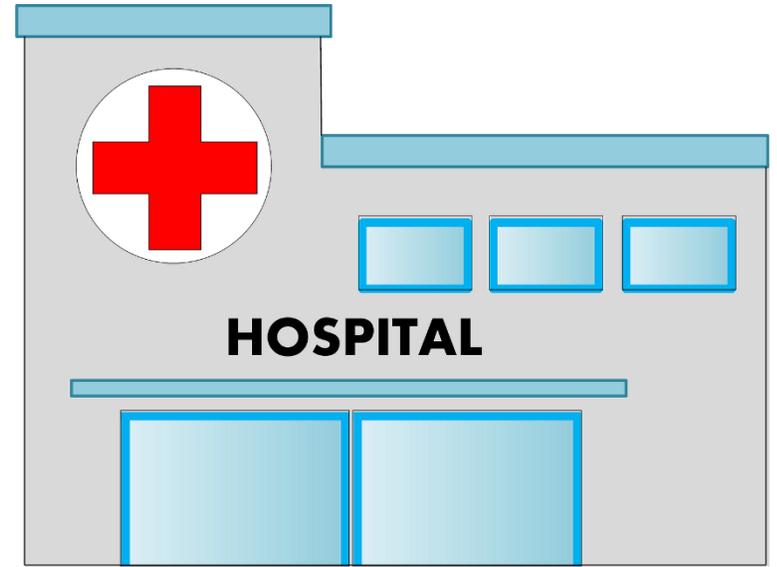
Claims
Submission

Reporting
Requirements

Clinical Data
Exchange

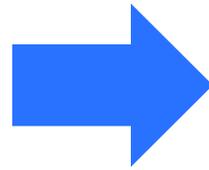


Local
Enhancement



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

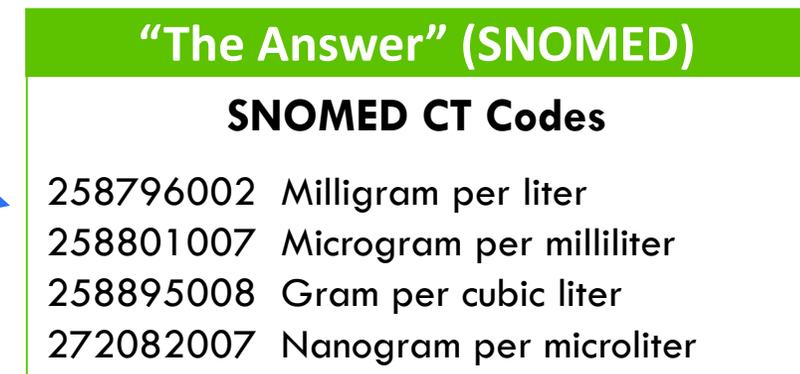
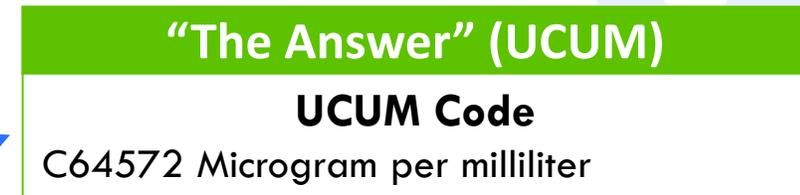
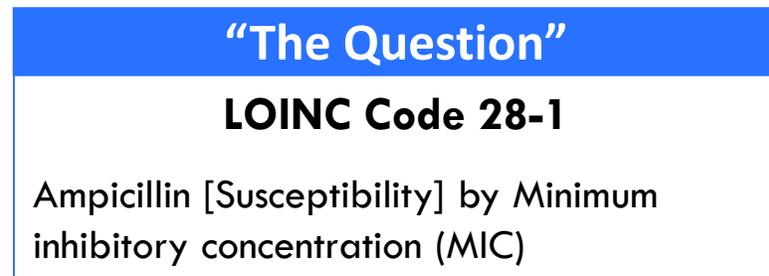
SOLOR & SHIELD

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

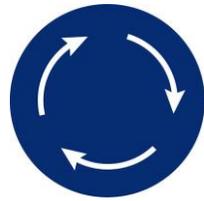
Proposed LIVD Integration

- 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)

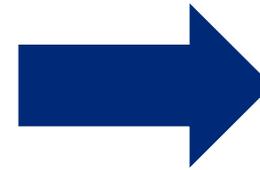
Integration into a Common Model



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 three main panels:

- Left Panel (Taxonomy):** Shows a hierarchical tree of concepts. The 'ACE' category is expanded, listing 'Clinvar Variant NM_000789.3(ACE):c.*185G>A' and 'Clinvar Variant NM_000789.3(ACE):c.*319A>G'. A red banner at the top indicates '5535 Inferred roots... More details'.
- Center Panel (Variant Detail):** Displays details for 'Clinvar Variant NM_000789.3(ACE):c.*185G>A'. It includes a 'CON' section with a note 'Active in SOLOR genomic module on Development path', an 'EXTENSIONS' section for 'STR' with the variant name, a 'DEF' section with the variant name, and 'AXIOMS' sections showing necessary sets and ACE relationships.
- Right Panel (Search Results):** Shows search results for 'ACE', listing various Clinvar variant identifiers 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

Appendix

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

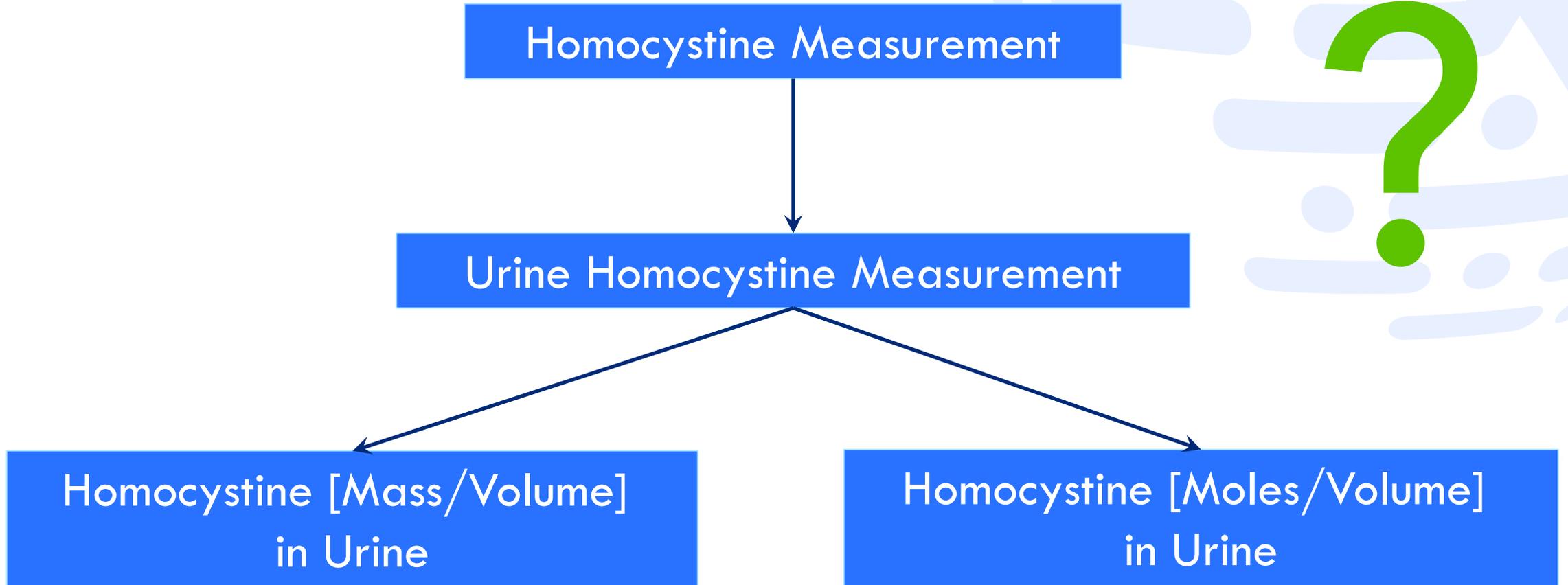
+urine +homocystine

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

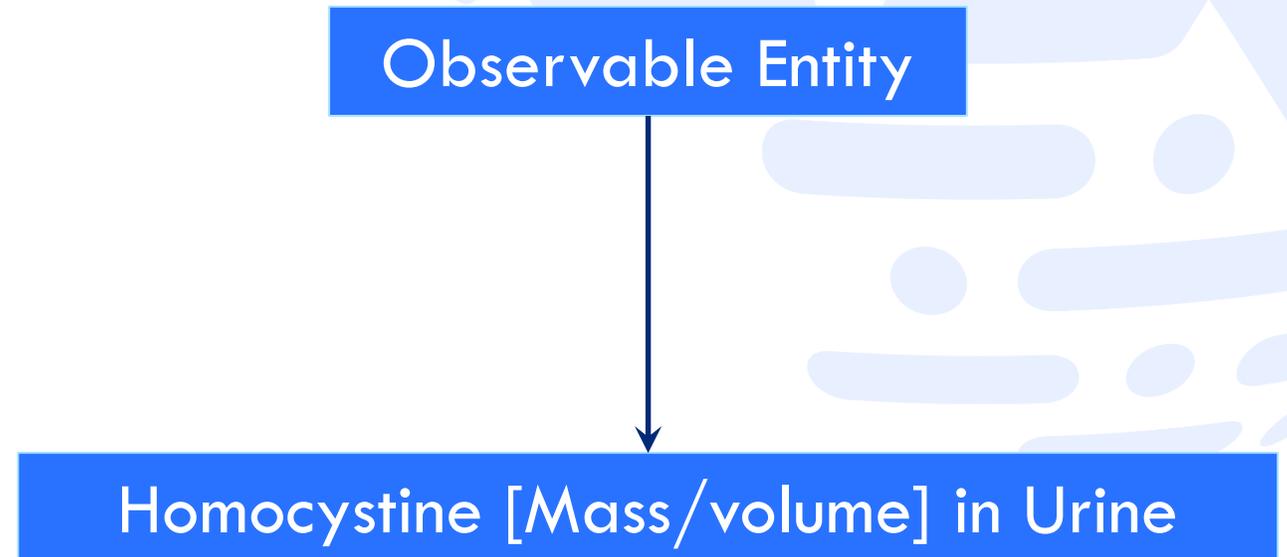
LOINC Concepts

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 →

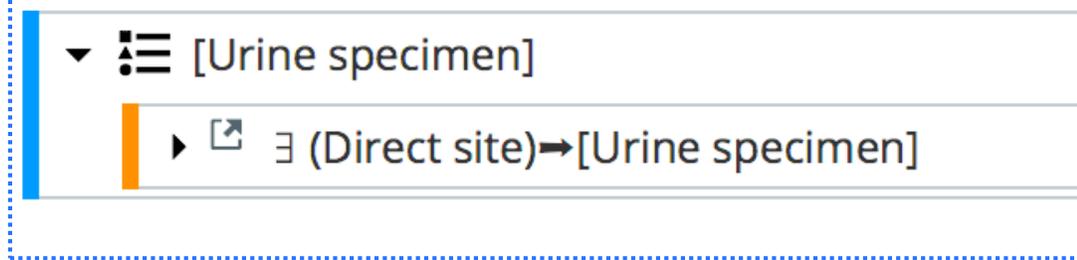
3 ⚙️

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

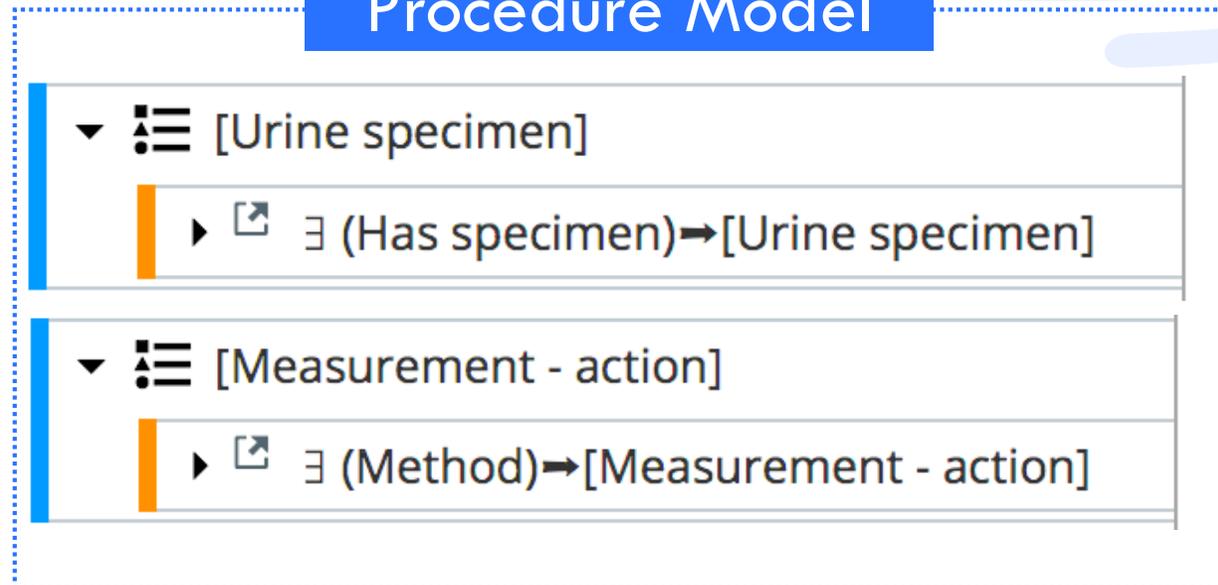


Minor Model Differences

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 must take into account all the different ways to represent the same thing
- It results in a redundant effort at best
- There is a greater opportunity for omissions, which may result in patient harm