



solor

HSPC 17th General Meeting

July 31, 2018

Keith E. Campbell MD PhD

Andrew Sills

Sarah Connelly PhD

SOLOR: <http://solor.io>

Healthcare Services Platform Consortium Project: <https://www.hspconsortium.org>

THE PROMISE



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



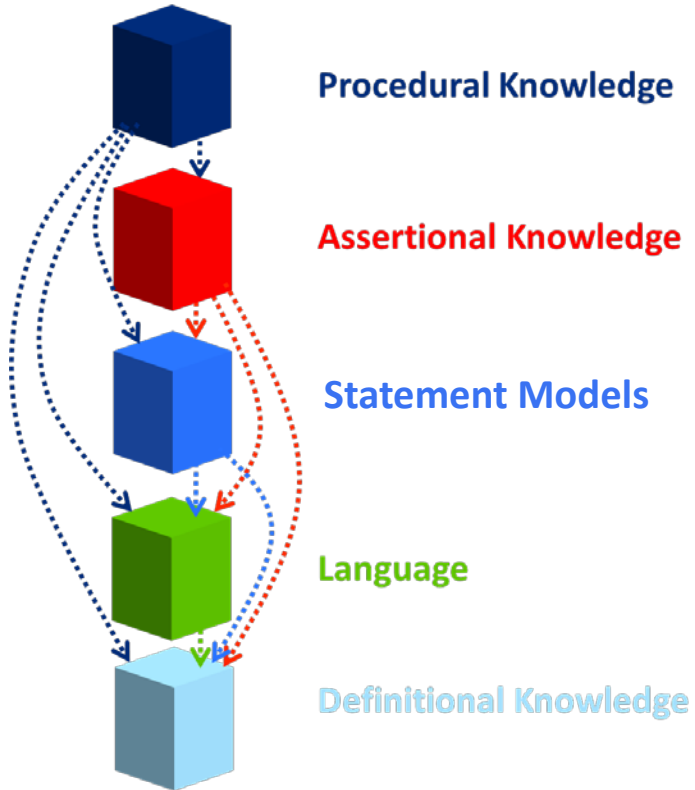
Integrate high-quality decision support into the clinical workflow across the continuum of care

Agenda

Topic	Slide(s)
Separation of Concerns	4 – 6
SOLOR Content Improvements	8-15
SOLOR Release Files of SNOMED CT Improvements	16 – 19
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Separation of Concerns

Separation of Concerns



Procedural Knowledge

Assertional Knowledge

Statement Models

Language

Definitional Knowledge

- Each architectural layer addresses **separate concerns**
- SOLOR—defines concepts to **support a statement model**
 - Action that may be requested
 - Action that may be performed
- Domain Model—defines a **statement model**
 - Measurement is a concern of the Domain Model
 - Subject of information

Statement Model

Clinical Statement																					
Narrative:	Ibuprofen 400 mg tablet oral every 6 hours as needed for back pain; may increase dose frequency to one tablet every 4 hours																				
Statement type:	<i>[Request]</i>																				
Subject of info:	<i>[410604004 Subject of record]</i>																				
Mode:	<i>[Template]</i>																				
Authors:	<i>[223366009 Healthcare professional]</i>																				
Action topic:	<i>[Procedure]-</i> <i>→[260686004 Method]→[129445006 Administration - action]</i> <i>→[363701004 Direct substance]→[197805 Ibuprofen 400 MG Oral Tablet]</i> <i>→[410675002 Route of administration]→[260548002 Oral]</i>																				
Circumstance:	<table border="1"> <thead> <tr> <th colspan="2">Request Circumstance</th> </tr> </thead> <tbody> <tr> <td>Timing:</td> <td><i>[2007-04-05T14:30Z, 2007-04-05T15:00Z]±P5M [ISO 8601]</i></td> </tr> <tr> <td>Purposes:</td> <td><i>[161891005 Backache (finding)]</i></td> </tr> <tr> <td>Triggers:</td> <td>∅ associate statement backache present</td> </tr> <tr> <td>Participants:</td> <td><i>[410604004 Subject of record]</i></td> </tr> <tr> <td>Priority:</td> <td><i>[50811001 Routine (qualifier value)]</i></td> </tr> <tr> <td>Repetitions:</td> <td> <table border="1"> <thead> <tr> <th colspan="2">Repetition</th> </tr> </thead> <tbody> <tr> <td>Start:</td> <td>Anytime, as needed</td> </tr> <tr> <td>Duration:</td> <td>24 hours</td> </tr> </tbody> </table> </td> </tr> </tbody> </table>	Request Circumstance		Timing:	<i>[2007-04-05T14:30Z, 2007-04-05T15:00Z]±P5M [ISO 8601]</i>	Purposes:	<i>[161891005 Backache (finding)]</i>	Triggers:	∅ associate statement backache present	Participants:	<i>[410604004 Subject of record]</i>	Priority:	<i>[50811001 Routine (qualifier value)]</i>	Repetitions:	<table border="1"> <thead> <tr> <th colspan="2">Repetition</th> </tr> </thead> <tbody> <tr> <td>Start:</td> <td>Anytime, as needed</td> </tr> <tr> <td>Duration:</td> <td>24 hours</td> </tr> </tbody> </table>	Repetition		Start:	Anytime, as needed	Duration:	24 hours
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What are the Implications of 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

SOLOR Content Improvements

Content work was completed for VA by Book Zurman, Inc. under the Informatics Support Services Contract No. VA701-16-C-0039.

Need for Consistent Representation



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

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



Negation in definitional layer causes confusion and delay

- Utilizing the wrong semantics
- Producing intractable computation
- Creating a poor separation of concerns

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

Content Selection and Review

Selection

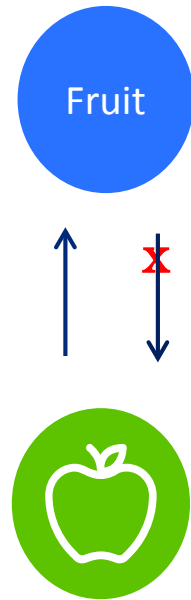
50,000 concepts selected

- Negation (no speech)
- Subject is not patient (father smokes)
- Compound observations (nausea and vomiting)

Review Process

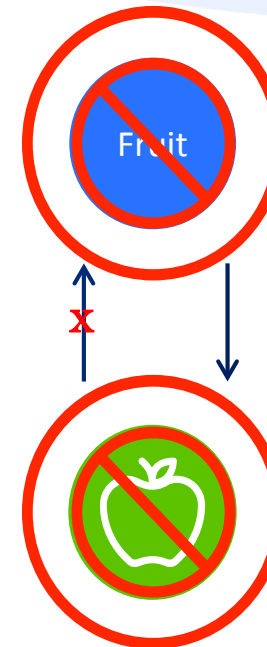
- Two independent reviewers
- Disagreements were analyzed and resolved
- 10% sample for each topic reviewed twice

Example of Negation



Having an "Apple" = Having a "Fruit"

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

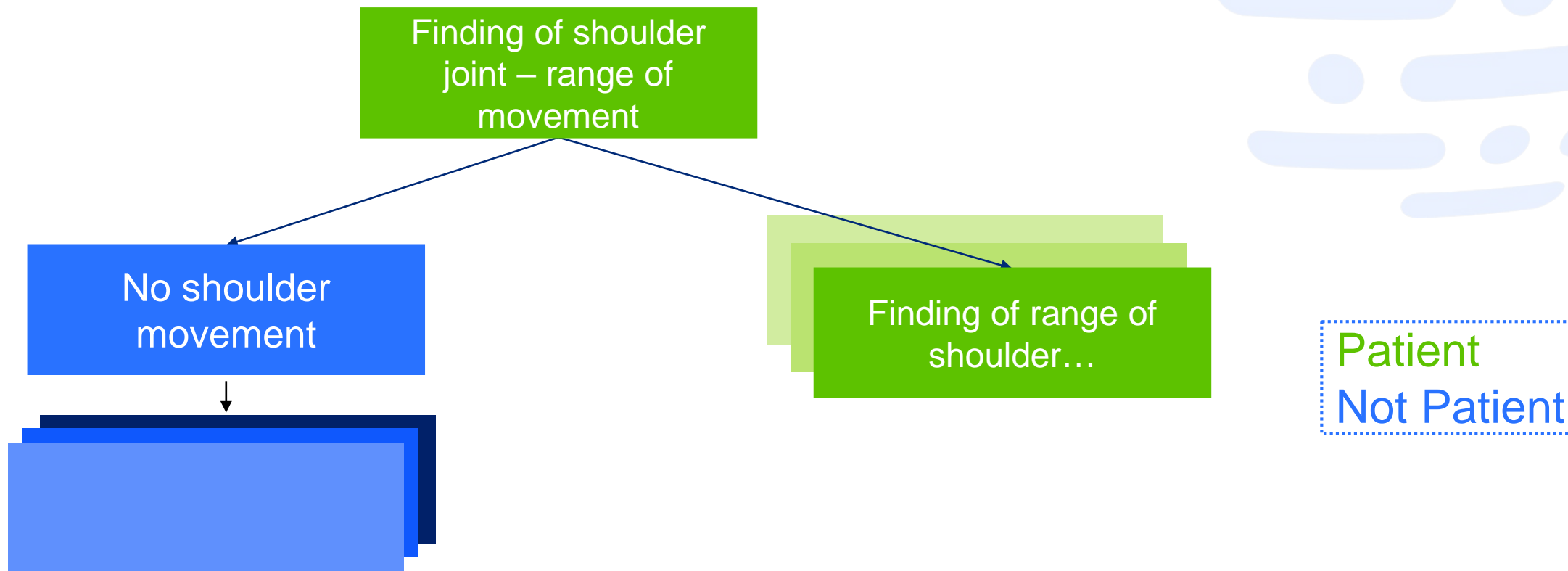


Having "No Fruit" = Having "No Apple"

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

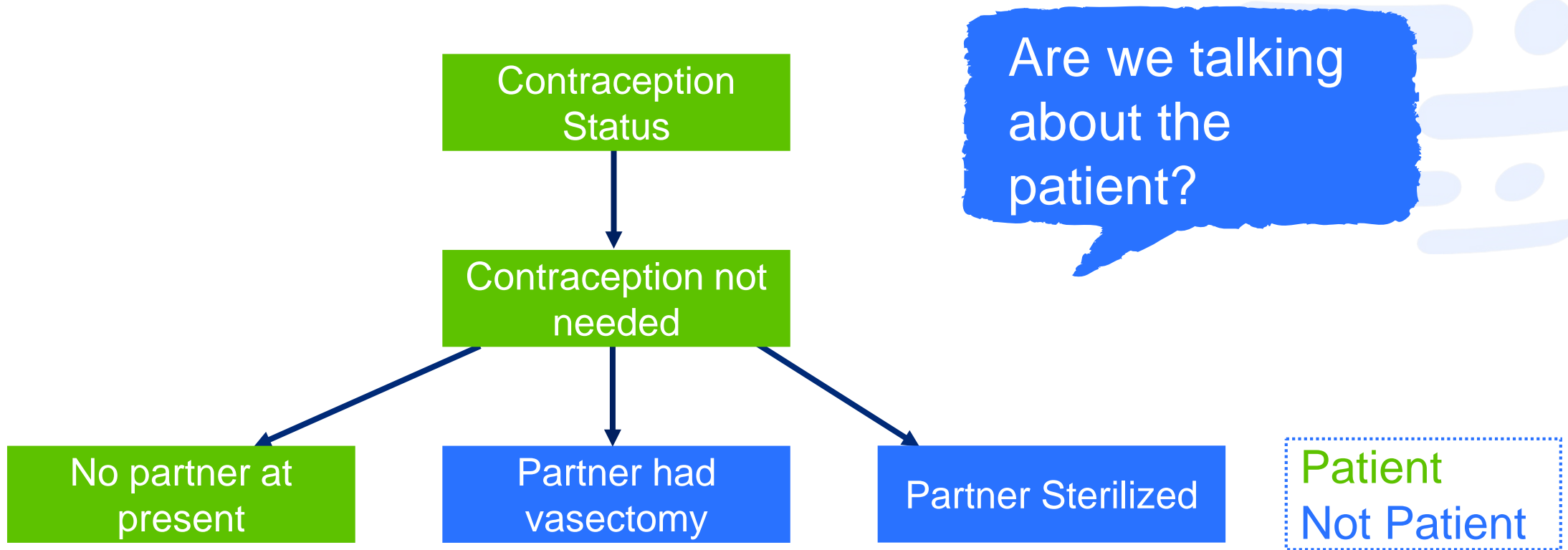
SNOMED Negation Example

What does “no shoulder joint movement” mean?



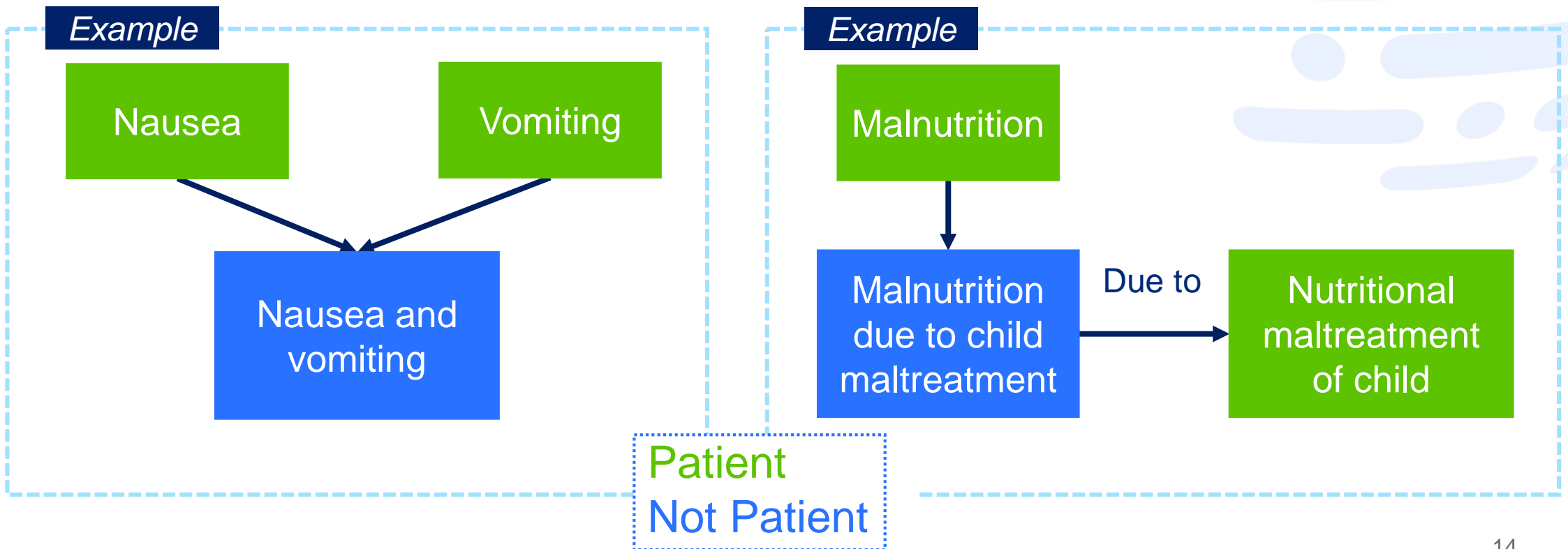
Patient is Not Subject of Record

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



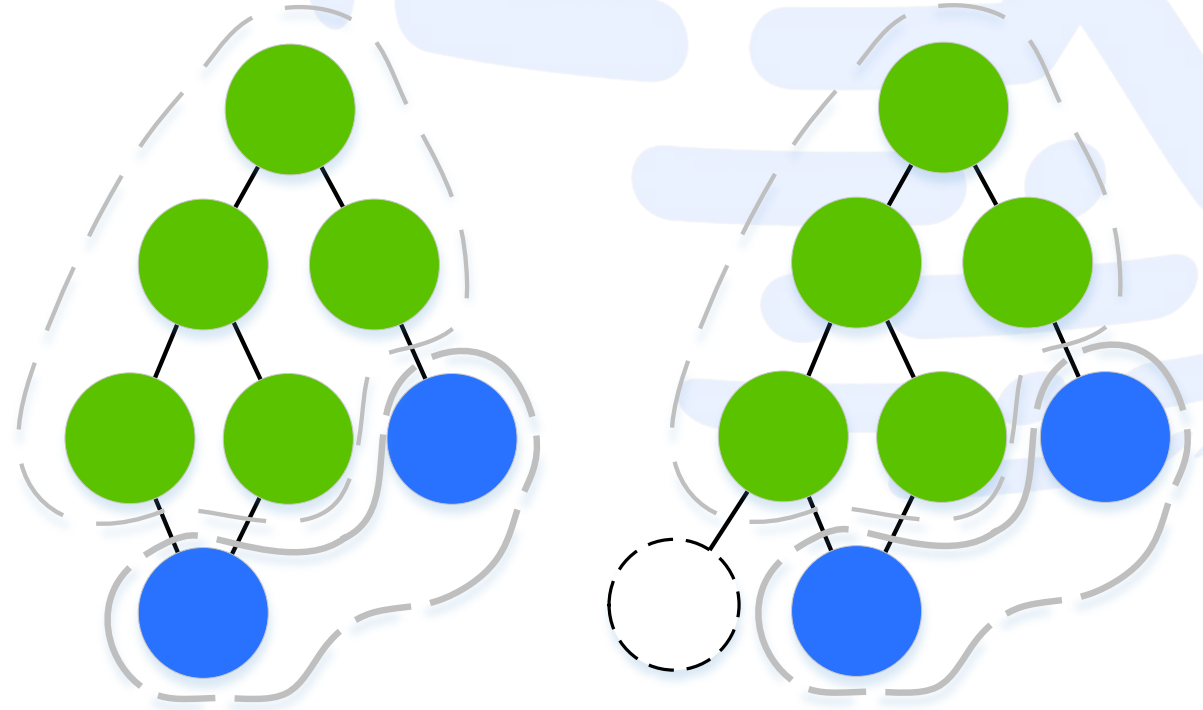
Compound Observations

- ☰ 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

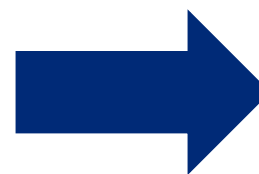
Extract, Transform, and Load



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 with a top bar containing tabs: '+', 'empty', and 'No shoulder movement x'. Below the tabs 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 'History' toggle set to 'OFF'. The main content area is titled 'Expand All' and contains a list of extensions under the heading 'CON'. The list includes:

- 6 Active in SNOMED CT® core modules on Development path
- 6 REF SNOMED legacy implication
Sufficient concept definition
- 6 STR SCTID
304298000
- 4 MBR Negated assemblage
Member
- 4 MBR Not compound assemblage
Member
- 4 MBR Patient is subject assemblage
Member

A red bracket groups the three MBR entries. A dashed green box contains the text: 'Concept is a member of these assemblages'.

RF2 Export from SOLOR Viewer

Easing Content Integration



- **Understood** that a custom SOLOR Release File format may inhibit future content integration
- **Researched** other Release File formats that could extend to the SOLOR Content
- **Focused** on requiring minimal custom implementation on the “receiving” terminology systems side
- **Decided** on using a custom implementation of the SNOMED Release File Format (**RF2**) for exporting

Breaking Down SOLOR Export

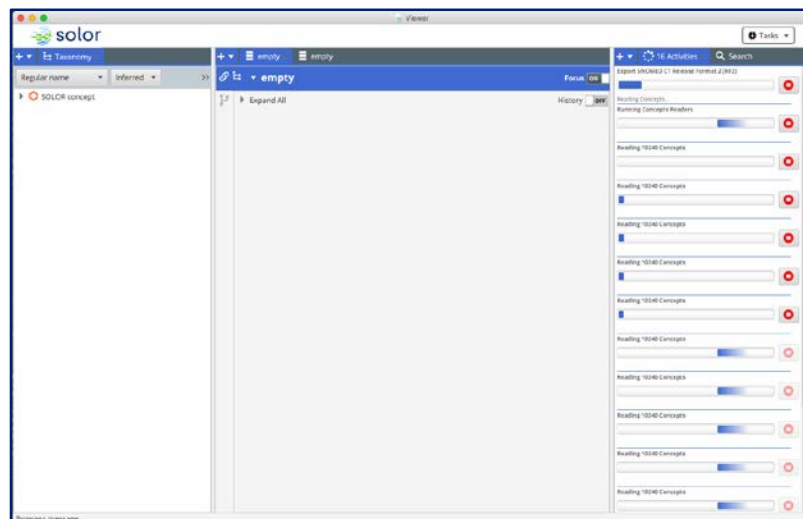


- **Identifiers & UUIDs** – Concepts within SOLOR content are assigned a RF2 compliant SCTID, adhering to appropriate partition identifiers and check-digits specifications and logic
- **SNOMED Concepts** – Original SCTIDs are preserved from previous SNOMED content imports (e.g. **55350005**)
- **RxNorm Concepts** – New SCTIDs are generated with a partition identifier of **97** (e.g. **116680973**)
- **SOLOR Concepts** – New SCTIDs are generated with a partition identifier of **99** (e.g. **150311056999778140999**)
- **File Names & Structure** – File naming adhere to the RF2 standard, as well as, the zipped folder structure (e.g. Full, Snapshot, Refset, etc)

SOLOR Export In Action!



- **Currently** SOLOR Viewer RF2 Export is in Beta Testing
- **Exporting** of SOLOR content is focused on all Concepts, Descriptions, and Relationships
- **Seeking** terminology tooling, providers, and platforms to integrate and share SOLOR RF2 content!



What's Next??

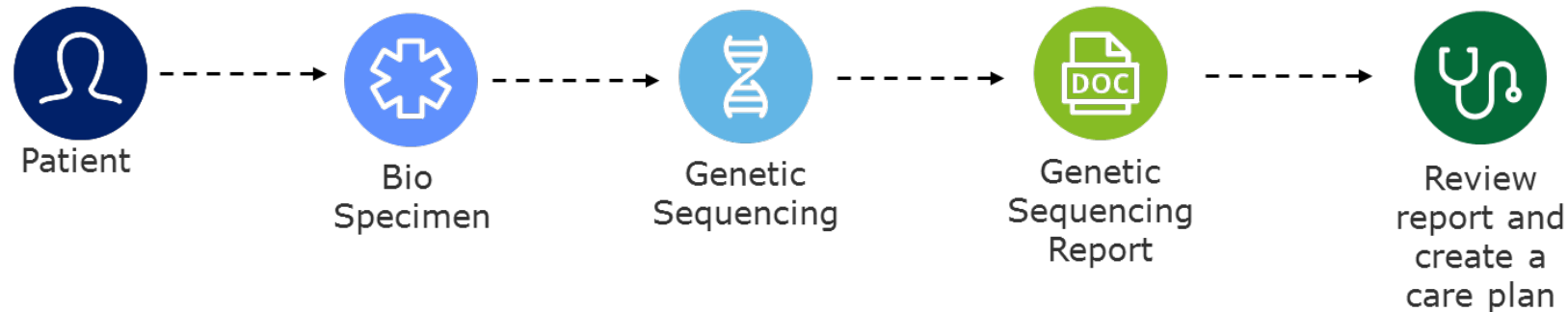
- RF2 Export will encompass SOLOR Assemblages, identifier, stated relationship, etc
- Official RF2 functionality will be released via solor.io in October 2018

SOLOR Genomic Content

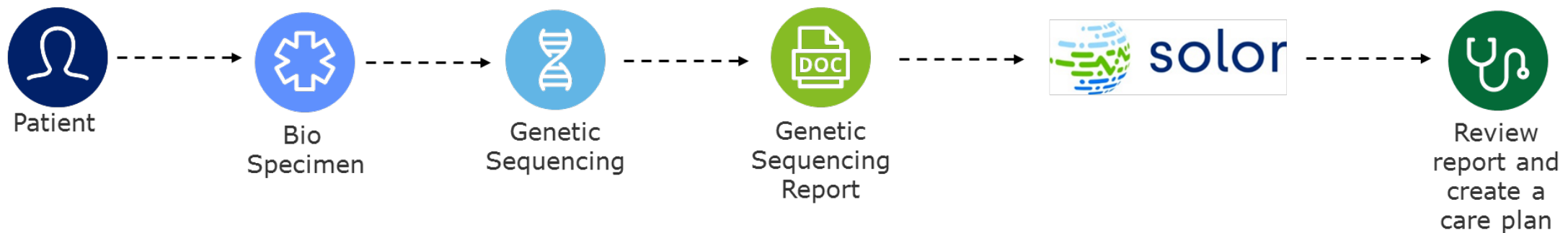
SOLOR Genetic Sequencing Model

The SOLOR Genetic Sequencing Extension can be used to improve variant to phenotype connections

Clinical Workflow for Genetic Testing



SOLOR Workflow for Genetic Testing



SOLOR Genetic Content Prototype

- **Utilize** Clinvar's summary data about variants and genes
- **Establish** relationship between desired variant and SNOMED concept

Variant Starting Point

NM_005228.4(EGFR):c.
2573T>G (p.Leu858Arg)

Variant Summary Data

31648 single nucleotide variant NM_005228.4(EGFR):c.2573T>G
(p.Leu858Arg) **1956** EGFR HGNC:3236 drug response 1 May
01, 2018 121434568 -
RCV000018084;RCV000418019;RCV000435684;RCV000018083;RCV0
00150629;RCV000211235;RCV000211410;RCV000211323.....

Disease Name Data

Lung cancer SNOMED CT C0684249
187875007 211980 16 Feb 2016 Disease

Gene Condition Source ID Data

1956 EGFR C0684249 Lung cancer
SNOMED CT 187875007 **211980** 16 Feb
2016



SOLOR Content Integration Update

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

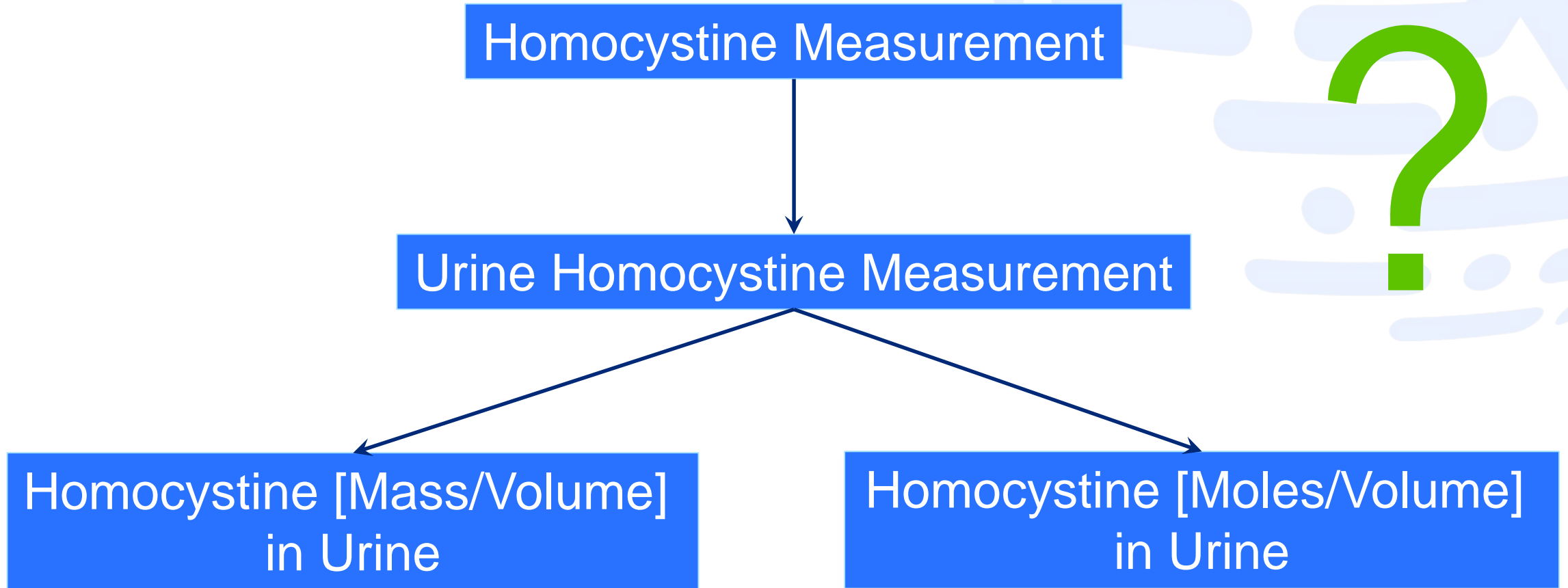
+urine +homocystine

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

Observable Entity

Homocystine [Mass/volume] in Urine

SNOMED ↔ LOINC

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

② Ⓜ

▶ **SYN** Urine homocystine measurement

② Ⓜ

▶ **SYN** Urine homocystine level

② Ⓜ

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 Ⓜ

▶ **SYN** Homocystine.free Ur-sCnc

① Ⓜ

DEF Necessary →

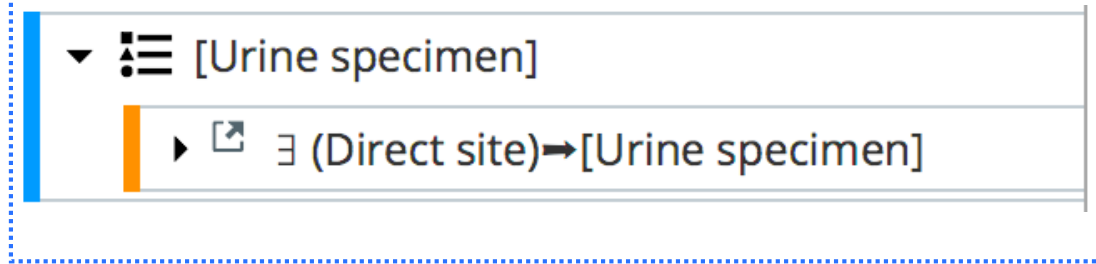
③ ⚙

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

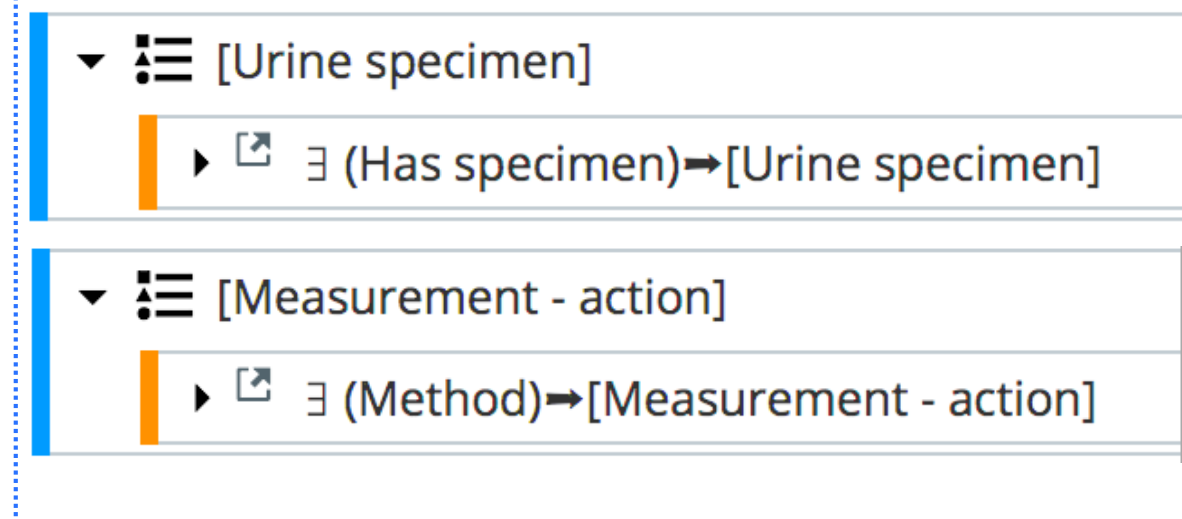


Minor Model Differences

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

RxNorm Integration

Product containing aspirin (medicinal product)

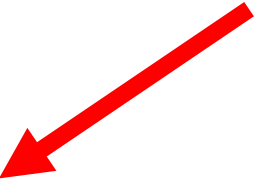
Expand All

CON

9 Active in SNOMED CT® core modules on Development path

Extensions:

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

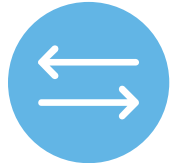


RxNorm Update



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
- We don't want to reinvent the wheel

What's New – What's Next – Get Involved

What's New

➔ FedHealthIT chose SOLOR for its 2018 Innovation Award on May 18, 2018! SOLOR was honored and presented the award at the [Fourth Annual FedHealthIT Innovation Awards](#) on June 12, 2018.

➔ OSEHRA awarded its Lifetime Achievement Award to Dr. Keith Campbell on July 19, 2018.

➔ Download SOLOR Viewer 1.2 from <http://solor.io>

➔ Download SOLOR Content from:

- SNOMED CT – Content Improvements
<https://healthservices.atlassian.net/wiki/spaces/SOLOR/pages/333119489/SOLOR+Assemblages>
- SNOMED CT – Skin Wound Assessment Extension
<https://healthservices.atlassian.net/wiki/spaces/SOLOR/pages/200114251/SOLOR+Skin+Wound+Assessment+Extension>

What's Next

- ➔ RF2-structured release format
- ➔ Continue efforts on LOINC integration
- ➔ Continue improvements to SNOMED CT
 - Inverse Concepts (Normal vs. Abnormal)
 - Primitive Concepts
 - Laterality Concepts

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/OSDHRA/komet>
 - ISAAC – <https://github.com/OSDHRA/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!

- Amplified
- Book Zurman, Inc.
- Cognitive
- CSIRO
- Deloitte
- HSPC
- Intermountain Health
- PenRad
- Sujanski & Associates
- TermMed
- VetsEZ
- Veterans Health Administration (VHA)

Q & A