

SOLOR Update

Integrated Terminology System

founded upon

SNOMED, LOINC, and RxNorm

SOLOR Participants

- SOLOR is a collaborative project
 - Veterans Health Administration
 - Health Services Platform Consortium
 - Intermountain Health Care
 - Other participants and observers through HSPC
- SOLOR project structure
 - SOLOR Modelers
 - SOLOR Observers
- SOLOR areas of focus
 - Safety concerns – determining equivalence
 - Representational needs
 - Terminology support for CIMI
 - VA extension concepts

Why SOLOR?

- Meaningful use standards, and other standards require:
 - SNOMED
 - LOINC
 - RxNorm
- These standards are overlapping—yet are siloed—leaving integration as an implementer exercise, harming safety and interoperability
- This overlapping—yet siloed—state of affairs does not benefit implementers, providers, or patients

Overlapping Silos

LOINC:

1L: Gentamicin is a component loinc (GENTAMICIN)

2L: Gentamicin is a component of a laboratory tests in loinc (Gentamicin^peak)

SNOMED:

1S: Gentamicin is a substance in SNOMED CT (a component in LOINC)

2S: Gentamicin is a component of a laboratory test in SNOMED (gentamicin peak)

3S: Gentamicin is a PRODUCT in SNOMED CT (a substance manufactured and sold)

4S: Gentamicin is an ALLERGEN in SNOMED CT

5S: Gentamicin is a presented in Prescribable/Dispensable forms in SNOMED (Gentamicin bone cement; Gentamicin 0.3% preservative-free eye drops)

6S: Gentamicin is specified in SNOMED administration and removal procedures (Insertion of Gentamicin beads into bone; Removal of Gentamicin beads from bone)

7S: Gentamicin is specified in poisonings/overdoses

8S: Gentamicin allergic reactions are defined clinical situations

9S: Acute drug-induced renal failure is a disorder in SNOMED

RxNorm:

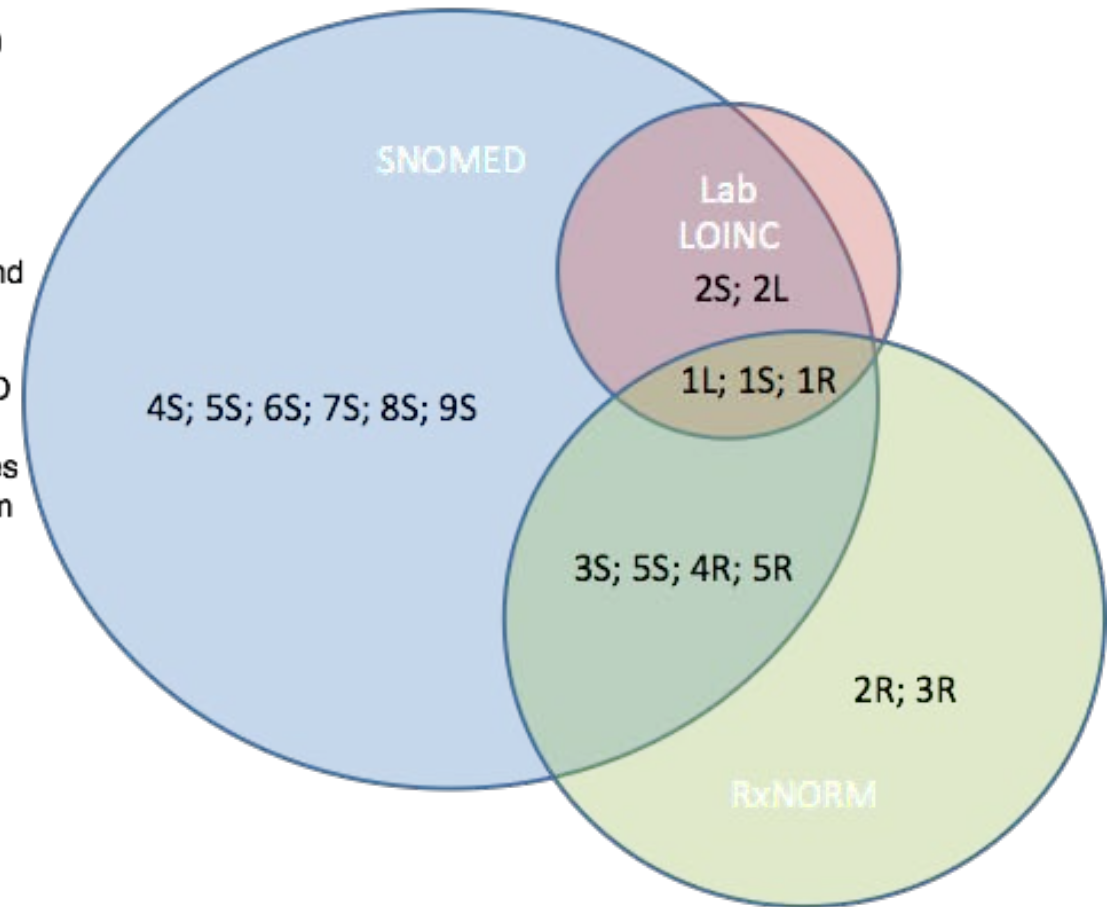
1R: Gentamicin is an ingredient in RxNorm (GENTAMICIN SULFATE)

2R: Gentamicin is a basis of strength in RxNorm (GENTAMICIN)

3R: Gentamicin is linked to Human Prescription Drug Labels

4R: Gentamicin is a presented in Prescribable/Dispensable forms in RxNorm (gentamicin sulfate 0.3 % Ophthalmic Solution)

5R: Gentamicin is a PRODUCT in RxNorm (a substance manufactured and sold)



Safety concerns related to terminology

- Knowledge Artifacts
 - Inability to *reproducibly* represent something clinically significant
 - Inability to determine *equivalence*
 - Errors in *expressing* an idea
 - Managing change over time within the content and its dependencies
- Data
 - Inability to *reproducibly* represent something clinically significant
 - Errors in *expressing* an idea
 - Managing change over time
- Complexity & overlapping silos
 - Reproducible expression of ideas – which system to use?
 - Inability to determine equivalence – mapping is not the answer...

SOLOR approach to safety concerns

- Provide integrated content in a standardized way
 - Improve ability to determine equivalence
 - OWL EL with concrete domains
 - Identify content that requires special handling
 - Resolve overlap through identification and representation of equivalent concepts as a single SOLOR concept, while maintaining provenance
 - Enable sharing of extensions with other SNOMED & LOINC license holders
- Open up the silos and integrate
- Reduce complexity
- Education

End goal: Executable knowledge sharing

- Overcome the “curly braces problem”
- Ability to share decreases cost of implementation and deployment
- Ability to share *executable* knowledge reduces risk of translation/mapping/reimplementation errors

Real enablement of patient safety at scale is when we can share executable knowledge...

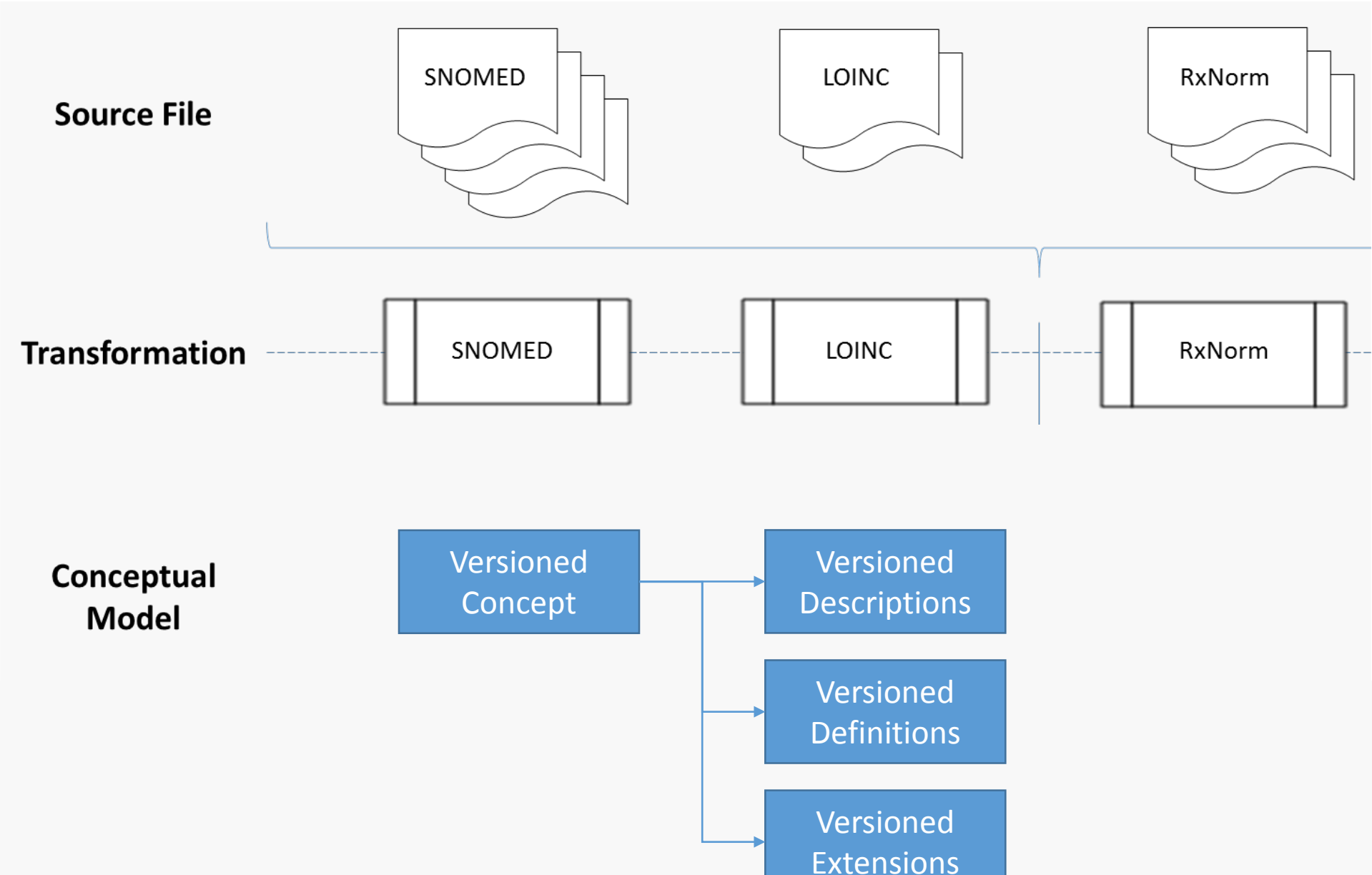
— Stan Huff

SOLOR Conceptual Model

- Representable within the standard SNOMED distribution model
 - Familiar, existing, mandated standard
 - Reuse of existing capabilities
 - SNOMED distribution model provides for
 - Versioned content
 - Modularity with versioned dependencies
- Computable, standardized semantics
 - OWL 2 EL with concrete domains – an *implemented* W3C standard
 - Extends more limited SNOMED CT semantics in a principled and standard way
 - Consistent with SNOMED/LOINC integration agreement



SOLOR Construction



Using a common model, content from various SDOs are represented in a common format for downstream use

Infrastructure Construction

Accomplishments

- Created a terminology repository to represent various terminologies such as SNOMED, LOINC and RxNorm
- Developing update guidelines for knowledge workers to address SDO content update impacts on locally created content
- Illustrated the potential of automated identifying additional/new codes for inclusion into value sets and/or rules to identify a potential cohort of patient population

Current Work

- Reviewing code to identify potential enhancements to SOLOR
- Using SOLOR components to model other terminologies

Content construction:

OWL 2 EL with concrete domain semantics

Overview: By having complete logic definitions to properly represent SNOMED CT concepts, it will result in more consistent data retrieval and content creation. Currently, only 24% of SNOMED CT concepts have logical definitions that are complete, and thus a big corpus of content are not used in the most optimal manner. Incorporating more semantics will allow for more concepts to have complete logic definitions enabling more consistent data retrieval and content creation.

This effort is to evaluate and provide new definitions for SNOMED CT concepts, specifically around Disjoint Content and Concrete Domain Content. Resulting artifact will utilize the full semantics of OWL-2 EL profile for content ingestion.

Disjoint Content and Concrete Domain Content, which are further explained in the next slides.

- Disjoint Content – two sets are said to be disjoint if they have no element in common
- Concrete Domain – used to model properties such as weight, name or age having concrete values such as integers or strings

Content construction: OWL 2 EL disjoint content

*Classes are disjoint if they cannot have common instances. In an ontology, all classes are assumed to have potential overlapping instances unless they are explicitly stated to not have them. **The current modeling of SNOMED CT does not contain any such statements therefore all concepts are considered to have the potential to allow overlapping concepts.***

Example

There are no formal statements that would prohibit the clinical findings and body structure hierarchies from containing concepts that have parents from both hierarchies even though this should never be the case. The top level primitive hierarchies like clinical findings and body structures should be disjoint.

Tattoo – Action [129327005]

Tattoo – Finding [341000119102]

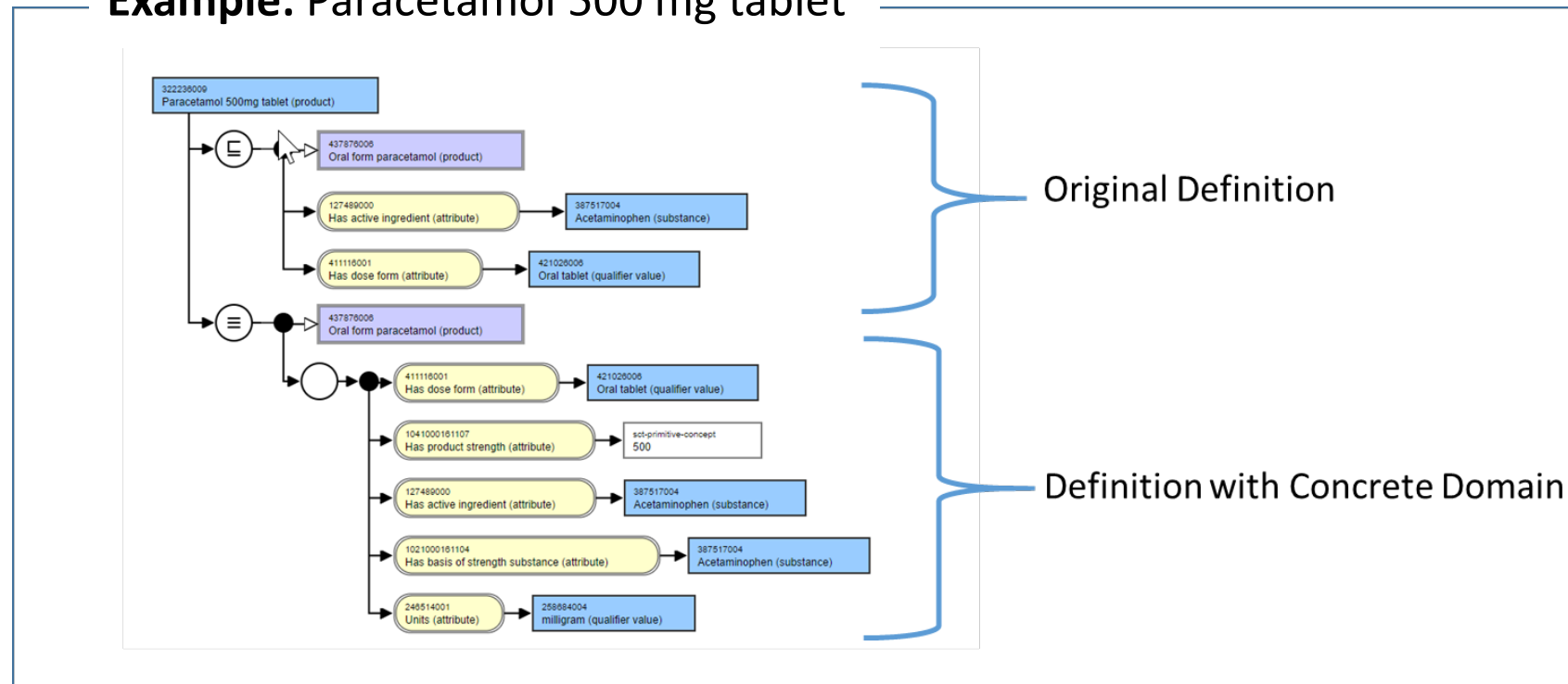
Tattooing – Procedure [14792009]

Tattooing – Qualifier [129327005]

Content construction: Concrete domain content

*Our initial work focused on medications and evaluating the use of concrete domains to represent not only the product strength, but also the unit of use size. In order to fully test the feasibility of concrete domains, additional attributes were also added to fully represent all information regarding medications which will then allow concepts to be marked as fully defined. **This will allow for testing the equivalence and subsumption of concepts by the Description Logic classifiers within the tooling.***

Example: Paracetamol 500 mg tablet



Color

- SNOMED has many findings related to color
 - 386713009 | Red color (finding) |
 - 720003003 | Reddish color urine (finding) |
 - 64412006 | Red stools (finding) |
 - 164424003 | On examination - skin red (finding) |
- None of the other findings use Red color (finding), nor do they use the color qualifiers
- We will identify an appropriate way to model color, model it, and contribute it to SNOMED for their consideration as part of SOLOR development

Task 5.5: Identified Content Should Fully Utilize OWL 2 EL Profile Semantics

Below indicated the accomplishments and current efforts:

Accomplishments

- Identified Concrete Domain Content
- Preliminary Concrete Domain RefSets in OWL Format
- First draft of Concrete Domain Content Whitepaper
- Identified Disjoint Content
- Submitted first draft of Disjoint Content Whitepaper

Current Work

- Finalizing Disjoint Content Whitepaper
- Finalizing Concrete Domain Content Whitepaper after the last wave of deliverables submission on 6/30
- Modeling the remainder of the Concrete Domain Content
- Identifying content to take advantage of General Concept Inclusion axioms and fully model them

Content construction : Identify SOLOR Content that requires special handling

Overview: To identify from a candidate list of 50,000 SNOMED CT concepts which concepts require special handling due to their definitions including negation, compound observations, and patient not the subject of record.

Example

- **Concepts expressing Negation may not be properly represented in SNOMED CT using the description logic currently available. When querying clinical data using these concepts special logic may be needed to aggregate them appropriately.**
 - E.g., Current non-drinker of alcohol (finding), Esophageal varices without bleeding (disorder), Vomiting without nausea (disorder)
- **Concepts where the Patient is not the subject should be identified so that they are only used in special cases.**
 - E.g., Spouse unable to care for patient (finding), Family not aware of diagnosis (finding), No transport available to carer (finding)
- **Compound Observation concepts may be better represented in the information model yet are modeled in SNOMED CT combined in various ways.**
 - E.g., Cramp in lower leg associated with rest (finding), Venous thrombosis due to central venous access device (disorder), Blindness AND/OR vision impairment level (disorder)

Task 5.10: Identify SOLOR Content that Requires Special Handling

Accomplishments

- Developed a more defined proposed ruleset and multiple examples for each RefSet of Concepts (including/excluding negation, patient as subject, and compound observation)
- Identified set of 51,093 concepts to categorize whether they are negated, about the patient, or compound observations.

Current Work

- Finalizing Rules and Guidelines for inclusion in DocBook
- Finalizing 6 RefSets for submission

Education

- SOLOR Observer workshops
 - Overview of SNOROCKET and OntoServer
 - Modeling with Description Logic, Cross edition queries
 - Clinical Observations Modeling
 - Standardizing capture, retrieval and exchange of clinical observations
 - Detailed Clinical Modeling, CEMs and CIMI
 - Examples of what could go wrong in clinical decision support, development process, knowledge artifacts
 - More...
- Developing integrated documentation

Delivery

- Draft for trial use planned for October 30th.
 - Content
 - Documentation
 - Examples of use