Combined Utilization of SNOMED-CT with LOINC for Comparative Effectiveness Research

SNOMED CT Implementation Showcase 2014

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Biomedical Informatics

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- Apelon

*The opinions expressed [in this presentation] are those of the authors and do not reflect the official position of AHRQ, HHS, NCRR, NCATS, or NIH

Objectives

- Mapping local coding schemata to SNOMED CT and LOINC for better representation of laboratory (lab) results and their enhanced retrieval for clinical research.

- Opportunities for data validation and ontology reasoning on linking SNOMED CT with LOINC.

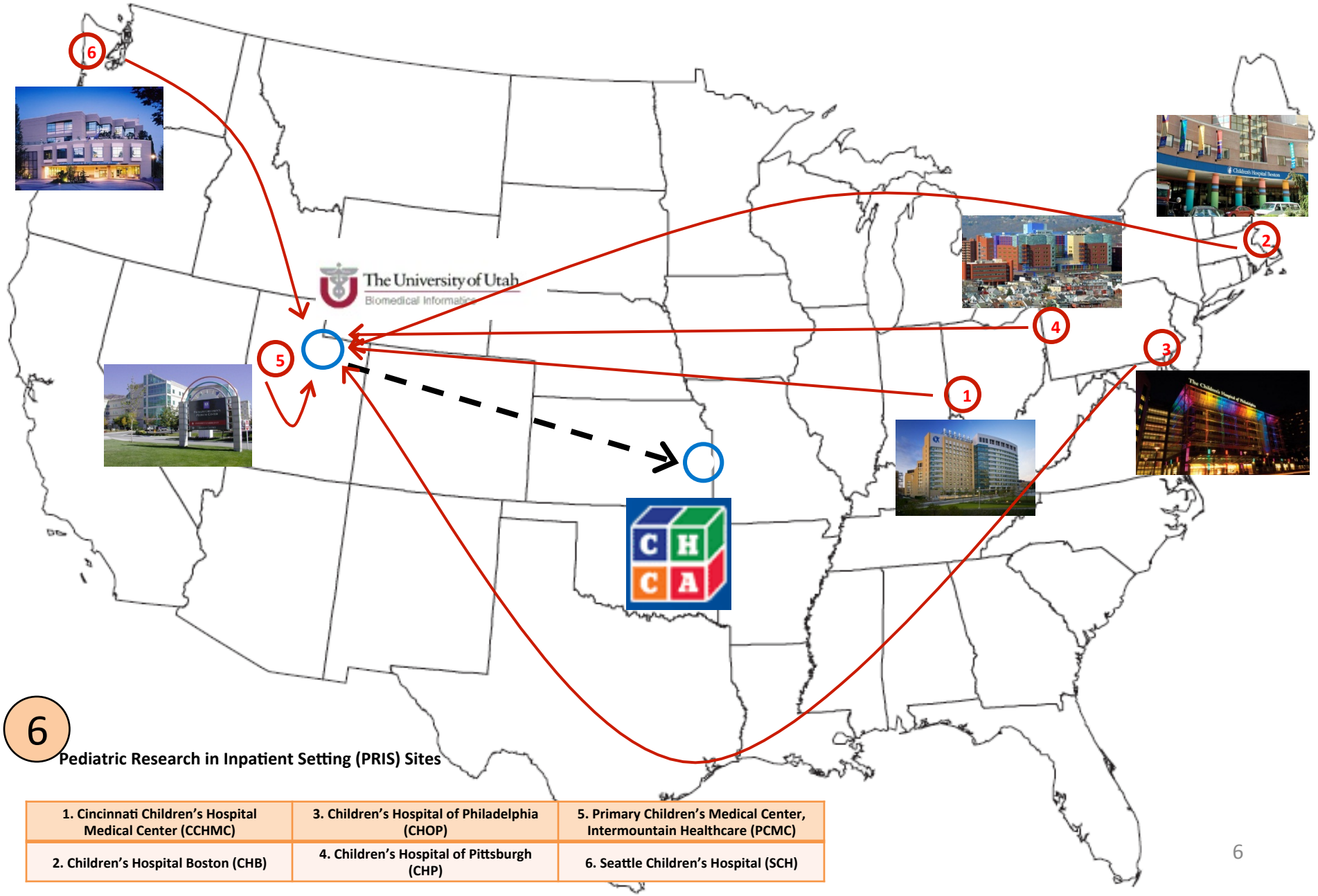
Overview

- What is PHIS+?
- What is FURTHeR/OpenFurther?
- What problems did we face with lab data?
- How did we use SNOMED-CT to improve LOINC mappings?
- What was another approach we could have used?
- Why was the approach we used using SNOMED-CT was better for our use case?

What is PHIS+ ?

- An effort to augment the Children's Hospital Association's (CHA) existing electronic database of administrative data called the Pediatric Health Information System (PHIS) with clinical data in order to conduct Comparative Effectiveness Research (CER) studies.
- Comparative effectiveness research (CER) is designed to inform health-care decisions by providing evidence on the effectiveness, benefits, and harms of different treatment options.
- University of Utah Biomedical Informatics partnered with CHA in this effort
- Agency for Healthcare Research and Quality (AHRQ) PROSPECT funded project.

PHIS+ Hospitals



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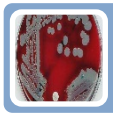
Pediatric Research in Inpatient Setting (PRIS) Sites

1. Cincinnati Children's Hospital Medical Center (CCHMC)	3. Children's Hospital of Philadelphia (CHOP)	5. Primary Children's Medical Center, Intermountain Healthcare (PCMC)
2. Children's Hospital Boston (CHB)	4. Children's Hospital of Pittsburgh (CHP)	6. Seattle Children's Hospital (SCH)

Overview PHIS+

3 **Data Streams**


Laboratory


Microbiology

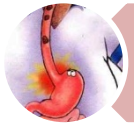

Radiology

4 **CER Studies**


Pneumonia


Appendicitis


Osteomyelitis


Gastroesophageal Reflux Disease

5 **Years Data**

- 2007 – 2011
- 2009 – Development
- 2012….

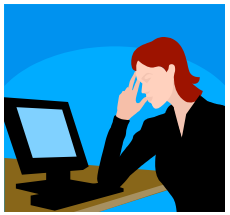
Electronic Data Sources for PHIS+ Hospitals

Site	Lab Information System	Electronic Medical Record	PHIS+ Lab Datasource
CCHMC	Cerner Millenium	Epic	Epic Clarity
CHB	Cerner Pathnet	Cerner	In-house data warehouse
CHOP	Meditech	Epic	In-house data warehouse
CHP	Sunquest	Cerner	Cerner PowerInsight*
PCMC	Sunquest	In-house system	In-house data warehouse
SCH	Cerner Pathnet	Cerner	Cerner PowerInsight

Narus et. al, **Federating Clinical Data from Six Pediatric Hospitals: Process and Initial Results from the PHIS+ Consortium. AMIA 2011**

What is FURTHeR/OpenFurther?

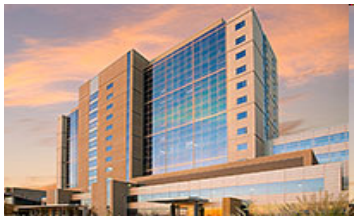
FURTHeR is an informatics platform designed to federate data from heterogeneous data sources.



Univ of Utah Hospitals & Clinics

Huntsman Cancer Institute

Intermountain Healthcare



VAMC Salt Lake City

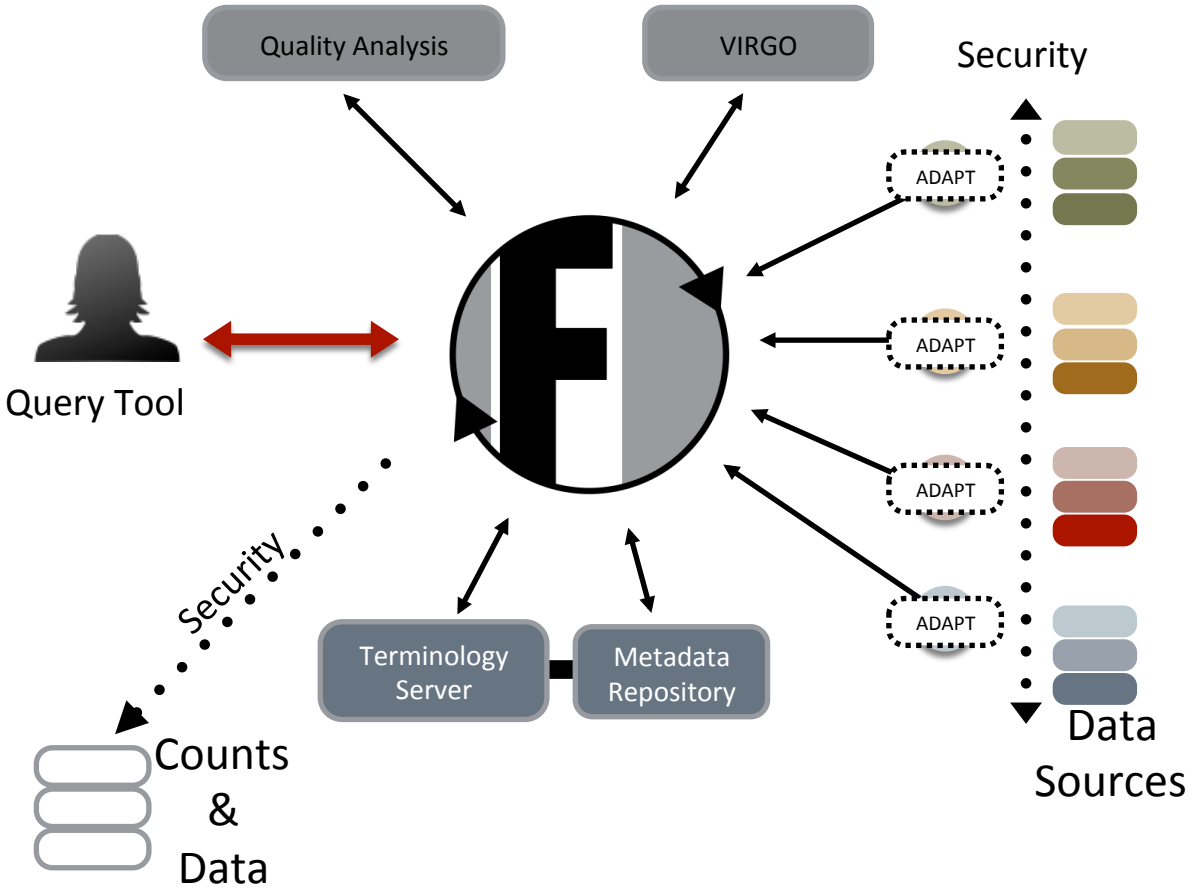
Other Partners

Utah Dept of Health (UDOH)

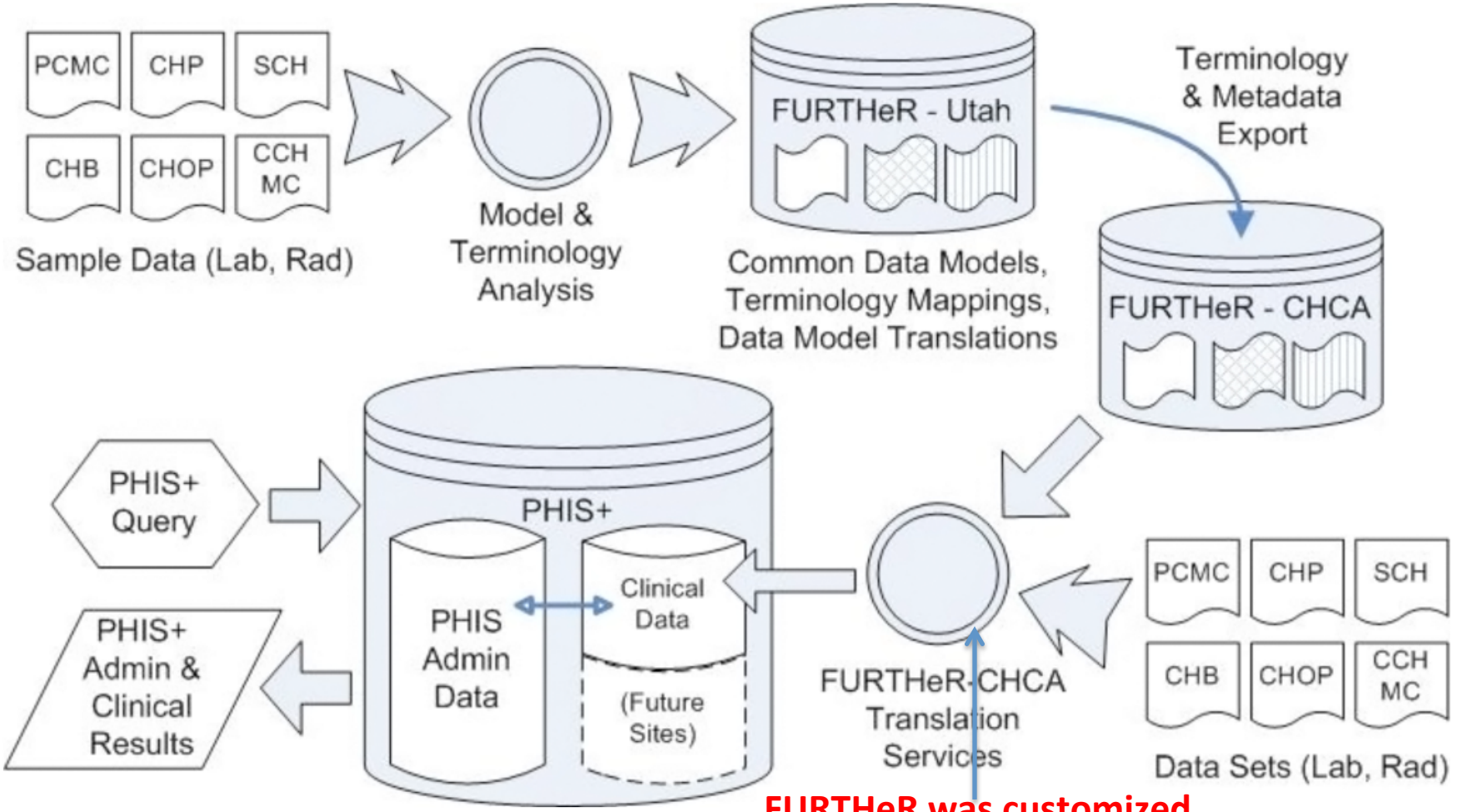
OpenFurther is an open source version of the platform & is available OpenFurther.org.

Component Overview

- Query Tool
- Federated Query Engine
- Data Source Adapters
- Admin & Security Components
- Virtual Identity Resolution on the GO (VIRGO)
- Quality & Analytics Framework
- Metadata Repository
- Terminology/Ontology Server



Developmental Process Overview



FURTHeR=**F**ederated **U**tah **R**esearch & **T**ranslational **H**ealth **e**-**R**epository

FURTHeR was customized to aggregate data for CHA

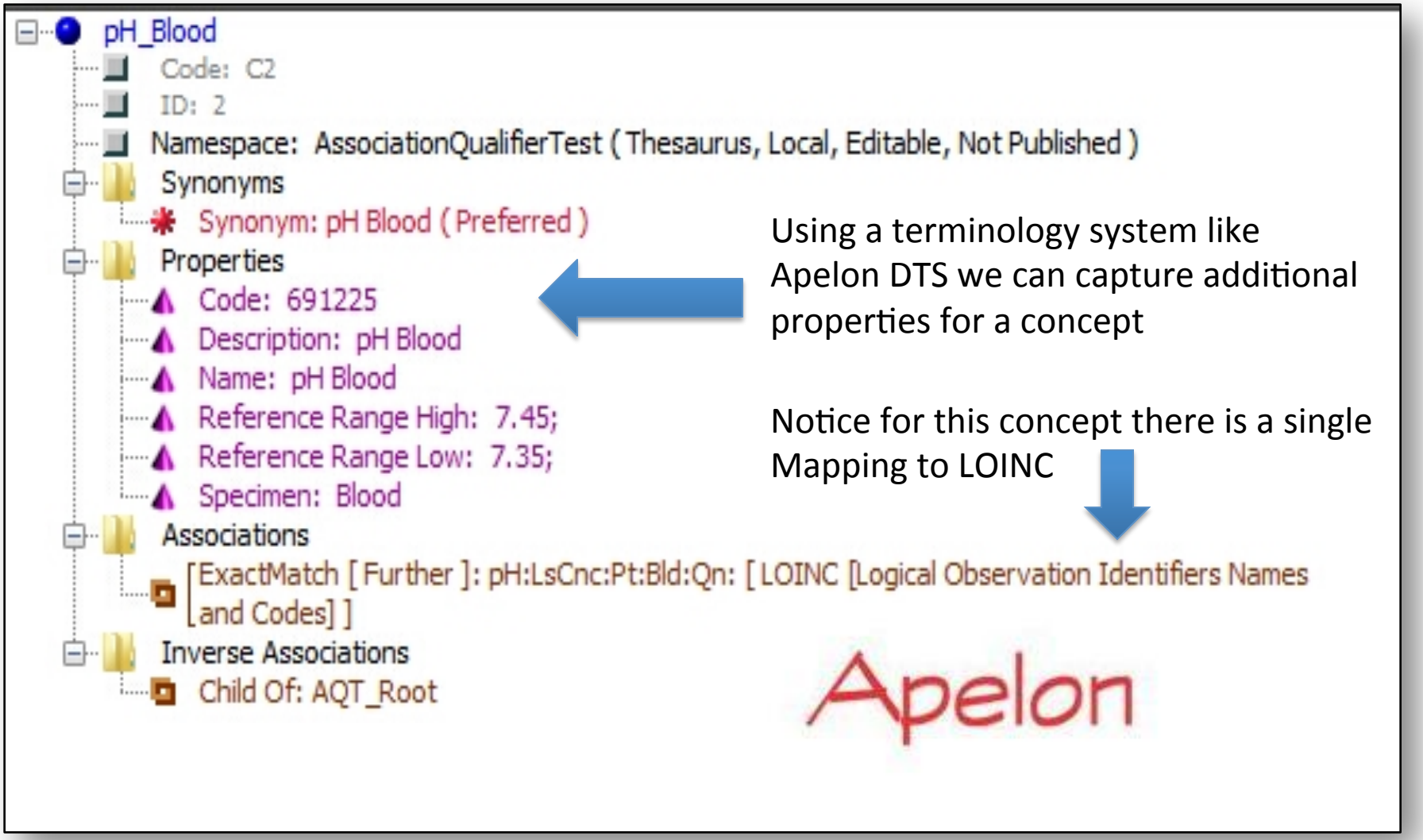
Narus et. al, **Federating Clinical Data from Six Pediatric Hospitals: Process and Initial Results from the PHIS+ Consortium. AMIA 2011**

OpenFurther Typical Lab Translation Handling

- OpenFurther translates each local site lab test code to a LOINC code.
- Mappings are manually created by a terminologist.
  - RELMA is helpful but not always used.

Local Test Code	Test Description	LOINC Code	LOINC NAME
691225	pH Blood	11558-4	pH of Blood

Terminology Server Perspective
Local Test Code/Single Specimen



Local Test Code Issues

Local Test Code	Test Description	LOINC Code Generic Specimen	LOINC NAME
699414	Body Fluid Appearance Abdominal	9335-1	Appearance of Body fluid
699414	Body Fluid Appearance Ascites	9335-1	Appearance of Body fluid
699414	Body Fluid Appearance Chest Fluid	9335-1	Appearance of Body fluid
699414	Body Fluid Appearance Joint Fl	9335-1	Appearance of Body fluid
699414	Body Fluid Appearance Knee	9335-1	Appearance of Body fluid

- Local Test Code having multiple specimens
- We could map to LOINC using the most generic specimen that all tests have in common

Local Test Code Issues

Local Test Code	Test Description	Generic Specimen	LOINC NAME	Specific Specimen	LOINC NAME
699414	Body Fluid Appearance Abdominal	9335-1	Appearance of Body fluid	14621-7	Appearance of Peritoneal fluid
699414	Body Fluid Appearance Ascites	9335-1	Appearance of Body fluid	14621-7	Appearance of Peritoneal fluid
699414	Body Fluid Appearance Chest Fluid	9335-1	Appearance of Body fluid	14620-9	Appearance of Pleural fluid
699414	Body Fluid Appearance Joint Fl	9335-1	Appearance of Body fluid	29605-3	Appearance of Synovial fluid
699414	Body Fluid Appearance Knee	9335-1	Appearance of Body fluid	29605-3	Appearance of Synovial fluid

- Mapping this more granularly to a specific specimen is more accurate and reflects the true local test.

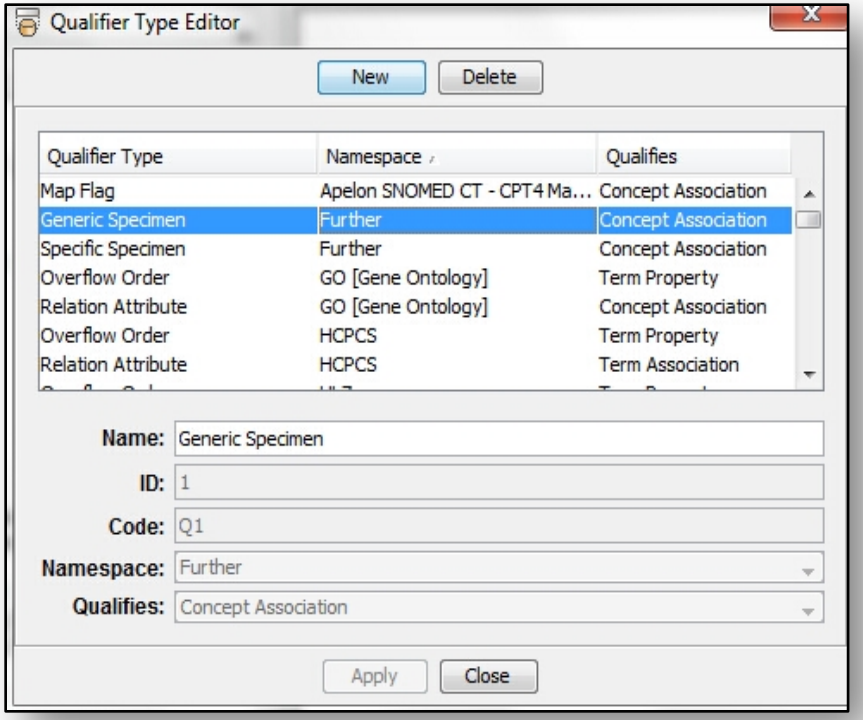
How can we map identical local codes to LOINC when those local codes represent different lab tests?

Leverage Specimen & Body Site

And… Synergy

Association Qualifiers

- Use **Association Qualifiers** to enable maps & translations to specimen specific LOINC Codes.
- Specimen descriptions from the source sometimes contained just body site information or a combination of specimen & body site
- Association Qualifiers Used
  - Generic Specimen
    - Body Fluid
  - Specific Specimen
    - Peritoneal Fluid
  - Body Site
    - Tissue Specimen (from some body site)



How OpenFurther Handles Lab Translations in PHIS+ Instance Using Association Qualifiers

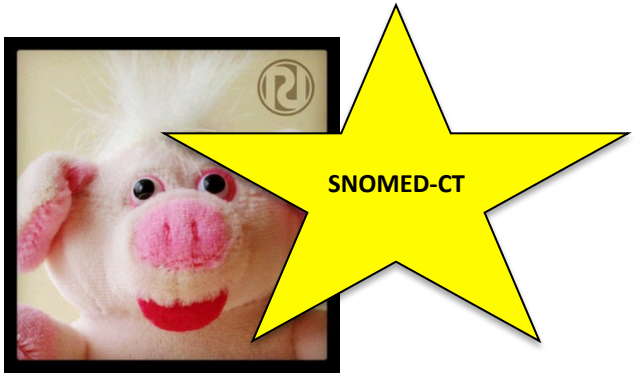
Data Needed For Translation
- Local Test Code
- Local Specimen Code

OpenFurther Checks Terminology Server
- hasSpecimenType
- hasBodySite

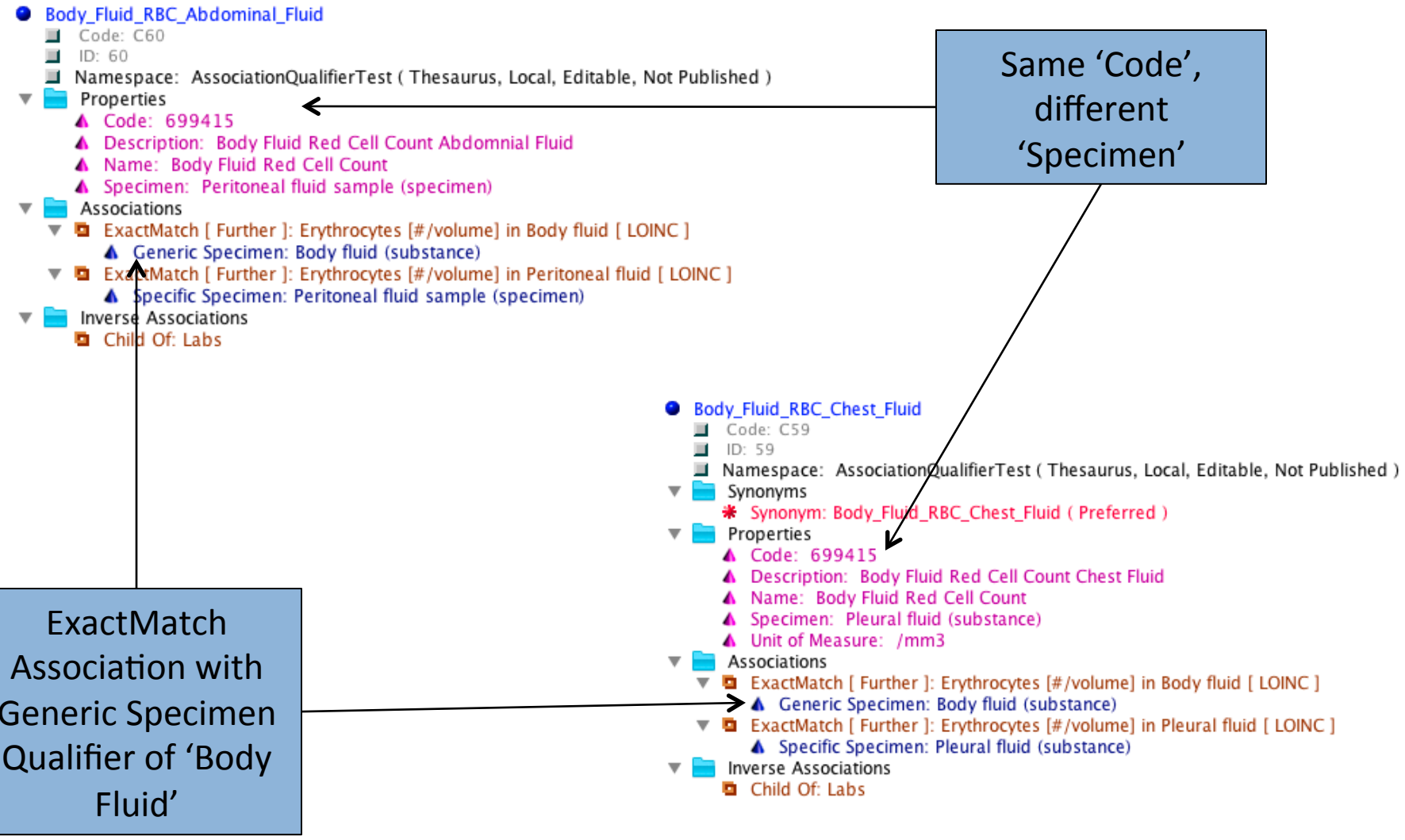
If hasSpecimenType is mapped it is used

If hasSpecimenType is NOT mapped hasBodySite is used

OpenFurther then checks Local Test Code and uses the hasSpecimenType or hasBodySite to check the qualifiers on the mapped LOINC codes



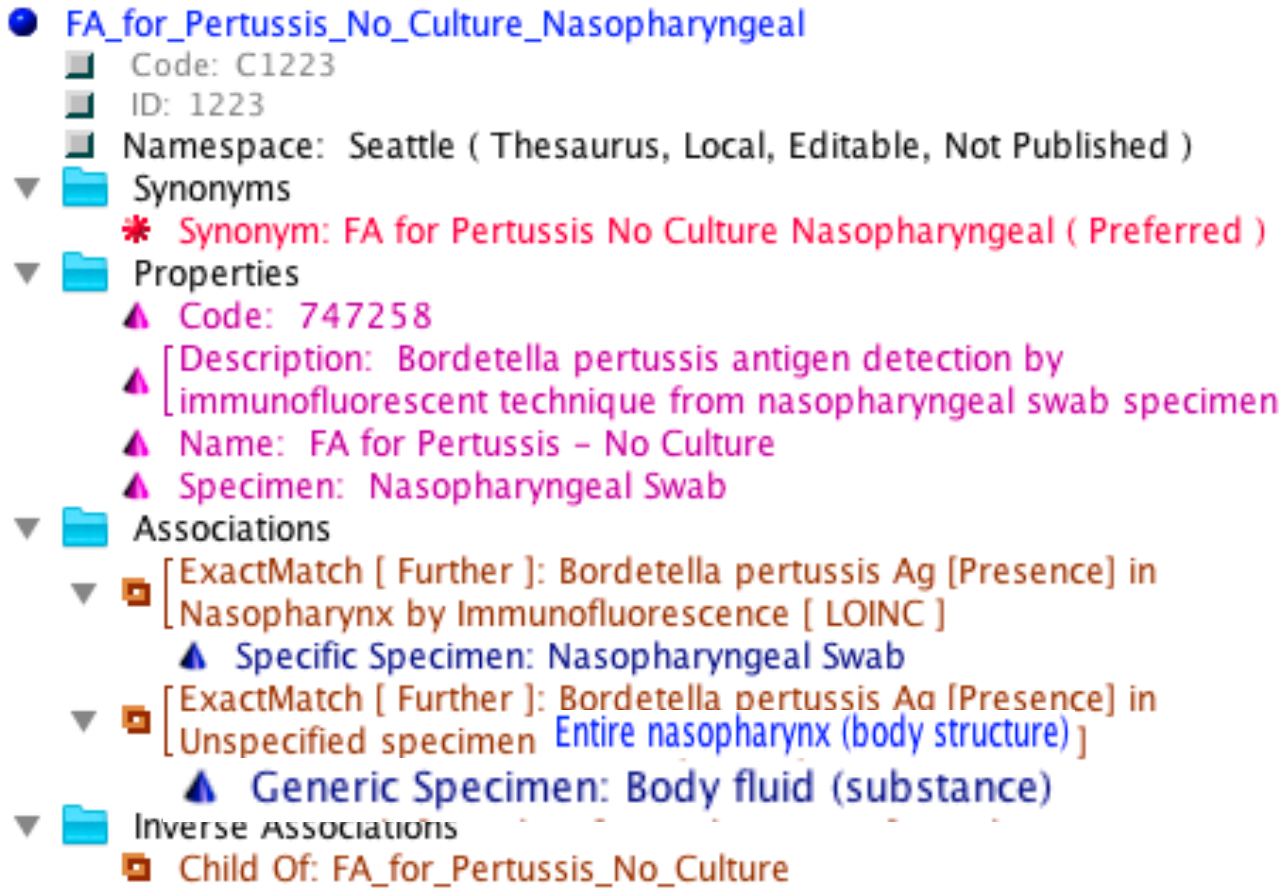
Test Code with Multiple Specimens



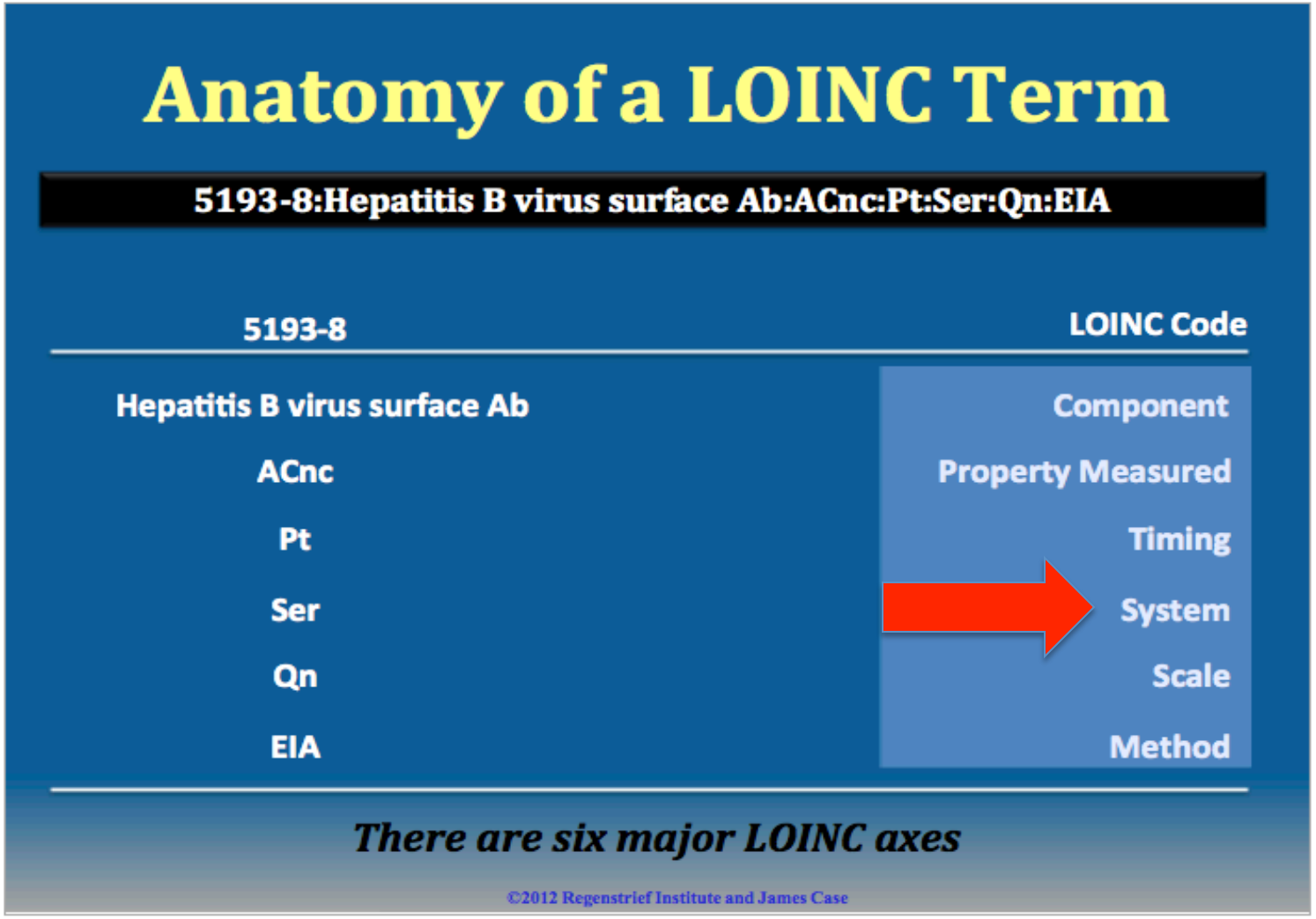
Test Code with Body Site

- Nasopharyngeal_Swab
  - Code: C1272
  - ID: 1272
  - Namespace: Seattle (Thesaurus, Local, Editable, Not Published)
  - Synonyms
    - Synonym: Nasopharyngeal Swab (Preferred)
  - Properties
    - Code: 312624 AssociationQualifierTest (Thesaurus, Local, Editable, Not
    - Code: 740247
    - Code: Nasopharyngeal Swab
    - Description: Nasopharyngeal Swab
    - Name: Admit Nasal Culture
    - Name: Nasopharyngeal Swab
  - Associations
    - hasBodySite [Further]: Entire nasopharynx (body structure) [SNOMED CT]
    - hasSpecimenType [Further]: Nasopharyngeal swab (specimen) [SNOMED CT]
  - Inverse Associations
    - Child Of: Specimen

Test Code with Body Site



Another Approach



Comparison

- 100 System Sample Types (System) Listed in LOINC User Manual
- 1329 possible specimens with SNOMED-CT
  - 36 Different options containing the word “Blood”
- >10000 possible body sites with SNOMED-CT

Our Approach Using SNOMED-CT Provides

- Two dimensions to query data for clinical research cohorts (using specimens and then tests or the reverse).
- SNOMED-CT hierarchy supports inclusion of specific tests that have child specimen/body site concepts that are not so obvious in LOINC (Subsumption e.g. arterial blood is_a child of blood). Other SNOMED-CT relations could also be used.
- Data Quality - If a blood glucose test has a urine specimen, we know that there is a data quality issue
- There isn't information loss as SNOMED-CT most times allows mapping to the same level of granularity of specimens/body sites as the local specimen descriptions.

Conclusion

- Mapping the specimen of LOINC to SNOMED-CT offers flexibility that is difficult or not possible by using LOINC alone.
- Mapping other axes of LOINC to SNOMED-CT might also be useful
- Mappings such as this could be shared and curated by the informatics community

Thank you!
Questions/Comments

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www.OpenFurther.org
@OpenFurther on Twitter

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