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Using LOINC with SNOMED CT

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Using LOINC with SNOMED CT

The Guide to Use of SNOMED CT and LOINC together provides advice on combined use of SNOMED CT and LOINC. It includes specifications of the files used for distribution maps and expression constraints developed as part of the cooperative work between SNOMED International and Regenstrief Institute Inc.

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1 Introduction

Purpose of This Guide

This guide provides advice on combined use of SNOMED CT and LOINC. It also contains specifications and guidance related to the distribution files containing the results of cooperative work linking SNOMED CT and LOINC.

Who Should Read This Guide

This guide is intended to be read by anyone interested in effective ways to use SNOMED CT and LOINC together in a clinical information system, laboratory information or any associated systems, specifications or standards. These people fall into two broad categories:

End Users of Applications and Service that Use SNOMED CT and/or LOINC

These people need:

- To be aware of the importance and benefits of effectively combining the use of SNOMED CT and LOINC to meet their requirements for entry, communication, retrieval and use of clinical and laboratory information.
- To understand their own data entry requirements in order to appreciate and make use of the potential benefits of integrated use of SNOMED CT and LOINC.

This guide provides:

- A high-level description of the features and benefits of SNOMED CT and LOINC and the added benefits of effective combined use.
- Specific guidance on use of the two terminologies in ways that make use of their strengths and the added value provided by links developed between them.

Designers and Developers of Applications, Services or Standards that Use SNOMED CT and/or LOINC

These people need:

- To understand the range of features supported by SNOMED CT and/or LOINC likely to be important for their users.
- To be able to develop systems that use SNOMED CT and LOINC together in ways that support the delivery of systems that meet user requirements and deliver practical benefits.

This guide provides:

- Guidance on approaches to use of SNOMED CT and LOINC which identify high-level approaches that minimize overlap and maximize synergy between the terminologies.
- High-level guidance on possible ways to utilize the maps and associations being developed as part of cooperative work between SNOMED International and Regenstrief Institute.
- Summaries of use cases of different ways of combining SNOMED CT and LOINC, that offer examples of evidence for the approaches recommended in this guidance.

Background and Scope

In July 2013, IHTSDO [1] and Regenstrief Institute Inc. (RII) signed a long-term agreement [2] to begin cooperative work linking their leading global healthcare terminologies: Logical Observation Identifiers Names and Codes, or LOINC, and SNOMED Clinical Terms. This agreement will help improve safety, functionality and interoperability for the rapidly growing number of clinicians who manage and exchange health data with electronic medical records.

The agreement builds on and complements the strengths of both organizations and terminologies. The cooperative work will link the rich clinical semantics of SNOMED CT to LOINC codes, which provide extensive coverage of laboratory tests and some types of clinical measurements. By aligning how the two terminologies represent the attributes of tests and some measurements, this collaboration will provide users a common framework within which to use LOINC and SNOMED CT.

Like IHTSDO, Regenstrief is a not-for-profit organization that seeks to enhance the effective delivery of health care. The organizations believe it makes sense to work together to limit duplication of effort and focus limited resources on enhancements that serve the practical needs of the growing number of users of LOINC and SNOMED CT.

The agreement defines a long-term, broadly scoped, working relationship. To underline the long-term commitment of both organizations, the new agreement will be in force for at least 10 years. The organizations' immediate focus is laboratory testing as well as some basic clinical measurements, and they intend to expand into other areas of mutual interest in the future.

As part of the cooperation agreement between IHTSDO and RII it was agreed that the organizations would develop joint guidance on ways in which SNOMED CT and LOINC should be used together. This guidance document is limited to the scope of the agreement and thus principally covers laboratory investigations along with vital signs and anthropomorphic measurements.

The guide starts with short introductions to SNOMED CT and LOINC followed by an overview of the cooperative work to bring them

closer. These sections identify the potential benefits of using SNOMED CT and LOINC together.

The remainder of the guide consists of advice on how to make effective combined use of SNOMED CT and LOINC in ways that recognize the scope and strengths of the two terminology resources. The guidance also considers ways to deliver added-value by using the links between SNOMED CT and LOINC developed as part of the cooperative work.

1. In January 2017, the International Healthcare Terminology Standards Development Organisation adopted the new trading name SNOMED International. However, for historical accuracy, this background section uses the former designation IHTSDO.
2. For further information about the agreement and cooperative work please see http://snomed.org/loinc-cooperation.

2 Short Introduction to SNOMED CT

2.1 Features of SNOMED CT

This section contains a high-level overview of SNOMED CT with some additional information in areas of direct relevance to subsequent chapters of this guide. For a more complete introduction to SNOMED CT see the SNOMED CT Starter Guide (http://snomed.org/sg) and for more detailed information refer to the SNOMED CT Document Library (http://snomed.org/doc).

SNOMED CT is a clinical terminology with global scope covering a wide range of clinical specialties, disciplines and requirements. As a result of its broad scope, one of the benefits of SNOMED CT is a reduction of specialty boundary effects that arise from use of different terminologies or coding systems by different clinicians or departments. This allows wider sharing and reuse of structured clinical information. Another benefit of SNOMED CT is that the same data can be processed and presented in ways that serve different purposes.

SNOMED CT allows a range of different options for immediate retrieval and subsequent reuse to address immediate and longer-term clinical requirements and the requirements of other users. The nature of SNOMED CT hierarchies allows information to be selectively retrieved and reused to meet different requirements at various levels of generalization (e.g. retrieval of subtypes of |Lung disorder| or |bacterial infection| would both include |Bacterial pneumonia|.

Scope

SNOMED CT has a broad scope of coverage. It includes concepts representing the wide range of types of information that need to be recorded in clinical records. As a result, practitioners from different disciplines and specialties can use SNOMED CT to record appropriate data at different stages in the delivery of patient care.

Components

SNOMED CT components consist of concepts, terms and relationships that enable effective representation of clinical information.

- Concepts: Every concept represents a unique clinical meaning, which is referenced using a unique, numeric and machine-readable SNOMED CT identifier. The identifier provides an unambiguous unique reference to each concept and does not have any ascribed human interpretable meaning.
- Descriptions: A set of textual descriptions are assigned to every concept. These provide the human readable form of a concept.
- Relationships: A relationship represents an association between two concepts. Relationships are used to logically define the meaning of a concept in a way that can be processed by a computer.
- These components are supported by reference sets (refsets). Refsets are resources that can be used to customize and configure the terminology for use in a particular country, organization, specialty or data entry situation.

Hierarchies

SNOMED CT concepts are related to one another within a subtype hierarchy. At the top of this hierarchy are general concepts referred to as top-level concepts. Clinically relevant concepts in SNOMED CT fall under one of the hierarchies shown in Table 2.1-1.

Table 2.1-1: Clinically Relevant SNOMED CT Hierarchies

404684003 |Clinical finding| 71388002 |Procedure| 363787002 |Observable entity| 410607006 |Organism| 123037004 |Body structure| 373873005 |Pharmaceutical / biologic product|	123038009 |Specimen| 105590001 |Substance| 260787004 |Physical object| 78621006 |Physical force| 362981000 |Qualifier value| 243796009 |Situation with explicit context|	419891008 |Record artifact| 272379006 |Event| 254291000 |Staging and scales| 48176007 |Social context| 308916002 |Environment or geographical location|

Concept Model

SNOMED CT concepts are also related to one another by defining relationships which represent characteristics of the meaning of a concept. Each of these relationships represents the value of an attribute. SNOMED CT currently uses more than fifty defining attributes, each of which is identified by a concept.

The set of rules that defines the types of relationships permitted between concepts is referred to as the concept model. These rules specify the set of concepts to which an attribute can be applied (the 'domain' of the attribute) and the permitted set of values for each attribute (the 'range' of the attribute).

From the perspective of the overlaps between SNOMED CT and LOINC the most significant parts of the concept model are the subtypes of:

- 363787002 |Observable entity|
- 386053000 |Evaluation procedure|

However in addition to this, concept s from several other SNOMED CT concept model domains provide non-numeric values that can be applied to a range of tests represented by LOINC Terms.

Description Logic

SNOMED CT relationships are validated and normalized using description logic (DL). The use of DL ensures logical consistency in the formal computer processable definitions of SNOMED CT concepts. This includes generation of a subtype hierarchy that is consistent with all the defining relationships. As a result, SNOMED CT is able to support more complete and consistent meaning-based retrieval than a terminology, classification or code system that is not validated using a formal logic.

Expressions

SNOMED CT can represent clinical information by using concept identifiers as simple codes in a patient record or message. However, it is also possible to express more detailed information by combining concepts into a postcoordinated SNOMED CT expression.

SNOMED CT support of the postcoordination technique allows additional clinical detail to be represented if required. For example, |Pneumococcal pneumonia| has a |Finding site| of |Lung structure|, which can be refined to |Right upper lobe of lung|.

Postcoordination greatly increases the depth of detail that SNOMED CT can represent without having to include every possible specific site for every possible disorder via a concept. For example, the concept |Bacterial pneumonia| has a defining relationship specifying its |Causative agent| as |Bacteria| and this can be refined to |Streptococcus pneumoniae|.

SNOMED CT expressions are a structured combination of one or more concept identifiers used to represent a clinical idea in a logical manner, which is automatically processable. Expressions are represented using the SNOMED CT compositional grammar, which is a lightweight syntax for the representation of SNOMED CT expressions.

Description logic allows alternative representations of the same or similar information to be recognized and compared. For example, |Pneumococcal pneumonia| refined by |Finding site| |Right upper lobe of lung| can be computed to have the same meaning as |Right upper lobe pneumonia| refined by |Causative agent| |Streptococcus pneumoniae|.

Usage

SNOMED CT is widely recognizes as the leading global healthcare terminology. In more than 25 Member countries SNOMED CT can be used under a free license. SNOMED CT is also used in more than forty non Member countries with low cost licenses for usage. The up to date list of SNOMED International Members countries is shown at http://snomed.org/members.

Within the USA, SNOMED CT has been adopted for use in problem list and quality measures as part of the Centers for Medicare and Medicaid Services Electronic Health Record (EHR) "Meaningful Use" incentive program as specified in the Standards and Certification Criteria. SNOMED CT is also a core element in national EHR initiative in many other Member countries and is widely used in healthcare communication standards including HL7 and IHE.

Maintenance, Governance and Licensing

SNOMED CT is maintained by SNOMED International, a not-for-profit association that is owned and governed by its national Members.

The International Edition of SNOMED CT is licensed by SNOMED International and updates are distributed every six months. The tab delimited release files include versioning data that allows changes to be tracked and supports generation of views of any earlier release.

National Extension and Customization

SNOMED CT is designed to support national extensions that enable addition of local translations and/or dialect variants, without undermining the global representation of meaning using SNOMED CT concept identifiers. Extensions also allow addition of national or local content specific to a particular region or use case.

Customizations represented using the SNOMED CT reference set mechanism allow sharable configuration to address local, specialty or organizational requirements.

2.2 Benefits of SNOMED CT

Many of the benefits of SNOMED CT arise from key features of the terminology described in the previous section including global reach, broad clinical scope, logic based design, extensibility and configurability to support language and other national, regional or organizational requirements.

It is widely recognized that use of an Electronic Health Record (EHR) improves communication and increases the availability of relevant information. The added-value of storing and communicating this information using SNOMED CT to represent clinical information is that this enables meaning-based retrieval. The benefits arising from this range from increased opportunities for real time decision support to more accurate retrospective reporting for research and management.

Use of SNOMED CT Benefits Individuals

SNOMED CT enabled clinical health records benefit individuals by:

- Enabling relevant clinical information to be recorded using consistent, common representations during a consultation.
- Enabling guideline and decision support systems to check the record and provide real-time advice, for example, through clinical alerts.
- Supporting the sharing of appropriate information with others involved in delivering care to a patient through data capture that allows understanding and interpretation of the information in a common way by all providers.
- Allowing accurate and comprehensive searches that identify patients who require follow-up or changes of treatment based on revised guidelines.
- Removing language barriers (SNOMED CT enables multilingual use).

Use of SNOMED CT Benefit Populations

SNOMED CT enabled clinical health records benefit populations by:

- Facilitating early identification of emerging health issues, monitoring of population health and responses to changing clinical practices.
- Enabling accurate and targeted access to relevant information, reducing costly duplications and errors.
- Enabling the delivery of relevant data to support clinical research and contribute evidence for future improvements in treatment.
- Enhancing audits of care delivery with options for detailed analysis of clinical records to investigate outliers and exceptions.

Use of SNOMED CT Supports Evidence-Based Healthcare

SNOMED CT enabled health records inform evidence based health care decisions by:

- Enabling links between clinical records and enhanced clinical guidelines and protocols.
- Enhancing the quality of care experienced by individuals.
- Reducing costs of inappropriate and duplicative testing and treatment.
- Limiting the frequency and impact of adverse healthcare events.
- Raising the cost-effectiveness and quality of care delivered to populations.

3 Short Introduction to LOINC

3.1 Features of LOINC

This section contains a high-level overview of LOINC with some additional information in areas of direct relevance to subsequent chapters of this guide. For a more complete introduction to LOINC and supporting resources see http://loinc.org/get-started.

Logical Observation Identifiers Names and Codes (LOINC®) is a terminology standard for identifying laboratory tests and other measurements. It specifies universal codes, names, and other attributes for laboratory results as well as clinical reports, physical exam findings, survey instruments and other observations. It was developed to enable the exchange and pooling of results from diverse sources in order to enhance clinical care, outcomes management and research.

Scope

LOINC codes include laboratory and other clinical observations. The laboratory portion of LOINC includes measurements made on specimens, such in chemistry, hematology, serology, microbiology (including parasitology and virology), toxicology, cell counts, antibiotic susceptibilities, and more. The clinical portion of LOINC includes codes for observations made on patients and populations. LOINC has codes for observations like vital signs and a wide range of other clinical observations. Vital signs and anthropomorphic measurement are included in the scope of the cooperation agreement. Other clinical domains are not currently included in the scope of the agreement with IHTSDO.

LOINC includes codes that identify test observations (e.g. blood culture, antibiotic sensitivity). Other code systems, including SNOMED CT, often provide values that can be applied to represent results (e.g. staphylococcus, amoxicillin). If we consider the observation as a question and the observation values as answers, LOINC provides codes for the questions and SNOMED CT provides codes for many of the non-numeric answers.

Maintenance, Governance and Licensing

LOINC is owned, maintained and licensed by the Regenstrief Institute, Inc. (RII). RII is a non-profit medical research organization associated with Indiana University School of Medicine. LOINC is available free of charge subject to the license conditions and terms of use http://loinc.org/terms-of-use. Updated versions are released twice a year. The LOINC web search tool is available at http://search.loinc.org The LOINC database and a free browsing and mapping program, the Regenstrief LOINC Mapping Assistant (RELMA®), can be downloaded from https://loinc.org/relma.

Usage

LOINC is widely adopted, and the user community continues to grow rapidly. The worldwide LOINC community presently has more than 34,000 users in 163 countries (see http://loinc.org/atlas).

Within the USA, LOINC has been adopted by large reference laboratories, health information exchanges, healthcare organizations, insurance companies, research applications, and several national standards initiatives and programs. In particular, LOINC was adopted as the standard for laboratory orders and results as part of the Centers for Medicare and Medicaid Services Electronic Health Record (EHR) "Meaningful Use" incentive program as specified in the Standards and Certification Criteria.

Outside the USA, LOINC has also been adopted as a national standard in more than 25 countries. In addition, there are many large data exchanges using LOINC around the world.

Structure

Each test is represented by a formal six-part LOINC name and assigned a LOINC code, which is a number with a check digit (see Table 1). Each code is also assigned an observation class (e.g., chemistry, hematology, and radiology); related names (to assist searches of the database); and other attributes.

For most classes of laboratory observations, there is also a "short name" (less than 40 characters long), and a Long Common Name that is more clinician friendly.

LOINC Terms, Codes and Axes

LOINC fully-specified names (including laboratory test results, clinical measurements, and results of other diagnostic studies) are defined in terms of six major axes as described in Table 2: 1. Component name, 2. Property, 3. Time, 4. System, 5. Scale, and 6. Method. The fully-specified (formal) LOINC name must include entries for the first five major axes; the method axis is included only when the method distinction makes an important difference to the clinical interpretation of the result.

Four additional minor axes are challenge information; adjustments; supersystem, e.g., fetus, blood product; and time operators (maximum, minimum, last, first), which are only used when relevant. The challenge axis is the most complex of the minor axes and includes the amount, route, and timing (e.g., oral glucose tolerance test). The details about these other axes can be found in the LOINC Users 'Guide.

Examples of LOINC terms are shown in Table 3.1-1.

Table 3.1-1: Examples of laboratory LOINC codes and formal LOINC names

LOINC Code	LOINC name (Componentname:Property:Time:Specimen:Scale:Method)
2951-2	SODIUM:SCNC:PT:SER/PLAS:QN
2955-3	SODIUM:SCNC:PT:UR:QN
2956-1	SODIUM:SRAT:24H:UR:QN
2164-2	CREATININE RENAL CLEARANCE:VRAT:24H:UR:QN
1514-9	GLUCOSE^2H POST 100 G GLUCOSE PO:MCNC:PT:SER/PLAS:QN
3665-7	GENTAMICIN^TROUGH:MCNC:PT:SER/PLAS:QN
17863-2	CALCIUM.IONIZED:MCNC:PT:SER/PLAS:QN
2863-9	ALBUMIN:MCNC:PT:SNV:QN:ELECTROPHORESIS

(http://www.clinchem.org/content/49/4/624.full.pdf)

Table 3.1-2: Formal model for constructing LOINC fully specified names

Axis Name	Description/Example
Component name	The analyte or attribute being measured or observed. E.g., sodium, body weight.
(Kind of) Property	Differentiates kinds of quantities relating to the same substance. E.g., mass concentration, catalytic activity.
Time (Aspect)	Identifies whether the measurement is made at a point in time or a time interval. E.g. 24H for a urine sodium concentration.
System	The specimen, body system, patient, or other object of the observation. E.g. cerebral spinal fluid, urine, radial artery.
(Type of) Scale	The scale or precision that differentiates among observations that are quantitative, ordinal (ranked choices), nominal (unranked choices), or narrative text.
(Type of) Method	An optional axis that identifies the way the observation was produced. It is used only when needed to distinguish observations that have clinically significant differences in interpretation if made by different methods.

(http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3376691/pdf/nihms355669.pdf)

LOINC creates only those combinations that have clinical relevance in laboratory medicine. Terms are not created by blind permutations. Regenstrief (with guidance from the LOINC committee) reviews new code requests carefully to make sure that only meaningful LOINC codes that can be pragmatically used by the LOINC community are added to the database.

LOINC Parts

The atomic elements that comprise a fully-specified LOINC name are called LOINC "Parts". Each fully-specified name will consist of 5 or 6 parts (depending on whether the Method is important for interpreting the result), each with a part type corresponding to one of the major axes described above. Each LOINC Part is also assigned an identifier (that begins with the prefix "LP"), and internally Regenstrief maintains links between the full LOINC term and the Parts that comprise it. Regenstrief uses LOINC Parts in many aspects of LOINC development, such as: adding synonymy, building hierarchies, creating alternate display names, linking descriptive text, and more.

The Parts and their linkages are not distributed as part of the main LOINC table, but they are part of the content used by the RELMA program.

LOINC "part" concepts (e.g. sodium) serve as building blocks for the description of tests and observations, in association with a set of semantic relations. For example, Sodium:SCnc:Pt:Ser/Plas:Qn, the laboratory test in which the molar concentration of sodium is measured in the plasma (or serum) is identified by 2951-2. The list of relations of this concept to other concepts ("parts") is shown in Table 3.1-3 and Table 3.1-4. For example, the "part" concept Sodium is linked to this test by the relationship component.

Table 3.1-3: Example of the relation of the LOINC code 2951-2 to LOINC Part codes

	LOINCCode	LOINC Name
LOINCTerm	2951-2	Sodium [Mass or Moles/volume] in Serum or Plasma

Part Type	Part No.	Part Name
Component	LP15099-2	Sodium
Property	LP6860-3	SCnc [Substance Concentration]
Time	LP6960-1	Pt [Point in time (spot)]
System	LP7576-4	Ser/P1as [Serum or Plasma]
Scale	LP7753-9	Qn
Method		

(http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2655945/)

Table 3.1-4: Example of the relation of the LOINC code 5778-6 to LOINC Part codes

	LOINCCode	LOINC Name
LOINC Term	5778-6	Color of Urine
Part Type	Part No.	Part Name
Component	LP28806-5	Color
Property	LP6886-8	Type
Time	LP6960-1	Pt [Point in time (spot)]
System	LP7681-2	Urine
Scale	LP7750-5	Nom [Nominal]
Method		

The LOINC terminology does not use description logic. However, the formal definitions provided by LOINC all conform to the 6-axis template (described in Table 2) and make use of named semantic relations.

In addition to creating codes for single tests, measurements, or observations, LOINC also defines concepts to represent collections of discrete elements such as panels (batteries), forms, and data sets.

For example, a CBC/FBC test (complete/full blood count) is expected to deliver a set of results for different components including leukocytes, erythrocytes, hemoglobin, hematocrit, etc.

Hierarchy Tree Structure

Regenstrief creates hierarchies to organize LOINC terms based on a structured arrangement of LOINC elements (also known as parts).RELMA has 5 selectable hierarchy trees that are commonly used to narrow the search limits returned:

- Class
- Multiaxial (component/system)
- System (specimen)
- Component
- Method

The LOINC hierarchy group LOINC concepts by specifying the parent-child relationship between the elements used in one (or more of the axes).

Most often, the hierarchies are used to restrict searches performed using RELMA.

The Multiaxial hierarchy organizes LOINC codes based on more than one of the LOINC name axes. For laboratory tests, it organizes first by the Component and then by the System. The Multiaxial Hierarchy is distributed as an accessory file that is part of the LOINC release.

Search Constraints | Class Hierarchy | Multi-axial Hierarchy | Component Hierarchy | System Hierarchy | Method Hierarchy

Row	Category orName	Component	Property	Timing	System	Scale	Method	ExUnits	DocSection	Rank	Code
1	Laboratory Categories										LP29693-6
2	Antibiotic Susceptibilities										LP7755-4
1772	Allergy Testing										LP7756-2
5729	Blood Bank Tests										LP7776-0
6649	Cardiopulmonary										LP172861-9
6657	Cell Markers										LP7783-6
8149	Challenge chemistry tests										LP7784-4
11878	Chemistry non challenge tests										LP7786-9
21306	Coagulation Tests										LP7788-5
22122	Cytology Studies										LP7789-3
22200	Drug toxicology tests										LP7790-1
29518	Drug Doses										LP7791-9
29925	Fertility Testing										LP7798-4
30166	Hematology/Cell counts										LP7803-2
32338	HLA Antigens										LP7806-5
32765	History relevant to laboratory testing										LP175679-2
32773	HNA										LP158133-1
32790	HPA antigen										LP65557-8
32807	Laboratory orders										LP94892-4
32830	Microbiology Tests (Culture, DNA, Ag, and Ab)										LP7819-8
43701	Miscellaneous tests										LP7820-6
43956	Molecular pathology tests										LP7822-2
45303	Deletions										LP7823-0
45337	Inversions										LP146061-9
45342	Mutations										LP7824-8
46273	Rearrangements										LP7825-5
46304	Translocations										LP7828-9
46416	Trinucleotide Repeats										LP7826-3
46467	Trisomy repeats										LP7827-1
46487	Miscellaneous molecular pathology										LP121011-3
46500	HL7 genetics										LP70593-6
46555	HL7 Cytogenetics										LP111381-2

Figure 3.1-1: Class hierarchy showing Class classification of laboratory tests

Search Constraints | Class Hierarchy | Multi-axial Hierarchy | Component Hierarchy | System Hierarchy | Method Hierarchy

Row	Category orName	Component	Property	Timing	System	Scale	Method	ExUnits	DocSection	Rank	Code
1	Microbiology										LP31755-9
2	Microorganism										LP14559-6
3	Bacteria										LP98185-9
4	Bacteria										LP14082-9
34	Bacteria biotype | Isolate										LP180118-4
36	Bacteria identified										LP37205-9
338	Bacterial genes										LP135277-4
359	Bacteria Identification tests										LP40282-3
388	Antibody coated bacteria										LP14327-8
395	Actinobacillus sp										LP28877-6
396	Actinobacillus sp Identified | XXX										LP49251-9
398	Actinobacillus pleuropneumoniae										LP14066-2
399	Actinobacillus pleuropneumoniae 1 Ab | Bld-Ser-Plas										LP47652-0
402	Actinobacillus pleuropneumoniae 3 Ab | Bld-Ser-Plas										LP47653-8
405	Actinobacillus pleuropneumoniae 5 Ab | Bld-Ser-Plas										LP47654-6
408	Actinobacillus pleuropneumoniae 7 Ab | Bld-Ser-Plas										LP47655-3
411	Actinobacillus pleuropneumoniae biovar 2 | XXX										LP47656-1
413	Actinobacillus pleuropneumoniae Ab | Bld-Ser...										LP46416-1
418	Actinobacillus pleuropneumoniae | Isolate										LP46415-3
420	Actinobacillus pleuropneumoniae | XXX										LP47657-9
422	Actinobacillus suis | Isolate										LP47658-7

Figure 3.1-2: Multiaxial hierarchy of LOINC showing relations in Microbiology parts of component

Search Constraints | Class Hierarchy | Multi-axial Hierarchy | Component Hierarchy | System Hierarchy | Method Hierarchy

Row	Category orName	Component	Property	Timing	System	Scale	Method	ExUnits	DocSection	Rank	Code
1	Specimen										LP7593-9
71	Serum, Plasma or Blood										LP7579-8
98	Serum or Blood										LP7575-6
106	Blood										LP7057-5
5155	Blood arterial										LP7067-4
5258	Blood capillary										LP7068-2
5399	Blood venous										LP7073-2
5459	Blood mixed venous										LP7071-6
5501	Blood arterial + Blood venous										LP101985-2
5502	Blood special sources										LP40337-5
5503	Dried blood spot										LP21304-8
5948	Blood cord										LP7069-0
6086	Blood central										LP40338-3
6113	Blood drawn from CRRT circuit										LP63632-1
6115	Blood peripheral										LP7072-4
6118	Positive blood culture										LP183539-8
6136	Plasma										LP7479-1
15833	Platelet poor plasma or blood										LP135710-4
15835	Serum or Plasma										LP7576-4
24439	Serum or Plasma + Blood venous										LP100815-2
24441	Serum										LP7567-3
44222	Aspirate										LP7037-7
44240	Bartholin cyst										LP175662-8
44242	Blood cellular components										LP40340-9
46551	Body fluid										LP7238-1
47816	Body Site Specimen										LP30569-5
49167	Breast source fluid										LP40344-1
49232	Ear fluid										LP157723-0
49234	Calculus (stone)										LP7096-3
49314	Cell types										LP30570-3

Figure 3.1-3: Multiaxial hierarchy of LOINC showing relations in system ax: specimen

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3.2 Benefits of LOINC

Vocabulary standards like LOINC and SNOMED CT demonstrate the "network effect". That is, they become more valuable as more people use them. LOINC is the most widely used laboratory code system, and its benefits continue to grow as adoption spreads. Regenstrief develops LOINC using best practices in terminology development. The development approach keeps the content coverage broad and current in the domains of interest.

As a result, LOINC users find many benefits because it:

- Enables comparability and analysis of consolidated laboratory result data. Many EHR health information exchange projects are using LOINC to pool and compare clinical lab results. Such analyses can be for the same patient across different laboratories or the same test across many patients.

- Facilitates integration of laboratory tests and reporting units across disparate lab systems within the same health delivery system. For example, LOINC facilitates the communication between hospital-based clinical labs and their reference clinical labs.
- Enables more efficient electronic ordering of tests from multiple laboratories.
- Supports all commonly used lab tests and the majority of tests done in specialty areas. In case a LOINC code is missing because it does not exist in the current version, an agile process for submitting new codes ensures that it will be created and published in the next update, always considering that the code is pragmatically useful in the Clinical lab global community.
- Facilitates increased access to laboratory test results across the continuum of care and reduces the need to repeat laboratory tests by providing a universal identifier for lab tests across care sites and systems.
- Improves quality and timeliness of laboratory results and interpretations since tests can be reviewed electronically.
- Accelerates secondary uses of clinical results for other purposes such as public health reporting, quality measurement, and other kinds of analyses.
- Allows global communication, but has support for local implementation with features like language translations.

4 Cooperative Work

4.1 Cooperative Work Overview

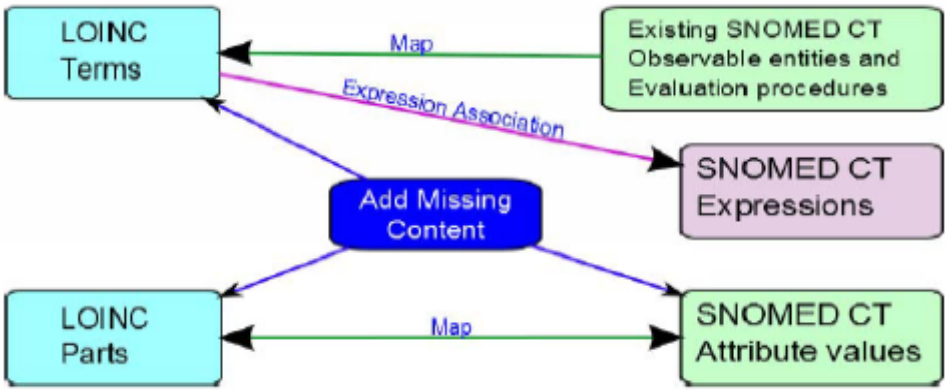


Figure 4.1-1: Overview of Cooperative Works – including maps, associations and content

4.2 Release File Specifications

4.2.1 LOINC Part map reference set

Introduction

The 705112009 |LOINC Part map reference set| is an instance of the |Map correlation and origin type reference set|. The general specification of the reference set type is included below and is followed by specific notes on the 705112009 |LOINC Part map reference set|.

Map Correlation and Origin Reference Set

Purpose

The |Map correlation and origin type reference set| is used to meet the requirements for representation of maps between code in another code system (other-codes) and a SNOMED CT concept where the following requirements apply.

1. A requirement to indicate the degree of correlation between the SNOMED CT concept and the other-codes.
2. A requirement to indicate whether a concept or code was added to either code system as a result of the mapping process and, in this case, to indicate in which code system the concept or code originated.
3. A requirement to represent the SNOMED CT attribute to which the other-code should be applied in order to capture the full specificity of the value represented by the other-code.
4. No requirements for mapping rules or advice to be included with each map.

Data Structure

Table 4.2.13-1: Map Correlation and Origin Reference Set - Data Structure

Field	Data type	Purpose
id	UUID	A 128 bit unsigned integer, uniquely identifying the reference set member.
effectiveTime	Time	Specifies the inclusive date at which this addition or change becomes effective.
active	Boolean	Specifies whether the member's state was active or inactive from the nominal release date specified by the effectiveTime field.
moduleId	SCTID	Identifies the member version's module. Set to a child of |Module| within the metadata hierarchy.
refsetId	SCTID	Identifies the reference set and must be a subtype of |Map correlation and origin type reference set| which is located in the metadata hierarchy as shown below: 900000000000454005 |Foundation metadata concept| 900000000000455006 |Reference set| 705111002 |Map correlation and origin type reference set|
referencedComponentId	SCTID	A reference to the SNOMED CT concept being mapped to/from the other-code.
mapTarget	String	The other-code to/from which the concept is mapped.
attributeId	SCTID	A reference to the SNOMED CT concept representing the attribute to which the referencedComponentId (other-code) applies. In some cases, other-codes may be overloaded with a meaning that combines the meaning of a specific attribute with a value applied to it in the SNOMED CT concept model, in these cases accurate mapping needs to specify both aspects of the meaning. The attributeId provides effective disambiguation in these cases. Values of attributeId are restricted to subtypes of |Concept model attribute| For example a code representing 'procedure site index finder' could not be mapped accurately simple to |Index finger| but also need to refer the implied attribute |Procedure site|.
correlationId	SCTID	The correlation between the SNOMED CT concept and the other-code. Possible values are the following subtypes of 447247004 |SNOMED CT source code to target map code correlation value|: 447559001 |Broad to narrow map from SNOMED CT source code to target code| 447557004 |Exact match map from SNOMED CT source code to target code| 447558009 |Narrow to broad map from SNOMED CT source code to target code| 447560006 |Partial overlap between SNOMED CT source code and target code|

contentOriginId	SCTID	Indication of whether concept was initially in one of the terminologies (SNOMED CT or other-codes) and added to the other as part of mapping or was in both terminologies at the outset. Values are subtype children of 705116007 |Original code system source for linked content value|.

Specific Notes on the LOINC Part map reference set

Refset Name

Values Specific to LOINC Term to Expression Reference Set

The following values are used in this reference set.

Value for refsetId

- 705112009 |LOINC Part map reference set|

Values for attributeId

The values of attributeId are constrained by the SNOMED CT concept model. Only attributes that can be applied to concepts in the |Observable entity| domain can be used in this reference set.

Values for contentOriginId

705117003 |Originally in LOINC|
705118008 |Originally in SNOMED CT|
705119000 |Originally in both LOINC and SNOMED CT|

Other Values

All other values are as specified for the |Map correlation and origin type reference set|.

4.2.2 LOINC Term to Expression Reference Set

Introduction

The |LOINC Term to Expression reference set| is an instance of a |Code to expression type reference set|. The general specification of the reference set type is included below and this is followed by specific notes on the |LOINC Term to Expression reference set|.

Code to Expression Type Reference Set

Purpose

The |Code to expression type reference set| is designed to enable associations between code in another code system (other-codes) an d SNOMED CT concepts, where the following constraints apply:

1. Some of the other-codes cannot be mapped to an individual SNOMED CT concept.
2. Licensing conditions (or other considerations) prevent addition of new SNOMED CT concepts to represent the same meaning as the other-codes.
3. The other-codes can be logically defined using the SNOMED concept model to represent the same meaning (sufficiently defined) or a similar though less specific meaning (primitive).
4. Other requirements similar for those applicable to mapping may also apply including:
    a. An indication of the degree of correlation between the other-code and the SNOMED CT expression.
    b. An indication of whether the other-code was created before any single concept representation of that meaning in SNOMED CT or whether the single concept representation in SNOMED CT predated the creation of the association.

Data Structure

The general approach to the above requirements is to associate each of the other-codes with a representation of the same logic based definition as would have been applied to a SNOMED CT concept with that meaning. However, since the other-code are not identified by an SCTID, the logical definition cannot be represented using defining relationships. There are two potential approaches to this, one would be to use a general purpose description logic language (e.g. OWL) and the other is to use a SNOMED CT expression to represent each definition. The |Code to expression type reference set| is designed to support the expression-based approach.

Table 4.2.14-1: Code to expression type reference set - Data Structure

Field	Data type	Purpose
id	UUID	A 128 bit unsigned integer, uniquely identifying the reference set member.
effectiveTime	Time	Specifies the inclusive date at which this change becomes effective.
active	Boolean	Specifies whether the member's state was active or inactive from the nominal release date specified by the effectiveTime field.
moduleId	SCTID	Identifies the member version's module. Set to a child of |Module|in the metadata hierarchy.
refsetId	SCTID	Identifies the reference set and must be a subtype of |Code to expression type reference set| which is located in the metadata hierarchy as shown below: 900000000000454005 |Foundation metadata concept| 900000000000455006 |Reference set| 705109006 |Code to expression type reference set|
referencedComponentId	SCTID	A reference to a SNOMED CT metadata concept referring to the code system containing the o ther-codes. This is a subtype of |Terminology system|.
mapTarget	String	The other-code associated with the SNOMED CT expression.
expression	String	A SNOMED CT expression that represents the SNOMED CT definition of the other-code. This expression may be a stated or inferred view of the definition provided that documentation of each identified reference set specifies the view provided. The expression must conform to the syntax defined in the SNOMED CT Compositional Grammar - Specification and Guide (http://snomed.org/scg).

definitionStatusId	SCTID	Indicates whether or not the expression contains a sufficient definition of the other-code in the mapTarget field. Possible values are the following subtypes of 900000000000444006 |Definition status|: 900000000000074008 |Necessary but not sufficient concept definition status| 900000000000073002 |Sufficiently defined concept definition status|
correlationId	SCTID	The correlation between the SNOMED CT expression and the other-code. Possible values are the following subtypes of 447247004 |SNOMED CT source code to target map code correlation value|: 447559001 |Broad to narrow map from SNOMED CT source code to target code| 447557004 |Exact match map from SNOMED CT source code to target code| 447558009 |Narrow to broad map from SNOMED CT source code to target code| 447560006 |Partial overlap between SNOMED CT source code and target code| When these values are applied to this reference set type, the phrase "SNOMED source code" is interpreted as meaning "SNOMED expression" and "target code" refers to the other-code..
contentOriginId	SCTID	Indication of whether concept was initially in one of the terminologies (SNOMED CT or other-codes) and added to the other as part of mapping or was in both terminologies at the outset. Values are subtype children of 705116007 |Original code system source for linked content value|

Specific Notes on the LOINC Term to Expression Reference Set

Rationale for Using a Code to Expression Type Reference Set

The |Code to expression type reference set| was designed to meet the known requirements for associating LOINC Terms with SNOMED CT expressions, in accordance with the terms of the cooperation agreement. The main reason for using expressions rather than OWL to represent the definitions, is that expressions can precisely represent all aspects of the definitions represented by SNOMED CT defining relationships. An additional factor was the relative human-readability of this format for review as demonstrated by the expression tab in the SNOMED International online browser (http://snomed.org/browser).

LOINC Associations

Each LOINC Term Code within the scope of the cooperative work completed to date is associated with a SNOMED CT expressions that represent its formal logical definition. The definition is represented in accordance with the SNOMED CT concept model and thus each LOINC Term code in related directly to the SNOMED CT concepts that define it. The same definition could a expression to represent the definition. If a LOINC Term is recognized as having the same meaning as an existing SNOMED CT concept the associated expression may in future be supplemented by a direct map.

Expression Format

Each expression conforms to the SNOMED CT Composition Grammar. For further details of the syntax please see the Compositional Grammar - Specification and Guide (http://snomed.org/scg). The expression represents the SNOMED CT definition of the LOINC Term based in the recently developed concept model for the |Observable entity| domain. Note that the expression that represents a LOINC Term does not include any inferred relationships with other LOINC Terms. Furthermore, since the new |Observable entity| has not yet been applied to many SNOMED CT concepts, the LOINC Terms are defined as subtypes |Observable entity| with an appropriate set of attribute relationships. Thus the expressions released in the beta release on 2017-03-31 included only stated relationships.

LOINC Term Code Status Changes

Deprecated statuses will cause the expression associations to be marked as inactive but trial use status will not be represented. LOINC Terms that were already deprecated at the time of initial mapping will not be included in maps and associations. However, dependent on demand and priority to assessments, it is possible these may be added later.

Values Specific to LOINC Term Expression Associations

The following values are used in this reference set.

Value for refsetId

- 705110001 |LOINC Term to Expression reference set|

Value for referencedComponentId

- 705114005 |LOINC Code System|

Values for contentOriginId

705117003 |Originally in LOINC|
705118008 |Originally in SNOMED CT|
705119000 |Originally in both LOINC and SNOMED CT|

Other Values

All other values are as specified for the |Code to expression type reference set|.

4.3 Benefits of Products of the Cooperative Work

Once the work of the Cooperative Agreement is completed, users of each terminology will receive added benefits.

LOINC Benefits to SNOMED CT Users

- LOINC codes will provide to SNOMED CT terminology extensive coverage of clinical laboratory tests and some types of clinical measurements. Likewise, the addition of SNOMED CT concepts from LOINC Parts will expand coverage in areas like substances, cell types, kinds of property, etc.
- LOINC provides greater granularity and specificity for coding of laboratory tests.
- Links between the terminologies will promote the usage of SNOMED CT by LOINC large global community.
- The Observables model related to clinical lab tests in SNOMED CT was based on the LOINC semantic model.

Additional benefits of linking SNOMED CT and LOINC are described in referenced papers written by Adamusiak and Bodenreider referenced at the end of this Chapter. [

SNOMED CT Benefits in Laboratory Area for LOINC Users

Linking LOINC terms to the SNOMED CT subtype hierarchy and description logic definitions provides an inferred hierarchy for LOINC terms. Some of these benefits were described by Adamusiak and Bodenreider (referenced at the end of this Chapter), including:

- SNOMED CT is currently being used in the laboratory area for reporting Microbiology results. Linkage to related LOINC codes provides a more integrated pattern of usage in this domain.
- The richness of SNOMED CT relations can provide novel insights into the original resource
- The hierarchy of parts used by LOINC terms can be informed by the SNOMED CT hierarchy, thus reducing duplicative work
- Hierarchical organization of LOINC terms can be inferred automatically
- SNOMED CT relationships can also provide enhanced subsumption for LOINC terms. New paths are not limited to abstract observations that group LOINC codes, but also LOINC codes themselves can be in direct relationships. This limits the need for creating abstract observations to group them.
- The SNOMED CT DL representation can enhance navigation among LOINC terms by providing access to more paths between the codes in the SNOMED CT hierarchy. Such navigation can make it easier to find an appropriate code.
- SNOMED CT DL can also enhance curation of LOINC content by enabling detection of duplicates and missing hierarchical relations.

References

Adamusiak T, Bodenreider O. Quality assurance in LOINC using Description Logic. AMIA Annu Symp Proc. 2012;2012:1099-108.

- http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3540427/pdf/amia_2012_symp_1099.pdf

SNOMED CT Starter Guide

SNOMED CT Technical Implementation Guide

5 Guidance on Use of SNOMED CT and LOINC Together

5.1 Use of SNOMED CT and/or LOINC in

Introduction

In order to develop guidance the guidelines in the following section, an environmental scan was conducted of different use case involving the use of SNOMED CT and/or LOINC

The use cases considered included:

- Practical clinical scenarios in which SNOMED CT and/or LOINC are currently used:
  - Bio-surveillance (animal/human health) networks.
  - Clinical laboratory reporting (mostly Microbiology area).
  - Infectious diseases for lab order entries.
- Healthcare information standards, that require or enable the use of SNOMED CT and/or LOINC.

Summary of Results

The summary information on this page is based on analysis of use cases and guidelines identified during an environmental scan of current usage of LOINC and SNOMED CT in clinical laboratory systems and related healthcare systems.

Table 5.1-1 summarizes recommendations for use of either SNOMED CT or LOINC in particular data elements. The recommendations are subdivided into categories based on particular scenarios or contexts of use. Figure 5.1-0 provides a graphical representation of the current use of SNOMED CT and LOINC for representing particular types of information, as identified in the environmental scan.

Table 5.1-1: Summary of use of SNOMED CT and LOINC in different data elements and scenarios

DATA ELEMENTS	SCENARIO		
	Bio-surveillance(human/animal)	Lab reporting (micro, infect diseases)	CIMI
Vital signs Name (Observation name)	LOINC	---	SNOMED CT
Vital signs Result (Observation value)	SNOMED CT	---	SNOMED CT
Laboratory Orders	LOINC	LOINC	---
Laboratory Test Results Name (Identifier)	LOINC	LOINC	LOINC
Laboratory Test Results no Quantitative (Value)	SNOMED CT	SNOMED CT	SNOMED CT
Specimens (Specimen Types, Specimen Source Types, ...)	SNOMED CT	SNOMED CT	SNOMED CT
Animal Species/Breeds	SNOMED CT	SNOMED CT	SNOMED CT
Procedures (Laboratory Methods)	SNOMED CT	SNOMED CT	SNOMED CT

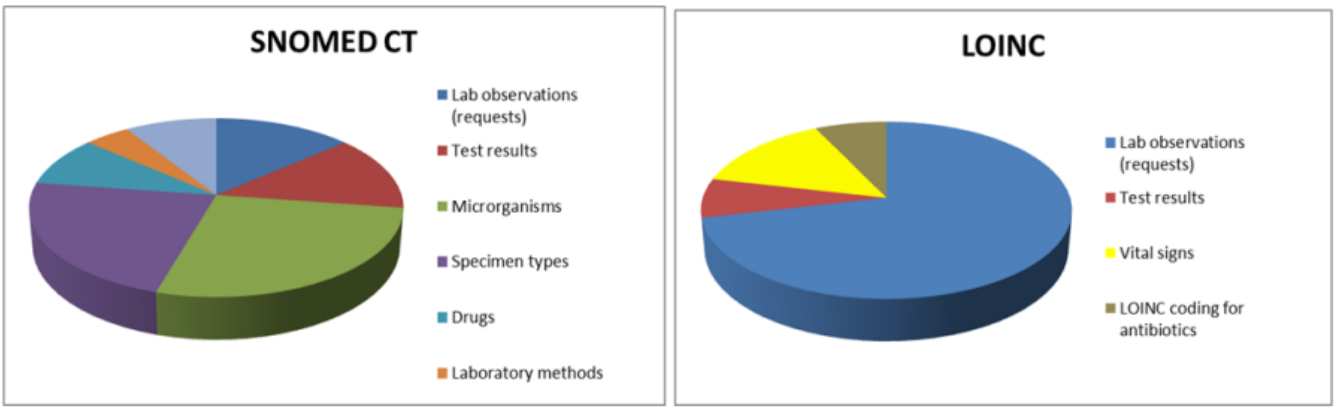


Figure 5.1-0: Current usage of SNOMED CT and LOINC for different use cases

5.2 Practical Guidance on Uses of SNOMED CT and LOINC

5.2.1 Guideline A - Vital Signs (Observation Names and Values)

Vital Signs Name (Observation Name)

Recommendation:

LOINC should be used as the standard coding system to identify the vital sign observation.

Alternative 1:

The SNOMED CT expression associated with a LOINC code for a vital sign may be used.

Alternative 2:

SNOMED CT concepts from the 46680005 |Observable entity| hierarchy may be used.

Vital Signs Result (Observation Value)

Recommendation:

Many vital signs are physical quantities and will thus be represented by numbers and units.

Where a vital sign observation requires a coded value SNOMED CT should be used as the standard coding system for such result values.

Examples

Example 1: An example value set for vital sign result type in PHIN-VADS (CDC)

Table 5.2.1-1: Value Set Code PHVS_VitalSignResult_HITSP

Concept Code	Concept Name	Preferred Concept Name	Code System Name
8310-5	Body Temperature	Body temperature:Temp:Pt:^Patient:Qn:	LOINC
8462-4	BP Diastolic	Intravascular diastolic:Pres:Pt:Arterial system:Qn:	LOINC
8480-6	BP Systolic	Intravascular systolic:Pres:Pt:Arterial system:Qn:	LOINC
8287-5	Head Circumference	Circumference.occipital-frontal:Len:Pt:Head:Qn:Tape measure	LOINC
8867-4	Heart Rate	Heart beat:NRat:Pt:XXX:Qn:	LOINC
8302-2	Height	Body height:Len:Pt:^Patient:Qn:	LOINC
8306-3	Height (Lying)	Body height^lying:Len:Pt:^Patient:Qn:	LOINC
2710-2	O2 % BldC Oximetry	Oxygen saturation:SFr:Pt:BldC:Qn:Oximetry	LOINC
9279-1	Respiratory Rate	Breaths:NRat:Pt:Respiratory system:Qn:	LOINC
3141-9	Weight Measured	Body weight:Mass:Pt:^Patient:Qn:Measured	LOINC
https://phinvads.cdc.gov/vads/ViewValueSet.action?id=7FFDBFB5-A277-DE11-9B52-0015173D1785#			

5.2.2 Guideline B - Laboratory Orders

Recommendation:

To identify the requested observation/test/battery LOINC should be used as the standard coding system.

Alternative 1:

The SNOMED CT expression associated with a LOINC code may be used.

Alternative 2:

SNOMED CT concepts from the 15220000 |Laboratory test| or 363787002 |Observable entity| hierarchies may be used.

Examples

Example 1: Value set for Lab Test orderables that could be used for influenza

Table 5.2.2-1: Value Set Code PHVS_LabTestOrder_PHLIP_Flu

Concept Code	Preferred Concept Name	Code System Name
68991-9	Epidemiologically important information for public health reporting panel	LOINC
29591-5	Enterovirus RNA [Presence] in Unspecified specimen by Probe & target amplification method	LOINC
60528-7	Enterovirus subtype [Type] in Unspecified specimen by Probe & target amplification method	LOINC
5843-8	EV XXX cult	LOINC
43364-9	Enterovirus identified in Unspecified specimen by Immunofluorescence	LOINC
5229-0	Influenza Virus A (Ab) CF Titer	LOINC
5230-8	Influenza Virus B (Ab) CF Titer	LOINC
6604-3	Influenza Virus Culture for Isolation on XXX	LOINC
6437-8	Influenza Virus A+B EIA on XXX	LOINC
5862-8	Influenza Virus A EIA on XXX	LOINC
https://phinvads.cdc.gov/vads/ViewValueSet.action?id=2EFBC056-83A9-E311-8D07-0017A477041A#		

Example 2: Laboratory Orders in National Animal Health Laboratory Network

The NAHLN uses LOINC codes to defining the test or panel/battery ordered as the Universal Service Identifier (OBR-4). In the NAHLN, new tests or panels that do not have an assigned LOINC Code, are identified with an alternative or local identifier.

Table 5.2.2-2: Subset of Test Codes in National Animal Health Laboratory Network

CODE	CODINGSYSTEM	TEXT
44273-1	LN	CSFV RNA XXX PCR-aCnc
10739-1	LN	Virus XXX EM
15444-3	LN	FLUA Ab Ser Ql ID
15448-4	LN	APMV1 Ab Titr Ser HAI
22822-1	LN	FLUA Ab Ser Ql EIA
22826-2	LN	FLUA XXX Bioassay

22832-0	LN	APMV1 XXX Bioassay
23002-9	LN	CSFV Ab Ser Ql EIA
23006-0	LN	CSFV Ag XXX Ql IF
23007-8	LN	CSFV Ag Tiss Ql ImStn
23108-4	LN	FMDV Ab Ser Ql EIA
23109-2	LN	FMDV Ab Ser Ql ID
23115-9	LN	FMDV Sertyp XXX CF
23120-9	LN	FMDV Sertyp XXX EIA
23121-7	LN	FMDV Sertyp Tissue PCR
23379-1	LN	Abn Prion Prot Brain Ql IB
23380-9	LN	Abn Prion Prot Brain Ql ImStn
23563-0	LN	VSIV Ab Ser Ql EIA
http://vtsl.vetmed.vt.edu/nahln/main.cfm?page=subset&subset=observation_id		

5.2.3 Guideline C - Laboratory Test Results (Observation Names and Values)

Laboratory Test Name (Observation Name)

Recommendation:

LOINC should be used as the standard coding system to identify the test (observation).

Alternative 1:

The SNOMED CT expression associated with a LOINC code may be used.

Alternative 2:

SNOMED CT concepts from the 15220000 |Laboratory test| or 363787002 |Observable entity| hierarchy may be used.

Laboratory Result Value (Observation Value)

Recommendation:

Laboratory test results are reported different value types. For example, an LDL cholesterol level may be reported as a numeric value type, the results of a blood culture might identify an organism, and the results of a genetic mutation analysis may be reported as narrative text. In LOINC, these value types are distinguished in the Scale attribute.

When a laboratory result observation requires a coded value, SNOMED CT should be used as the standard coding system for such result values. The majority of coded results for reportable laboratory results fall into one of the following SNOMED CT hierarchies:

- |Microorganism|
- |Substance|
- |Evaluation finding (finding)|
- Presence and absence findings
  - |Presence findings|
  - |Absence findings|

Implications of using SNOMED CT for result values

In laboratory test result reporting, the semantic relationship between the identification of the observation and its value is that the asserted value "refines" or "qualifies" the meaning of the laboratory test that is specified in the identification of the observation. In other words, how a particular result should be reported depends upon what is being used as an identification of the observation. This is true regardless of whether SNOMED CT is used.

When SNOMED CT is used for a coded result value, this understanding of the semantic relationship is consistent with the use of refinement as specified in the SNOMED CT Concept Model.

Examples

Example 1: Reportable Condition Mapping Table (RCMT)-Lab Test & Results. CDC Vocabulary Server

The Reportable Condition Mapping Table (RCMT) provides mappings between reportable conditions and their associated LOINC laboratory tests and SNOMED results.

The RCMTs use standards suggested for the meaningful use measure "reportable lab result reporting to public health". They can be used to filter the output of clinical labs for test results that are of interest to public health.

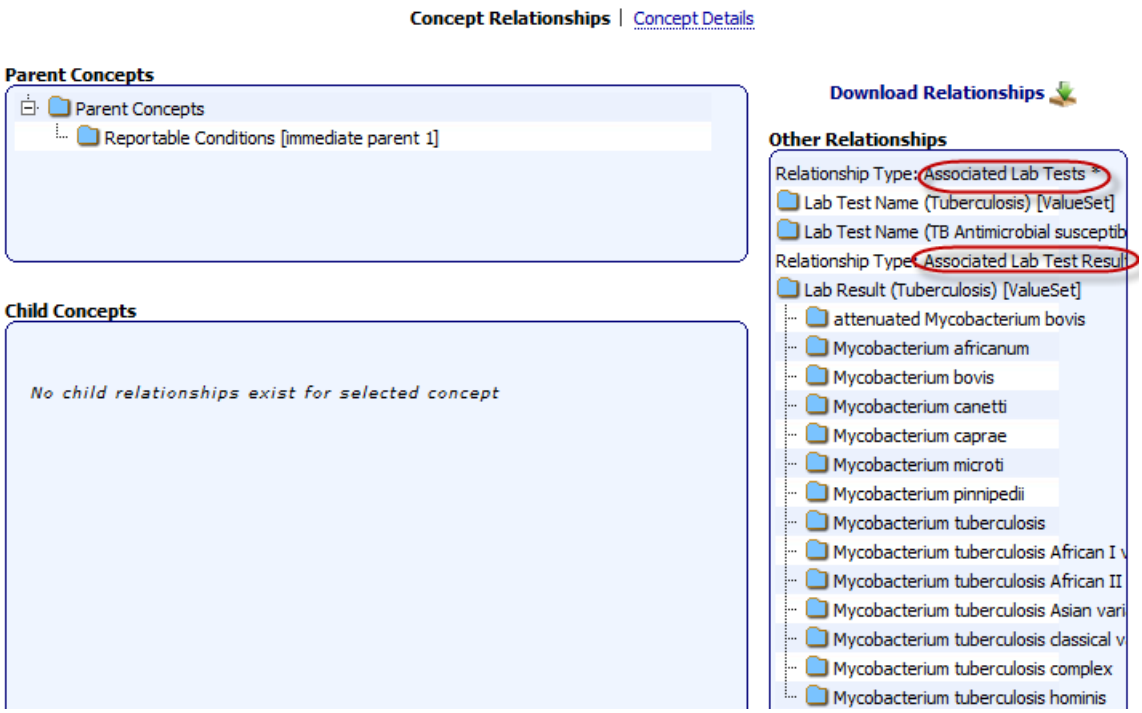


Figure 5.2.3-1: CDC Vocabulary Server (PHIN VADS). RCMT Tree (Navigator) e.g: Tuberculosis

Table 5.2.3-1: Relationships - Condition and Lab Tests/Results Notifiable Event (Disease/Condition) Code list: Tuberculosis

Code 1	Name 1	Relationship Type	Concept Name 2	Concept Code 2	Code System Name 2
10220	Tuberculosis	Associated Lab Test Results	Attenuated Mycobacterium bovis (organism)	33610009	SNOMED CT
10220	Tuberculosis	Associated Lab Test Results	Mycobacterium africanum (organism)	51320008	SNOMED CT
10220	Tuberculosis	Associated Lab Test Results	Mycobacterium bovis (organism)	27142009	SNOMED CT
10220	Tuberculosis	Associated Lab Test Results	Mycobacterium canetti (organism)	414789006	SNOMED CT
10220	Tuberculosis	Associated Lab Test Results	Mycobacterium caprae (organism)	430579009	SNOMED CT
10220	Tuberculosis	Associated Lab Test Results	Mycobacterium microti (organism)	70801007	SNOMED CT
10220	Tuberculosis	Associated Lab Test Results	Mycobacterium pinnipedii (organism)	430914003	SNOMED CT
10220	Tuberculosis	Associated Lab Test Results	Mycobacterium tuberculosis (organism)	113861009	SNOMED CT
10220	Tuberculosis	Associated Lab Test Results	Mycobacterium tuberculosis African I variant (organism)	243372002	SNOMED CT
10220	Tuberculosis	Associated Lab Test Results	Mycobacterium tuberculosis African II variant (organism)	243373007	SNOMED CT
10220	Tuberculosis	Associated Lab Test Results	Mycobacterium tuberculosis Asian variant (organism)	243371009	SNOMED CT
10220	Tuberculosis	Associated Lab Test Results	Mycobacterium tuberculosis classical variant (organism)	243370005	SNOMED CT
10220	Tuberculosis	Associated Lab Test Results	Mycobacterium tuberculosis complex (organism)	113858008	SNOMED CT
10220	Tuberculosis	Associated Lab Test Results	Mycobacterium tuberculosis hominis (organism)	36354002	SNOMED CT
10220	Tuberculosis	Associated Lab Tests	Gamma interferon background Bld EIA-aCnc	71776-9	LOINC
10220	Tuberculosis	Associated Lab Tests	IGNF neg cntrl Bld	74279-1	LOINC
10220	Tuberculosis	Associated Lab Tests	M bovis Ab Ser Ql	23239-7	LOINC
10220	Tuberculosis	Associated Lab Tests	M bovis Ab Ser Ql EIA	23240-5	LOINC

10220	Tuberculosis	Associated Lab Tests	M bovis Ag Bld Ql	23242-1	LOINC
10220	Tuberculosis	Associated Lab Tests	M bovis Ag Tiss Ql ImStn	23241-3	LOINC
10220	Tuberculosis	Associated Lab Tests	M bovis tuberc IGNF Pnl Bld	53703-5	LOINC
10220	Tuberculosis	Associated Lab Tests	M bovis tuberc-control IGNF Bld-aCnc	53704-3	LOINC
10220	Tuberculosis	Associated Lab Tests	M bovis-M avium tuberc IGNF Bld-aCnc	53702-7	LOINC
10220	Tuberculosis	Associated Lab Tests	M tb A60 Ab Ser Ql EIA	55224-0	LOINC
10220	Tuberculosis	Associated Lab Tests	M tb A60 IgM Ser Ql EIA	55223-2	LOINC
10220	Tuberculosis	Associated Lab Tests	M TB Cmplx DNA XXX Ql PCR	38379-4	LOINC
https://phinvads.cdc.gov/vads/ViewCodeSystemConcept.action?oid=2.16.840.1.114222.4.5.277&code=10220					

Example 2: CIMI

The Clinical Information Modeling Initiative (CIMI) is an international collaboration dedicated to improving the interoperability of healthcare information systems through shared implementable clinical information models. CIMI's goal is to provide a common format for detailed specifications for the representation of health information content so that semantically interoperable information may be created and shared in health records, messages, and documents.

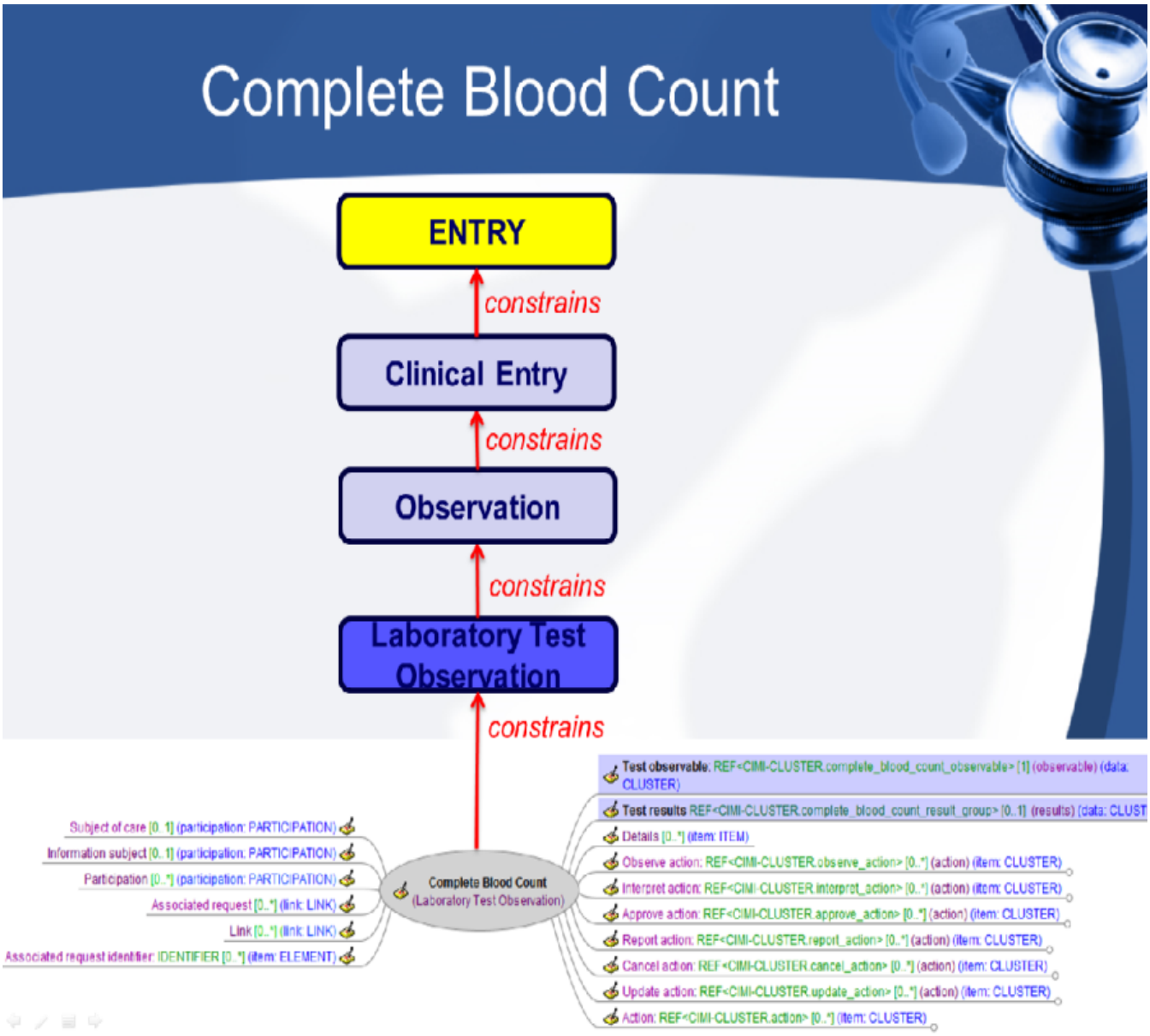


Figure 5.2.3-2: CIMI archetype map for laboratory results report

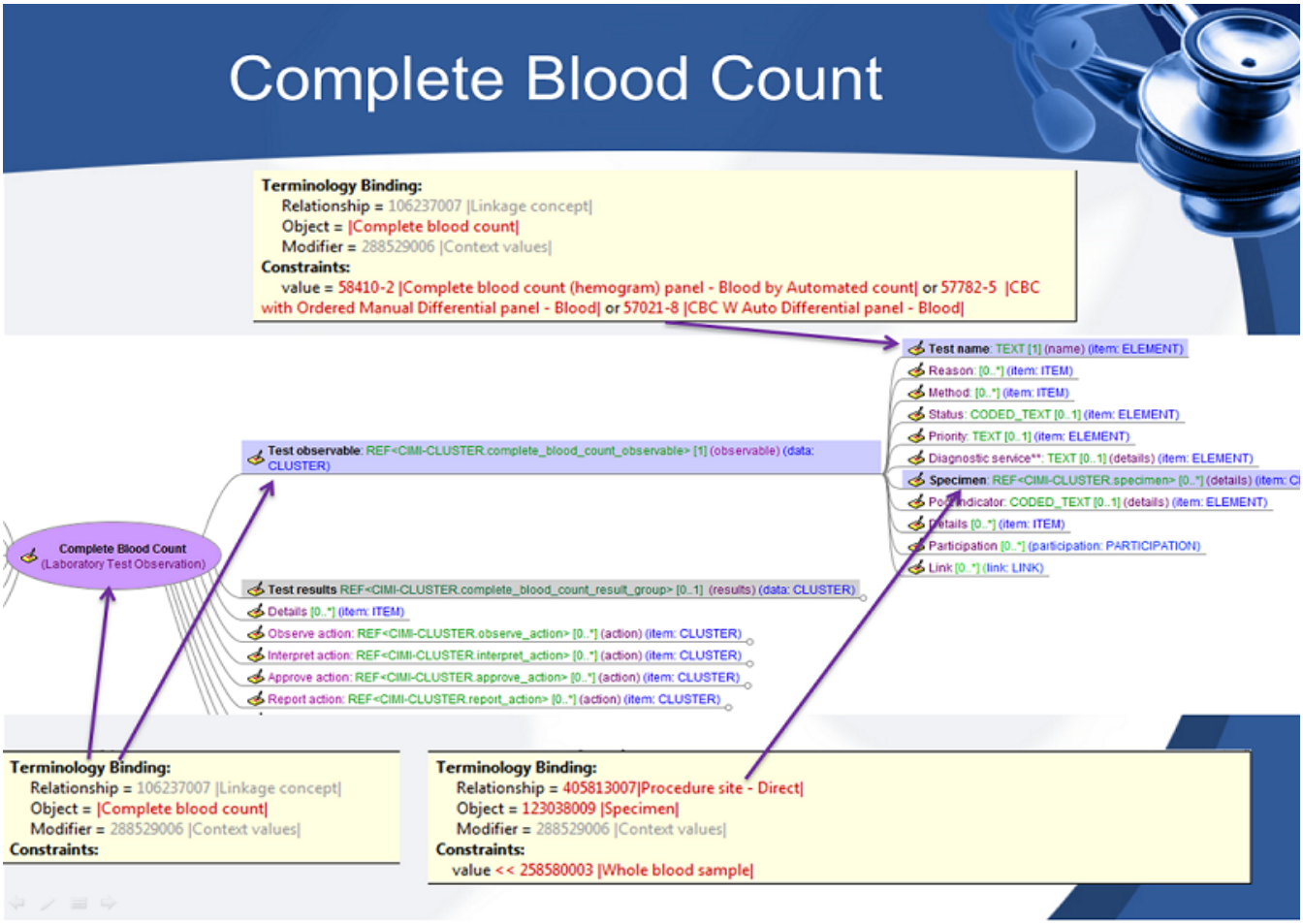


Figure 5.2.3-3: CIMI Modelling Taskforce Report

Example 3: Value set for Microorganisms/Infectious agents (PHIN-VADS CDC)

Microbiology reporting is a common example of laboratory tests that are reported with coded result values (i.e. the microorganism identified). Use of SNOMED CT to code such results enables reporting and decision support capabilities.

Table 5.2.3-2: Value Set Code PHVS_Microorganism_CDC

Concept Code	Preferred Concept Name	Code System Name
54857005	63U-11 virus	SNOMED CT
66177001	75V-2374 virus	SNOMED CT
77627007	75V-2621 virus	SNOMED CT
54454006	78V-2441 virus	SNOMED CT
11946001	Abadina virus	SNOMED CT
113714003	Abiotrophia defectiva	SNOMED CT
409815006	Abiotrophia para-adiacens	SNOMED CT
372391001	Abiotrophia species	SNOMED CT
17822001	Abras virus	SNOMED CT
https://phinvads.cdc.gov/vads/ViewValueSet.action?id=06B09CEF-0E37-E111-A720-0050568D00F8#		

5.2.4 Guideline D - Specimens

Recommendation:

Were specimen source (type, source site and collection method) is conveyed in attributes other than the test name, these values should be coded using SNOMED CT.
In particular:

- specimen type terms should be drawn from the 123038009 |Specimen| hierarchy in SNOMED CT
- specimen source site terms should be drawn from the 123037004 |Body structure| hierarchy
- specimen collection method terms should be drawn from the 71388002 |Procedure| hierarchy

Notes:

Laboratory test names typically include the specimen (e.g. the LOINC "System") upon which the observation was made, but some attributes about the specimen can be carried in other parts of the information or messaging model. Where such other specimen attributes are reported as coded values, they should use SNOMED CT concepts.

Examples

Example 1: Part of the Value set for Specimen Type (PHIN-VADS CDC)

Table 5.2.4-1: Value Set Code NHSNSpecimenTypeCode

Concept Code	Preferred Concept Name	Code System Name
258414004	Adipose tissue sample	SNOMED-CT
309141004	Adrenal gland specimen	SNOMED-CT
119373006	Amniotic fluid specimen	SNOMED-CT
309479002	Artery sample	SNOMED-CT
309493009	Bile duct biopsy sample	SNOMED-CT
119341000	Bile specimen	SNOMED-CT
309491006	Biliary tract tissue sample	SNOMED-CT
119297000	Blood specimen	SNOMED-CT
119359002	Bone marrow specimen	SNOMED-CT
https://phinvads.cdc.gov/vads/ViewValueSet.action?id=6F61F377-E515-43D2-BFEB-4BF135244033#		

Example 2: Specimen type and specimen source site in NAHLN messaging

The Specimen Type (SPM.4) field describes the precise nature of the entity that will be the source material for the observation. While every effort will be made to provide coded values for specimen types being used in NAHLN agent testing, there may be cases where a coded value specific to a particular specimen type is not immediately available. In these instances, an alternative coded value and description of the specimen may be sent in components 4-6 of the CWE data type. In some cases the precise term is not available in the coded reference system. In these situations, it is allowable to send the original text of the specimen description in the CWE.9 component

An example of coded value for SPM.4

```
<SPM.4>
<CWE.1>661000009100</CWE.1>
<CWE.2>Oropharyngeal swab</CWE.2>
<CWE.3>SCT</CWE.3>
<CWE.9>OP swabs</CWE.9>
</SPM.4>
```

The Specimen Source Site (SPM.8) contains an identifier for the source of the specimen (i.e the anatomical location, organ or site from which the specimen originated). This field is needed when the SNOMED specimen hierarchy does not contain a precoordinated term that adequately describes the specimen. For example, in the case where tonsillar tissue is obtained from a pig by scraping, the source would be 'Tonsillar structure (palatine)' In general this field is only needed when additional information about the region from where the specimen was collected is needed. For environmental specimens this field may supply additional information on where the specimen originated. In cases where the specimen and specimen source are identical, this field need not be populated.

There is no one correct answer to precisely which detail should be provided by a pre-coordinated, more specific specimen type and which with a less specific type plus a specimen source. Many specimen/source combinations could be correctly expressed either way. The NAHLN will try to provide guidance on specific testing protocols.

An example of SPM.8, used in conjunction with SPM.4

```
<SPM.4>
<CWE.1>128168004</CWE.1>
<CWE.2>Tissue specimen from liver</CWE.2>
<CWE.3>SCT</CWE.3>
</SPM.4>
<SPM.8>
<CWE.1>89255003</CWE.1>
<CWE.2>right lateral lobe of liver</CWE.2>
<CWE.3>SCT</CWE.3>
</SPM.8>
```

5.2.5 Guideline E - Animal Species and Breeds

Recommendation:

Where there is a requirement to identify an animal species, concepts from the SNOMED CT 387961004 |Animal| hierarchy should be used.

Examples

Example 1: Part of Value set for Animal species for animal rabies. PHIN-VADS (CDC)

Table 5.2.5-1: Value Set Code PHVS_AnimalSpecies_AnimalRabies

Concept Code	Preferred Concept Name	Code System Name
77108002	Alopex lagopus	SNOMED CT
68014009	Canis familiaris	SNOMED CT
8909006	Canis latrans	SNOMED CT
68552000	Caprine species	SNOMED CT
257529001	Cow	SNOMED CT
26570006	Equine species	SNOMED CT
125085001	Equus asinus asinus	SNOMED CT
107003000	Family cervidae	SNOMED CT
https://phinvads.cdc.gov/vads/ViewValueSet.action?id=F9D34BBC-617F-DD11-B38D-00188B398520#		

5.2.6 Guideline F - Procedures (Laboratory Methods)

Recommendation:

Where it is useful to code more specific information about testing method to a more granular level than what is contained in the test name, such details should be coded with SNOMED CT.

Examples

Example 1: Value set for anti-microbial Susceptibility test methods for invasive Pneumococcal disease (PHIN-VADS CDC)

In Bio-surveillance, specific test methods can be populated with SNOMED (Anti-microbial susceptibility test methods or Varicella lab test method) in HL7 (specimen collection method) or CDC Code system for laboratory test method identifier.

Table 5.2.6-1: Value Set Code PHVS_AntimicrobialSuceptiblilityTestMethod_IPD

Concept Code	Concept Name	Preferred Concept Name	Code System Name
104232004	Antibiotic sensitivity, agar diffusion method (procedure)	AGAR	SNOMED CT
39334004	Broth microdilution susceptibility test (procedure)	BROTH	SNOMED CT
359872008	Disk diffusion susceptibility test (procedure)	DISK	SNOMED CT
104234003	Gradient strip susceptibility test (procedure)	STRIP	SNOMED CT
https://phinvads.cdc.gov/vads/ViewValueSet.action?id=515EF9FD-212B-DF11-B334-0015173D1785#			

Example 2: Value set for Varicella lab testing (PHIN-VADS CDC)

Table 5.2.6-2: Value Set Code PHVS_LabTestMethod_VZ

Concept Code	Preferred Concept Name	Code System Name
73512001	Electron microscopic study	SNOMED CT
84095005	Tzanck smear method	SNOMED CT
https://phinvads.cdc.gov/vads/ViewValueSet.action?id=DB645D26-69A0-DD11-8A3F-00188B398520#		

5.2.7 Practical Uses of Part Maps and Expression Associations

Examples

Example 1: Link between causative agent organism and tests for organisms

Description

A GP needs to confirm a diagnosis of Pulmonary Tuberculosis. To do so, launches a query in order to obtain all the related lab tests.

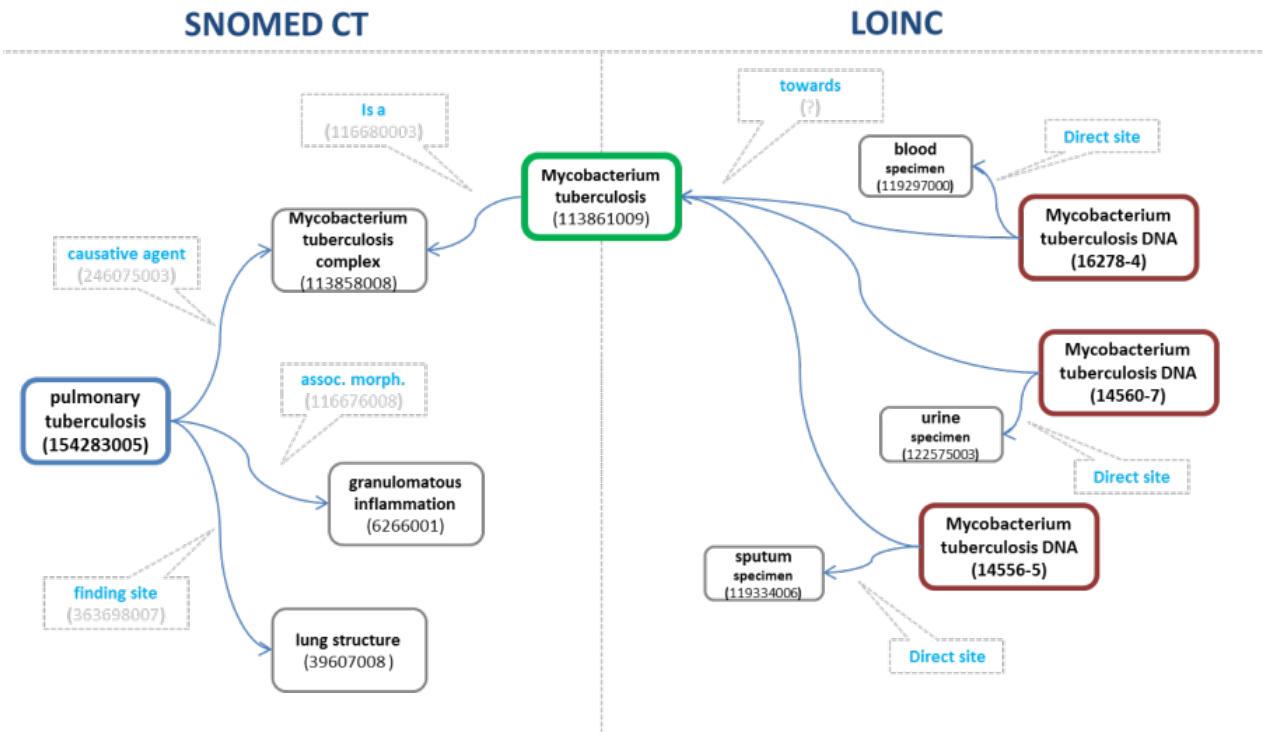


Figure 5.2.7-1: Link between causative agent organism and tests for organisms

Conclusion

System retrieves all those clinical lab tests which component (towards) is related to the causative agent of the disease.
It is possible to refine the selection by considering the relationship between the disease finding site and the specimen source topography.

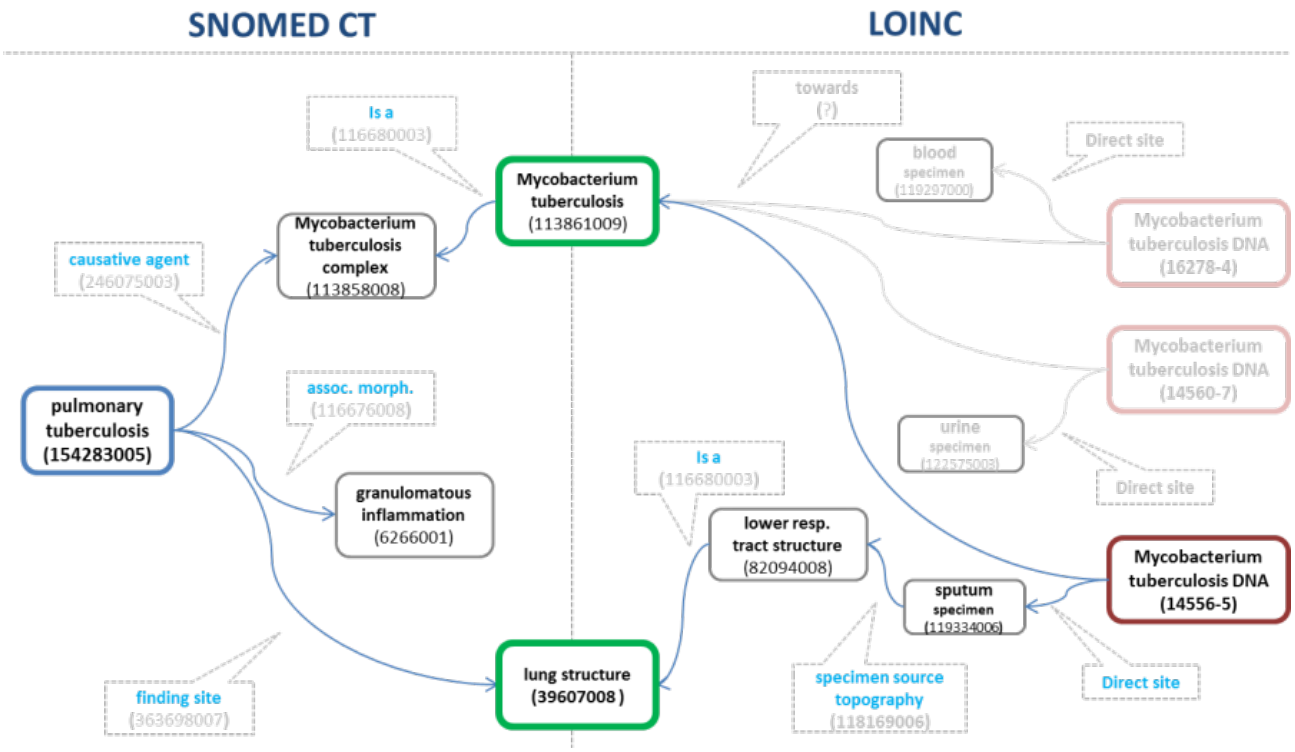


Figure 5.2.7-2: Link between finding site of disorder and specimen

Example 2: Link between antibody in SNOMED CT and LOINC

Description

A GP needs to check vaccinations status level for rubella and queries the system for which lab tests are related.

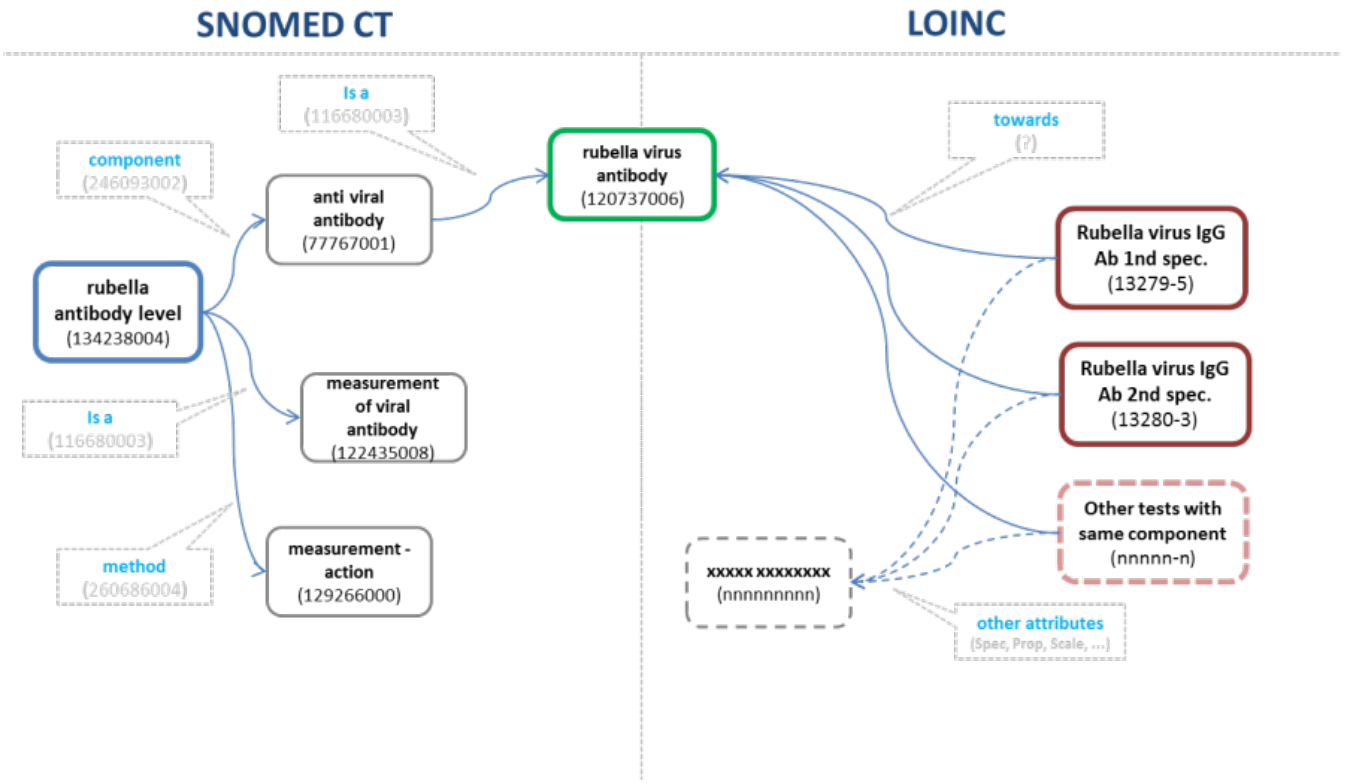


Figure 5.2.7-3: Link between antibody in SNOMED CT and LOINC

Conclusion

System retrieves all those clinical lab tests which component (towards) is equivalent to the component of the evaluation procedure.

Example 3: Link between substance in SNOMED CT and measurement in LOINC

Description

A GP needs to confirm a diagnosis of Hemochromatosis. To do so, launches a query in order to obtain related lab tests.

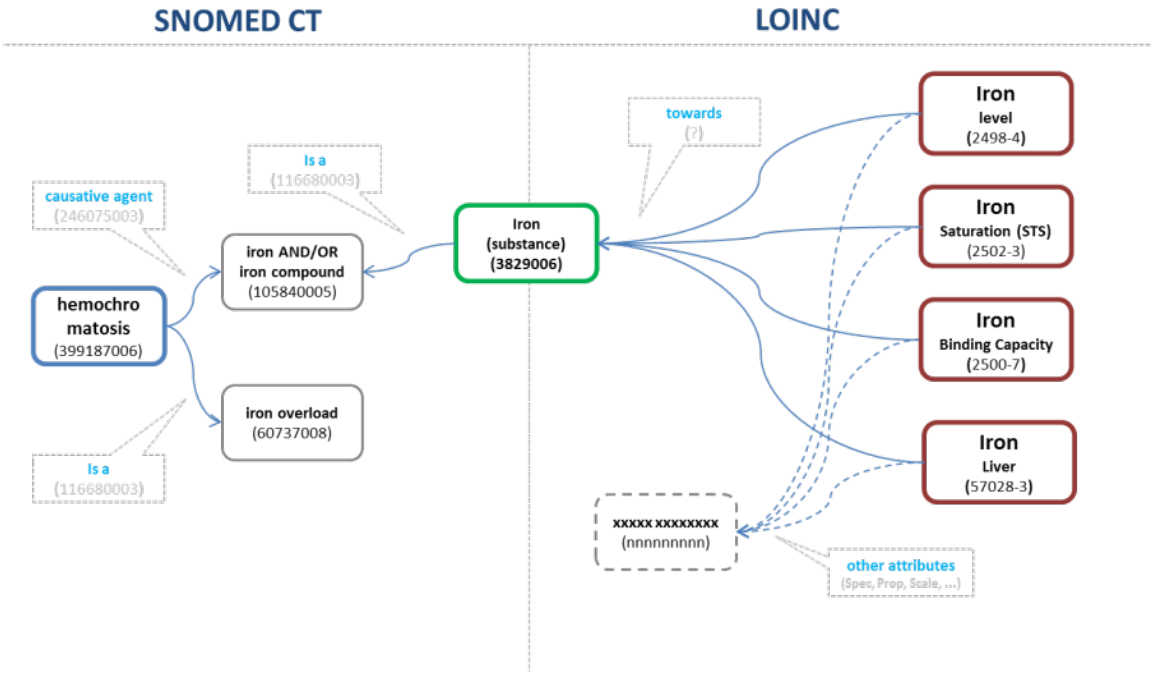


Figure 5.2.7-4: Link between substance in SNOMED CT and measurement in LOINC

Conclusion

System retrieves all those clinical lab tests which component (towards) is related to the causative agent of the disease.

The semantic net shown in the previous graphics, could be used as a basis for decision algorithm optimization as shown in Figure 5.2.7-5

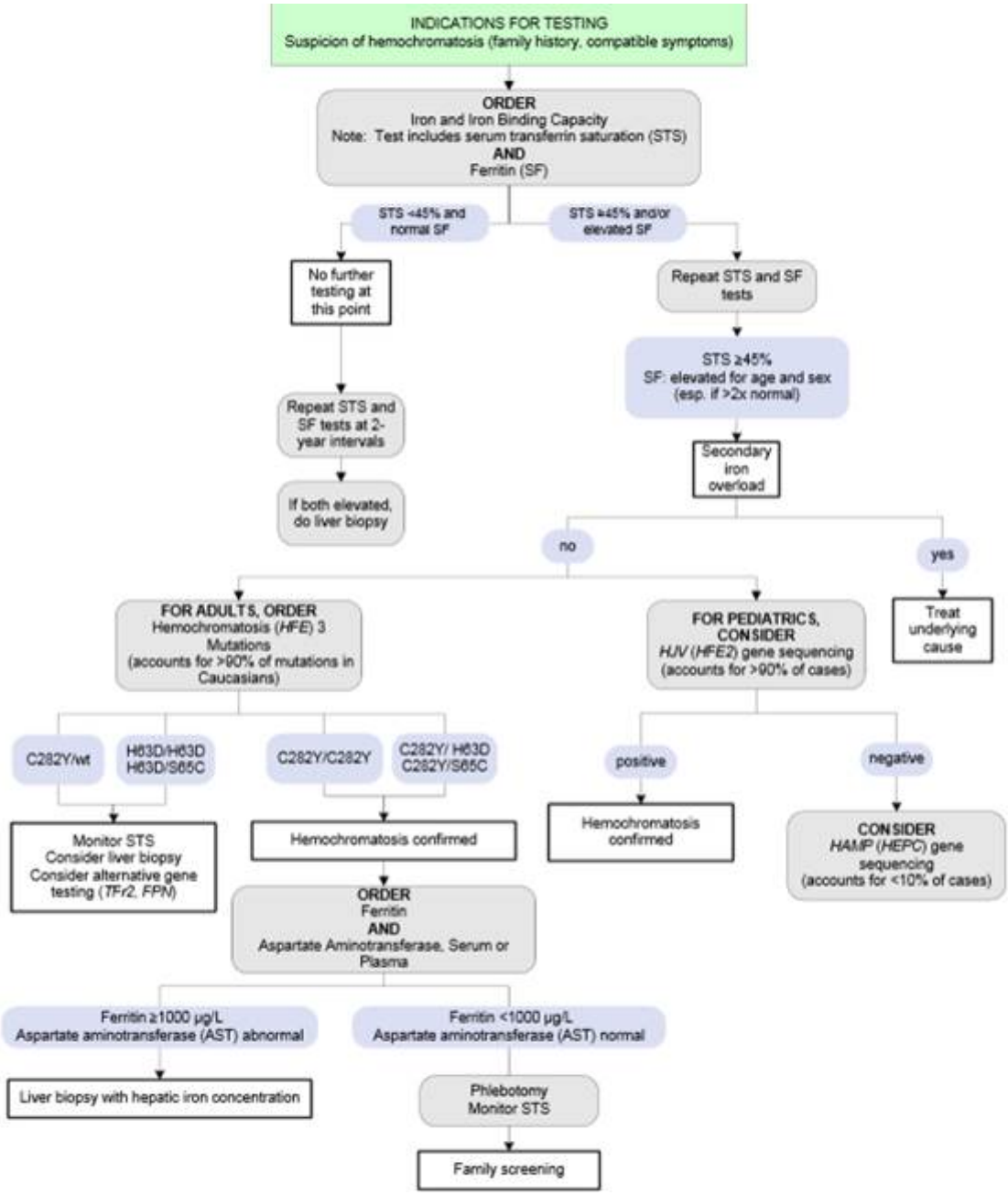
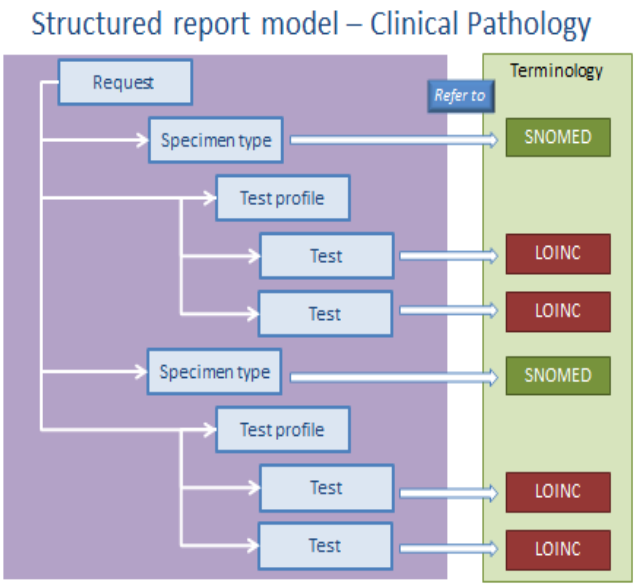


Figure 5.2.7-5: RUP HFE decision algorithm

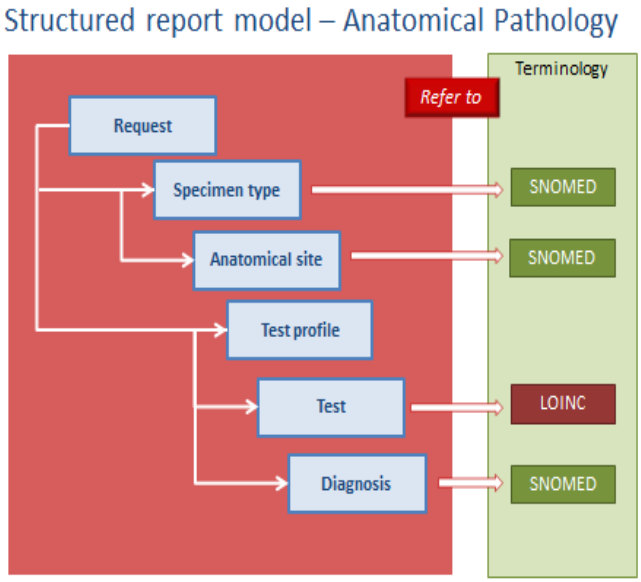
Example 4: LOINC and SNOMED CT in the Interface Between Laboratory Data and EHR

Table 5.2.7-1: Illustrations of Implementation of LOINC and SNOMED CT in the Interface Between Laboratory Data and EHR

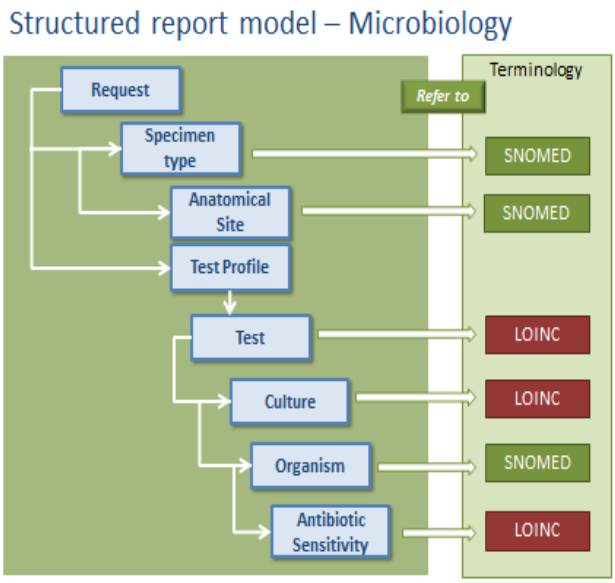
Diagram of Simplified Information Model	Description



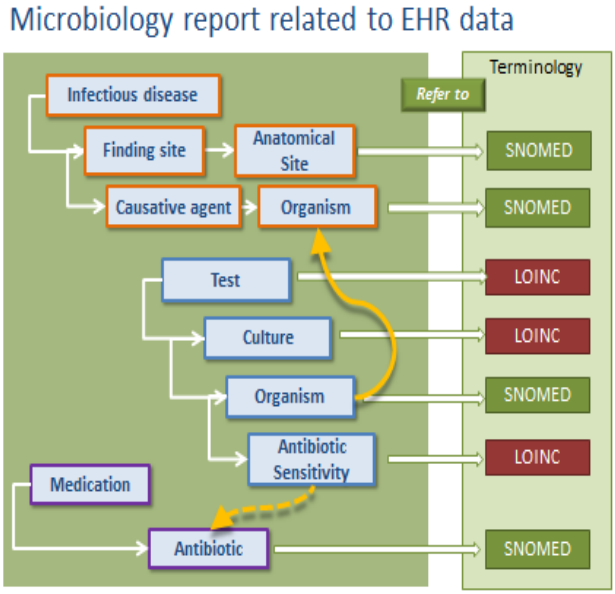
This diagram illustrates a general case of a laboratory test on two specimens (coded with SNOMED CT) and test profiles containing four tests (coded using LOINC) two of which are applied to each of these specimens.



This diagram illustrates an anatomical pathology test for a specimen (e.g. a biopsy) taken from a particular site. Both the specimen type and site are coded using SNOMED CT. In this case the test is coded using LOINC and the diagnosis arising from the interpretation of the test result is coded using SNOMED CT.
Although not shown in this illustration, specific pathological findings leading to the diagnosis could also be coded using SNOMED CT.



This diagram outlines a recommended approach to representing a structured microbiology report using SNOMED CT and LOINC for different elements.



This diagram illustrates relationships between EHR entries coded using SNOMED CT and a microbiology report coded using the mixture of LOINC and SNOMED shown above.
In one case the link between organisms is simple, since both elements are coded using SNOMED CT. In the other the use of LOINC to represent a sensitivity test has an indirect link to a pharmaceutical product which contains that antibiotic. The latter in this case is represented using SNOMED CT.

Note: The diagrams in this table are based on illustrations used in presentation by Hong Kong Hospital Authority (HKHA) as part of their work on matching their requirements to a combination of SNOMED CT and LOINC coding.

5.2 Terminology Scenarios - Summary

The summary information on this page is based on analysis of use cases and guidelines identified during an environmental scan of current usage of LOINC and SNOMED CT in clinical laboratory systems and related healthcare systems.

Table 5.2-1 summarizes recommendations for use of either SNOMED CT or LOINC in particular data elements. The recommendations are subdivided into categories based on particular scenarios or contexts of use. Figure 5.2-0 provides a graphical representation of the current use of SNOMED CT and LOINC for representing particular types of information, as identified in the environmental scan.

Table 5.2-1: Summary of use of SNOMED CT and LOINC in different data elements and scenarios

DATA ELEMENTS	SCENARIO		
	Bio-surveillance(human/animal)	Lab reporting (micro, infect diseases)	CIMI
Vital signs Name (Observation name)	LOINC	---	SNOMED CT
Vital signs Result (Observation value)	SNOMED CT	---	SNOMED CT
Laboratory Orders	LOINC	LOINC	---
Laboratory Test Results Name (Identifier)	LOINC	LOINC	LOINC
Laboratory Test Results no Quantitative (Value)	SNOMED CT	SNOMED CT	SNOMED CT
Specimens (Specimen Types, Specimen Source Types, ...)	SNOMED CT	SNOMED CT	SNOMED CT
Animal Species/Breeds	SNOMED CT	SNOMED CT	SNOMED CT
Procedures (Laboratory Methods)	SNOMED CT	SNOMED CT	SNOMED CT

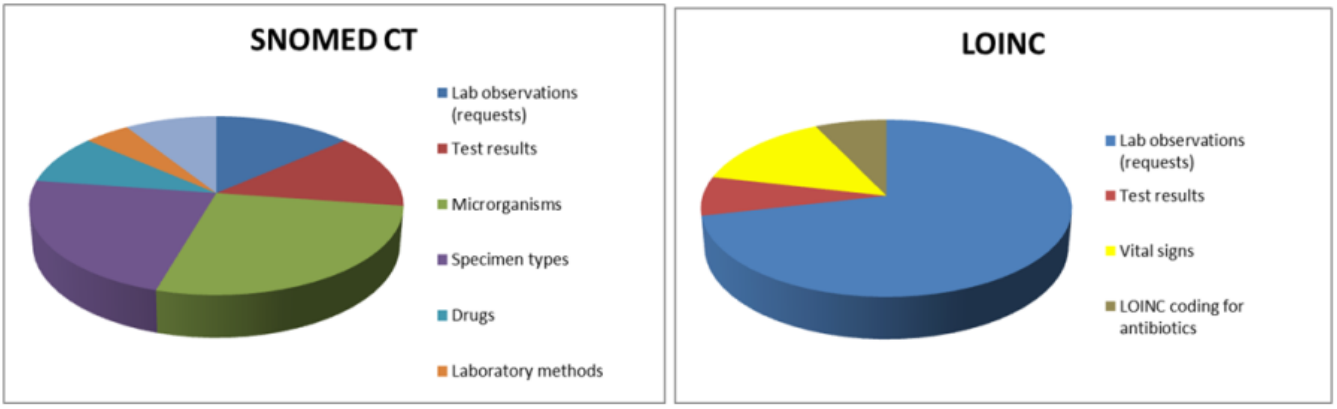


Figure 5.2-0: Current usage of SNOMED CT and LOINC for different use cases

6 References

The following references identify sources of information related to the guidelines in this document. The materials provide examples of current use of SNOMED CT and LOINC together. Further detail about these and other examples were included in the report of the horizon scan which formed the first part of this study.

Sources Used for Information on CDC

- https://www.cdc.gov
- https://phinvads.cdc.gov/vads/SearchVocab.action

Sources Used for Information on NAHLN

NAHLN Terminology services

- http://vtsl.vetmed.vt.edu/nahln/main.cfm

- http://vtsl.vetmed.vt.edu/nahln/main.cfm?page=subset&subset=universal_service_id

NAHLN HL7 Implementation Guide For Laboratory Results Messaging (Document version 3.0)

- http://vtsl.vetmed.vt.edu/nahln/main.cfm

Clinical LOINC tutorial - Introductions. 2009.

- http://es.slideshare.net/dvreeman/2009-08-13-clinical-loinc-tutorial-introductions-and-foundations

HL7 Version 2.5.1 Implementation Guide: Electronic Laboratory Reporting to Public Health, Release 2 - US Realm

- http://www.hl7.org/implement/standards/product_brief.cfm?product_id=329

Sources Used for Information on CIMI

CIMI History and Overview

3/11/2014, Version 1.0

- http://www.semantichealthnet.eu/SemanticHealthNet/assets/File/CIMI%20Background%202014%2003%2010.pdf

SNOMED CT Binding Strategy for CIMI Models

Cambridge, MA, September 21, 2013, Stanley M Huff, MD, Chief Medical Informatics Officer

Joint CIMI and SemanticHealthNet Meeting

Brussels, Belgium March 13-14, 2014

- A Brief Review of CIMI Progress, Plans, and Goals
  - http://www.opencimi.org/node/96
- CIMI Modelling Taskforce Report
  - http://informatics.mayo.edu/CIMI/index.php/SHN_CIMI/Brussels_March_13-15,_2014

Sources Used for Information on Health Level 7

Health Level Seven International

- http://www.hl7.org/implement/standards/index.cfm?ref=nav

HL7 Version 2.5.1 Implementation Guide: Electronic Laboratory Reporting to Public Health, Release 1 (US Realm), 2010

- http://www.hl7.org/implement/standards/product_brief.cfm?product_id=98

HL7 Version 2.5.1 Implementation Guide: Electronic Laboratory Reporting to Public Health, Release 2 (US Realm), 2014

- http://www.hl7.org/implement/standards/product_brief.cfm?product_id=329

HL7 Version 2.5.1 Implementation Guide: Orders and Observations; Ambulatory Lab Result (ELINCS), Release 1, 2008

- http://www.hl7.org/implement/standards/product_brief.cfm?product_id=31

HL7 Version 2.5.1 Implementation Guide: Orders and Observations; Interoperable Laboratory Result Reporting to EHR, Release 1, 2007

- http://www.hl7.org/implement/standards/product_brief.cfm?product_id=94

HL7 Version 2.5.1 Implementation Guide: S&I Framework Lab Results Interface, Release 1- US Realm, 2012

- http://www.hl7.org/implement/standards/product_brief.cfm?product_id=279

HL7 Version 2.5.1 Implementation Guide: S&I Framework Laboratory Orders from EHR, Release 1 - US Realm, 2013

- http://www.hl7.org/implement/standards/product_brief.cfm?product_id=152

