

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