Brief Introduction to LOINC & CLNtk

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Introduction to LOINC

What LOINC is?

- LOINC stands for Logical Observation Identifiers Names and Codes: A database & universal standard for identifying medical laboratory observations
- Developed & maintained by the Regenstrief Institute, a US non-profit medical research organization.
- Purpose: To assist in the electronic exchange and gathering of clinical results (such as laboratory tests, clinical observations, outcomes management and research)
- Publicly available at no cost

Purpose

- LOINC was created in response to the demand for an electronic database for clinical care and management and is *publicly available at no cost*
- LOINC is a common language for identifying health measurements, observations, and documents & applies universal code names and identifiers to medical terminology related to electronic health records
- The purpose is to assist in the electronic exchange and gathering of clinical results (such as laboratory tests, clinical observations, outcomes management and research)

THE LOINC CONCEPT MODEL

LOINC: Divisions

Laboratory: focuses on the observations and measurements that can be made on specimen

- Chemistry, Hematology, Serology, Microbiology (including parasitology and virology)
- Toxicology , Allergy testing, Molecular pathology
- Drugs and cell counts for blood smears and cerebrospinal fluids
- Antibiotic susceptibilities

Clinical: focuses on the observations and measurements that can be made on patients.

- Vitals signs, Hemodynamics, Intake/output, ECG, Obstetric ultrasound, Cardio echo
- Urologic imaging, Pulmonary ventilator management, Survey instruments, Phenx and other

LOINC: Basic Structure

- Codes are unique and have no meaning
- Unique identifier; Not inferable
- Each LOINC record corresponds to a single test or panel
- Includes long names, short names, and synonyms
- LOINC codes have a fixed-length field of 3-7 characters
- Format – nnnnnn-n (where the last n is a mod 10 check digit)
- Number after (-) is the check digit, is automatically created by the coding system

Examples: LOINC codes and formal LOINC names

LOINC CODES	LOINC Names
8886-4	Heart rate method
8889-8	Heart rate by Pulse oximetry
2955-3	Sodium [Moles/volume] in Urine
24356-8	Urinalysis complete panel - Urine
58077-9	Urinalysis complete W Reflex Culture panel - Urine
69742-5	CBC W Differential panel, method unspecified - Blood
34565-2	Vital signs, weight and height panel
44249-1	PHQ-9 quick depression assessment panel [Reported.PHQ]

LONIC: Anatomy

- A formal, distinct, and unique 6-axes/part name is given to each term for test or observation identity.
- The database currently has over 100,000 observation terms that can be accessed and understood universally.
- Each database record includes six fields for the unique specification of each identified single test, observation, or measurement.
- LOINC's goal is to create different codes for each test, measurement, or observation that has a clinically different meaning.
- To do that LOINC codes distinguish a given observation (test ordered/reported, survey question, clinical document) across 6 dimensions that we call Parts.

LOINC Parts

Component (Analyte)

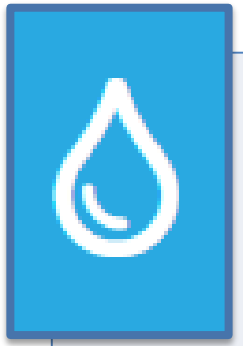
- The substance or entity being measured or observed
- For eg: Sodium, Body Weight

Property

- The characteristic or attribute of the analyte
- For eg: Mass Concentration, Catalytic activity

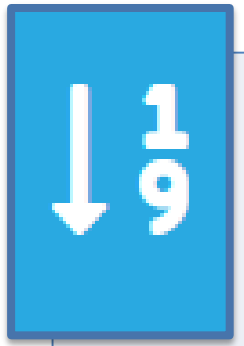
Time

- The interval of time over which an observation was made
- For eg: 24H for a Urine Sodium Concentration
-



System (Specimen)

- The specimen or thing upon which the observation was made
- For eg: Cerebral Spinal Fluid, Urine, Radial Artery



Scale

- How the observation value is quantified or expressed: quantitative, ordinal, nominal

Method

- [OPTIONAL] A high-level classification of how the observation was made. Only needed when the technique affects the clinical interpretation of the results.

LOINC: Component

- The substance or entity that is measure, evaluated, or observed
- Sodium, Glucose, Brucella sp.identified, HIV1 P24 antigen, Cytomegalovirus antibody, Body weight are some of the examples for Component
- Example - 18262-6:Cholesterol.in LDL:MCnc:Pt:Ser/Plas:Qn:Direct assay

LOINC: *Kind of Property*

- Characteristics or attribute of analyte that's being measured
- Different kinds of quantities relating to the same substance.

Example:

- The mass concentration versus the substance (molar) concentration of sodium in a urine sample, or the absolute eosinophil count versus the percent of the total white count that is made up of eosinophils
- Mass, substance, catalytic activity, arbitrary, number are some of Properties
- **Example:** 18262-6: Cholesterol.in LDL:MCnc:Pt: Ser/Plas:Qn:Direct assay

LOINC: Property

LOINC: Property expression	Fully Named Properties
MCnc	Mass concentration (mg/dl)
SCnc	Substance concentration (U mol/l)
MCnt	Mass content (measured in units)
CCnc	Catalytic concentration (u/l)
Prid	Presence or identity
Imp	Impression
Type	Kind of quantity

Timing

- The interval of time over which the observation was made
- The allowed values for non-point *Time Aspect are defined as a syntax exactly like the syntax for the times in* challenge tests, for example: <numeric value><S|M|H|W>. The most common one is **24H**
- Time Aspect Modifier: The second and optional subpart of the *Time component allows an indication of some sub-selection or* integration of the measures taken over the defined period of time: **8H^max heart rate** would be the highest heart rate observed over 8H (Shift). **Min, max, first, last, mean are the other possible values for this subpart**
- **Example:** Cholesterol.in LDL:MCnc:Pt:Ser/Plas:Qn:Direct assay

Timing

LOINC: Time	Abbreviations
Pt	Point in time
12 H	12 hours collection
24 H	24 hours collection
Stdy	Duration of the study
XXX	Not specified; time will be reported in another part of the electronic message

System

- The system (context) or specimen type upon which the observation was made
- **Example:** Cholesterol.in LDL:MCnc:Pt:Ser/Plas:Qn:Direct assay

LOINC Abbreviation	System
Bld	Whole blood
Ser/Plas	Serum or plasma
Tiss	Tissue
XXX	Unknown, unspecified in the test name, and/or specified in another part of the message

Scale

- Distinguishes between observations of different types between quantitative from categorical result

Example:

- Cholesterol.in LDL:MCnc:Pt:Ser/Plas:Qn:Direct assay

LOINC Abbreviation Scale	Scale
Qn	Quantitative
Ord	Ordinal
Nom	Nominal (Unranked collection, Taxaonomy)
Nar	Narrative
Doc	Information collection

Method

- A classification of how the analyte was measured or the information was obtained
- Methods need only be expressed as part of the name when they provide a distinction between tests that measure the same Component (Analyte) For instance, whole blood glucose tested with a test strip might be distinguished in the Method field
- Method is rarely significant for many chemical and hematological tests, it is often important to immunochemical/serology testing, because the sensitivity and specificity of some tests varies greatly with the Method
- For this reason, you will commonly see Methods included in microbiology tests and coagulation tests within the LOINC database

Method

Example:

- Cholesterol.in LDL:MCnc:Pt:Ser/Plas:Qn:Direct assay

LOINC abbreviations	Method
IA Immunoassay	Immunoassay
LC/MS/MS	Liquid Chromatography-Tandem Mass Spectrometry
Molgen	Molecular genetics
CT	Computer tomography
Estimated	Estimated

Example: LOINC - Axes/Parts

- 18262-6:Cholesterol. in LDL:MCnc:Pt:Ser/Plas:Qn:Direct assay

CODES	AXES / PART
18262-6	LOINC code
Cholesterol. in LDL	Component
MCnc	Property
Pt	Timing
Ser/ Plas	System
Qn	Scale
Direct assay	Method

Importance of LOINC Axes - Explained

LOINC	Component	Property	Timing	System	Scale	Units	Long Name
2947-0	Sodium	SCnc	Pt	Bld	Qn	mmol/L	Sodium [Moles/volume] in Blood
2950-4	Sodium	SCnc	Pt	Body fld	Qn	mmol/L	Sodium [Moles/volume] in Body fluid
27419-0	Sodium	SRat	24H	Stool	Qn	meq/24H	Sodium [Moles/time] in 24 hour Stool
14055-8	Sodium	SCnt	Pt	Stool	Qn	meq/kg	Sodium [Moles/mass]in 24 hour Urine
21527-7	Sodium	MRat	24H	Urine	Qn	mg/24H	Sodium [Moles/time]in 24 hour Urine
21526-9	Sodium	MCnc	24H	Urine	Qn	mg/dL	Sodium [Moles/volume] in 24 hour Urine
9485-4	Sodium	MCnc	Pt	Water	Qn	ppm	Sodium [Moles/volume] in Water

Structure: LOINC Names

- LOINC creates several different text labels /names to represent each concept
- We call the six-part formal name,
  - the **Fully-Specified Name (FSN),** for mapping purpose
  - We also create a more clinician-friendly display called the **Long Common Name (LCN)** and
  - a **Short Name** that can be handy when you need a column header in a report

LOINC Names

Fully-Specified Name (FSN)

- The six-part formal Name
- *<component/analyte>:<kind of property of observation or measurement>:<time aspect>:<system type>:<scale>:<method>*
- *For eg- Leukocytes: NCnc: Pt: CSF: Qn: Manual count*

Long Common Name (LCN)

- Clinician-friendly display
- *For eg- Leukocytes [#/volume] in Cerebral spinal fluid by Manual count*

Short Name

- Need a column header in a report
- *For eg- WBC # CSF Manual*

Fully Specified Name

- For Mapping
- The FSN typically uses official, scientific names for things in the Component but abbreviations for the Property and System
- FSN contains 5/6 parts in its names: <component/analyte> : <kind of property> : <time aspect> : <system type> : <scale> : <method>
- Example:
  - Sodium:SCnc:Pt:Urine:Qn

Long Common Name (LCN)

- For Primary Display Name
- The **Long Common Name** is designed to be a more fully spelled out and **human readable name**
- Transforms the cryptic Property abbreviations like MCnc into more understandable phrases like Mass/volume, and drops the default timing of Pt.
- Example:

- Urea nitrogen [Mass/volume] in Serum or Plasma

Short Name

- For Column header, old-school systems with character limits
- Many older laboratory information systems had tiny field limits for test names
- LOINC creates Short Names with a target limit of 40 characters to fit some of those constraints
- Handy for column headers on reports - compact label

Example:

- BUN SerPl-mCnc
- Not all LOINC terms have them, so they can't be used as identifying keys in any database
- Across all of LOINC, about 8,000 terms do not have a Short Name

Advantages

- Improved communication in integrated health delivery networks
- Supports aggregated electronic health records
- Permits automatic transfer to public health authorities of case reports for reportable diseases
- Improved transfer of payment particularly claims attachments
- Supports reduction of errors

NOT A Part of LOINC Name

- Reason for the test
- Test instrument
- Specific details about the specimen
- Priority
- Where testing was done
- Who did the test
- Test interpretation
- Pricing
- Anything not part of the naming the test
- Things from other fields in an HL7 artifact

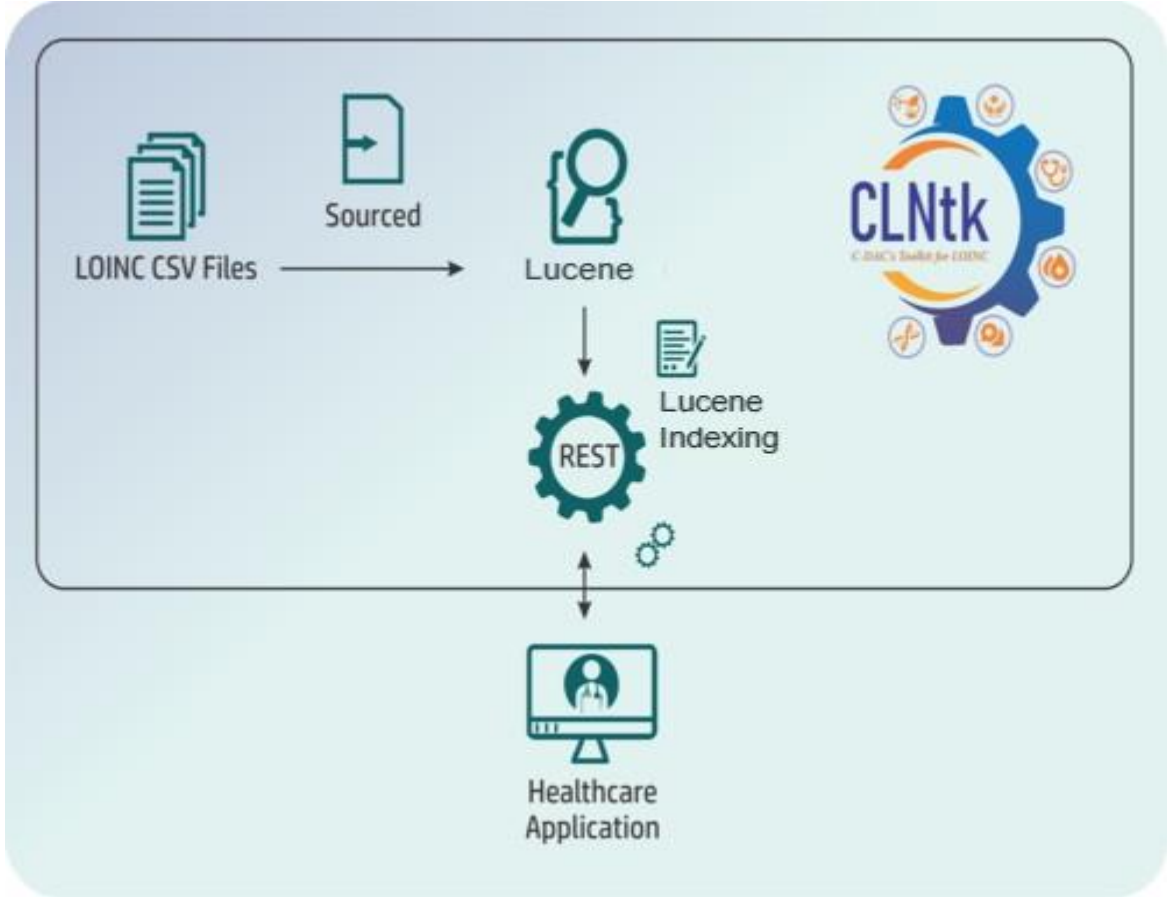
C-DAC’S TOOLKIT FOR LOINC (CLNTK)

C-DAC's Toolkit for LOINC (CLNtk)

- Specially designed FOSS application for easy access and integration of LOINC standard in health care applications
- Provides simple to use REST APIs for LOINC integration
- Enables clinical informatician and researchers to find out relevant LOINC codes from its components including, long common name, short name, display name, and other related information
- More details & download available at:

https://www.cdac.in/index.aspx?id=hi_hs_medinfo_loinc_home

CLNtk Architecture



- Allows Lucene index creation from the LOINC standard CSV files like LOINC CSV, LOINC Panel & Forms CSV and LOINC Part CSV
- Provides a layer of REST APIs categorized as LOINC APIs and Supporting APIs
- Support Advanced search for LOINC APIs
- Demo Application

CLNtk Package Structure & Prerequisite s/w Requirements

- Extracted zip contains following:
  - loincserv.war - war ready to deploy in application server (Ex: tomcat).
  - demo - sample laboratory test example.
  - README.txt - assist you how to set up Toolkit.
  - license.txt and NOTICE.txt.
- Prerequisite Software
  - JAVA 17
  - Apache Tomcat 10.1.x
  - Browser Compatibility
    a. Edge: version 42 and higher
    b. Chrome: 88.0 and higher

CLNtk APIs

LOINC APIs

GET	`/v2/expand/panel`	Provides facility to retrive information of particular panel by specifying class parameter.
GET	`/v2/lookup`	Provides facility to find information about specified Loinc Number.
GET	`/v2/search`	Provides facility to search through LOINC short name/long common name/display name/related names/component/system/property based on different filter parameters provided.

Supporting APIs

GET	`/v2/classes`	Gives list of all classes available in Loinc.
GET	`/v2/components`	Gives list of all components available in Loinc.
GET	`/v2/methods`	Gives list of all methods available in Loinc.
GET	`/v2/properties`	Gives list of all properties available in Loinc.
GET	`/v2/scales`	Gives list of all scales available in Loinc.
GET	`/v2/systems`	Gives list of all systems available in Loinc.
GET	`/v2/timings`	Gives list of all timings available in Loinc.
GET	`/v2/version`	Gives version of LOINC standard indexed

Thank You!

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