LOINC

https://loinc.org/slideshows/loinc-for-beginners-december-2017/

Serum sodium

- A sodium blood test is a routine test that allows your doctor to see how much sodium is in your blood. It's also called a serum sodium test. Sodium is an essential mineral to your body. It's also referred to as Na+.
- Sodium is particularly important for nerve and muscle function. Your body keeps sodium in balance through a variety of mechanisms. Sodium gets into your blood through food and drink. It leaves the blood through urine, stool, and sweat. Having the right amount of sodium is important for your health. Too much sodium can raise your blood pressure.

Serum sodium

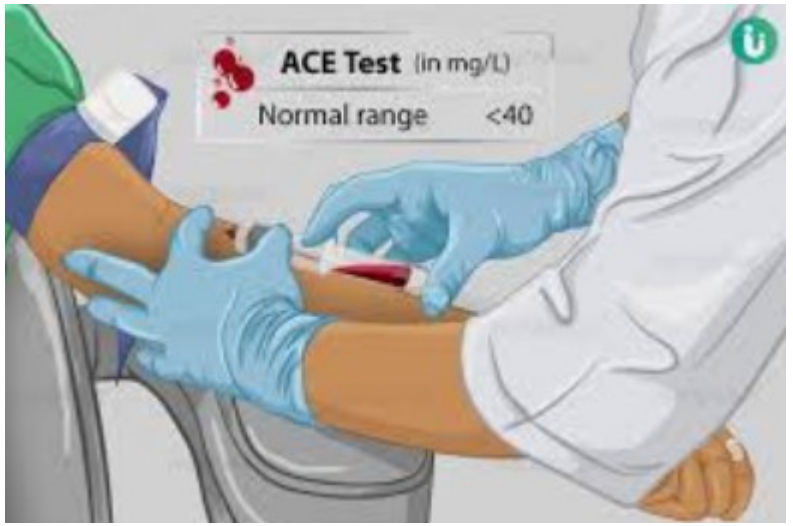
- In EHR, different hospitals or clinics might use different naming conventions:
  - C1231
  - SNA
  - Sodium Test
  - Na+ blood test

- It is a huge barrier for sharing data across departments, clinics and hospitals

Life without LOINC

CODE	NAME
AGTCE	Angiotensin Converting Enzyme
5523	ACE SerPl Qn
ACE	ACE
22441	AngioTens Conv Enz
99234	ACE (angiotensin)
25284D	Angiotensin-1-Converting Enzyme
2737317	ACE (serum)
6881A	Angiotensin Converting Enzyme, Ser
3800ACE	ANGIOTENSIN CONVERTING ENZYME, S
77934A	Angio Convt Enzym
919109	ACE, SERUM
34ACE	Angiotensin Con. Enz
ANGCE	Angiotensin CE
6621456	Angio. Conv. Enzyme

https://www.mountsinai.org/health-library/tests/ace-blood-test



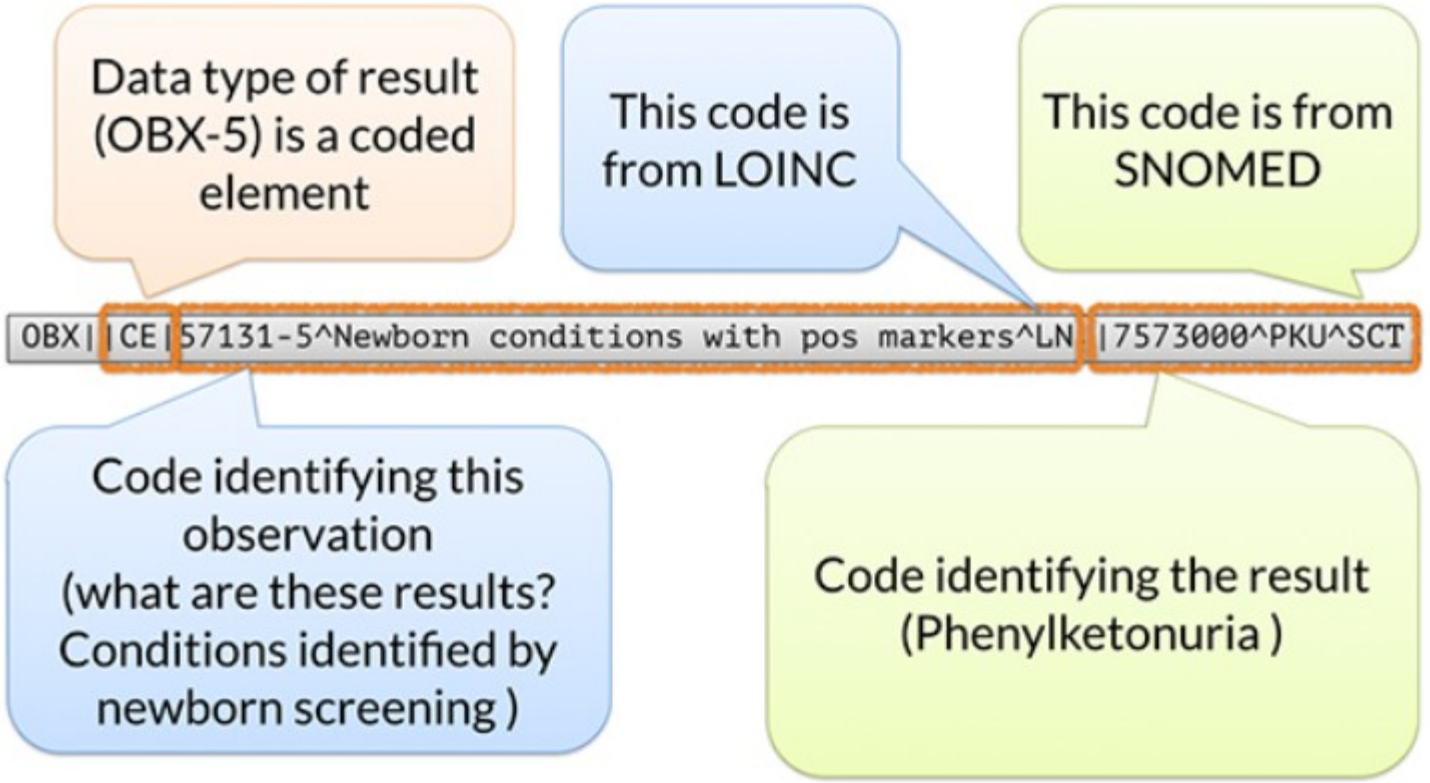
Lower than normal ACE level may indicate:

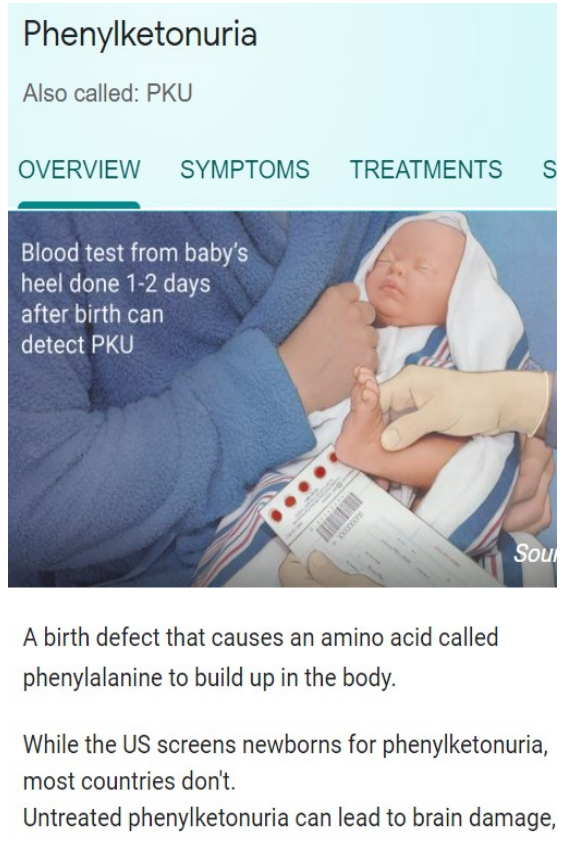
- Chronic liver disease
- Chronic kidney failure
- Eating disorder called anorexia nervosa
- Steroid therapy (usually prednisone)
- Therapy for sarcoidosis
- Underactive thyroid (hypothyroidism)

LOINC (Logical Observation Identifiers Names and Codes)

- The international standard for identifying health measurements, observations, and documents.
- LOINC is the global lingua franca for identifying tests and observations.

a LOINC code identifies the question and a SNOMED CT code represents the answer





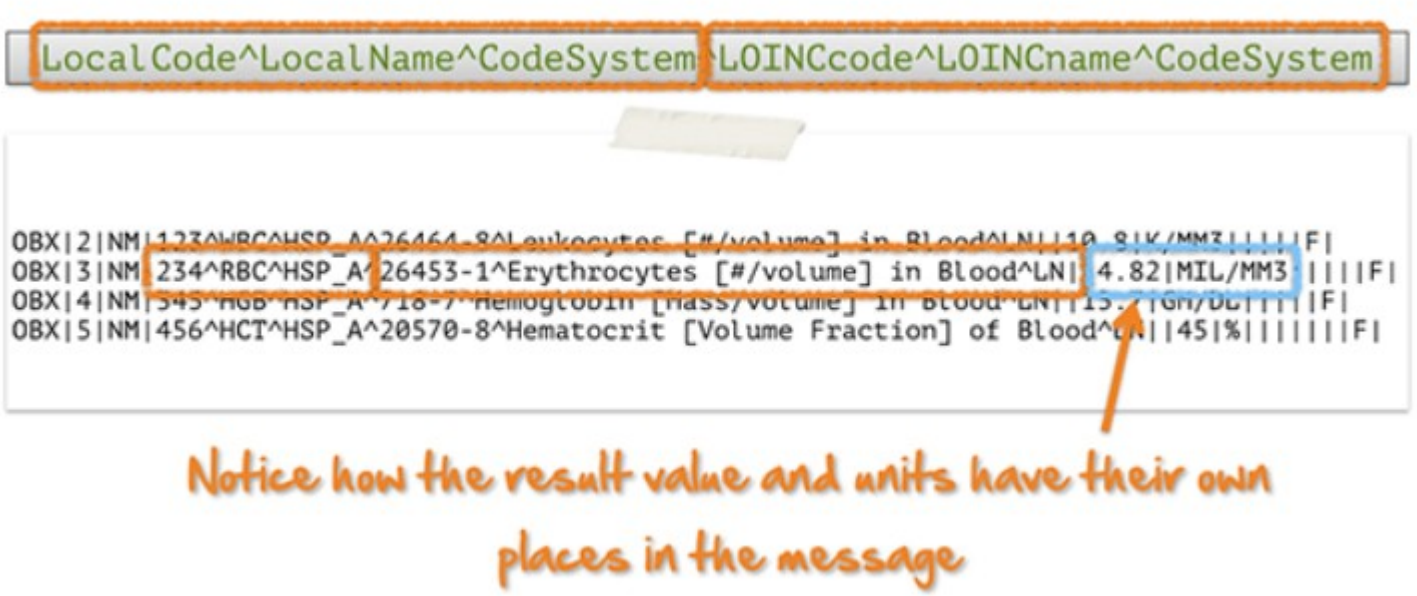
LOINC

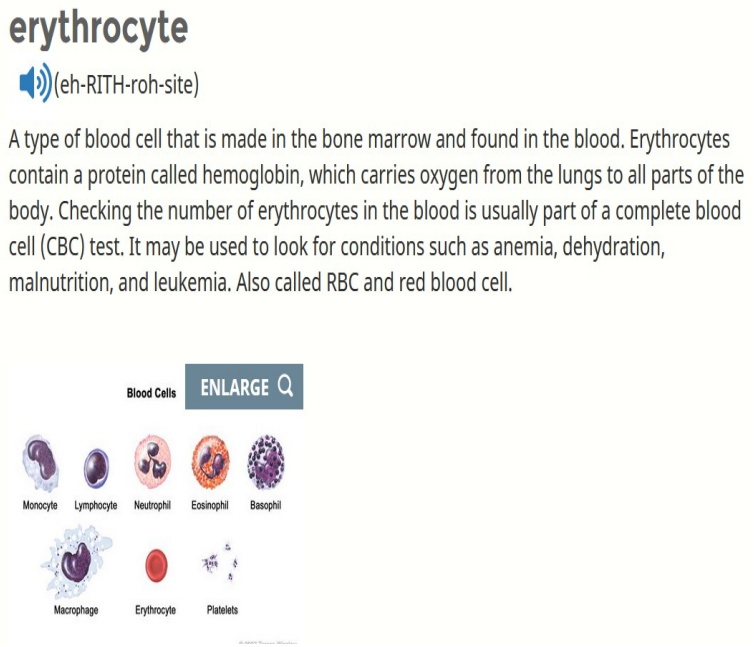
- LOINC provides a set of universal names and ID codes for identifying laboratory and clinical test results. LOINC facilitates the exchange and pooling of results, such as blood hemoglobin, serum potassium, or vital signs, for clinical care, outcomes management, and research.

- Started in 1994 at Regenstrief, Indiana

- Originally, LOINC provides a code system for the observation identifier field (OBX-3) of the HL7 observation reporting message

Sending local test codes and names along with LOINC codes





The OBX-3 slot allows 2 sets of triplets, one for your local concept and one for the concept from the vocabulary standard LONIC code.

Numeric Results

Using HL7 version 2.x + LOINC

NM (numeric) means the answer will be a numeric value

Result Value

```
OBX||NM|26453-1^RBC # Bld^LN||4.82|10*6/uL|
```

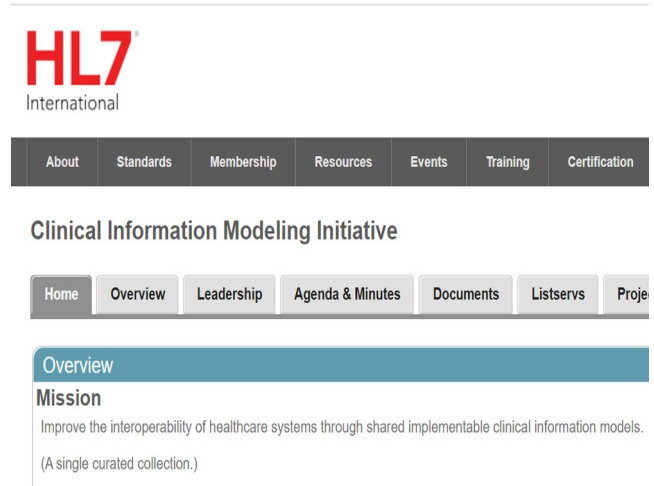
Units

Same thing.

Different format.

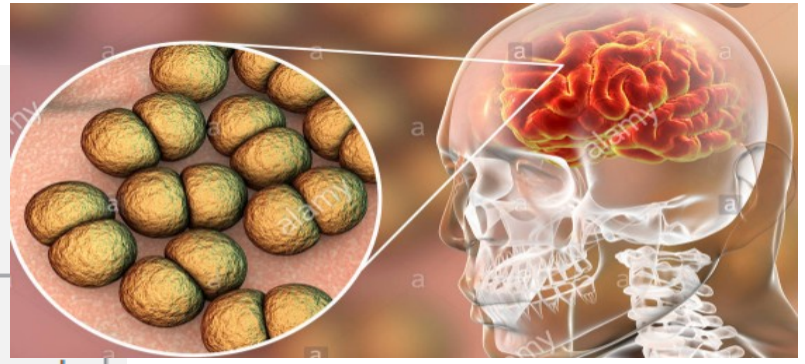
Using HL7 FHIR + LOINC


```
{
  "resourceType": "Observation",
  "id": "body-height",
  "meta": {
    "profile": [
      "http://hl7.org/fhir/StructureDefinition/
vitalsigns"
    ]
  },
  "text": {
    "status": "generated",
    "div": ""
  },
  "status": "final",
  "code": {
    "coding": [
      {
        "system": "http://loinc.org",
        "code": "8302-2",
        "display": "Body height"
      }
    ],
    "text": "Body height"
  },
  "subject": {
    "reference": "Patient/example"
  },
  "effectiveDateTime": "1999-07-02",
  "valueQuantity": {
    "value": 66.899999999999991,
    "unit": "in",
    "system": "http://unitsofmeasure.org",
    "code": "[in_i]"
  }
}
```

Coded Result Values

Using HL7 version 2.x + LOINC + SNOMED CT



CE (coded element) means the answer will be coded

Observation Identifier: this is a blood culture

LN means this code is from LOINC

```
OBX||CE|600-7^Bacteria identified in Blood by Culture^LN||
      17872004^Neisseria meningitidis^SCT
```

Answer Identifier: meningococcus (trouble)

SCT means this code is from SNOMED CT

LOINC	Long Common Name	Component	Property	Timing	System	Scale	Method	Class	Type	Units
600-7	Bacteria identified in Blood by Culture	Bacteria identified	Prid	Pt	Bld	Nom	Culture	MICRO		

LOINC Term

- A LOINC term is defined as the combination of the LOINC code and the *Fully Specified Name* (FSN).
  - The LOINC code is a unique, permanent identifier
  - The FSN is composed of five or six main *Parts*

- All names are case insensitive.

LOINC Code

18262-6

The unique, permanent identifier that serves as a computer processable representation of a LOINC Term

Sequential *hints at relative age*

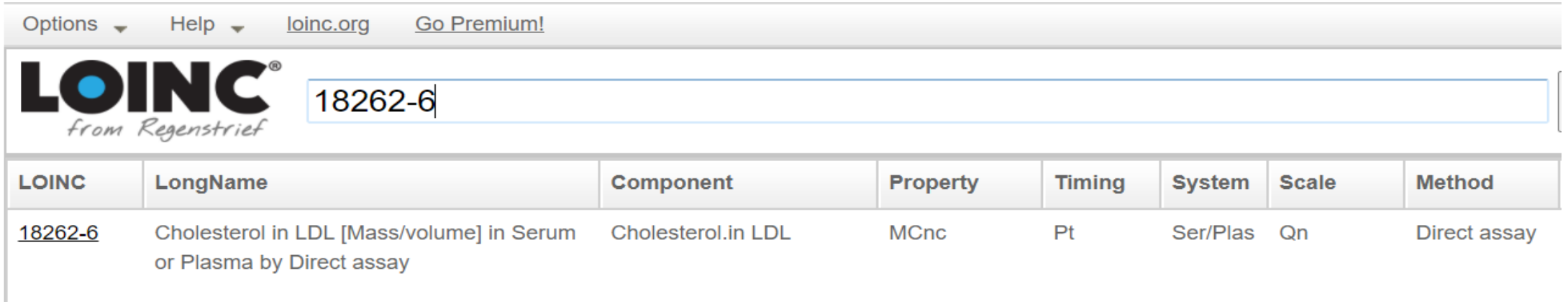
Penultimate dash

Final character is Mod-10 check digit

Carries no intrinsic meaning

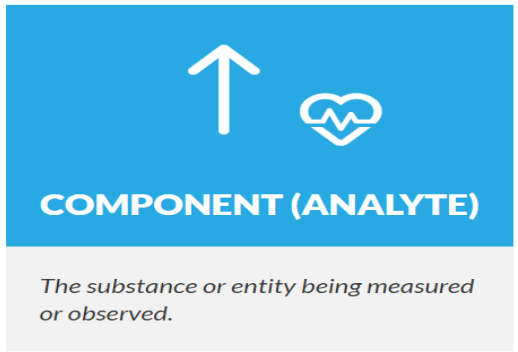
Once released, never removed

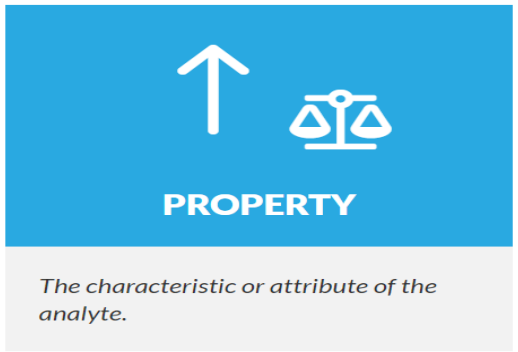
https://search.loinc.org/searchLOINC/search.zul

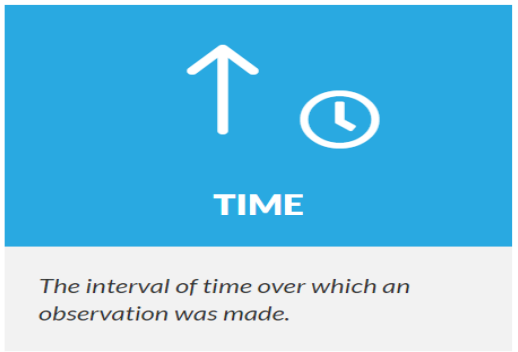


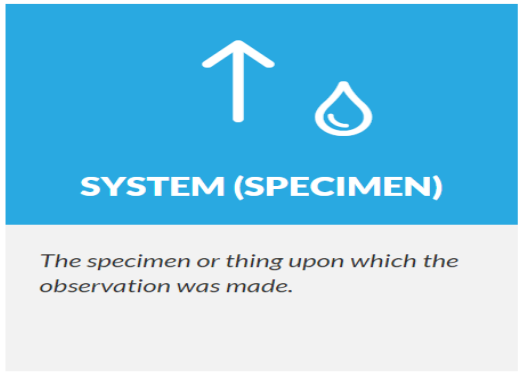
LOINC Code

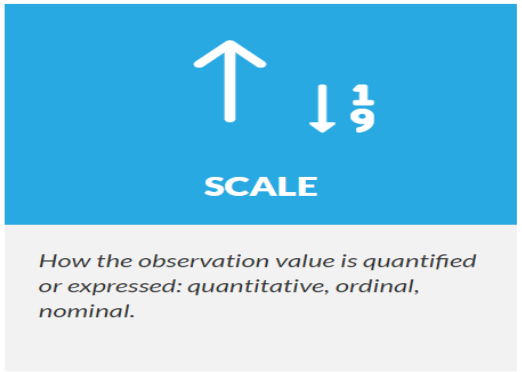
- LOINC's goal is to create different codes for each test, measurement, or observation that has a clinically different meaning. To do that LOINC codes distinguish a given observation (test ordered/reported, survey question, clinical document) across six dimensions that we call Parts.

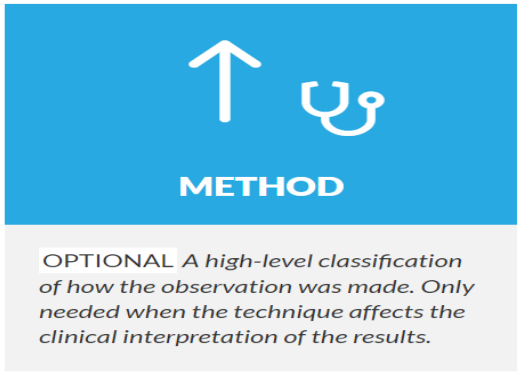




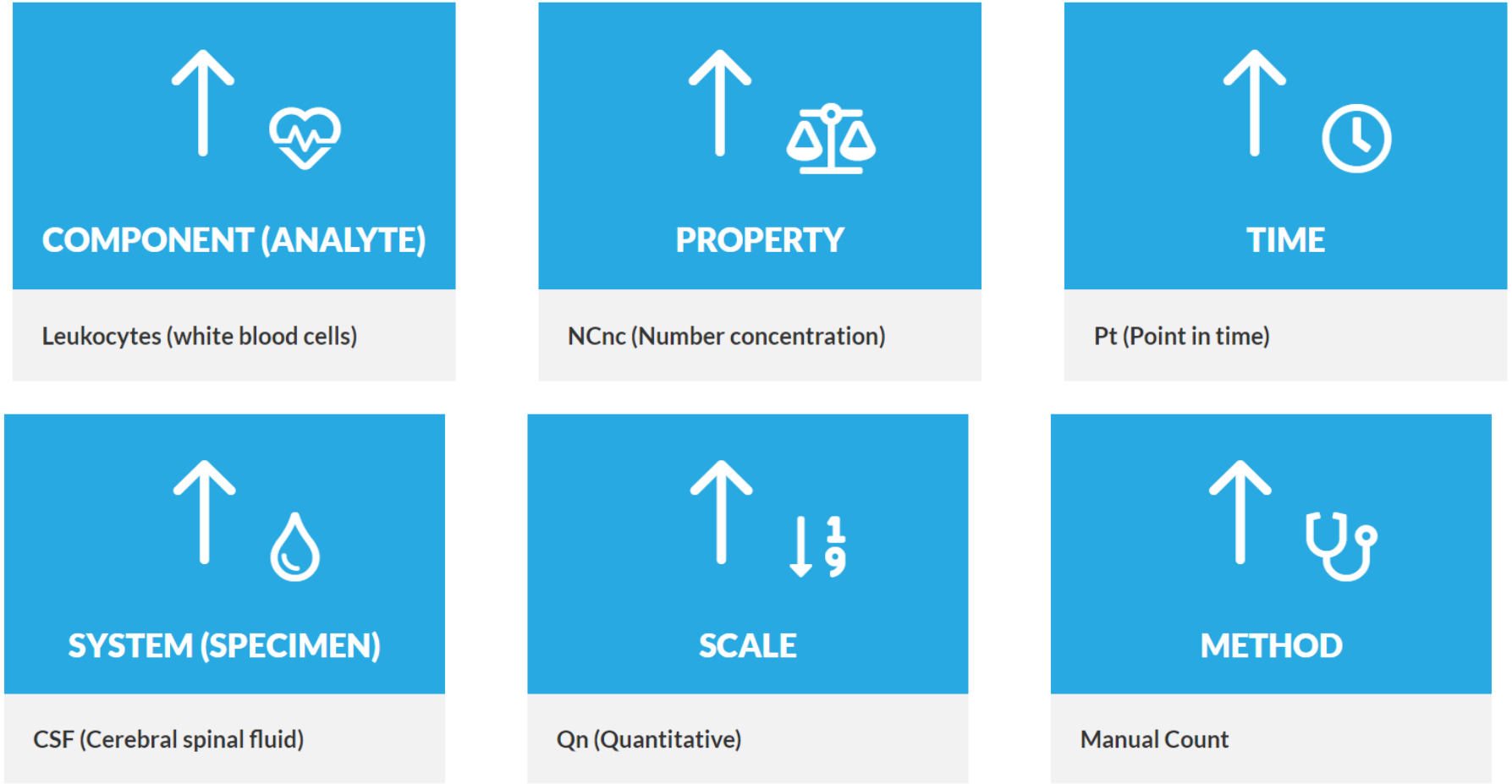








LONIC Code example



Here is a breakdown of the LOINC for a ***manual count of white blood cells in cerebral spinal fluid specimen***, which is represented by LOINC code [806-0]:

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.

Component

The substance or entity that is measured, evaluated, or observed

Examples

Component
Sodium
Glucose
Brucella sp. identified
HIV 1 p24 antigen
Cytomegalovirus antibody
Body weight

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

Property

The characteristic or attribute of the analyte that is measured, evaluated, or observed.

Example Properties

LOINC Abbreviation	Property	Example units
MCnc	Mass concentration	mg/dL
SCnc	Substance concentration	umol/L
MCnt	Mass content	mg/g
CCnc	Catalytic concentration	U/L
Prid	Presence or identity	

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

Timing

The interval of time over which the observation or measurement was made

Examples

LOINC Abbreviation	Time Aspect
Pt	Point in time
12H	12 hour collection
24H	24 hour collection
7D	7 days (look back period)

Tip: If Timing != Pt, Property is often a "Rate"

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

System

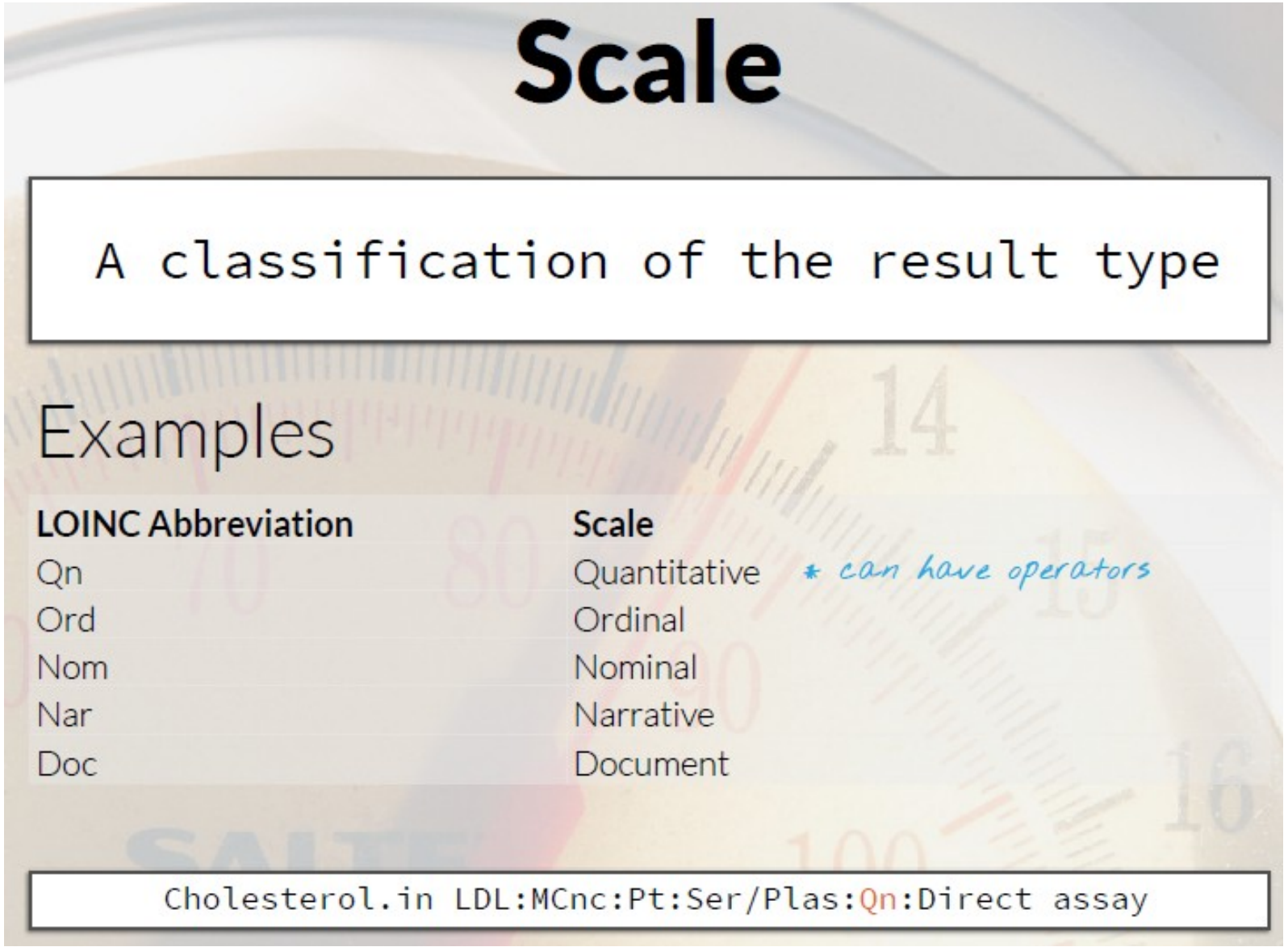
The system (context) or specimen type upon which the observation was made.

Examples

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.

*See LOINC Users' Guide for further discussion

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



In the example previously alluded to, the presence or absence of pain would be considered **nominal data**, while the severity of pain represented by categories such as none, mild, moderate, or severe would be **ordinal data**. If pain was analyzed on a Visual Analog Scale from 0-100, where 100 would be two times as painful as 50, this would be **numerical data**.

Method

A classification of how the analyte was measured or the information was obtained

Only needed if interpretation affected

different normal ranges, test sensitivities, etc

Specified at a generic level

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

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

Table 3. Example of clinical LOINC terms and names (with axes emphasized by separation into columns).

Code	Component	Property	Time	System	Scale	Method
8302-2	BODY HEIGHT:	LEN	PT	^PATIENT	QN	
3140-1	BODY SURFACE:	AREA	PT	^PATIENT	QN	DERIVED
8331-1	BODY TEMPERATURE:	TEMP	PT	MOUTH	QN	
8632-2	QRS AXIS:	ANGLE	PT	HEART	QN	EKG
8642-1	PUPIL DIAMETER:	LEN	PT	EYE.RIGHT	QN	AUTO
21611-9	AGE:	TIME	PT	^PATIENT	QN	ESTIMATED
19867-1	CAPACITY.VITAL:	VOL	PT	RESPIRATORY SYSTEM	QN	
9279-1	BREATHS:	NRAT	PT	RESPIRATORY SYSTEM	QN	
11882-8	GENDER:	FIND	PT	^FETUS	NOM	US

LOINC Names

- LOINC creates several different text labels (names) to represent each concept. We call the six-part formal name, as described above, the **Fully-Specified Name (FSN).** 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. Here are the names for LOINC code 806-0:

Fully-Specified Name (FSN)	Long Common Name (LCN)	Short Name
Leukocytes: NCnc: Pt: CSF: Qn: Manual count	Leukocytes [#/volume] in Cerebral spinal fluid by Manual count	WBC # CSF Manual

Scope of LOINC

Laboratory

The laboratory portion of LOINC covers anything that you can test, measure, or observe about a specimen. It contains the usual categories of chemistry, hematology, serology, microbiology (including parasitology and virology), toxicology; as well as categories for cell counts, antibiotic susceptibilities, and more.

Clinical

We think of "clinical" as pretty much everything except lab. The clinical portion of LOINC covers anything that you can test, measure, or observe about a patient without removing that specimen from them. LOINC has codes for observations like vital signs, hemodynamics, intake/output, EKG, obstetric ultrasound, cardiac echo, urologic imaging, gastroendoscopic procedures, pulmonary ventilator management, radiology studies, clinical documents, selected survey instruments (e.g. Glasgow Coma Score, PHQ-9 depression scale, CMS-required patient assessment instruments), and other clinical observations.

	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		

	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		

Discrete Measures and Observations

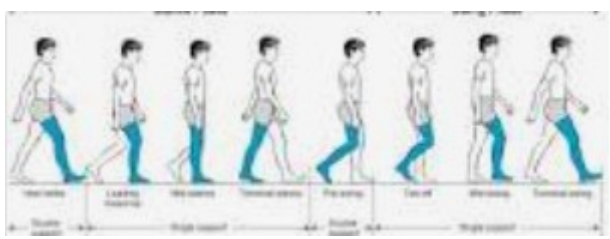
LOINC creates codes for laboratory tests and clinical observations that represent a discrete measurement such as:

- Single lab tests (e.g. glucose [mg/dL] in urine)
- Questions on a survey or form (e.g. "are you able to jump up and down?")
- Measurements on a patient (e.g. body height)
- Distinct elements on a report. (e.g. physical observations about gait)

Collections

We also create codes for a collection of measurements like the following:

- Panel of laboratory tests (e.g. complete blood count [CBC] with auto differential panel)
- Set of questions on a survey or form (e.g. PROMIS pediatric item bank for asthma)
- Group of clinical measurements on a patient (e.g. body temperature panel)
- A document or report (e.g. discharge summary)



LOINC Panel Hierarchy

LOINC CODE	LONG COMMON NAME	LOINC STATUS
57021-8	**CBC W Auto Differential panel - Blood**	**Active**

Panel Hierarchy

Details for each LOINC in Panel | LHC-Forms

LOINC	Name	R/O/C	Cardinality	Example UCUM Units
57021-8	CBC W Auto Differential panel - Blood			
58410-2	CBC panel - Blood by Automated count			
6690-2	Leukocytes [#/volume] in Blood by Automated count	R		10*3/uL
789-8	Erythrocytes [#/volume] in Blood by Automated count	R		10*6/uL
718-7	Hemoglobin [Mass/volume] in Blood	R		g/dL
4544-3	Hematocrit [Volume Fraction] of Blood by Automated count	R		%
787-2	MCV [Entitic volume] by Automated count	R		fL
785-6	MCH [Entitic mass] by Automated count	R		pg

https://loinc.org/57021-8/

LOINC CODE
62068-2

LONG COMMON NAME
PROMIS pediatric item bank - asthma - version 1.0

LOINC STATUS
Active

Panel Hierarchy

Details for each LOINC in Panel | LHC-Forms

LOINC	Name	R/O/C	Cardinality	Example UCUM Units
62068-2	PROMIS pediatric item bank - asthma - version 1.0			
62069-0	In the past 7 days - I felt scared that I might have trouble breathing because of my asthma			
62070-8	In the past 7 days - My chest felt tight because of my asthma			
62071-6	In the past 7 days - I felt wheezy because of my asthma			
62213-4	In the past 7 days - I had trouble breathing because of my asthma			
62072-4	In the past 7 days - I had trouble sleeping at night because of my asthma			
62073-2	In the past 7 days - It was hard for me to play sports or exercise because of my asthma			
62074-0	In the past 7 days - It was hard to take a deep breath because of my asthma			

https://loinc.org/62068-2/

LOINC CODE	LONG COMMON NAME	LOINC STATUS
18842-5	**Discharge summary**	**Active**

Part Description

LP72467-1 **Discharge summary note**

Discharge summary is a synopsis of a patient's admission to a hospital; it provides pertinent information for the continuation of care following discharge. The summary may include the reason for hospitalization, procedures performed, the care, treatment and services provided, the patient's condition and disposition at discharge, information provided to the patient and family, and provisions for follow-up care.

Source: HL7

Fully-Specified Name

Component	Discharge summary note
Property	Find
Time	Pt
System	{Setting}
Scale	Doc
Method	{Role}

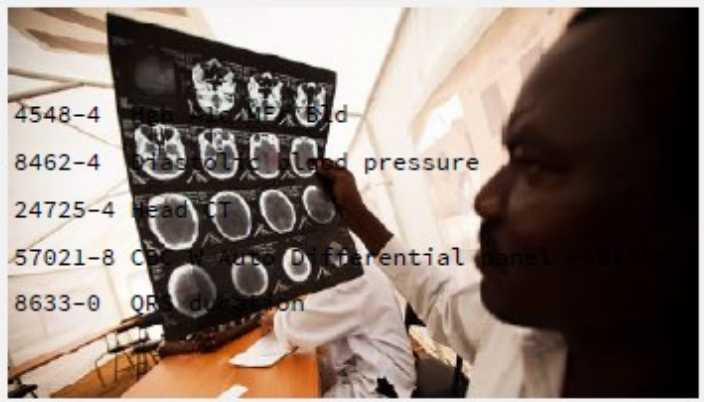
https://loinc.org/18842-5/

84,000+ standardized variables

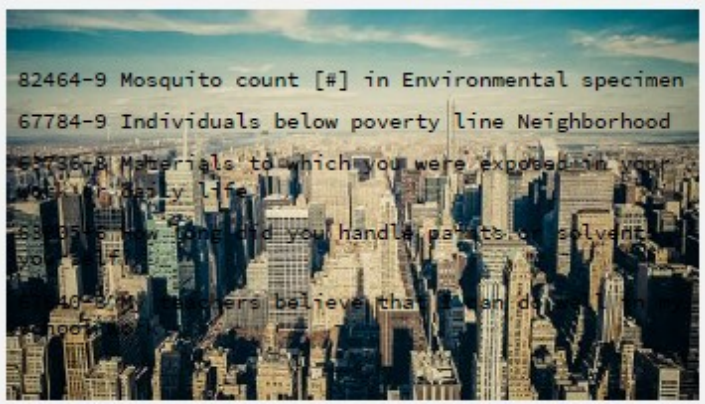
Genetics

Lifestyle

Lab and clinical



Environmental



Global Adoption

Translations

A remarkable global translation effort is also fueling international adoption of LOINC. You can see all of the linguistic variants in which LOINC is available on our International section.

163 countries

LOINC License

No cost use

Worldwide

In perpetuity

Commercial or noncommercial purposes

Encourages translation

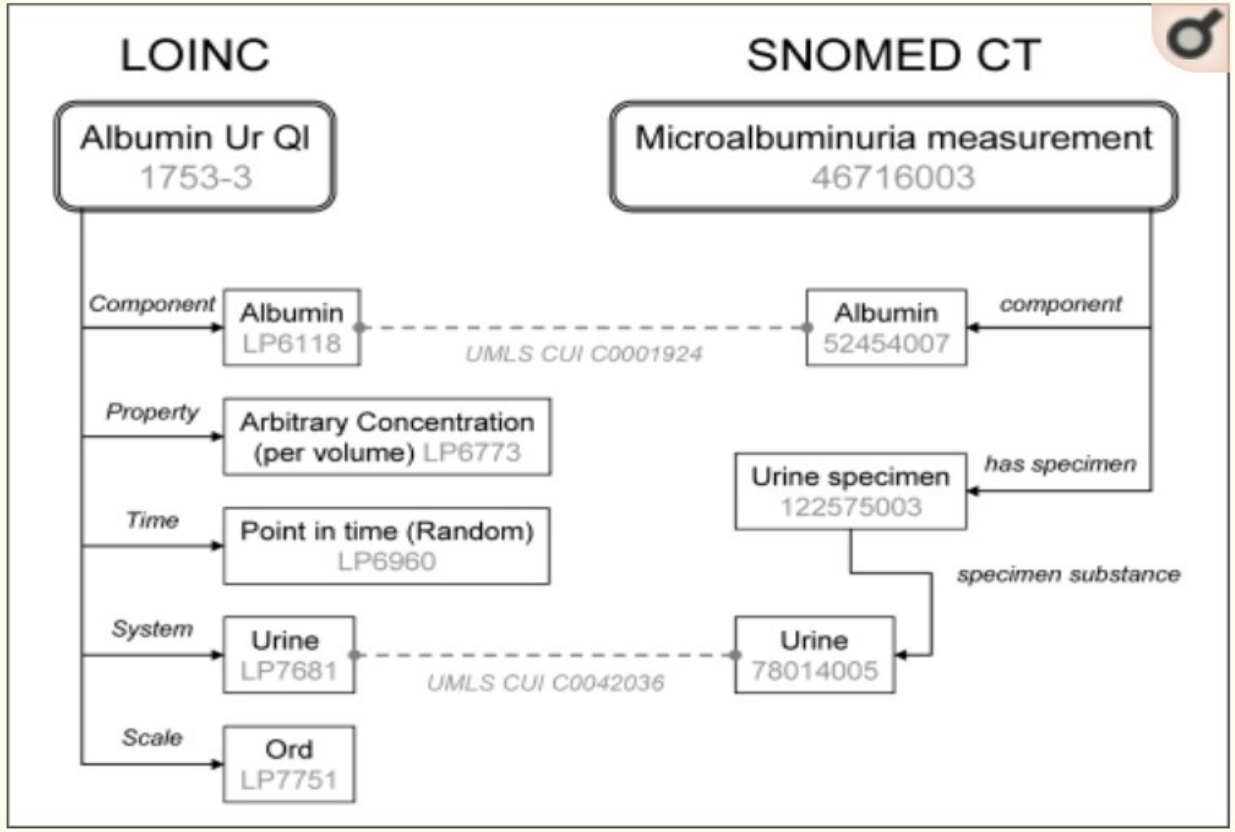
LOINC and Snomed CT

Table 2.1-1: Clinically Relevant SNOMED CT Hierarchies

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

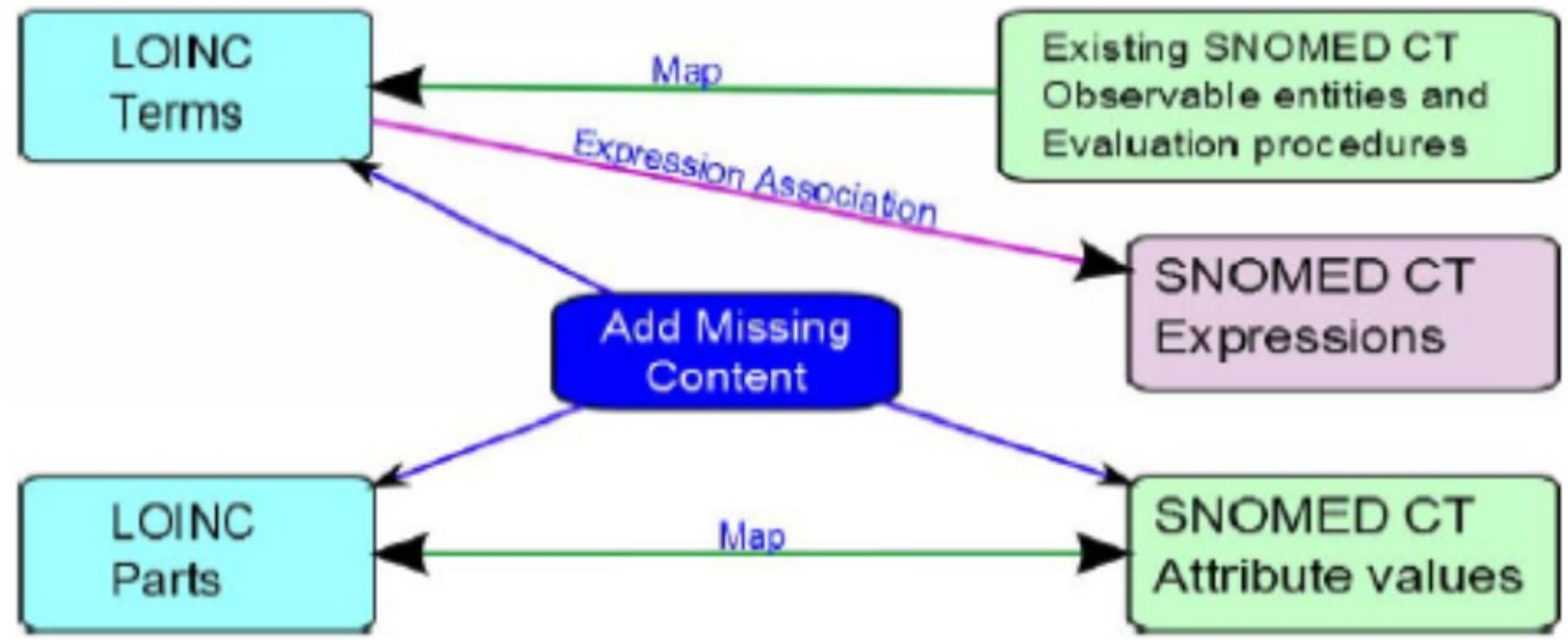
LOINC includes codes that identify test observations (e.g. blood culture, antibiotic sensitivity). Other code systems, including SNOMED CT, often provide values that can be applied to represent results (e.g. staphylococcus, amoxicillin). If we consider the observation as a question and the observation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

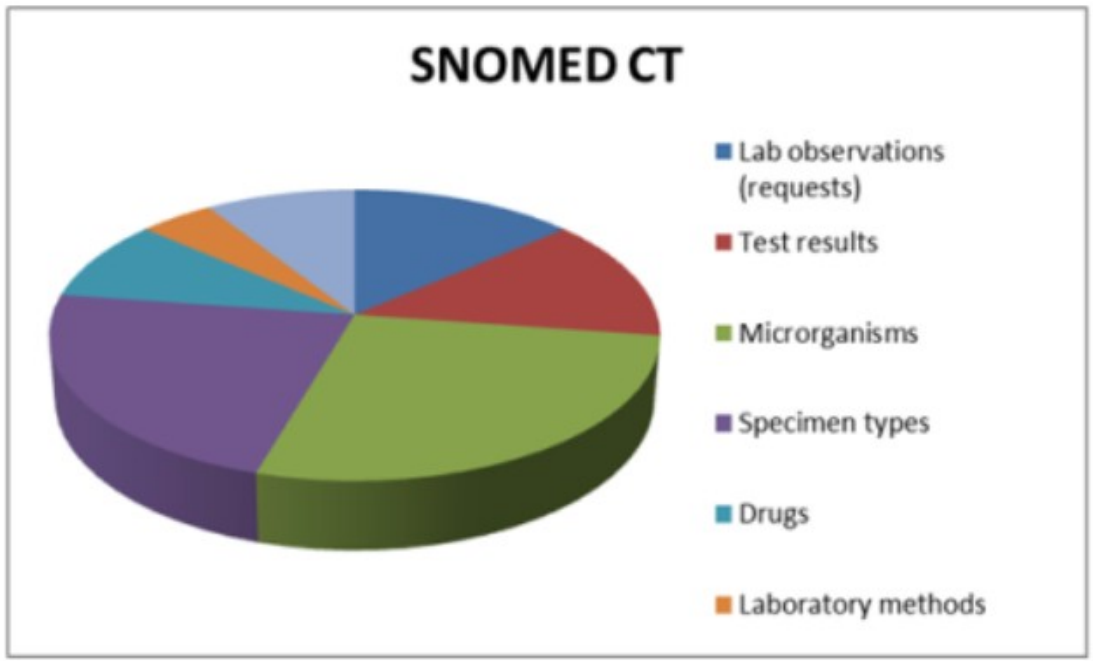
LOINC and SNOMED CT

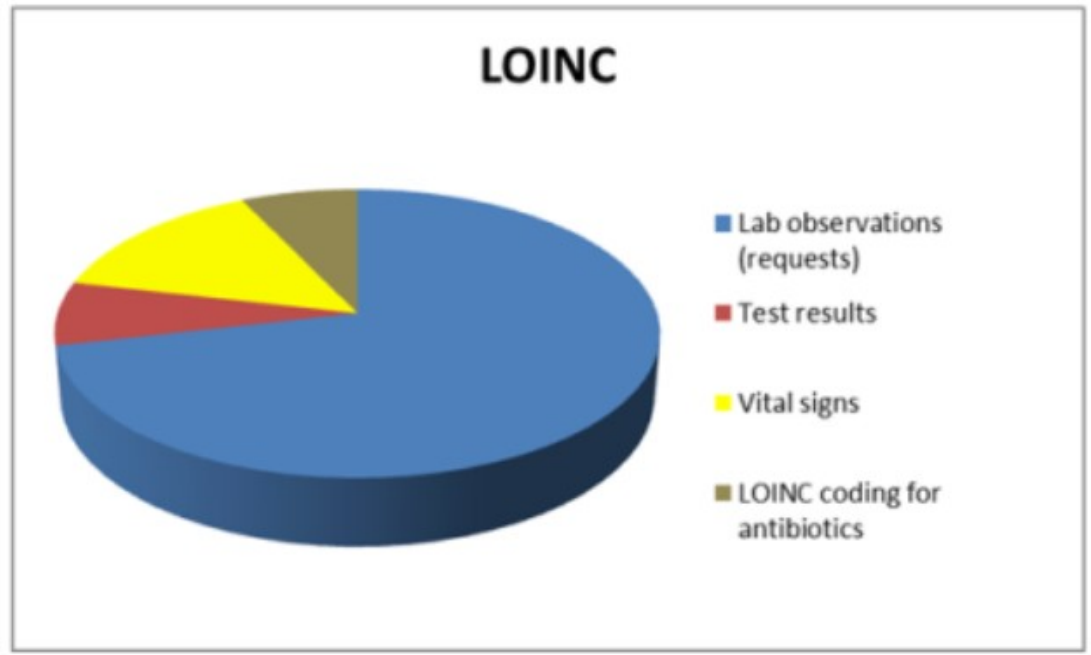


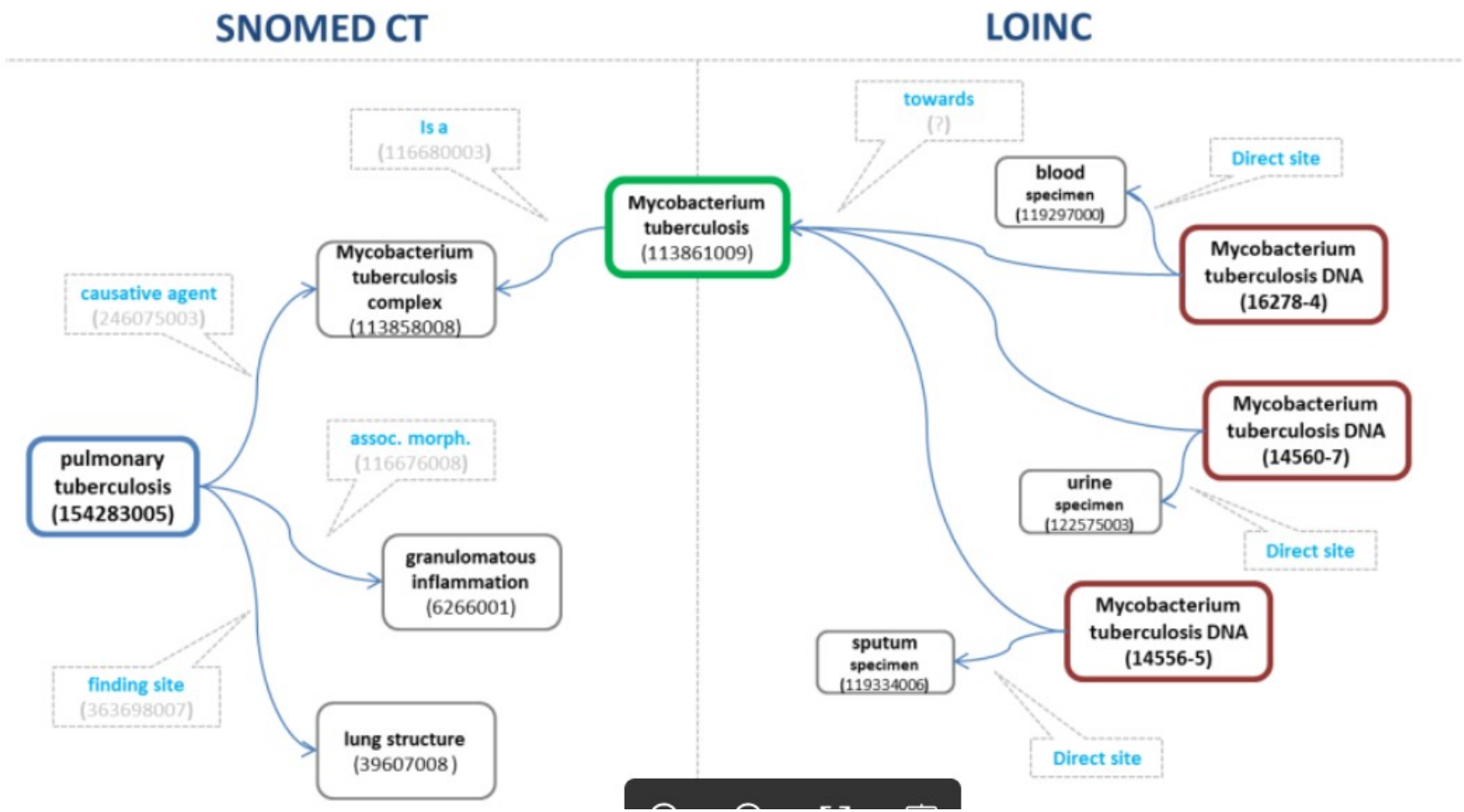
A urine microalbumin test is a test to detect very small levels of a blood protein (albumin) in your urine. A microalbumin test is used to detect early signs of kidney damage in people who are at risk of developing kidney disease.

LOINC and SNOMED CT




SNOMED CT
Lab observations (requests)
Test results
Microrganisms
Specimen types
Drugs
Laboratory methods


LOINC
Lab observations (requests)
Test results
Vital signs
LOINC coding for antibiotics

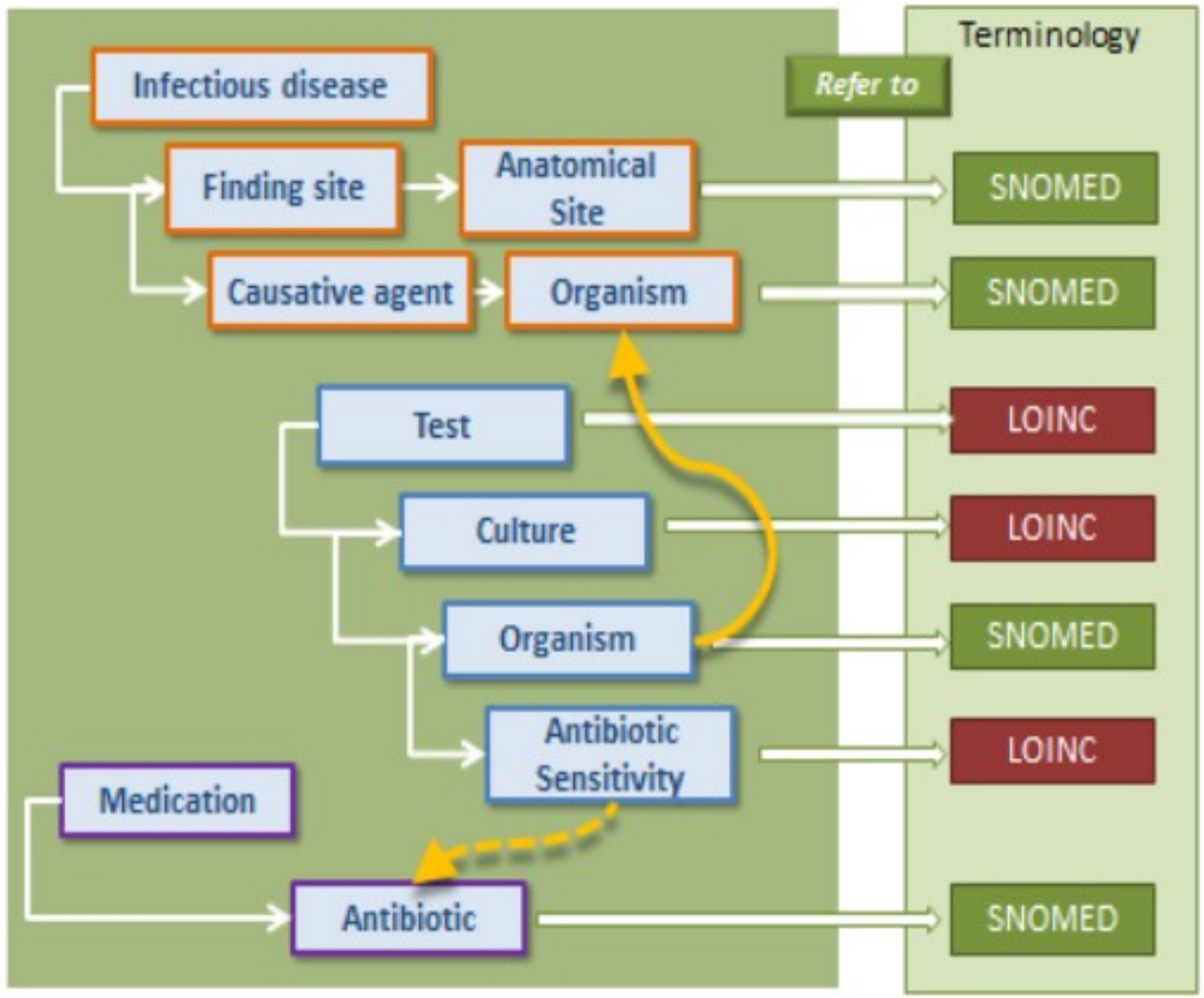


LOINC	LongName
14560-7	Mycobacterium tuberculosis DNA [Presence] in Urine by NAA with probe detection

LOINC	LongName
14556-5	Mycobacterium tuberculosis DNA [Presence] in Sputum by NAA with probe detection

LOINC	LongName
16278-4	Mycobacterium tuberculosis DNA [Presence] in Blood by NAA with probe detection

Microbiology report related to EHR data



MIMIC III LOINC

MIMIC-III Clinical Database Demo 1.4

File: <base> / D_LABITEMS.csv (37,760 bytes)

row_id	itemid	label	fluid	category	loinc_code
1	50800	SPECIMEN TYPE	BLOOD	BLOOD GAS	
2	50801	Alveolar-arterial Gradient	Blood	Blood Gas	19991-9
3	50802	Base Excess	Blood	Blood Gas	11555-0
4	50803	Calculated Bicarbonate, Whole Blood	Blood	Blood Gas	1959-6
5	50804	Calculated Total CO2	Blood	Blood Gas	34728-6
6	50805	Carboxyhemoglobin	Blood	Blood Gas	20563-3
7	50806	Chloride, Whole Blood	Blood	Blood Gas	2069-3
8	50807	Comments	Blood	Blood Gas	
9	50808	Free Calcium	Blood	Blood Gas	1994-3

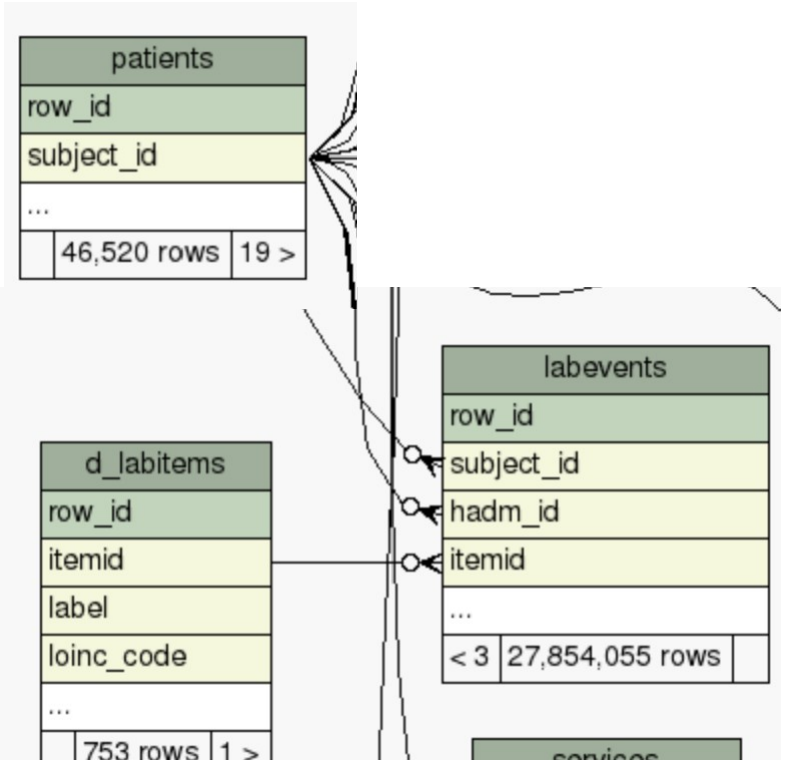
SQL on labitems table

```
SELECT *
FROM d_labitems
```

```
SELECT COUNT(itemid), loinc_code
FROM d_labitems
GROUP BY loinc_code;
```

```
SELECT COUNT(itemid),
loinc_code
FROM d_labitems
GROUP BY loinc_code
ORDER BY COUNT(itemid) DESC;
```

```
SELECT COUNT(itemid), category
FROM d_labitems
GROUP BY category;
```



RxNorm

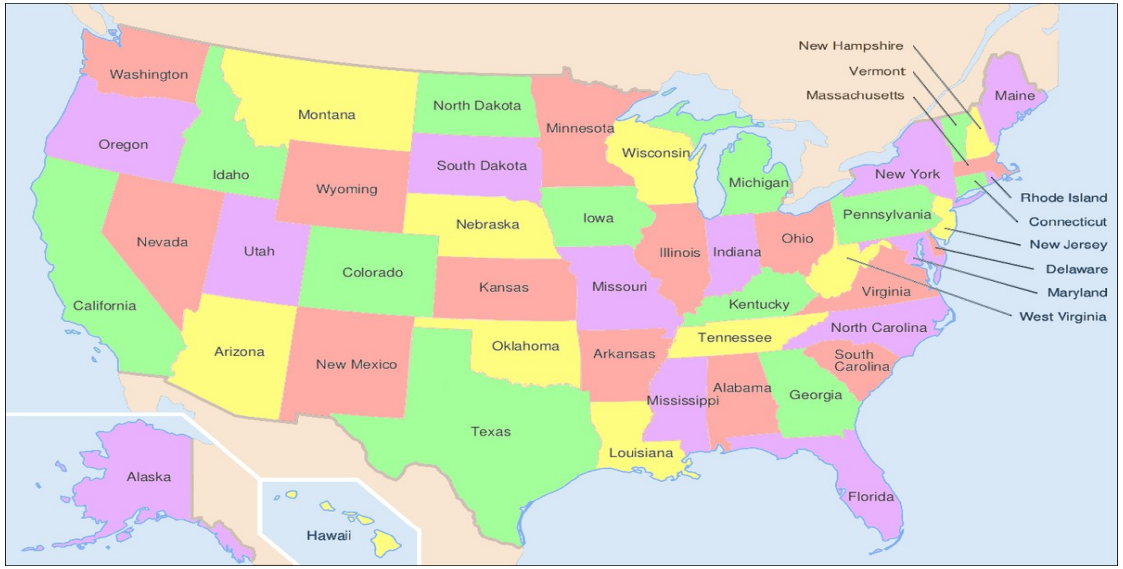
https://www.nlm.nih.gov/bsd/disted/video/clin_info/rxnorm.html

Betsy Lehman

- In 1994, Betsy Lehman, a reporter of Boston Globe and mother of two young girls, was battling advanced stage of breast cancer. She was killed by the four times the intended dose of a powerful chemotherapy drug at Dana-Farber Hospital (the world premier cancer center). – Betsy Lehman Center

https://betsylehmancenterma.gov/

The Problem:
The US Lacks a Centralized Health Care Data System



EHR Software

Integrated Systems

Epic athenahealth MEDITECH Allscripts Cerner virence

Best Of Breed

CureMD EXPERITY QS/1 PRACTICE VELOCITY cpsi PICIS plexus iProcedures wellsoft Elekta HARRIS HEALTHCARE

ClinicalWorks Pulse amazingcharts dr chrono ScriptPro swisslog ARIUM Greenway Health AdvancedMD eMDs sunquest

ElationHealth practicefusion kareo Pulse8 SCC DocuTAP MatrixCare MEDHOST IntrinsiQ

PointClickCare CoreCloud SURGICAL INFORMATION SYSTEMS varian PSYCHE flatiron ORCHARD Software Omnicell

The Problem:
The US Lacks a Centralized Health Care Data System

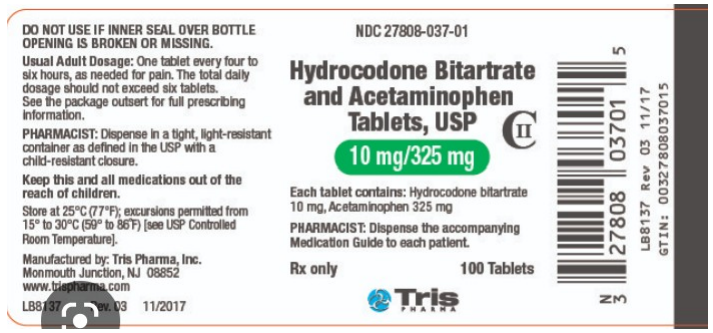
Obredon (hydrocodone / guaifenesin) is a liquid used to treat cough and loosen mucus in your lungs when you have a cold. It's a combination medication that contains an opioid, so it has a risk of becoming habit-forming. It can also cause sleepiness, constipation, and dizziness.

Joe has a bad cough with a lot of mucous

https://www.goodrx.com/obredon/what-is

OBREDON 2.5mg-200mg/5mL Solution; (9487)

HYDROCODONE BITARTRATE 2.5 mg in 5 mL / GUAIFENESIN 200 mg in 5 mL ORAL SOLUTION [OBREDON]; (6069433)



What is this Medicine?

GUAIFENESIN; HYDROCODONE (gwye FEN e sin; hye droe KOE done) helps to temporarily stop or reduce a dry and nonproductive cough.

Similar Brand Name Drugs : Flowtuss: Oral solution (2.5-200mg)
Similar Generic Drugs : Narcotic Cough/Cold Preparations: Oral solution (2.5-200mg)

The Solution:
RxNorm Standardized Drug Terminology

interoperability

OBREDON 2.5mg-200mg/5mL Solution (9487)

HYDROCODONE BITARTRATE 2.5 mg in 5 mL / GUAIFENESIN 200 mg in 5 mL ORAL SOLUTION [OBREDON] (6069433)

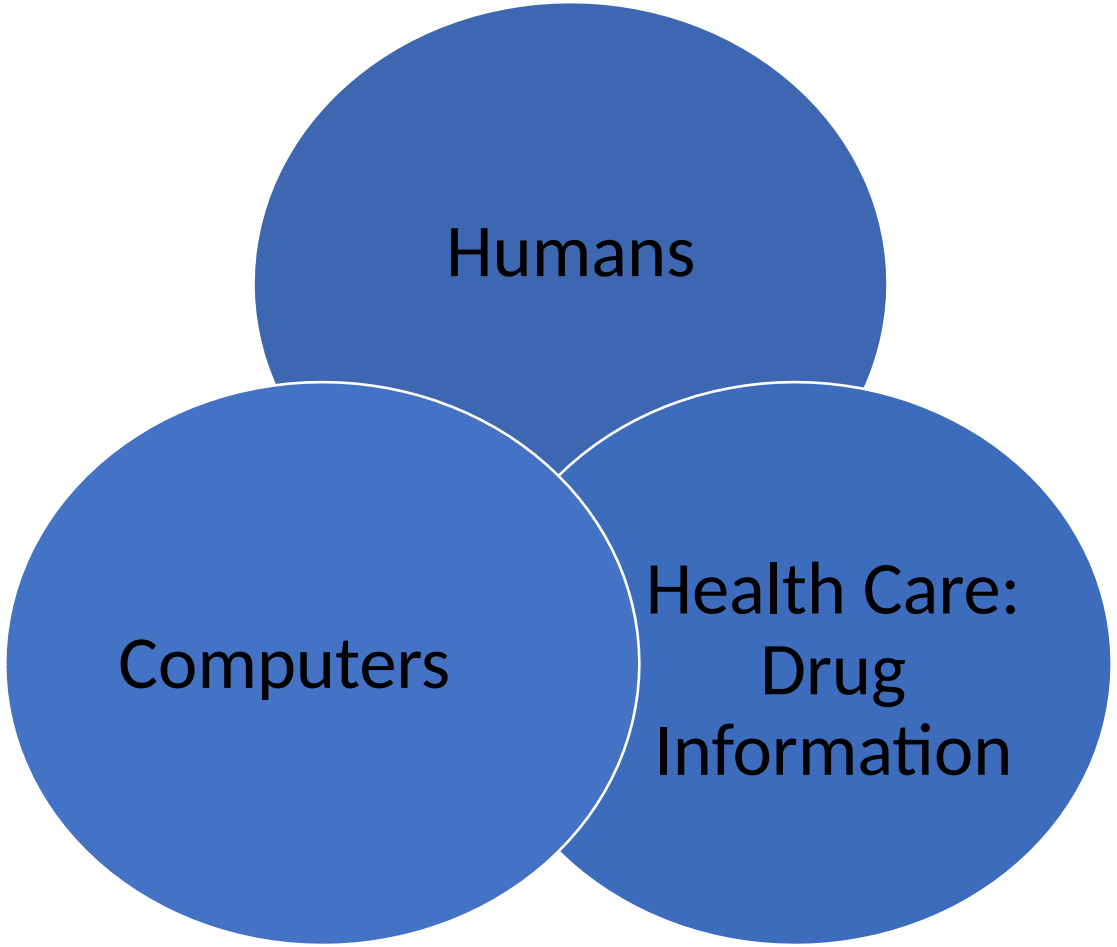
RxNorm Standardized Name and Code

Name: Guaifenesin 40 MG/ML / Hydrocodone Bitartrate 0.5 MG/ML Oral Solution [Obredon] **Code:** 1598284

- OBREDON 2.5mg-200mg/5mL Solution (9487)
- HYDROCODONE BITARTRATE 2.5 mg in 5 mL / GUAIFENESIN 200 mg in 5 mL ORAL SOLUTION [OBREDON] (6069433)

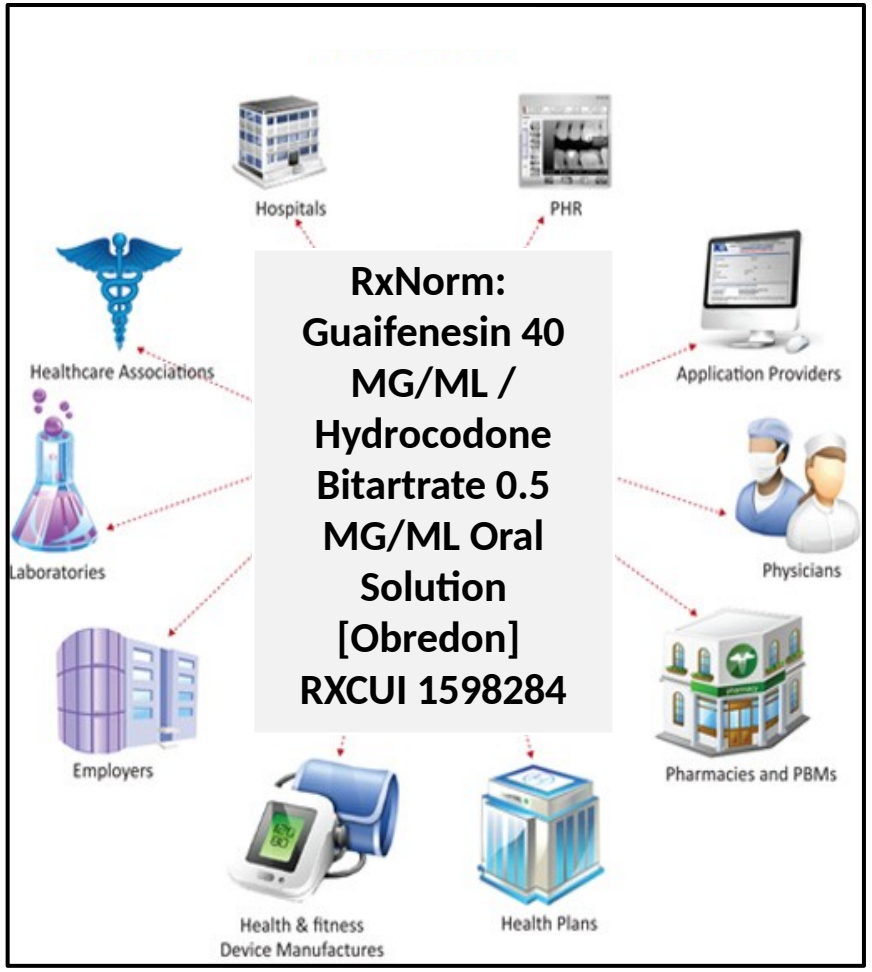
What is RxNorm?

- Standardized naming system to codify clinical drugs.
- National standard for coding clinical drugs in the U.S.
- Tool for supporting semantic interoperation between different systems.



RxNorm in the Health Ecosystem

MTHSPL:
HYDROCODONE BITARTRATE 2.5 mg in 5 mL / GUAIFENESIN 200 mg in 5 mL ORAL SOLUTION [OBREDON]



GS: OBREDON 2.5mg-200mg/5mL Solution

MMSL:
Obredon, 200 mg-2.5 mg/5 mL oral liquid

RxNorm Use Cases

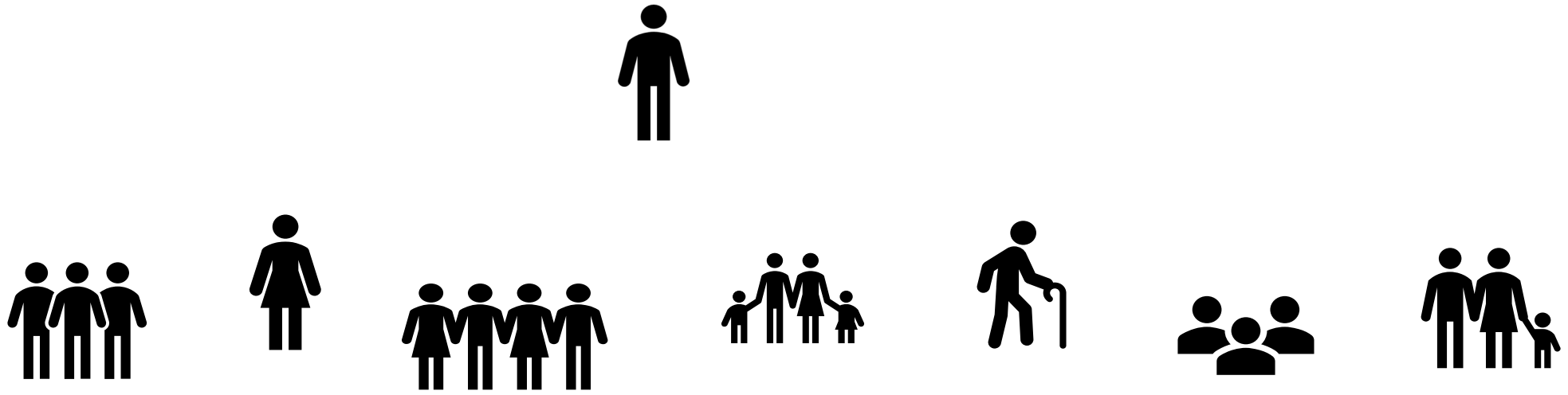
- **e-Prescribing**

- **Clinical Research**
  - Aggregate and analyze prescription datasets

- **Research Data Management**
  - Data management plans to make data FAIR:
    - **F**indable
    - **A**ccessible
    - **I**nteroperable
    - **R**eusable

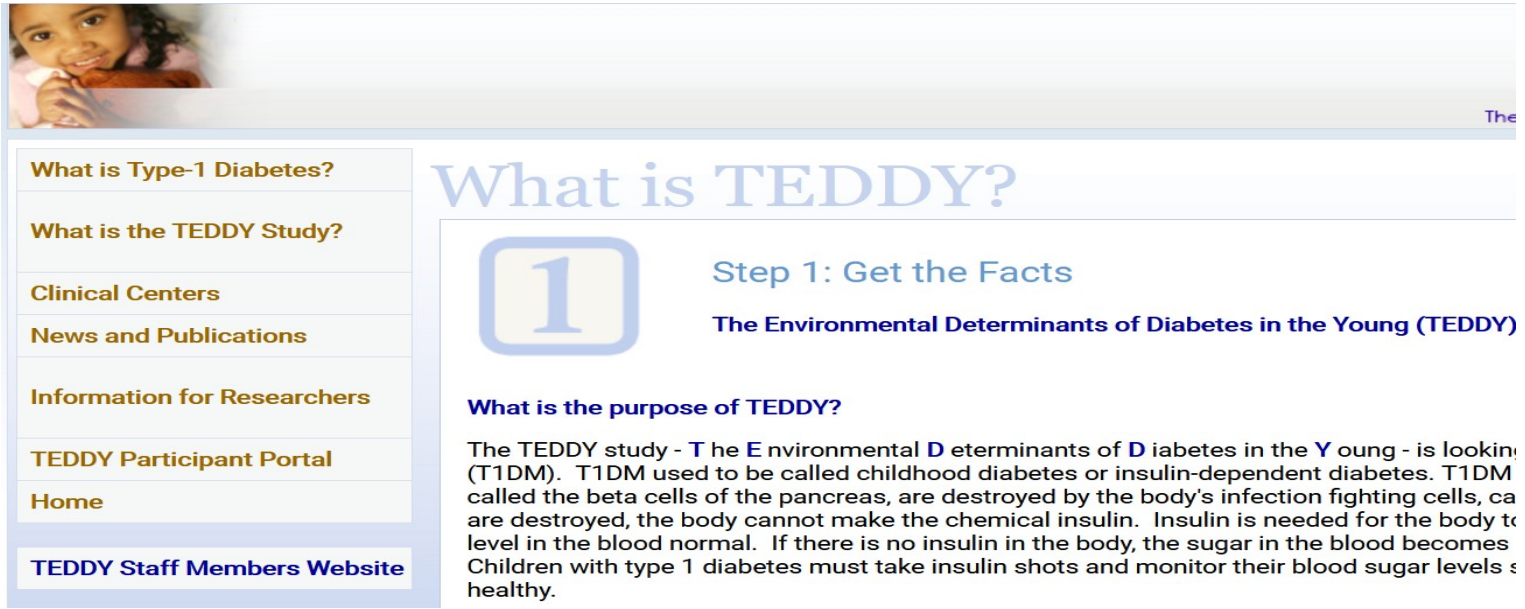
RxNorm in Clinical Research

- RxNorm allows population-based studies of prescription drugs.
  - Joe is taking an opioid.
  - Researchers want to know about the prescribing patterns in Joe's county.
  - **Prescription medications already coded with RxNorm can yield faster results.**



RxNorm in Research Data Management

- TEDDY Study
  - **T**he **E**nvironmental **D**eterminants of **D**iabetes in the **Y**oung
  - Epidemiologic study exploring genetic and environmental factors related to childhood diabetes in children (from birth to age 15) by collecting medication data.
  - **Researchers decided to use RxNorm to code medications when developing the Research Data Management plan.**



RxNorm

- RxNorm is two things:
  - a normalized naming system for generic and branded drugs; and
  - a tool for supporting semantic interoperation between drug terminologies and pharmacy knowledge base systems.
- The National Library of Medicine (NLM) produces RxNorm.

RxNorm

- RxNorm contains the names of prescription and many over-the-counter drugs available in the United States.
- RxNorm includes generic and branded:
  - Clinical drugs - pharmaceutical products given to (or taken by) a patient with therapeutic intent
  - Drug packs - packs that contain multiple drugs, or drugs designed to be administered in a specified sequence

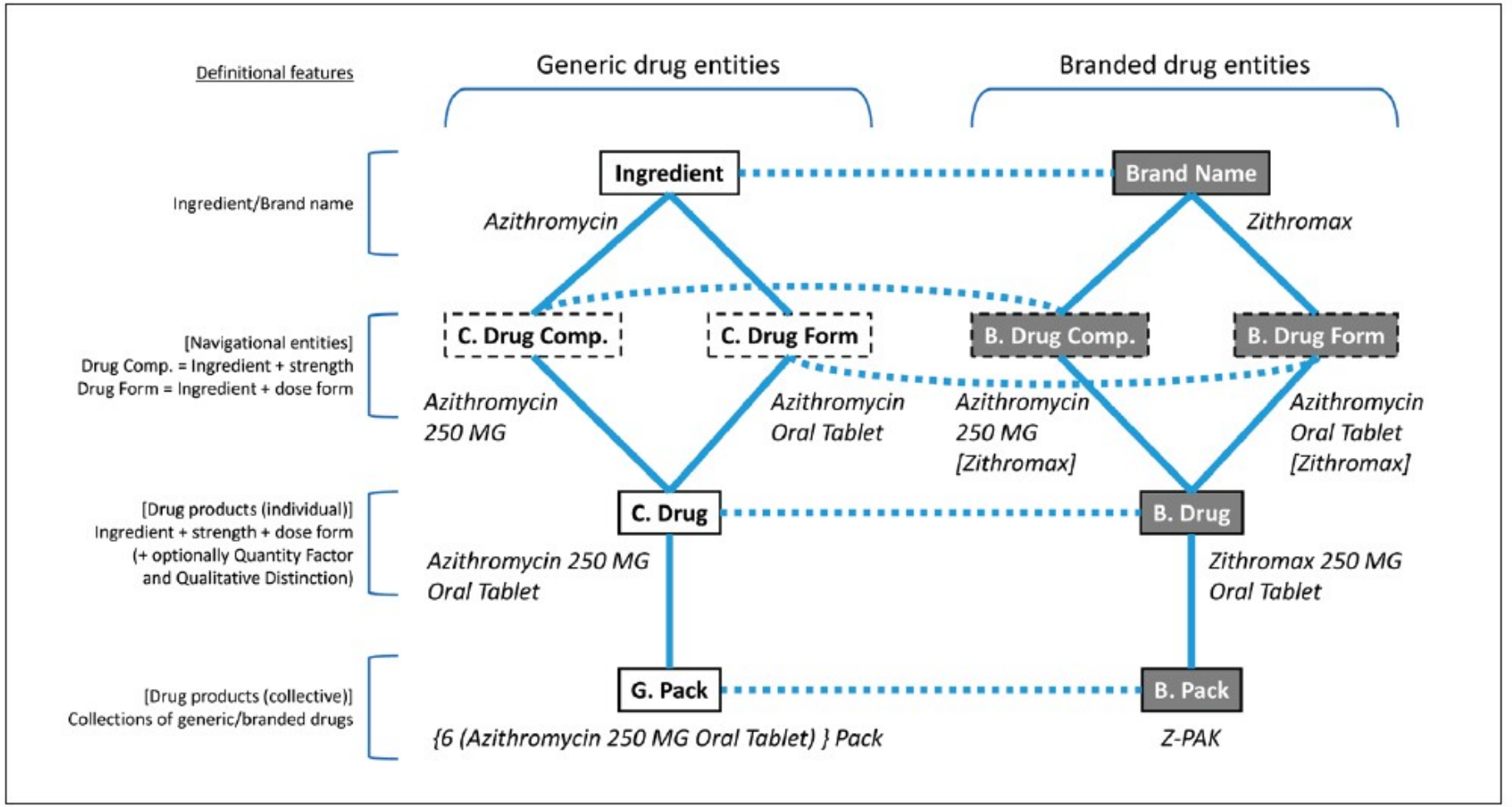


Fig. 3 Organizational structure of RxNorm, with its different types of drug entities (ingredient, brand name, clinical drug component, branded drug component, clinical drug, branded drug, generic pack, branded pack), using Azithromycin products as an example. Generic entities are on the left-hand side and branded entities are on the right hand-side. The definitional elements for each type of drug entity are indicated on the left. The lines between types of drug entities represent named relationships in RxNorm. (Relationship names are omitted for simplicity).

https://pubmed.ncbi.nlm.nih.gov/30157516/

How to build RxNorm

- **1. Group source data into collections of synonyms (called concepts).**
- Sample source data:
  - Naproxen Tab 250 MG
  - Naproxen 250mg tablet (product)
  - NAPROXEN@250 mg@ORAL@TABLET
  - Naproxen 250 MILLIGRAM In 1 TABLET ORAL TABLET
  - NAPROXEN 250MG TAB,UD [VA Product]
- Sources format their drug names in many different ways. Although the drug names in this Naproxen example appear different, they all have the same meaning at a certain level of abstraction. RxNorm groups these as synonyms into one concept.

How to build RxNorm

- **2. Create an RxNorm normalized name for each concept (if the concept is in-scope and unambiguous).**
  - About 60% of the drug names from RxNorm source vocabularies receive RxNorm normalized names. RxNorm normalized names and codes are available in SAB=RXNORM which is one of the source vocabularies within the full RxNorm data set.
  - The other 40% of source vocabulary drug names do not receive RxNorm normalized names because they are either out-of-scope or their names are too ambiguous including medical devices, foods, and enzymes.
  - The Naproxen concept above is in-scope for RxNorm, so it is assigned an RxNorm normalized name. The normalized name consists of the ingredient, strength, and dose form (in that order) for fully-specified generic drugs.
  - In our example, the RxNorm normalized name is 'Naproxen 250 MG Oral Tablet'. The branded version of this drug uses the same format but includes the brand name in brackets at the end (e.g., 'Naproxen 250 MG Oral Tablet [Prosaid]').

The **brand name** of a **medication** is the **name** given by the company that makes the **drug** and is usually easy to say for sales and marketing purposes. The **generic name**, on the other hand, is the **name** of the active ingredient. Apr 19, 2017

How to build RxNorm

- **3. Assign an RxNorm concept unique identifier (RXCUI) to each concept and an RxNorm atom unique identifier (RXAUI) to each atom.**
  - RXCUI
    - Every name and code provided to NLM by a source vocabulary receives an RXCUI.
    - An RXCUI is a machine-readable code or identifier that points to the common meaning shared by the various source names grouped and assigned to a particular concept.
  - RXAUI
    - Concepts are collections of synonyms at a given level of abstraction. Each drug name carries additional characteristics, including its source, its code (the unique identifier assigned by its source), and its term type (described below). An atom is a drug name plus these additional characteristics. Each atom within a concept receives an atom unique identifier, an RXAUI.

How to build RxNorm

- **4. Include relationships and attributes from the source data.**
  - Source data include more than drug names in some cases. Data can also include relationships that link drug names to other drug names and ingredients, as well as other information, such as National Drug Codes (NDCs), marketing categories, and pill imprint information.

How to build RxNorm

- **5. Create related RxNorm names and relationships.**
  - In addition to the fully complete clinical drug names (ingredient, strength, and dose form), RxNorm also creates names at other levels of specificity:
    - ingredient / precise ingredient / multiple ingredients
    - ingredient + strength
    - ingredient + dose form / ingredient + dose form group

Along with the RxNorm fully-specified name 'Naproxen 250 MG Oral Tablet', NLM creates:

- 'Naproxen'
- 'Naproxen 250 MG'
- 'Naproxen Oral Tablet' / 'Naproxen Oral Products' / 'Naproxen Pills'

RxNorm links these names using relationships. Here are a few examples:

- 'Naproxen 250 MG Oral Tablet' has_dose_form 'Oral Tablet'
- 'Naproxen' ingredient_of 'Naproxen 250 MG'
- 'Naproxen 250 MG Oral Tablet' isa 'Naproxen Oral Tablet'
- 'Naproxen Pills' has_ingredient 'Naproxen'

Sample Drug Names from Data Sources

ranitidine 15 mg/mL oral syrup
RANITIDINE HCL 15 mg/mL ORAL SYRUP
RANITIDINE HCL 15 mg/mL ORAL SYRUP
RANITIDINE HCL@15 mg/mL@ORAL@SYRUP
Ranitidine HCl Syrup 15 MG/ML (75 MG/5ML)
Ranitidine Hydrochloride 15 MG/ML Oral Solution
Ranitidine Hydrochloride 15mg/1mL Oral solution
Ranitidine 15 MG/ML Oral Solution
RANITIDINE 15 MG ORAL SYRUP

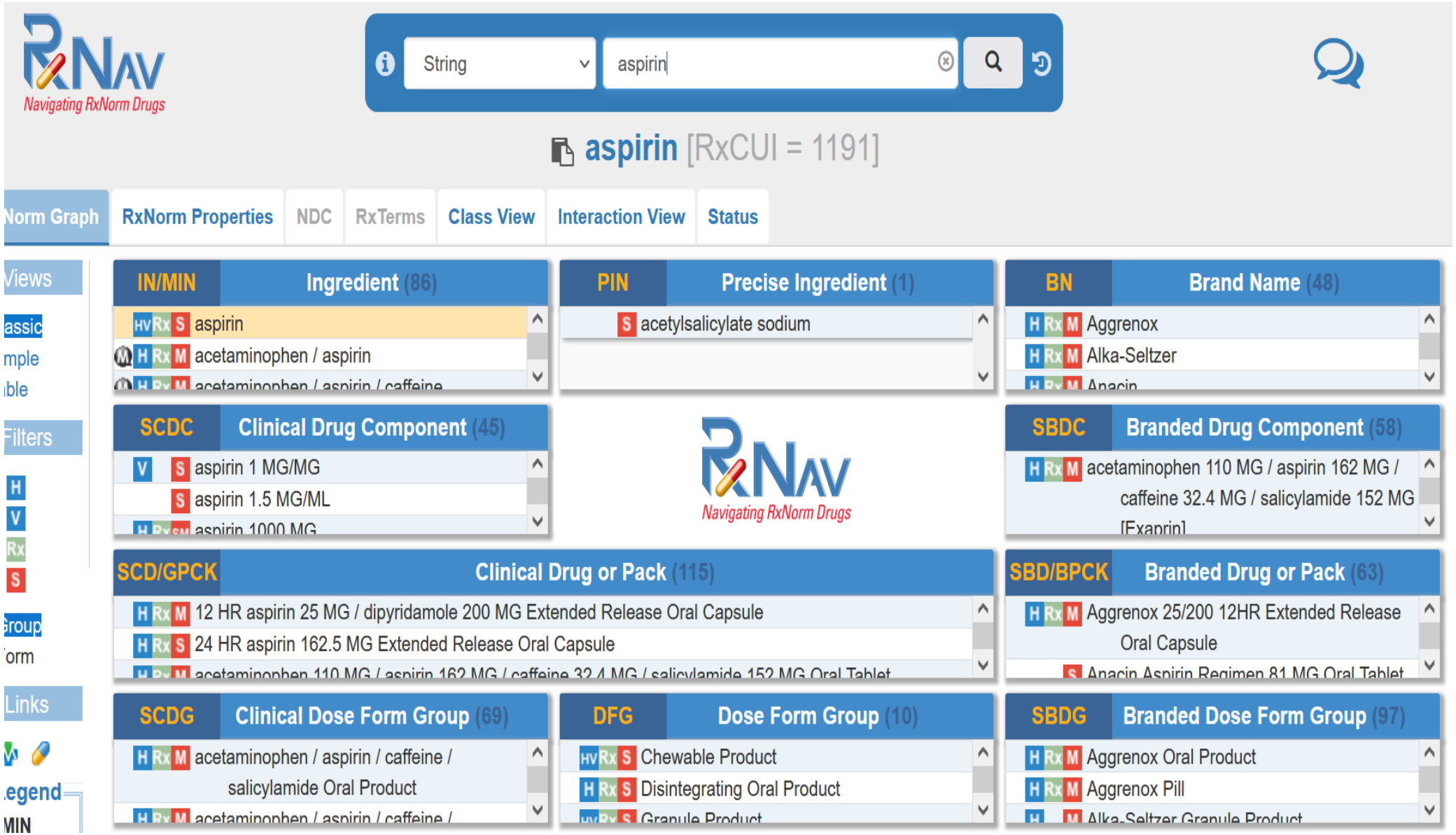
RANITIDINE HYDROCHLORIDE 15 MG ORAL SYRUP
RANITIDINE HYDROCHLORIDE 16.8 MG ORAL SYRUP
RANITIDINE HYDROCHLORIDE 75 MG ORAL SOLUTION
RANITIDINE HYDROCHLORIDE 15 mg in 1 mL ORAL SYRUP
RANITIDINE HYDROCHLORIDE 15 MG ORAL SYRUP
Ranitidine 15 mg in 1 mL ORAL SOLUTION
RANITIDINE 15 MG ORAL SOLUTION
RANITIDINE HYDROCHLORIDE 16.8 MG ORA

RxNorm Normalized Name: **Ranitidine 15 MG/ML Oral Solution**
RxNorm Concept Unique Identifier (RXCUI) = **705610**

Ranitidine is **used to** treat ulcers of the stomach and intestines and prevent them from coming back after they have healed. This medication is also **used to** treat certain stomach and throat (esophagus) problems (such as erosive esophagitis, gastroesophageal reflux disease-GERD, Zollinger-Ellison syndrome).

Accessing RxNorm Data

- RxNorm Files Download page (UMLS License might be required).
- RxNorm-related Application Programming Interfaces (APIs)
  - allows web-based access using pre-installed queries
- RxNorm web-based browser (RxNav): https://rxnav.nlm.nih.gov/

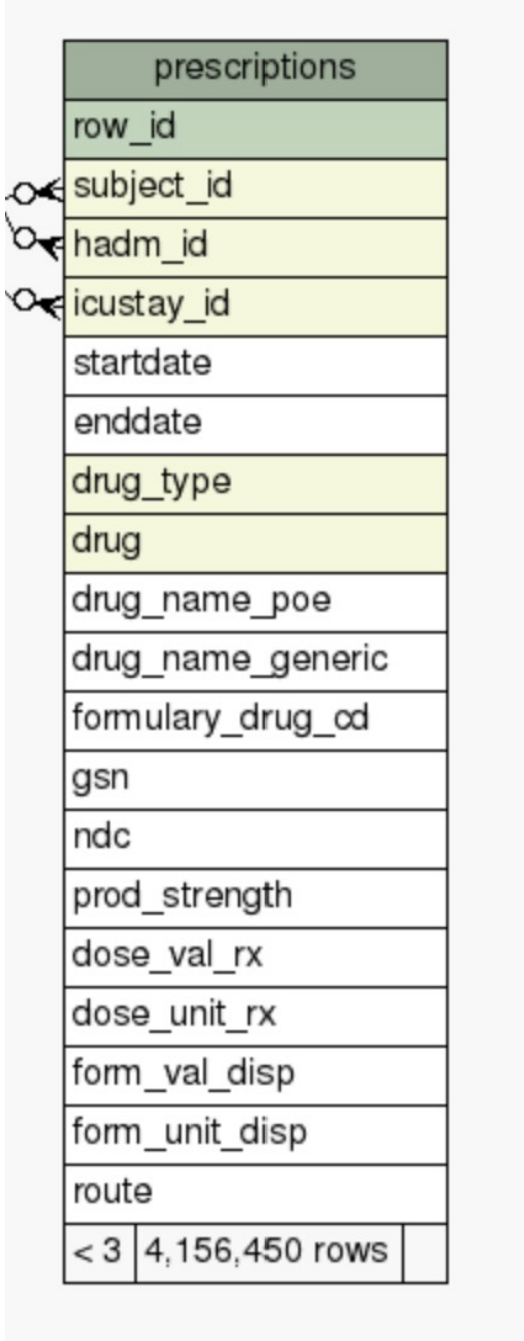

RxNav
Navigating RxNorm Drugs
String
aspirin
aspirin [RxCUI = 1191]
Norm Graph
RxNorm Properties
NDC
RxTerms
Class View
Interaction View
Status
Views
Filters
Links
IN/MIN Ingredient (86)
aspirin
acetaminophen / aspirin
PIN Precise Ingredient (1)
acetylsalicylate sodium
BN Brand Name (48)
Aggrenox
Alka-Seltzer
SCDC Clinical Drug Component (45)
aspirin 1 MG/MG
aspirin 1.5 MG/ML
RxNav
Navigating RxNorm Drugs
SBDC Branded Drug Component (58)
acetaminophen 110 MG / aspirin 162 MG / caffeine 32.4 MG / salicylamide 152 MG [Exaprin]
SCD/GPCK Clinical Drug or Pack (115)
12 HR aspirin 25 MG / dipyridamole 200 MG Extended Release Oral Capsule
24 HR aspirin 162.5 MG Extended Release Oral Capsule
SBD/BPCK Branded Drug or Pack (63)
Aggrenox 25/200 12HR Extended Release Oral Capsule
SCDG Clinical Dose Form Group (69)
acetaminophen / aspirin / caffeine / salicylamide Oral Product
DFG Dose Form Group (10)
Chewable Product
Disintegrating Oral Product
SBDG Branded Dose Form Group (97)
Aggrenox Oral Product
Aggrenox Pill

MIMIC III Prescriptions Table

```
SELECT drug_type, drug,
drug_name_poe, ndc
FROM prescriptions
WHERE drug LIKE '%citrate%';
```

```
SELECT drug_type, drug,
drug_name_poe, ndc
FROM prescriptions
WHERE drug LIKE '%citrate%' AND
ndc NOT LIKE 'None';
```

drug_type	drug	drug_name_poe	ndc
MAIN	citrate	citrate	0
MAIN	fentaNYL citrate (PF)	fentaNYL citrate (PF)	10019003867
MAIN	Calcitrate	Calcitrate	66553000401
MAIN	sodium citrate	sodium citrate	0



References

- LOINC User's Guide: https://loinc.org/kb/users-guide/introduction/
- LOINC for beginners: https://loinc.org/slideshows/loinc-for-beginners-december-2017/
- LOINC annual report: https://loinc.org/files/reports/2019%20LOINC%20Annual%20Report.pdf
- LOINC search: https://search.loinc.org/searchLOINC/search.zul

RxNorm Resources

- RxNorm Home Page: https://www.nlm.nih.gov/research/umls/rxnorm/index.html
- RxNav and API Landing Page:

  https://rxnav.nlm.nih.gov/
- RxNorm Download Files Page: https://www.nlm.nih.gov/research/umls/rxnorm/docs/rxnormfiles.html