



# Logical Observation Identifiers Names and Codes (LOINC)

National Resource Centre for EHR Standards (NRCeS) Team  
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- LOINC stands for **Logical Observation Identifiers Names and Codes**
- It is a database and universal standard for identifying medical laboratory observations
- It was developed and is maintained by the Regenstrief Institute, a US non-profit medical research organization
- It is endorsed by the American Clinical Laboratory Association and the College of American Pathologists

- 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)
- LOINC codes represent the “question” for a test or measurement

# 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 <sup>+</sup> 2H POST 100 G GLUCOSE PO:MCNC:PT:SER/PLAS:QN
3665-7	GENTAMICIN <sup>+</sup> TROUGH:MCNC:PT:SER/PLAS:QN
17863-2	CALCIUM.IONIZED:MCNC:PT:SER/PLAS:QN
2863-9	ALBUMIN:MCNC:PT:SNV:QN:ELECTROPHORESIS

## Codes for individual observations

<u>6690-2</u>	Leukocytes [# /volume] in Blood by Automated count
<u>2339-0</u>	Glucose [Mass/volume] in Blood
<u>29463-7</u>	Body weight
<u>55423-8</u>	Number of steps in unspecified time Pedometer

## Codes for collections (panels and documents)

<u>57021-8</u>	CBC W Auto Differential panel - Blood
<u>34565-2</u>	Vital signs, weight and height panel
<u>44249-1</u>	PHQ-9 quick depression assessment panel
<u>36813-4</u>	CT Abdomen and Pelvis W contrast IV
<u>18842-5</u>	Discharge summary





# THE LOINC CONCEPT MODEL

LOINC has **two** main divisions:

- **Laboratory**

- Contains test names and results
- Standard test names and codes
  - Includes 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**

- Contains measurement of vital parameters etc
  - Vitals signs, hemodynamics, intake/output, ECG, obstetric ultrasound, cardio echo, urologic imaging, pulmonary ventilator management, survey instruments, Phenx and other

- 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 within the LOINC database
- **Format** – nnnnnnn-n (where the last n is a mod 10 check digit)
- Number after (-) is check digit, is automatically created by the coding system
- The check digit is always a number from 0-9 and serves to help avoid errors in transcription of the code



- A formal, distinct, and unique **6-axes/part** name is given to each term for test or observation identity.
- The database currently has over **83,000** 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: Axes/Parts



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.

# Example: LOINC - Axes/Parts



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

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

# Example of the relation of the LOINC code 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 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

# Component: Substructures/Subparts



- Component also has **substructures/subparts**
  - The principal name (e.g., the name of the Analyte or the measurement)
  - The Challenge or provocation, *if relevant, including the time delay, substance of challenge, amount administered, and route of administration*
  - Any standardization or Adjustment
- The three subparts of the first part follow this syntax:
  - <[analyte] . [subclass] . [sub-subclass]> ^ <[time delay] post [amount] [substance] [route]) <adjustment>
- In the above syntax, the carat (^) is a required delimiter and the “dot” (.) separates the *Analyte name from its subspecies*



# Examples : Challenge



Situations	LOINC examples
To describe measurements taken at a specified point after the beginning of an ongoing treatment	Creatinine^12H post peritoneal dialysis
Specifying a time elapsed since challenge, the time delay slot can be used to name a clock time when the measurement was taken	Glucose^10 AM specimen
For drug peak (obtained at a time presumed to reflect the highest concentration)	Glucose^30M post 100 g glucose PO:MCnc:Pt:Ser/Plas:Qn
Physiologic challenges	Triglyceride^post 12H CFst

# Adjustments/corrections (3rd subpart)



- The third subpart of the data element contains calculations that adjust or correct some measured value.
- This subpart is used to distinguish corrected or adjusted values from the uncorrected measurement, e.g., corrected cell counts from the raw cell counts.
- **Examples:**
  - Calcium.ionized^^adjusted to pH 7.4:SCnc:Pt:Ser/Plas:Qn
  - Leukocytes^^corrected for nucleated erythrocytes:NCnc:Pt:Bld:Qn

- Formal name of Analyte (e.g. Calcium)
  - Must specify any “subanalyte”
    - e.g. Coronavirus Ag
  - May have a subclass – separated by “.”
    - e.g. Calcium.Free
- Challenge - e.g, 1H post 100 gm Glucose PO
  - Two subparts separated by “post”
  - <time delay> *post* <challenge type>
- Adjustments/corrections
  - E.g. Adjusted to pH 7.4

- Characteristics or attribute of envelope 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 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

- 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



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

- 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

- Patient is the default (not specified)
- Supersystem identifies a sample from a source other than the patient whose record the result is being stored is not the patient, e.g., fetus, blood product unit, donor, etc.
- It is an optional second part, delimited with a “^”, indicates the supersystem source of the sample if it is not the patient, such as fetus, blood product unit, donor, etc.
- Examples:
  - 818-5:A Ag:ACnc:Pt:**RBC^BPU**:Ord:
  - 11670-7:Blood flow.mean:Vel:Pt:**Aortic arch^fetus**:Qn:US.doppler

- 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

- 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

## 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



# 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: With An Example



- Example:
  - LOINC code [806-0](#) is considered below
- Fully-Specified Name (FSN)
  - Leukocytes: NCnc: Pt: CSF: Qn: Manual count
- Long Common Name (LCN)
  - Leukocytes [# /volume] in Cerebral spinal fluid by Manual count
- Short Name
  - 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

- 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

- Currently most clinical laboratories and other diagnostic services use HL7 to send their results electronically from their reporting systems to their care systems.
- Most labs, however, identify tests in these messages by means of their internal code values.
- Care systems must either use the internal codes provided by laboratory or map to LOINC or local codes.
- Universal use of LOINC would solve this problem, and there is momentum to move in this direction.



# 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

# LOINC: Fit With Other Standards



- LOINC codes represent the “question” for a test or measurement
- Codes from other standards (e.g. SNOMED CT) represent the “answer.”
- Not always a code is necessary for the result value
- For quantitative results, the "answer" is just the numeric value—with its associated units of measure

# Local test codes and names with LOINC codes



- HL7 message standard (OBX-3 slot) allows 2 sets of triplets, one for your local concept and one for the concept from the vocabulary standard

Local Code^Local Name^CodeSystem LOINCcode^LOINCname^CodeSystem

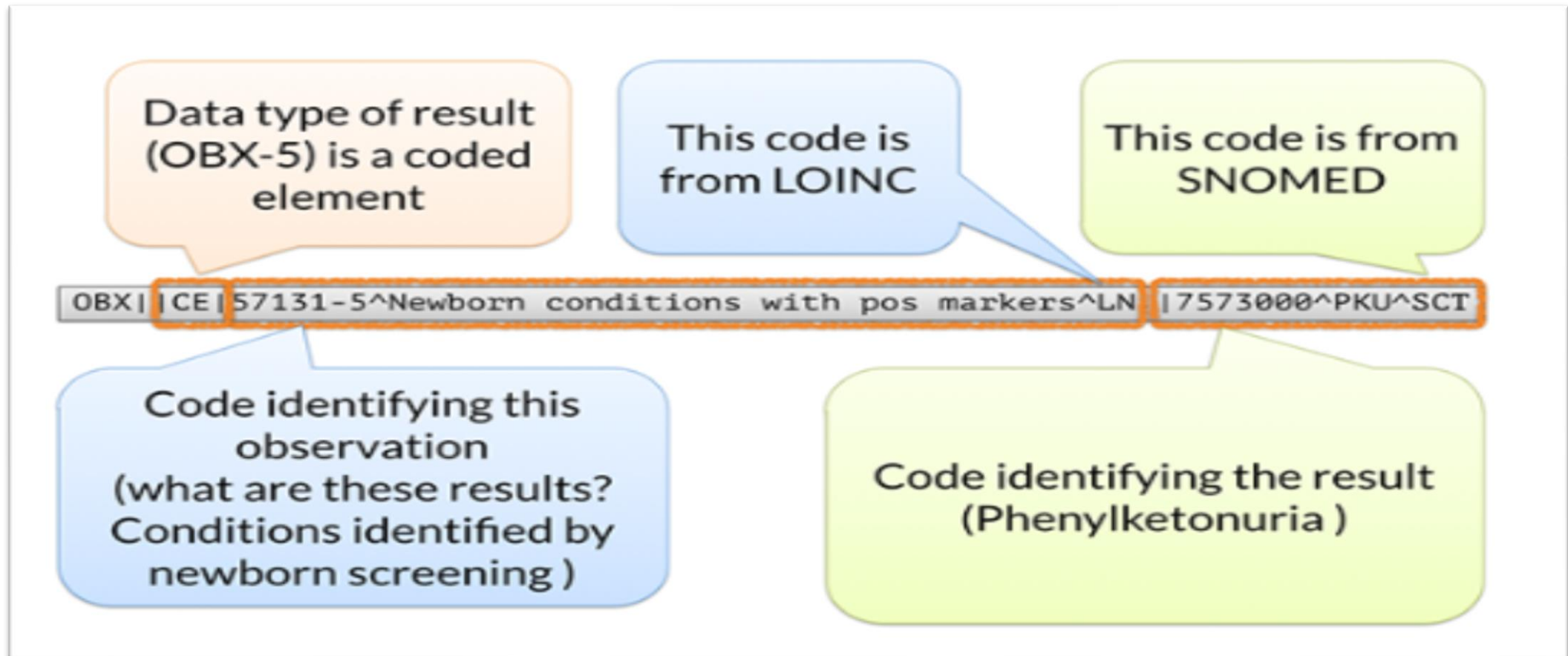
```
OBX|2|NM|123^WBC^HSP_A^26464-8^Leukocytes [#/volume] in Blood^LN||10.8|K/MM3|F|
OBX|3|NM|234^RBC^HSP_A^26453-1^Erythrocytes [#/volume] in Blood^LN|4.82|MIL/MM3|F|
OBX|4|NM|545^HGB^HSP_A^716-7^Hemoglobin [mass/volume] in Blood^LN||15.7|Gn/DL|F|
OBX|5|NM|456^HCT^HSP_A^20570-8^Hematocrit [Volume Fraction] of Blood^LN||45|%|F|
```

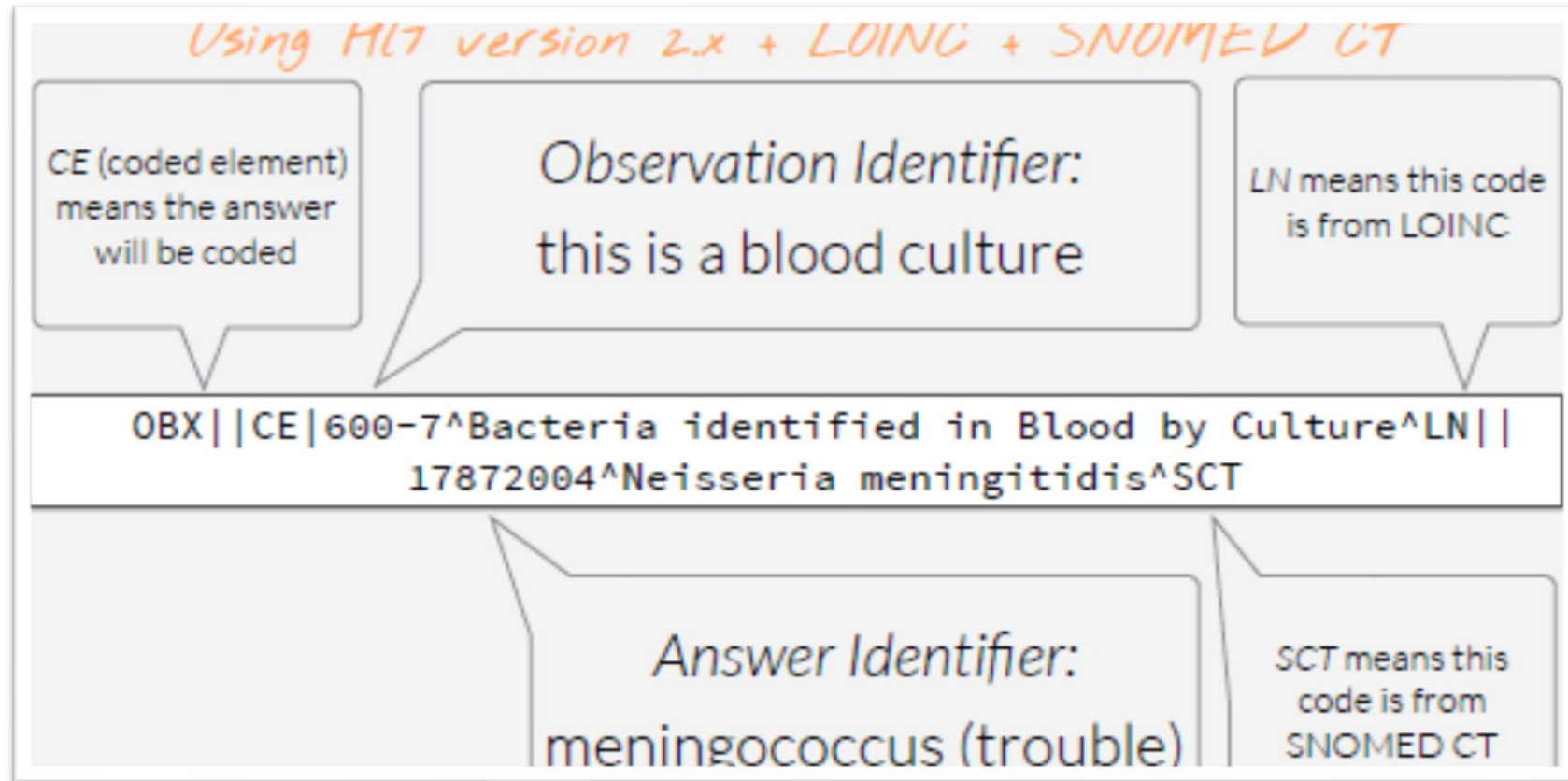
Notice how the result value and units have their own places in the message

# LOINC: Fit With Other Standards – A View



- An example of the place in the HL7 message where the test results go, you can see how a LOINC code identifies the question and a SNOMED CT code represents the answer:





## LOINC: Fit With Other Standards



- RELMA<sup>®</sup> is the [Regenstrief LOINC Mapping Assistant](#)
- RELMA is not just for searching the LOINC database. It's optimized to help you identify and map your local terms to LOINC codes
- Functions:
  - Quickly import a set of local terms either from your test catalog file or a sample of HL7 messages
  - Viewing the all the relevant details about a particular LOINC, and even other local tests from LOINC repository that have been mapped to that LOINC term
  - Search for LOINC terms in any of the available linguistic variants
  - Request new LOINC codes from Regenstrief
  - Search and map to LOINC codes even without an internet connection



# References



- Learn LOINC - <https://loinc.org/learn/>
- LOINC User Guide - <https://loinc.org/file-access/download-id/9031/>

# Thank You

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