

Advancing Interoperability with LOINC



 @djvreeman

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INDIANA UNIVERSITY

SCHOOL OF MEDICINE

Department of Medicine



Regenstrief Institute

Better Care. Better Health.

Disclosure

I'm President of Blue Sky Premise, LLC which published the book LOINC Essentials.

I'm PI on a contract from bioMérieux for LOINC content development (and many federal and non-profit funding sources for LOINC).

This material contains content from LOINC® (<http://loinc.org>). The LOINC Table, LOINC Table Core, LOINC Panels and Forms File, LOINC Answer File, LOINC Part File, LOINC Group File, LOINC Document Ontology File, LOINC Hierarchies, LOINC Linguistic Variants File, LOINC/RSNA Radiology Playbook, and LOINC/IEEE Medical Device Code Mapping Table are copyright © 1995-2018, Regenstrief Institute, Inc. and the Logical Observation Identifiers Names and Codes (LOINC) Committee and is available at no cost under the license at <http://loinc.org/license>.

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Members of the LOINC Community who have made donations or became Premium Members



Interoperability

People who want their Health IT systems to work together and understand each other

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

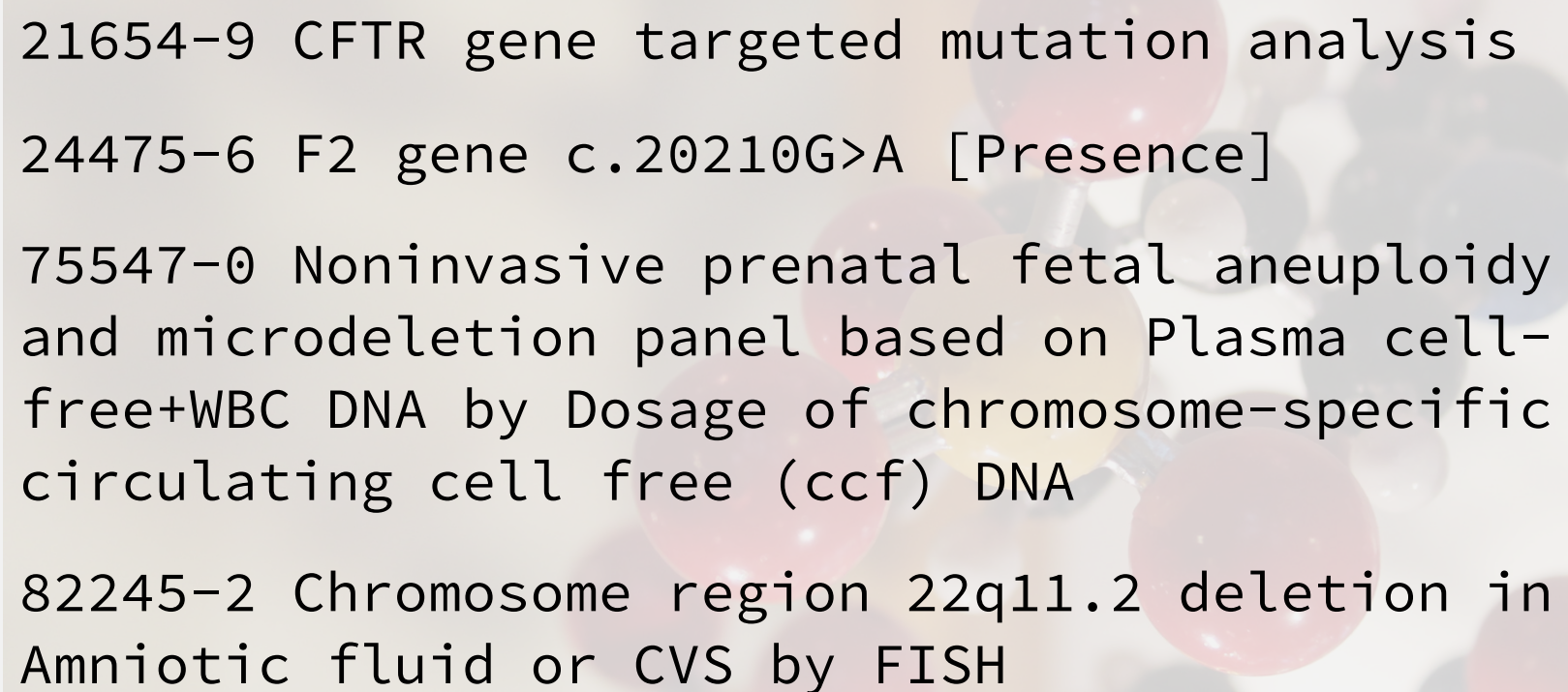
LOINC

The universal standard for identifying health measurements, observations, and documents.

LOINC terms have the specificity to distinguish between clinically important differences.

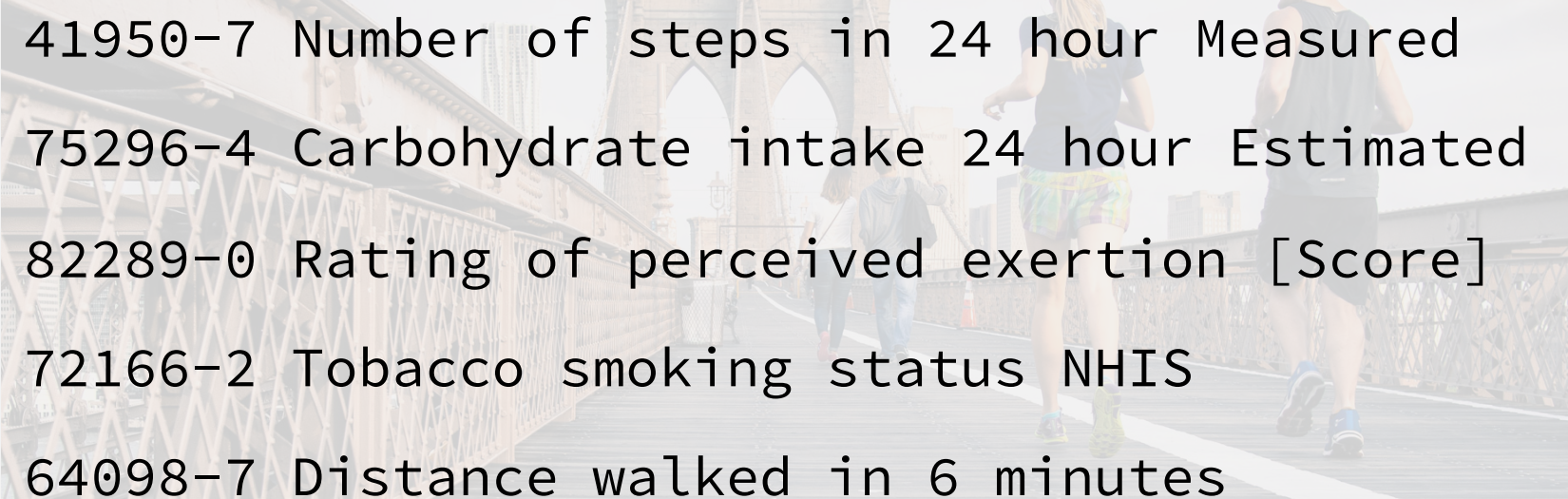
LOINC is a rich trove of 87,000+ standardized variables

Genetics



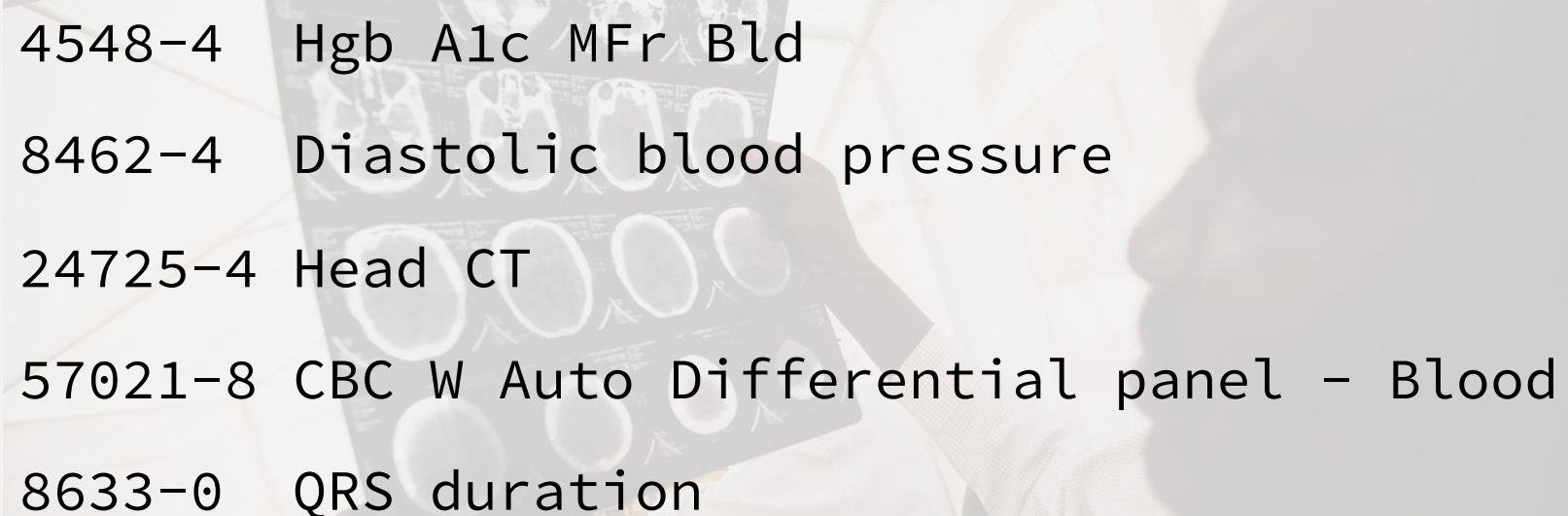
21654-9 CFTR gene targeted mutation analysis
24475-6 F2 gene c.20210G>A [Presence]
75547-0 Noninvasive prenatal fetal aneuploidy and microdeletion panel based on Plasma cell-free+WBC DNA by Dosage of chromosome-specific circulating cell free (ccf) DNA
82245-2 Chromosome region 22q11.2 deletion in Amniotic fluid or CVS by FISH

Lifestyle



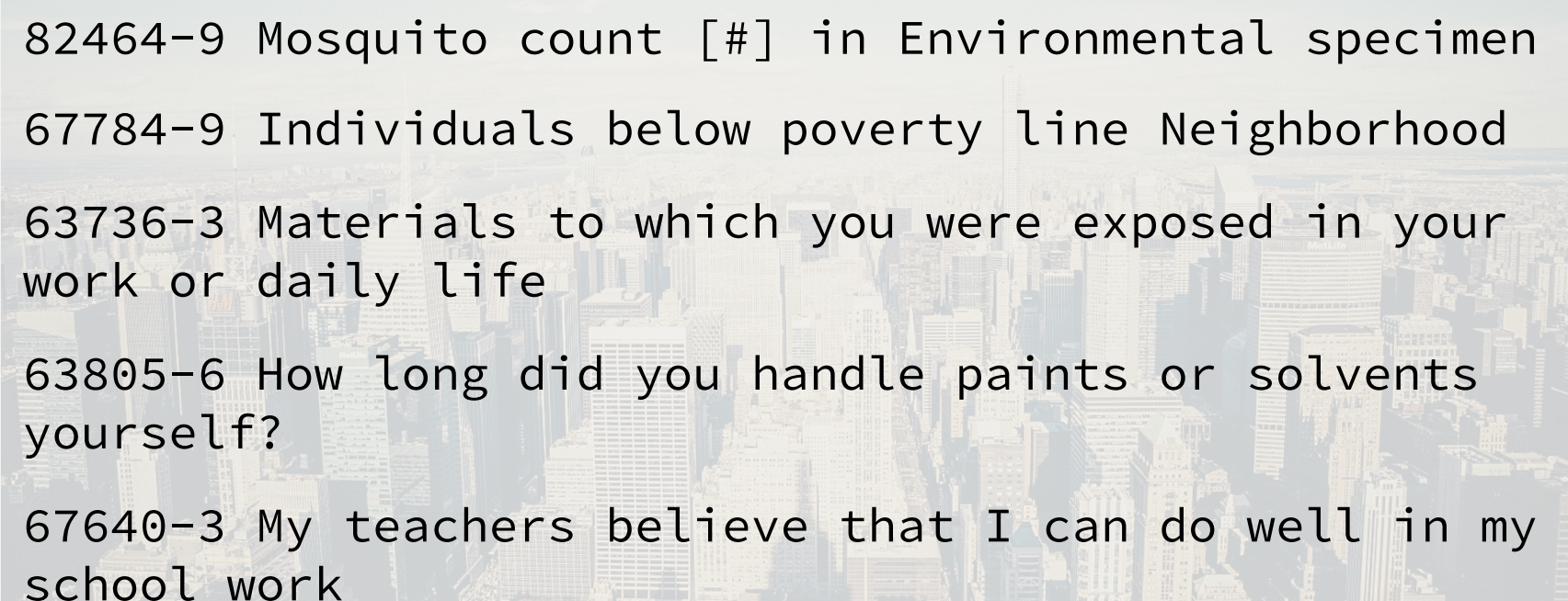
41950-7 Number of steps in 24 hour Measured
75296-4 Carbohydrate intake 24 hour Estimated
82289-0 Rating of perceived exertion [Score]
72166-2 Tobacco smoking status NHIS
64098-7 Distance walked in 6 minutes

Lab and clinical



4548-4 Hgb A1c MFr Bld
8462-4 Diastolic blood pressure
24725-4 Head CT
57021-8 CBC W Auto Differential panel - Blood
8633-0 QRS duration

Environmental



82464-9 Mosquito count [#] in Environmental specimen
67784-9 Individuals below poverty line Neighborhood
63736-3 Materials to which you were exposed in your work or daily life
63805-6 How long did you handle paints or solvents yourself?
67640-3 My teachers believe that I can do well in my school work

68,000+ registered users from 172 countries



LOINC is designed for Observations

It works equally well in HL7 v2, CDA, FHIR, or CDMs

```
{
  "resourceType": "Observation",
  "id": "body-height",
  "meta": {...},
  "text": {...},
  "status": "final",
  "category": [
    {
      "coding": [...],
      "text": "Vital Signs"
    }
  ],
  "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]"
  }
}
```

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

Structured Answer Lists

NORMATIVE ANSWER LIST ([LL1016-6](#))

Source: PROMIS

SEQ#	Answer	Code	Score	Answer ID
1	Never	1	1	LA6270-8
2	Rarely	2	2	LA10066-1
3	Sometimes	3	3	LA10082-8
4	Often	4	4	LA10044-8
5	Always	5	5	LA9933-8

LOINC Answer Lists

ID (contains "LL" prefix)

Can be defined as enumerated or pointers

Contains extra attributes about the package

LOINC Answers

ID (contains "LA" prefix)

String-based, not truly "concept" based

Have some mappings to external codes (e.g. SNOMED CT)



LOINC Distribution

Major releases twice per year

Many release artifacts

Online and desktop browser, API (via FHIR)

Documentation

You can download LOINC as the following combined file—or the various individual files referenced below.

LOINC and RELMA Complete Package

LOINC and RELMA Complete Download File
VERSION 2.64 AND 6.23 • RELEASED 2018-06-15 (2 MONTHS AGO)

578 MB
Compressed zip file containing the RELMA® program installer (Windows) and all of the core LOINC® files, including the LOINC® Table (all formats), documentation, and all accessory files.

LOINC and RELMA Files à la carte

LOINC Table

VERSION 2.64 AND 6.23
RELEASED 2018-06-15

The LOINC table contains fields for LOINC codes, each of the six parts of the formal code, LOINC synonyms, comments, and other information. It is distributed as a CSV format text file or a Microsoft Access database.

A release-to-release Change File and Change Reports are available. Documentation includes LOINC Release Notes and the comprehensive LOINC User's Guide.

[Download Options](#)

RELMA

VERSION 2.64 AND 6.23
RELEASED 2018-06-15

The Regenstrief LOINC Mapping Assistant (RELMA®) is a Microsoft Windows application for mapping LOINC codes to LOINC codes. Documentation includes RELMA Release Notes and a comprehensive RELMA Manual.

You can also read the complete description of [RELMA's features and requirements](#).

[Download Options](#)

Accessory Files

VERSION 2.64
RELEASED 2018-06-15

Other files in the LOINC distribution:

- LOINC Display Name File
- Hierarchy and Panel Structure Files
- Top 2000+ Results
- Top 300 Orders
- Common UCUM Codes
- Linguistic Variants File
- LOINC/SNOMED CT Expression Association and Map Sets (Technology Preview)
- LOINC/IEEE Medical Device Code Mapping Table
- LOINC Document Ontology
- LOINC/RSNA Radiology Playbook

[Download Options](#)

A small taste of LOINC





LOINC is famous for lab test content, but you still might not know about...

Newborn screening

Full set of terms, included in [HL7 IG Lab Results Interface \(LRI\)](#)

Genetic reporting

2000+ tests, including collections for structured reporting of simple variants, structural and copy number variants, complex variants, and pharmacogenomic studies. [PMID: [25656513](#)] See [HL7 LRI](#) and the developing [FHIR CG IG](#).

Orders

Not only single tests, but 1,000+ order panels and a consensus-vetted list of 1,500 order codes covering 95% of common volume. See loinc.org/usage/orders

Public health

Close work with CDC on emerging diseases and reportable conditions

Clinical Notes and Documents

2,700+ terms with a specialized structure

loinc.org/document-ontology

Radiology Procedures

Wonderful collaboration with RSNA [PMID: [29850823](https://pubmed.ncbi.nlm.nih.gov/29850823/)]

5,800 terms with rich metadata

loinc.org/radiology

Broad collection of other clinical variables

Vital signs

CDC's vital statistics forms (birth, death, etc)

CMS's patient assessment instruments

Nursing Assessments

Physical Therapy National Outcomes Database

NEMESIS and NTDS

ESRD variables

Chronic kidney disease management

Ophthalmology variables

Medical device measurements via IEEE 11073

ECG, PFT, spirometry, etc

...10,000+ assessment and patient reported outcome terms



Current U.S. Landscape

Brief Summary of LOINC Adoptions

HL7 v2 Lab Standards Quartet: LRI, LOI, ELR, eDOS

Observation Identifier (OBX-3) and Universal Service ID (OBR-4)

LOINC shall be used as the standard coding system for this field if an appropriate LOINC code exists, i.e., the LOINC concept is available in the LOINC database, accurately represents the observation, and has a status that allows its use...If a local coding system is in use, a local code should also be sent to help with identification of coding issues. When no valid LOINC exists the local code may be the only code sent.

Producer's Obs ID (OM1-2), Other Obs ID (OM1-7) Obs in an ordered test (OM5-2), Clinical Info Request (OMC-4)

The laboratory's local test code and coding system shall be used to identify the orderable test in its electronic Directory of Services. LOINC shall be used as the standard alternate vocabulary to identify an orderable test. The performing laboratory makes the determination of an applicable LOINC order code. When no applicable LOINC code exists, the local code may be the only code defined in the eDOS.

Argonaut Project FHIR IG / US Core IG

Data element query of the ONC Common Clinical Data Set and Document query

Observation.code

Each observation must have a LOINC code, if available. Other (e.g. local) codes allowed if no suitable LOINC exists

DocumentReference.Type, SmokingStatus Observation.Code, VitalSigns

All bound to value sets of LOINC codes

C-CDA 2.1*

Result Observation

5. **SHALL** contain exactly one [1..1] **code**, which **SHOULD** be selected from CodeSystem LOINC (urn:oid:2.16.840.1.113883.6.1) (CONF:1198-7133).
 - a. This code **SHOULD** be a code from the LOINC that identifies the result observation. If an appropriate LOINC code does not exist, then the local code for this result **SHALL** be sent (CONF:1198-19212).

Other uses

All Document type codes

All Section codes

Vital sign observations

ADL result type

Food and Nutrition and anthropometric variables

Skin and wound measurements

FDA

Requiring LOINC for lab test data in studies starting after 2020 (see [Data Standards Catalog](#))

Strong support of LOINC to identify IVD tests; helped inspire [LIVD](#)*

Broad vision towards using real-world evidence in post market surveillance

**also recommended by CLIAAC, now under ballot as FHIR IG*

Logical Observation Identifiers Names and Codes for *In Vitro* Diagnostic Tests

Guidance for Industry and Food and Drug Administration Staff

Document issued on June 15, 2018.

For questions about this document, contact the Digital Health Unit in the Office of the Center Director at (301) 796-6900 or email: DigitalHealth@fda.hhs.gov.



U.S. FOOD & DRUG
ADMINISTRATION

U.S. Department of Health and Human Services
Food and Drug Administration
Center for Devices and Radiological Health
Center for Biologics Evaluation and Research

CDC

Longtime users of LOINC: electronic lab reporting, case reporting, immunization messaging, National EMS Info System, National Trauma Data Standards, vital statistics, etc

CMS

Many eCQM definitions expressed with LOINC (per HITSC advice)

Under Impact Act 2014, all CMS-required patient assessment instruments are standardized in LOINC

Real world LOINC use (U.S.)



Reference labs have mapped observations

Orders are a work in progress

The big research networks use it in CDMs: OHDSI, PCORnet, Mini-Sentinel, etc.

PCORnet reports 94% LOINCed lab results in its network

On-the-wire coded results are widespread, but less frequent

Diameter Health (200+ orgs) reports 51% LOINC lab results

Emerging ecosystem of knowledge products leveraging LOINC

Smart on FHIR apps, Infobutton-powered decision support (UpToDate[®], MedlinePlus), etc

Recommendations

The background image is a dark, grayscale photograph of a person's hands writing on a document with a pen. The person is wearing a light-colored, long-sleeved shirt. In the background, a laptop and a tablet are visible on a desk. The overall scene suggests a professional or academic setting where recommendations are being written or reviewed.



Vocabulary standards grow
because *USERS* ask

(we don't need to invent more)

Medicine keeps evolving

If we're missing content, just ask: loinc.org/submissions

Interoperability low hanging fruit

Diagnostic imaging reports

C-CDA, FHIR, DICOM, and FHIR all support LOINC/RSNA Playbook. (It's also in ISA).

Other clinical measurements and observations

No special structures needed. Gestational age, body surface area, color of wound edge, PFT, etc...

Clinical notes

Argonaut is on it...

Patient reported outcomes measures, surveys, assessments

Lab orders

Harder because of order set proliferation, but LOI and eDOS exist. No MU requirements/incentives to use.

Upstream standardization is best

When IVD vendors identify standard codes, all the downstream consumers benefit.

LOINC and SNOMED CT Together

danielvreeaman.com/snomed

Recommendations:

Use LOINC for observations (orders and results).
Use SNOMED CT for observation values and assertions (e.g. problems)

Endorsed by both Regenstrief and SNOMED.

Caveat:

Use LOINC Answers for observation values in standardized assessments (nursing, PRO, etc) and other specialized/required strings. Will also need to accommodate other observation values: HGVS syntax, ISCN, ClinVar, star allele nomenclature, etc.

New tools for data aggregators

LOINC Groups

Roll-ups of equivalent LOINC codes for a specific purpose

Download and FHIR API based access available

Better display names for lab tests

Improved, unique, and more “user-friendly”

Still a work in progress

Happy LOINCing!

loinc.org

