LOINC and Other Coding Systems

Indy FHIR March 2018

LOINC History

Logical **O**bservation **I**dentifiers **N**ames and **C**odes

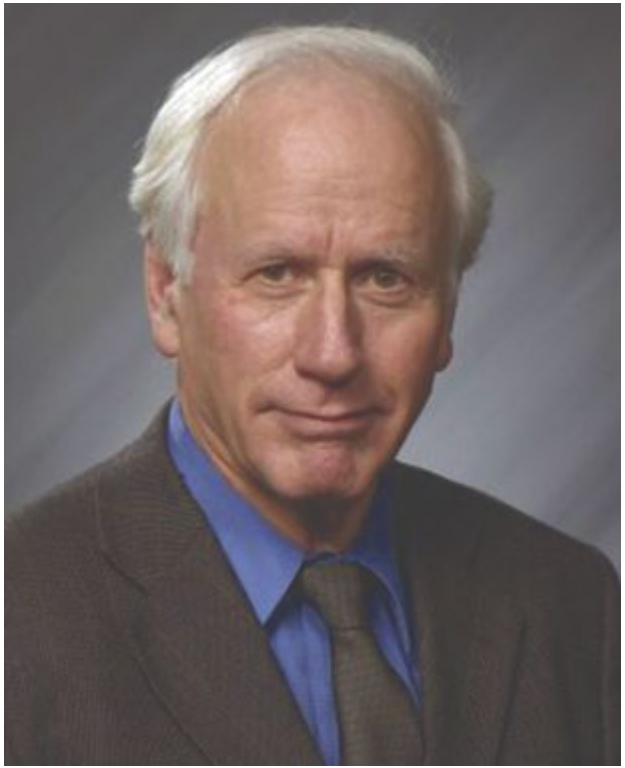
Started in 1994 by Clem J. McDonald, MD while at Regenstrief Institute

Developed into an International Standard

Committee formed early on.

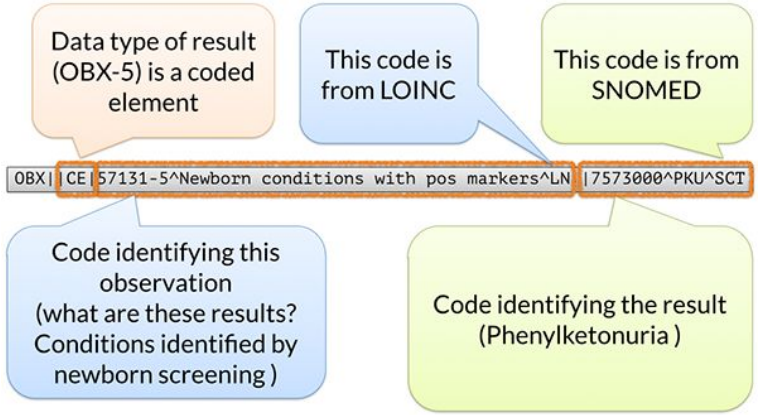
Formed to facilitate exchange of clinical laboratory and observational data results.

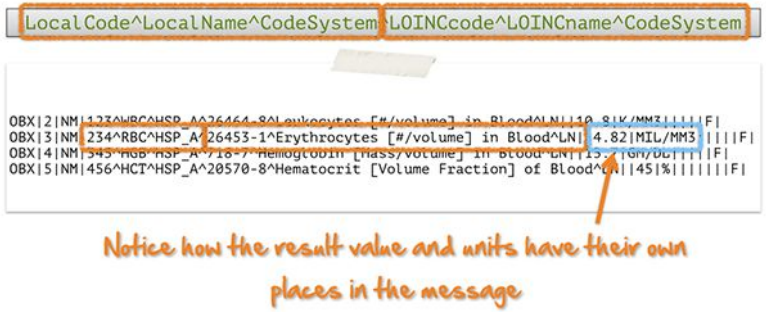
https://loinc.org/about/



LOINC Basics

- LOINC codes represent the “question” for a test or measurement
- Other coding systems provide the Qualitative Answers
  - Such as SNOMED CT
- Standard FHIR Coding System for Observations and Laboratory Results http://hl7.org/fhir/us/core/StructureDefinition-us-core-observationresults.html
- LOINC also provides some “answers” such as survey answers link Smoking Status





LOINC Parts

LOINC Parts:

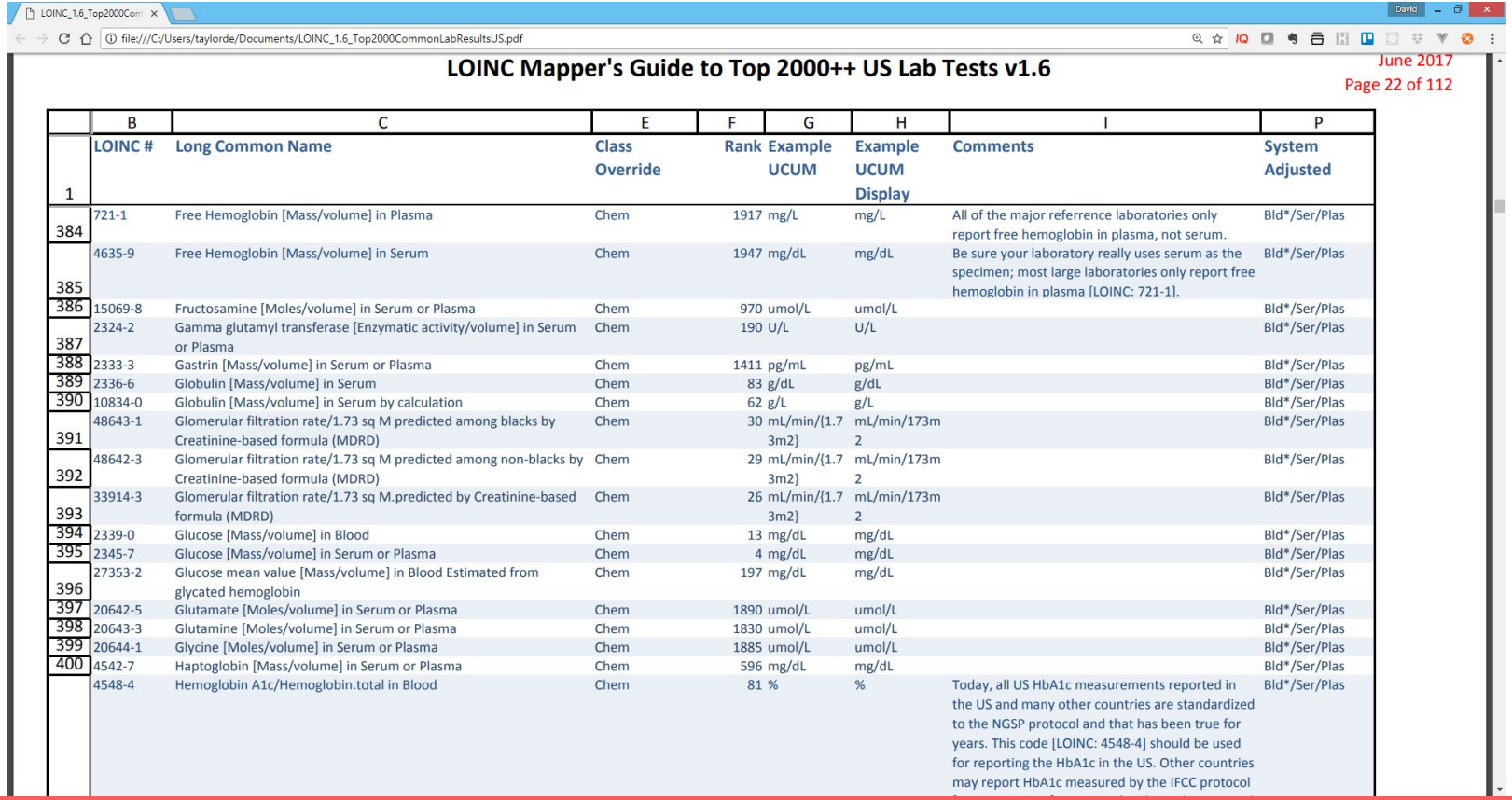
COMPONENT (ANALYTE) - The substance or entity being measured or observed.
PROPERTY - The characteristic or attribute of the analyte.
TIME - The interval of time over which an observation was made.
SYSTEM (SPECIMEN) - The specimen or thing upon which the observation was made.
SCALE -How the observation 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 Example

COMPONENT (ANALYTE) - Leukocytes (white blood cells)
PROPERTY - NCnc (Number concentration)
TIME - Pt (Point in time)
SYSTEM (SPECIMEN) - CSF (Cerebral spinal fluid)
SCALE - Qn (Quantitative)
METHOD - Manual Count

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

Screen Shot from Loinc Common Codes PDF



LOINC_1.6_Top2000Com

file:///C:/Users/taylorde/Documents/LOINC_1.6_Top2000CommonLabResultsUS.pdf

LOINC Mapper's Guide to Top 2000++ US Lab Tests v1.6

	B	C	E	F	G	H	I	P
1	LOINC #	Long Common Name	Class Override	Rank	Example UCUM	Example UCUM Display	Comments	System Adjusted
384	721-1	Free Hemoglobin [Mass/volume] in Plasma	Chem	1917	mg/L	mg/L	All of the major referrence laboratories only report free hemoglobin in plasma, not serum.	Bld*/Ser/Plas
385	4635-9	Free Hemoglobin [Mass/volume] in Serum	Chem	1947	mg/dL	mg/dL	Be sure your laboratory really uses serum as the specimen; most large laboratories only report free hemoglobin in plasma [LOINC: 721-1].	Bld*/Ser/Plas
386	15069-8	Fructosamine [Moles/volume] in Serum or Plasma	Chem	970	umol/L	umol/L		Bld*/Ser/Plas
387	2324-2	Gamma glutamyl transferase [Enzymatic activity/volume] in Serum or Plasma	Chem	190	U/L	U/L		Bld*/Ser/Plas
388	2333-3	Gastrin [Mass/volume] in Serum or Plasma	Chem	1411	pg/mL	pg/mL		Bld*/Ser/Plas
389	2336-6	Globulin [Mass/volume] in Serum	Chem	83	g/dL	g/dL		Bld*/Ser/Plas
390	10834-0	Globulin [Mass/volume] in Serum by calculation	Chem	62	g/L	g/L		Bld*/Ser/Plas
391	48643-1	Glomerular filtration rate/1.73 sq M predicted among blacks by Creatinine-based formula (MDRD)	Chem	30	mL/min/{1.73m2}	mL/min/173m2		Bld*/Ser/Plas
392	48642-3	Glomerular filtration rate/1.73 sq M predicted among non-blacks by Creatinine-based formula (MDRD)	Chem	29	mL/min/{1.73m2}	mL/min/173m2		Bld*/Ser/Plas
393	33914-3	Glomerular filtration rate/1.73 sq M.predicted by Creatinine-based formula (MDRD)	Chem	26	mL/min/{1.73m2}	mL/min/173m2		Bld*/Ser/Plas
394	2339-0	Glucose [Mass/volume] in Blood	Chem	13	mg/dL	mg/dL		Bld*/Ser/Plas
395	2345-7	Glucose [Mass/volume] in Serum or Plasma	Chem	4	mg/dL	mg/dL		Bld*/Ser/Plas
396	27353-2	Glucose mean value [Mass/volume] in Blood Estimated from glycated hemoglobin	Chem	197	mg/dL	mg/dL		Bld*/Ser/Plas
397	20642-5	Glutamate [Moles/volume] in Serum or Plasma	Chem	1890	umol/L	umol/L		Bld*/Ser/Plas
398	20643-3	Glutamine [Moles/volume] in Serum or Plasma	Chem	1830	umol/L	umol/L		Bld*/Ser/Plas
399	20644-1	Glycine [Moles/volume] in Serum or Plasma	Chem	1885	umol/L	umol/L		Bld*/Ser/Plas
400	4542-7	Haptoglobin [Mass/volume] in Serum or Plasma	Chem	596	mg/dL	mg/dL		Bld*/Ser/Plas
	4548-4	Hemoglobin A1c/Hemoglobin.total in Blood	Chem	81	%	%	Today, all US HbA1c measurements reported in the US and many other countries are standardized to the NGSP protocol and that has been true for years. This code [LOINC: 4548-4] should be used for reporting the HbA1c in the US. Other countries may report HbA1c measured by the IFCC protocol	Bld*/Ser/Plas

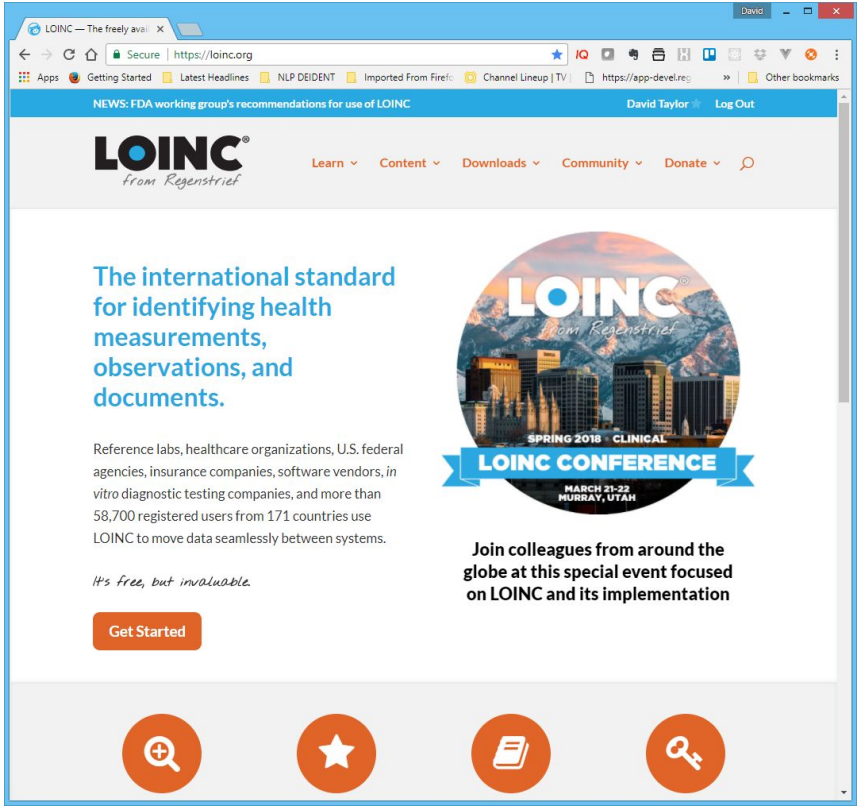
A1C Loinc Code

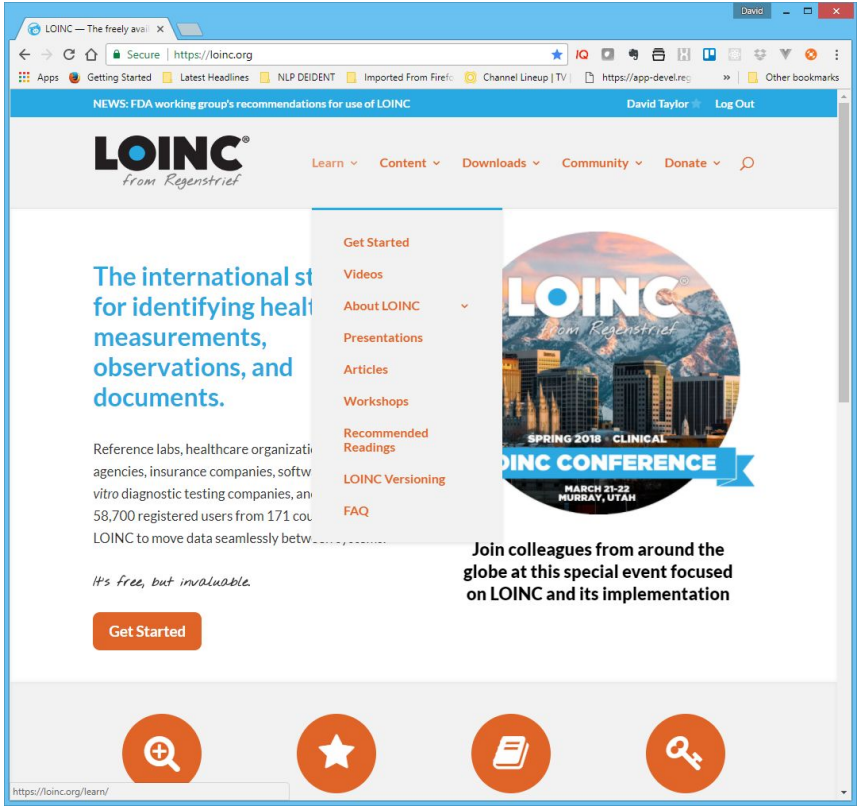
Code	Long Common Name	Class	Rank	UCUM / Display	
4548-4	Hemoglobin **A1c**/Hemoglobin.total in Blood	Chem	81	%	%

Today, all US HbA1c measurements reported in the US and many other countries are standardized to the NGSP protocol and that has been true for years. This code [LOINC: 4548-4] should be used for reporting the HbA1c in the US. Other countries may report HbA1c measured by the IFCC protocol [LOINC: 59261-8], a protocol with results reported in units of mmol/mol. In Japan and parts of Spain it may be measured using the Japanese protocol. All three protocols produce different numeric values

System(Specimen) = Bld*/Ser/Plas

LOINC.org Website Overview



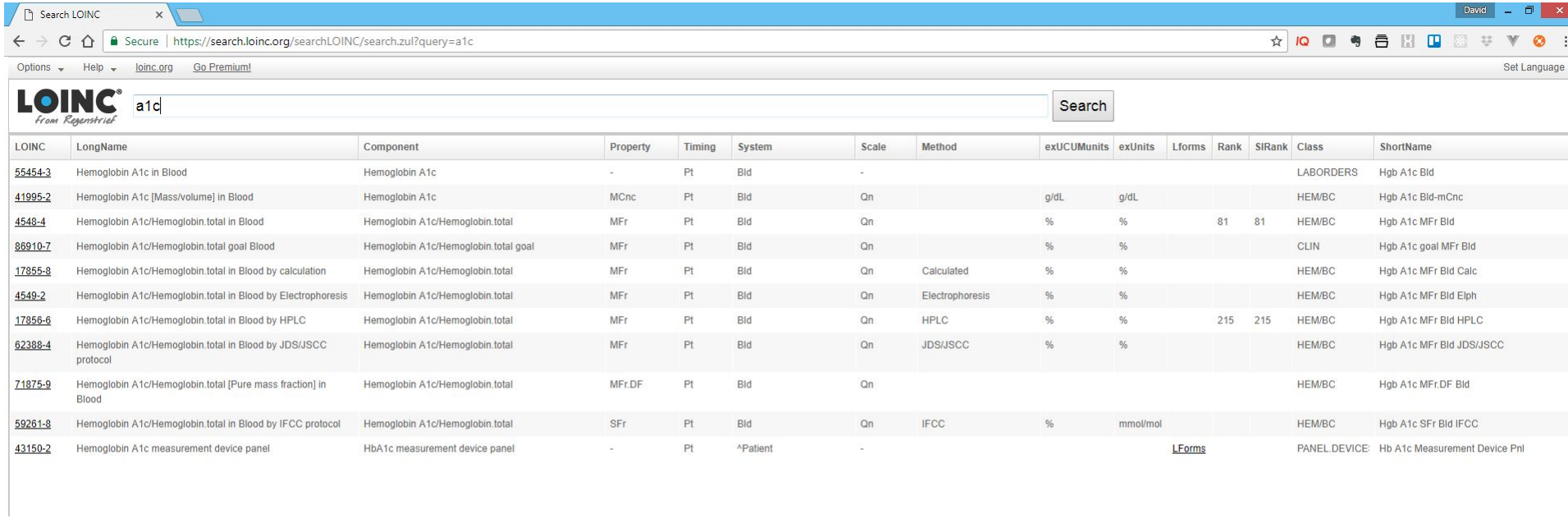


LOINC Key Downloads and Tools

- LOINC User Guide
  https://loinc.org/download/loinc-users-guide/
- LOINC Top 2000 Lab Results - 98% of used codes
  https://loinc.org/usage/obs/
- LOINC Top 300 Orders - 95% of used codes
  https://loinc.org/usage/orders/
- LOINC Relma Tool - Search, etc. for Windows
  https://loinc.org/downloads/relma/
- LOINC Accessory Files
  https://loinc.org/downloads/accessory-files/

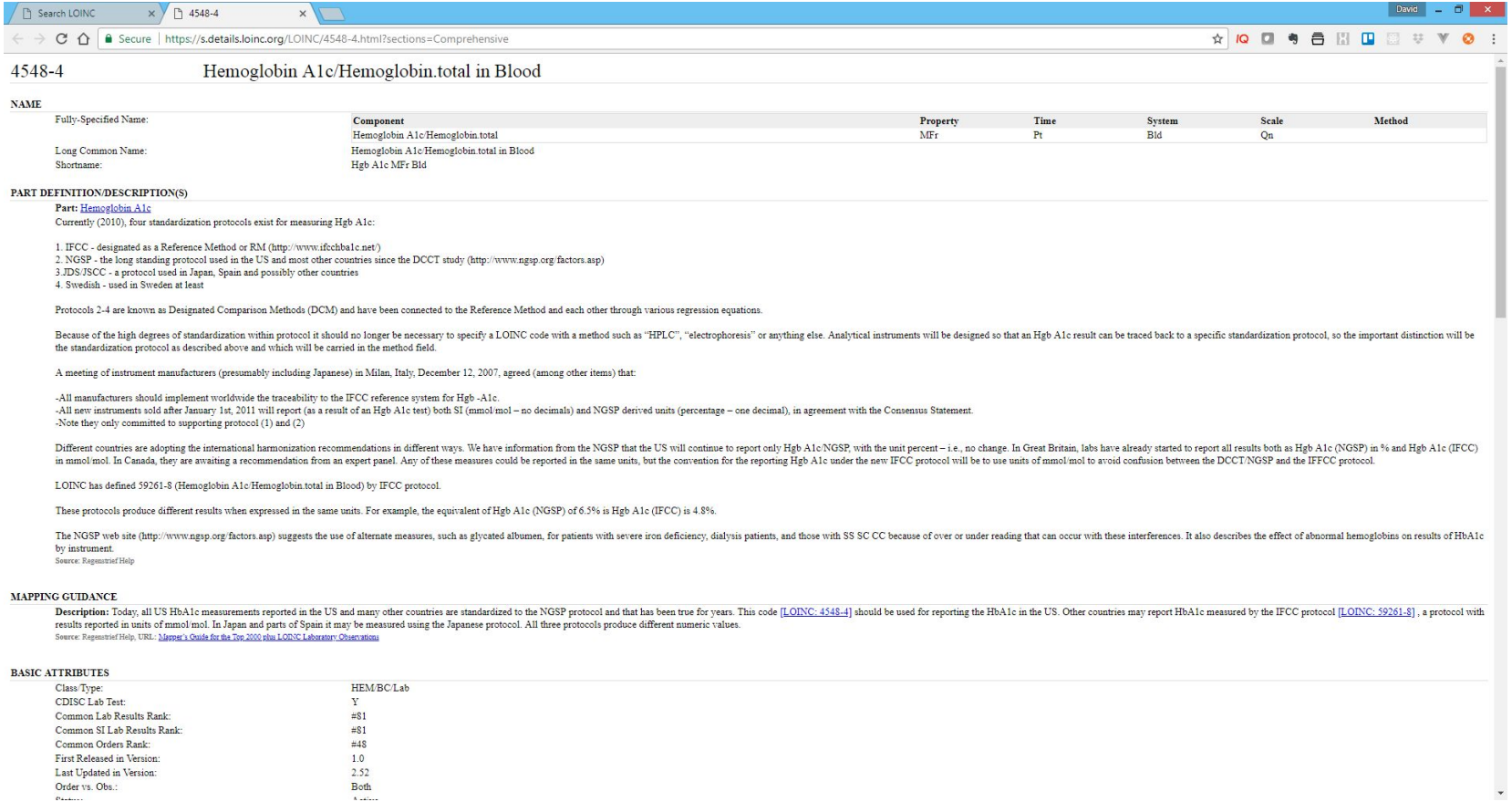
LOINC Search

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



LOINC	LongName	Component	Property	Timing	System	Scale	Method	exUCUMunits	exUnits	Lforms	Rank	SIRank	Class	ShortName
55454-3	Hemoglobin A1c in Blood	Hemoglobin A1c	-	Pt	Bld	-							LABORDERS	Hgb A1c Bld
41995-2	Hemoglobin A1c [Mass/volume] in Blood	Hemoglobin A1c	MCnc	Pt	Bld	Qn		g/dL	g/dL				HEM/BC	Hgb A1c Bld-mCnc
4548-4	Hemoglobin A1c/Hemoglobin.total in Blood	Hemoglobin A1c/Hemoglobin.total	MFr	Pt	Bld	Qn		%	%		81	81	HEM/BC	Hgb A1c MFr Bld
86910-7	Hemoglobin A1c/Hemoglobin.total goal Blood	Hemoglobin A1c/Hemoglobin.total goal	MFr	Pt	Bld	Qn		%	%				CLIN	Hgb A1c goal MFr Bld
17855-8	Hemoglobin A1c/Hemoglobin.total in Blood by calculation	Hemoglobin A1c/Hemoglobin.total	MFr	Pt	Bld	Qn	Calculated	%	%				HEM/BC	Hgb A1c MFr Bld Calc
4549-2	Hemoglobin A1c/Hemoglobin.total in Blood by Electrophoresis	Hemoglobin A1c/Hemoglobin.total	MFr	Pt	Bld	Qn	Electrophoresis	%	%				HEM/BC	Hgb A1c MFr Bld Elph
17856-6	Hemoglobin A1c/Hemoglobin.total in Blood by HPLC	Hemoglobin A1c/Hemoglobin.total	MFr	Pt	Bld	Qn	HPLC	%	%		215	215	HEM/BC	Hgb A1c MFr Bld HPLC
62388-4	Hemoglobin A1c/Hemoglobin.total in Blood by JDS/JSCC protocol	Hemoglobin A1c/Hemoglobin.total	MFr	Pt	Bld	Qn	JDS/JSCC	%	%				HEM/BC	Hgb A1c MFr Bld JDS/JSCC
71875-9	Hemoglobin A1c/Hemoglobin.total [Pure mass fraction] in Blood	Hemoglobin A1c/Hemoglobin.total	MFr.DF	Pt	Bld	Qn							HEM/BC	Hgb A1c MFr.DF Bld
59261-8	Hemoglobin A1c/Hemoglobin.total in Blood by IFCC protocol	Hemoglobin A1c/Hemoglobin.total	SFr	Pt	Bld	Qn	IFCC	%	mmol/mol				HEM/BC	Hgb A1c SFr Bld IFCC
43150-2	Hemoglobin A1c measurement device panel	HbA1c measurement device panel	-	Pt	^Patient	-				LForms			PANEL.DEVICE	Hb A1c Measurement Device Pnl

LOINC Search Details



Search LOINC | 4548-4 | David

Secure | https://s.details.loinc.org/LOINC/4548-4.html?sections=Comprehensive

4548-4 Hemoglobin A1c/Hemoglobin.total in Blood

NAME

	Component	Property	Time	System	Scale	Method
Fully-Specified Name:	Hemoglobin A1c/Hemoglobin.total	MFr	Pt	Bld	Qn	
Long Common Name:	Hemoglobin A1c/Hemoglobin.total in Blood					
Shortname:	Hgb A1c MFr Bld					

PART DEFINITION/DESCRIPTION(S)

Part: Hemoglobin A1c

Currently (2010), four standardization protocols exist for measuring Hgb A1c:

1. IFCC - designated as a Reference Method or RM (http://www.ifcchba1c.net/)
2. NGSP - the long standing protocol used in the US and most other countries since the DCCT study (http://www.ngsp.org/factors.asp)
3.JDS/JSCC - a protocol used in Japan, Spain and possibly other countries
4. Swedish - used in Sweden at least

Protocols 2-4 are known as Designated Comparison Methods (DCM) and have been connected to the Reference Method and each other through various regression equations.

Because of the high degrees of standardization within protocol it should no longer be necessary to specify a LOINC code with a method such as "HPLC", "electrophoresis" or anything else. Analytical instruments will be designed so that an Hgb A1c result can be traced back to a specific standardization protocol, so the important distinction will be the standardization protocol as described above and which will be carried in the method field.

A meeting of instrument manufacturers (presumably including Japanese) in Milan, Italy, December 12, 2007, agreed (among other items) that:

-All manufacturers should implement worldwide the traceability to the IFCC reference system for Hgb -A1c.
-All new instruments sold after January 1st, 2011 will report (as a result of an Hgb A1c test) both SI (mmol/mol – no decimals) and NGSP derived units (percentage – one decimal), in agreement with the Consensus Statement.
-Note they only committed to supporting protocol (1) and (2)

Different countries are adopting the international harmonization recommendations in different ways. We have information from the NGSP that the US will continue to report only Hgb A1c/NGSP, with the unit percent – i.e., no change. In Great Britain, labs have already started to report all results both as Hgb A1c (NGSP) in % and Hgb A1c (IFCC) in mmol/mol. In Canada, they are awaiting a recommendation from an expert panel. Any of these measures could be reported in the same units, but the convention for the reporting Hgb A1c under the new IFCC protocol will be to use units of mmol/mol to avoid confusion between the DCCT/NGSP and the IFFCC protocol.

LOINC has defined 59261-8 (Hemoglobin A1c/Hemoglobin.total in Blood) by IFCC protocol.

These protocols produce different results when expressed in the same units. For example, the equivalent of Hgb A1c (NGSP) of 6.5% is Hgb A1c (IFCC) is 4.8%.

The NGSP web site (http://www.ngsp.org/factors.asp) suggests the use of alternate measures, such as glycated albumen, for patients with severe iron deficiency, dialysis patients, and those with SS SC CC because of over or under reading that can occur with these interferences. It also describes the effect of abnormal hemoglobins on results of HbA1c by instrument.

Source: Regenstrief Help

MAPPING GUIDANCE

Description: Today, all US HbA1c measurements reported in the US and many other countries are standardized to the NGSP protocol and that has been true for years. This code [LOINC: 4548-4] should be used for reporting the HbA1c in the US. Other countries may report HbA1c measured by the IFCC protocol [LOINC: 59261-8] , a protocol with results reported in units of mmol/mol. In Japan and parts of Spain it may be measured using the Japanese protocol. All three protocols produce different numeric values.

Source: Regenstrief Help, URL: Mapper's Guide for the Top 2000 plus LOINC Laboratory Observations

BASIC ATTRIBUTES

Class/Type:	HEM/BC/Lab
CDISC Lab Test:	Y
Common Lab Results Rank:	#81
Common SI Lab Results Rank:	#81
Common Orders Rank:	#48
First Released in Version:	1.0
Last Updated in Version:	2.52
Order vs. Obs.:	Both
Status:	Active

UCUM - Unified Code for Units of Measure

- Another FHIR Specified Coding Standard
- Managed by the same group at Regenstrief that manages LOINC
- Provides a standard specification for Units of Measure
- Used in the standard FHIR Profiles
  - http://hl7.org/fhir/us/core/StructureDefinition-us-core-observationresults.html
- http://unitsofmeasure.org/trac
- UCUM is based on the ISO 80000: 2009 Quantities and Units standards
- Specification: http://unitsofmeasure.org/ucum.html
-

Examples of UCOM Units

unit term	suggested alternatives	name or "reading"
/[arb'U]		per arbitrary unit
/[HPF]		per high power field
/[iU]		per international unit
/{tot}		per total count
/g{creat}	/g	per gram of creatinine
/g{HGB}	/g	per gram of hemoglobin
/g{tot'nit}	/g	per gram of total nitrogen
/g{tot'ptot}	/g	per gram of total protein
/g{wet'tis}	/g	per gram of wet tissue
/kg		per kilogram
/kg{body'wt}	/kg	per kilogram body weight
/L		per liter
/m3		per square meter
/min		per minute
/mL		per milliliter

SNOMED CT -

Systematized Nomenclature of Medicine -- Clinical Terms

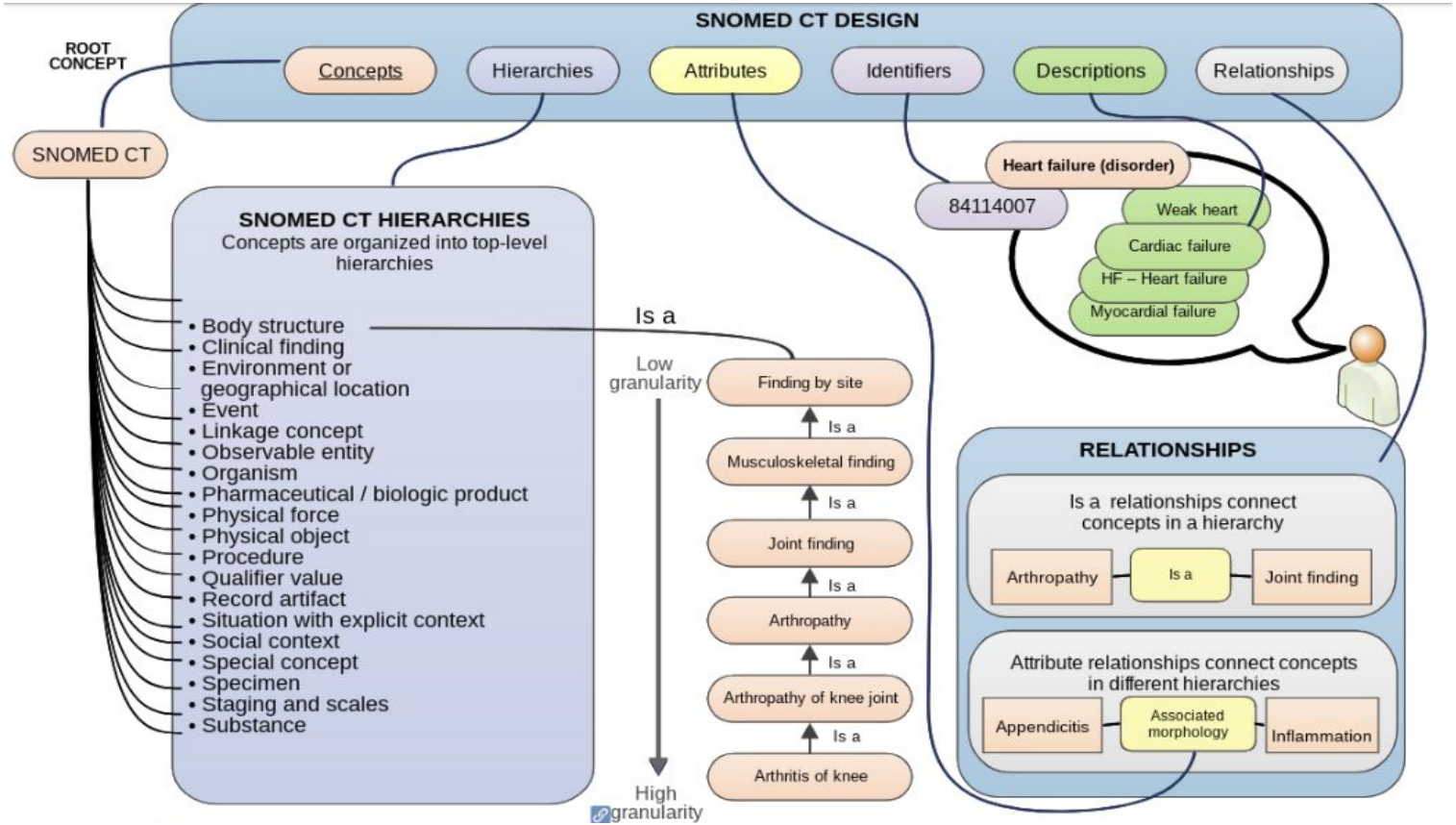
https://www.snomed.org/snomed-ct

In FHIR typically used to specify

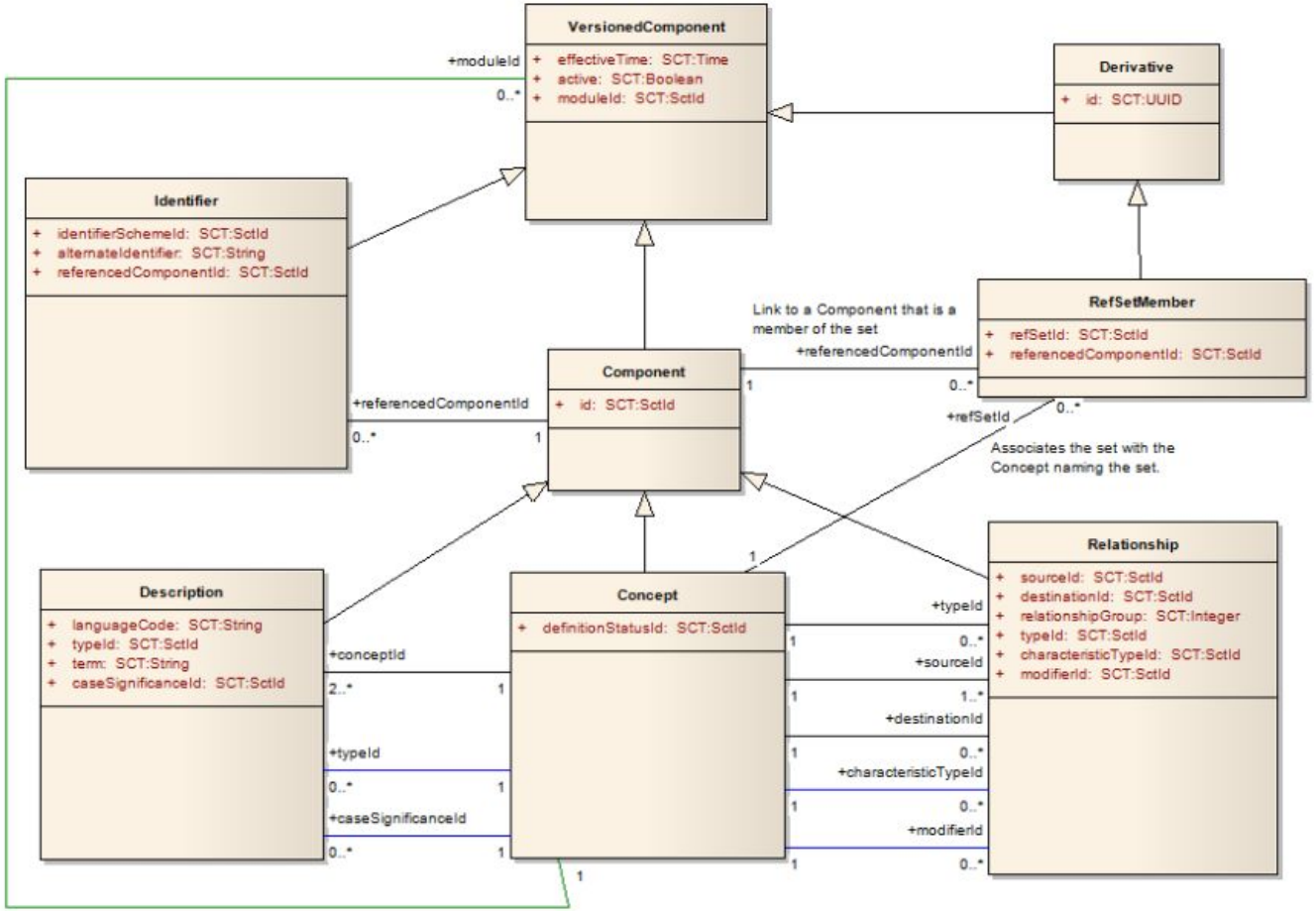
- Observation “Answers”
- Conditions

- Included in the UMLS

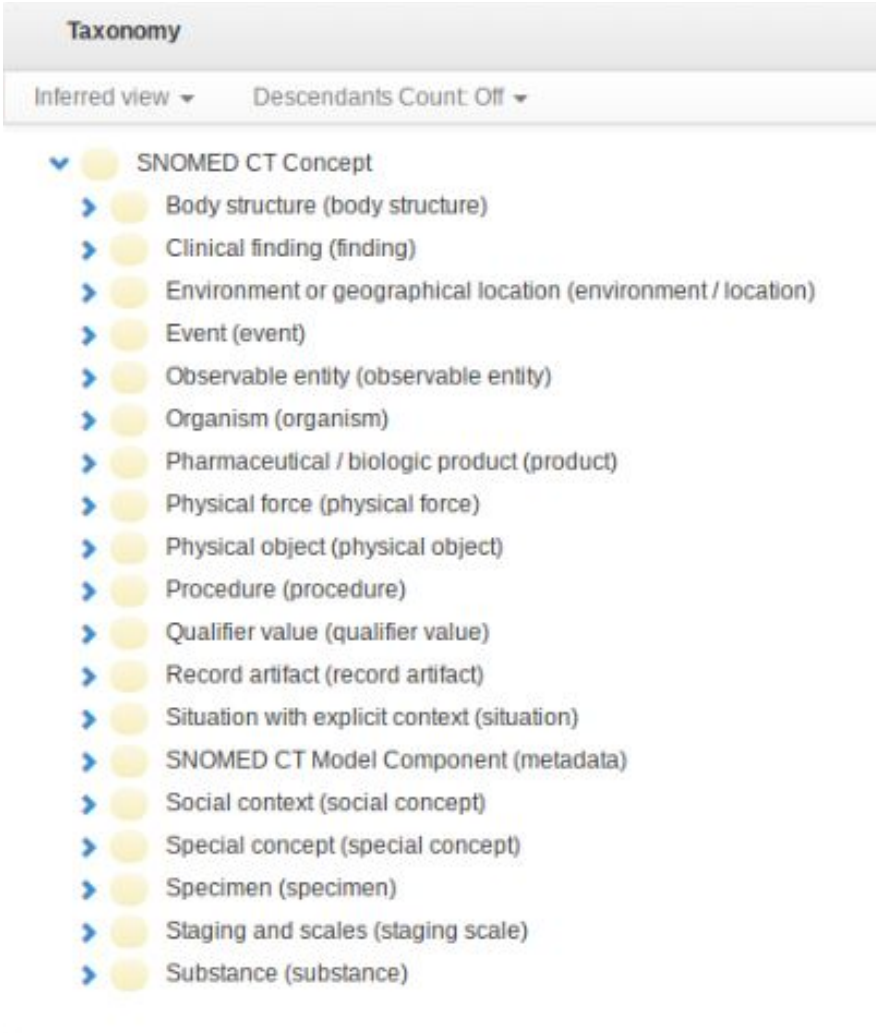
Snomed CT Heirarchy



Snomed CT Model



Snomed CT Code Hierarchy - Top Level



Snomed CT Code Hierarchy - Example

More info on Snomed CT

Training: https://elearning.ihtsdotools.org/

Documentation: https://confluence.ihtsdotools.org/display/DOC

Starter Guide: https://confluence.ihtsdotools.org/display/DOC

Browse: http://browser.ihtsdotools.org

FHIR STU3 (3.0.1) Overview

- http://hl7.org/fhir/stu3/index.html
- Resource Type Change Examples
  - MedicationOrder->MedicationRequest
  - Actor + BehalfOf, what was just a single reference before are now multiple attributes grouped together
- Overview of STU3 resources, etc.
-

DSTU2 to STU3 mappings

Example: http://hl7.org/fhir/stu3/referralrequest.html

Comprehensive Difference: http://hl7.org/fhir/stu3/diff.html

FHIR Mapping Language Specification: http://hl7.org/fhir/stu3/diff.html