HL7® FHIR® DevDays

JUNE | 2023

Introduction to SNOMED with FHIR

Peter G. Williams

HL7 FHIR DevDays 2023 | Hybrid Edition, Amsterdam | June 6–9, 2023 | @HL7 | @FirelyTeam | #fhirdevdays | www.devdays.com

ORGANIZED BY firely | HL7 International

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- SNOMED International

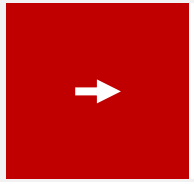
SNOMED International

Leading healthcare terminology, worldwide

What is SNOMED CT & Why is it Great?

- Comprehensive
- Computable
- Variable granularity

- The most comprehensive & precise clinical terminology in the world
- Structured & controlled clinical vocabulary
- Ontology, directed acyclic graph, polyhierarchy
- Self describing
- Modeling controlled by the MRCM - Machine Readable Concept Model

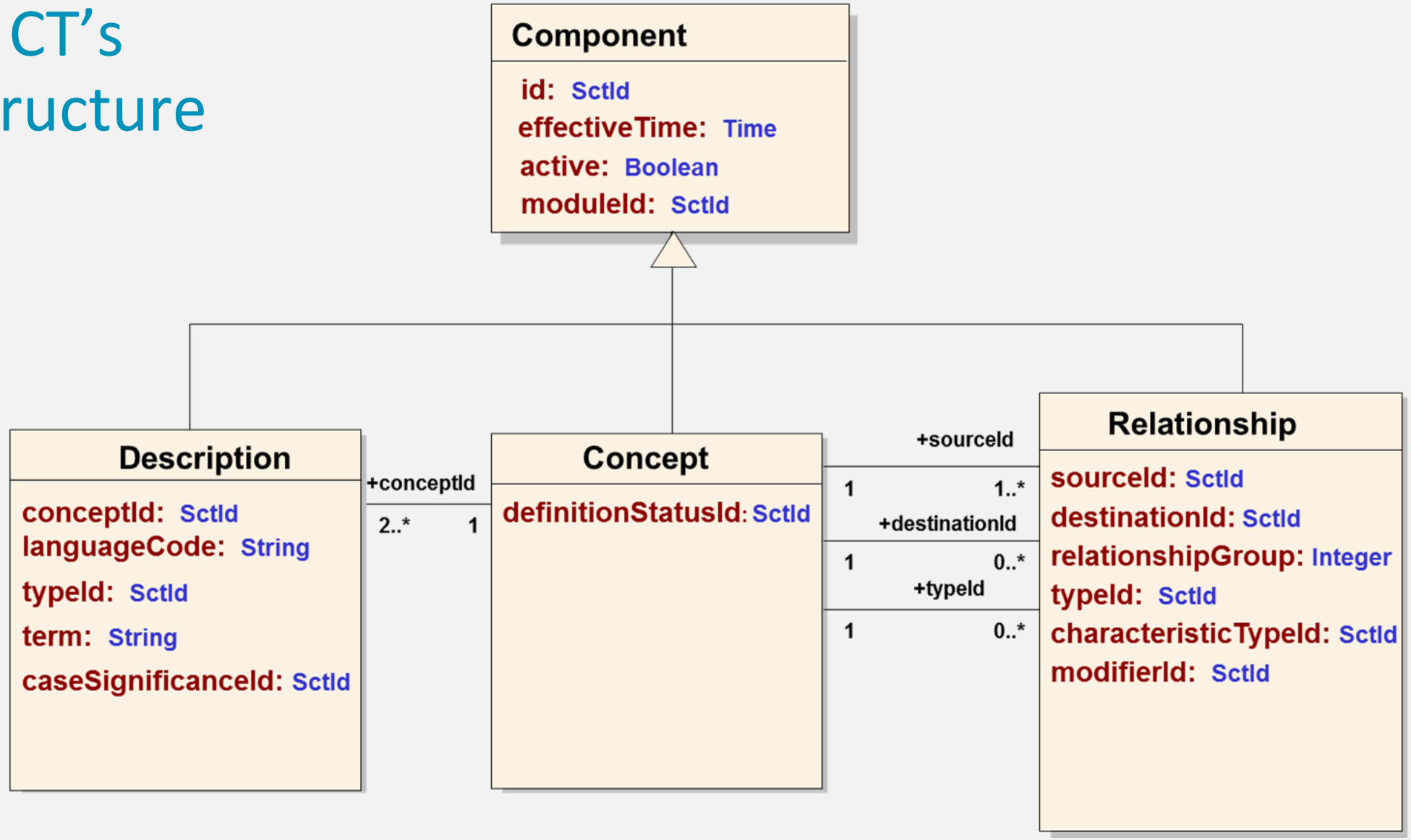


To learn more visit:
http://snomed.org

Learning Objectives

- Appreciate how terminology and information models work together
- Understand the logical structure of SNOMED CT
- Gain understanding of what SNOMED Expression Constraint Language is, and how it reduces maintenance of FHIR ValueSets
- Know that implicit ValueSets can build context sensitive, performant FHIR enabled applications

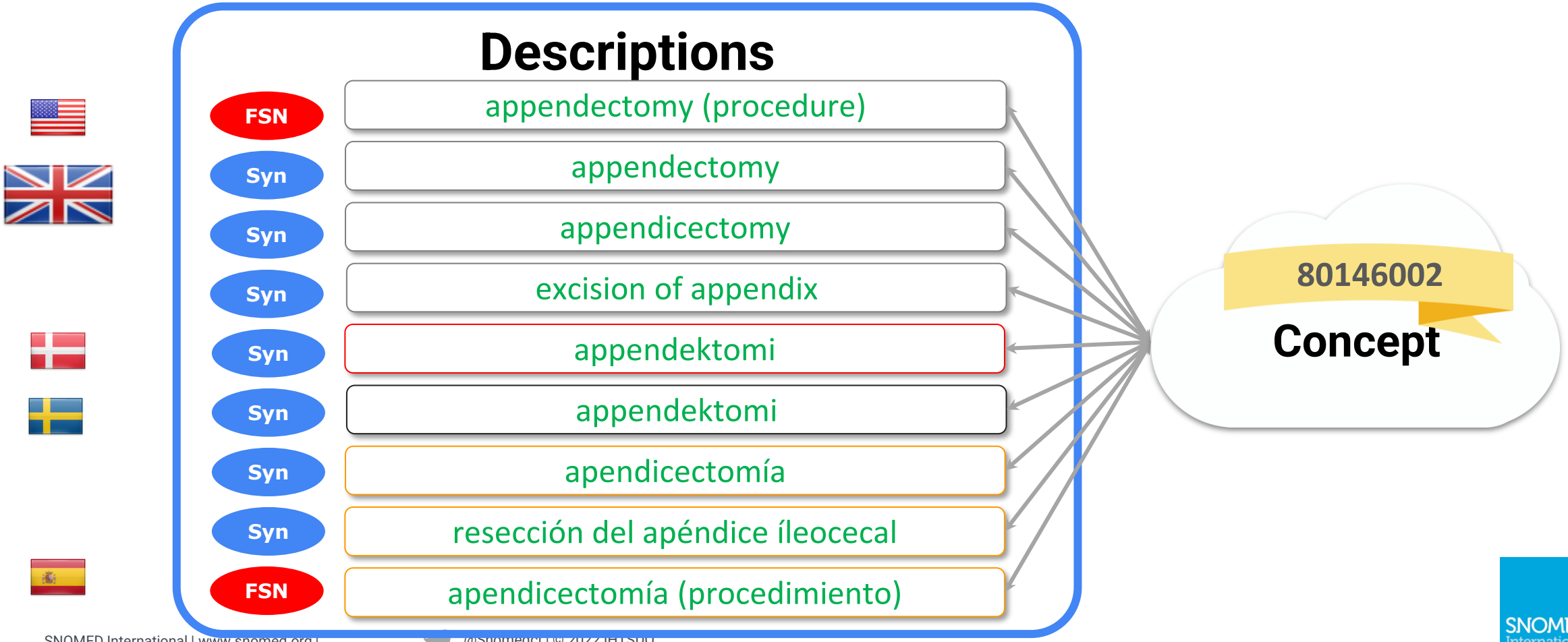
SNOMED CT's Logical Structure



- Concepts are the central components of SNOMED CT
- A SNOMED CT Concept is a clinical idea associated with a unique identifier
  - The meaning is specified by an association with a term known as the fully specified name (FSN)
  - The link between the identifier and the meaning of that clinical idea is permanent and unchangeable

Description Acceptability and Preferences

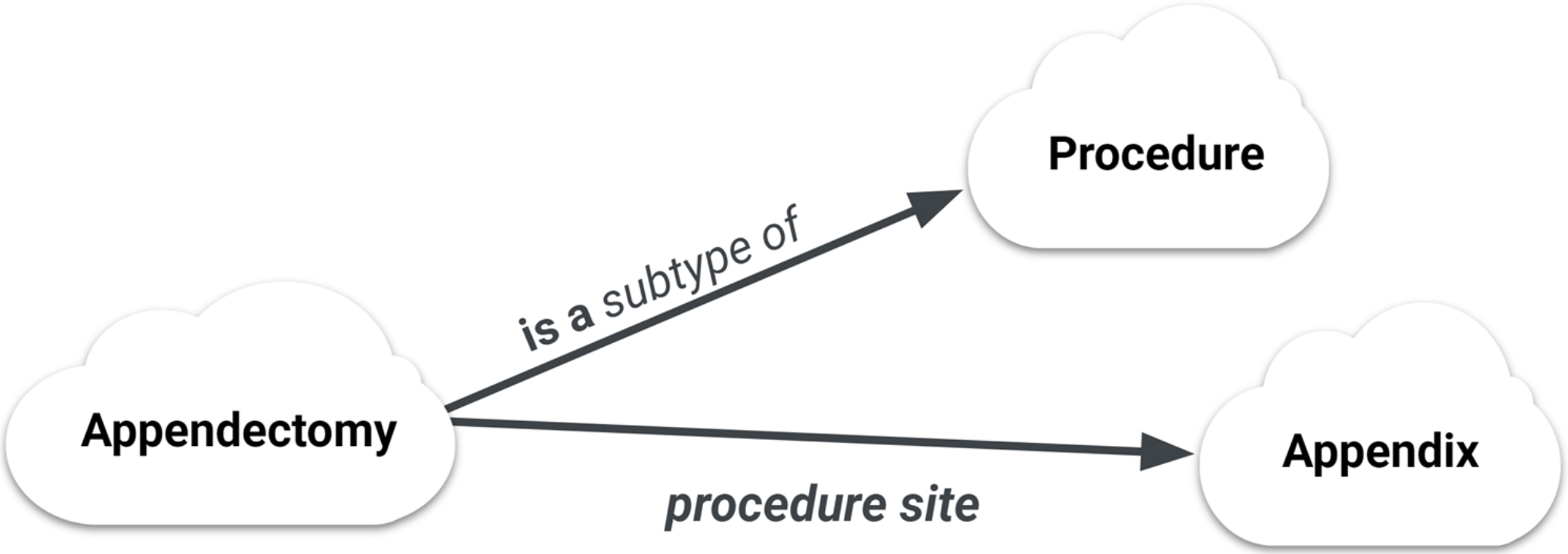
Language or dialect *acceptability* and *preferences* for particular terms are specified (in “Language Refsets”)



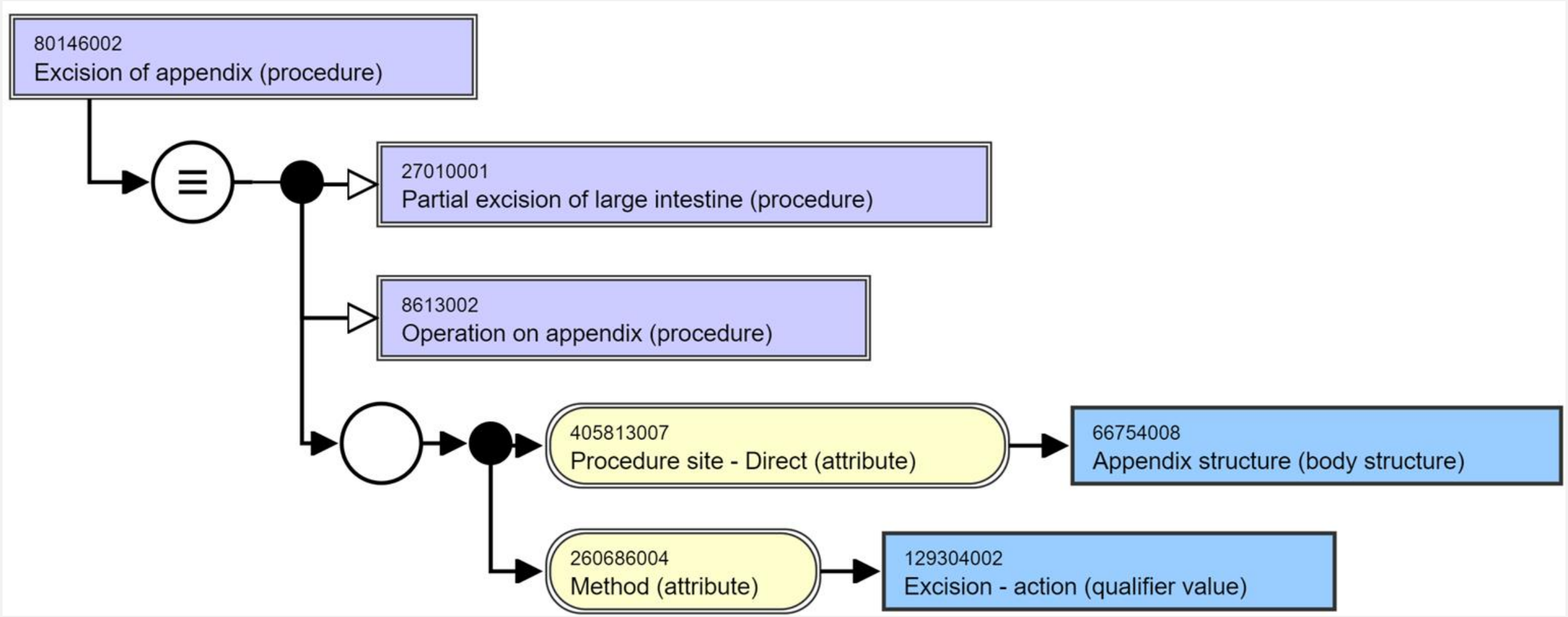
@SNOMEDCT | © 2022 IHTSDO

Relationships

- Concept triple - source, type, target
- Express defining characteristics & can be grouped together



Attributes


80146002
Excision of appendix (procedure)
≡
27010001
Partial excision of large intestine (procedure)
8613002
Operation on appendix (procedure)
405813007
Procedure site - Direct (attribute)
66754008
Appendix structure (body structure)
260686004
Method (attribute)
129304002
Excision - action (qualifier value)

SNOMED CT Reference Sets

- Simple Refset (subset, valueset)
- Simple Map
  - Attribute Value Refset
  - Association Refset
  - Language Refset
- Complex Map (extra rules eg ICD-10)

Expression Constraint Language (ECL)

Symbol	Meaning
<	Descendants Of
<<	Descendants and Self
: , =	Where, Having Value
^	Member Of
*	Any
MINUS, AND, OR, ( )	Logical Operations

ECL Example

```
< 763158003 |Medicinal product (product)| :
    << 762951001 |Has ingredient (attribute)| =
          255641001 |Caffeine (substance)|,
   732946004 |Has presentation strength denominator
  value (attribute)| = *
```

The Snowstorm Terminology Server

SNOWSTORM
by SNOMED International

- https://github.com/IHTSDO/snowstorm
- Build initially for SI's Authoring and Browser Applications
- Now supports other code systems!
- Scalable storage using Elasticsearch
- Platform agnostic Java implementation
- Open source Apache 2.0 license
- See also https://github.com/IHTSDO/snowstorm-x

NB Snowstorm is not commercially supported

Task Title:

INFRA-6803 fix for active lang refset on inactive desc

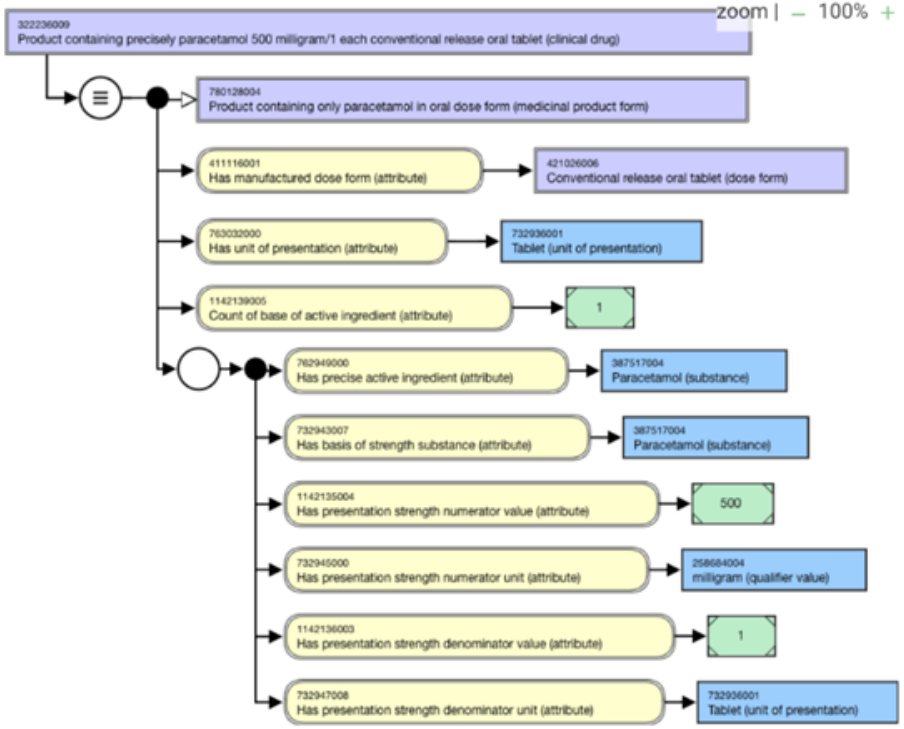
Task Details:

- Edit Task Details
- Classify
- Validate
- Submit For Review
- Promote This Task to the Project
- Begin Promotion Automation

Product containing precisely paracetamol 500 milligram/1 each conventional release oral tablet (clinical drug)

Stated | Inferred | AF

zoom | – 100% +



Product containing precisely paracetamol 500 milligram/1 each conventional release oral tablet (clinical drug)

ci	Product containing precisely paracetamol 500 milligram/1 each conventional release oral tablet (clinical drug)	FSN	us:P	gb:P
ci	Acetaminophen 500 mg oral tablet	SYN	us:P	gb:A
ci	Paracetamol 500 mg oral tablet	SYN	us:A	gb:P

Axiom

Is a	Medicinal product (product)
Has manufactured dose form	Conventional release oral tablet (dose form)
Has unit of presentation	Tablet (unit of presentation)
Count of base of active ingredient	1
Has precise active ingredient	Paracetamol (substance)
Has basis of strength substance	Paracetamol (substance)
Has presentation strength numerator value	500
Has presentation strength numerator unit	milligram (qualifier value)
Has presentation strength denominator value	1
Has presentation strength denominator unit	Tablet (unit of presentation)

+1 Add Group

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Raise an Issue

Using SNOMED CT with FHIR (and Snowstorm)

- Terminology Resources with Operations particular to SNOMED CT

CodeSystem	ValueSet	ConceptMap
$lookup	Implicit ValueSets	$translate
$validate-code	$validate-code	
$subsumes	$expand	

CodeSystem - $lookup

…/CodeSystem/$lookup?system=http://snomed.info/sct&code=840539006

…/CodeSystem/$lookup?code=840539006&
system=http://snomed.info/sct&
version=http://snomed.info/sct/900000000000207008/version/20190731

…/CodeSystem/$lookup?code=322236009
&system=http://snomed.info/sct&property=normalForm

```
- {
    name: "property",
  - part: [
      - {
            name: "code",
            valueString: "normalForm"
        },
      - {
            name: "valueString",
            valueString: "780128004|Product containing only paracetamol in oral dose form
            (medicinal product form)| : 411116001|Has manufactured dose form (attribute)| =
            421026006|Conventional release oral tablet (dose form)|, 763032000|Has unit of
            presentation (attribute)| = 732936001|Tablet (unit of presentation)|,
            1142139005|Count of base of active ingredient (attribute)| = #1, { 762949000|Has
            precise active ingredient (attribute)| = 387517004|Paracetamol (substance)|,
            732943007|Has basis of strength substance (attribute)| = 387517004|Paracetamol
            (substance)|, 1142135004|Has presentation strength numerator value (attribute)| =
            #500, 732945000|Has presentation strength numerator unit (attribute)| =
            258684004|milligram (qualifier value)|, 1142136003|Has presentation strength
            denominator value (attribute)| = #1, 732947008|Has presentation strength denominator
            unit (attribute)| = 732936001|Tablet (unit of presentation)| }"
        }
    ]
},
```

Cross Edition Lookups

http://snomed.info/id/443971000124108?_format=fhir

ValueSet - $expand

…/ValueSet/allergyintolerance-code/$expand?
force-system-version=http://snomed.info/sct|http://snomed.info/sct/45991000052106&
displayLanguage=sv,en&
filter=pollen

Implicit ValueSets

Procedures on the heart

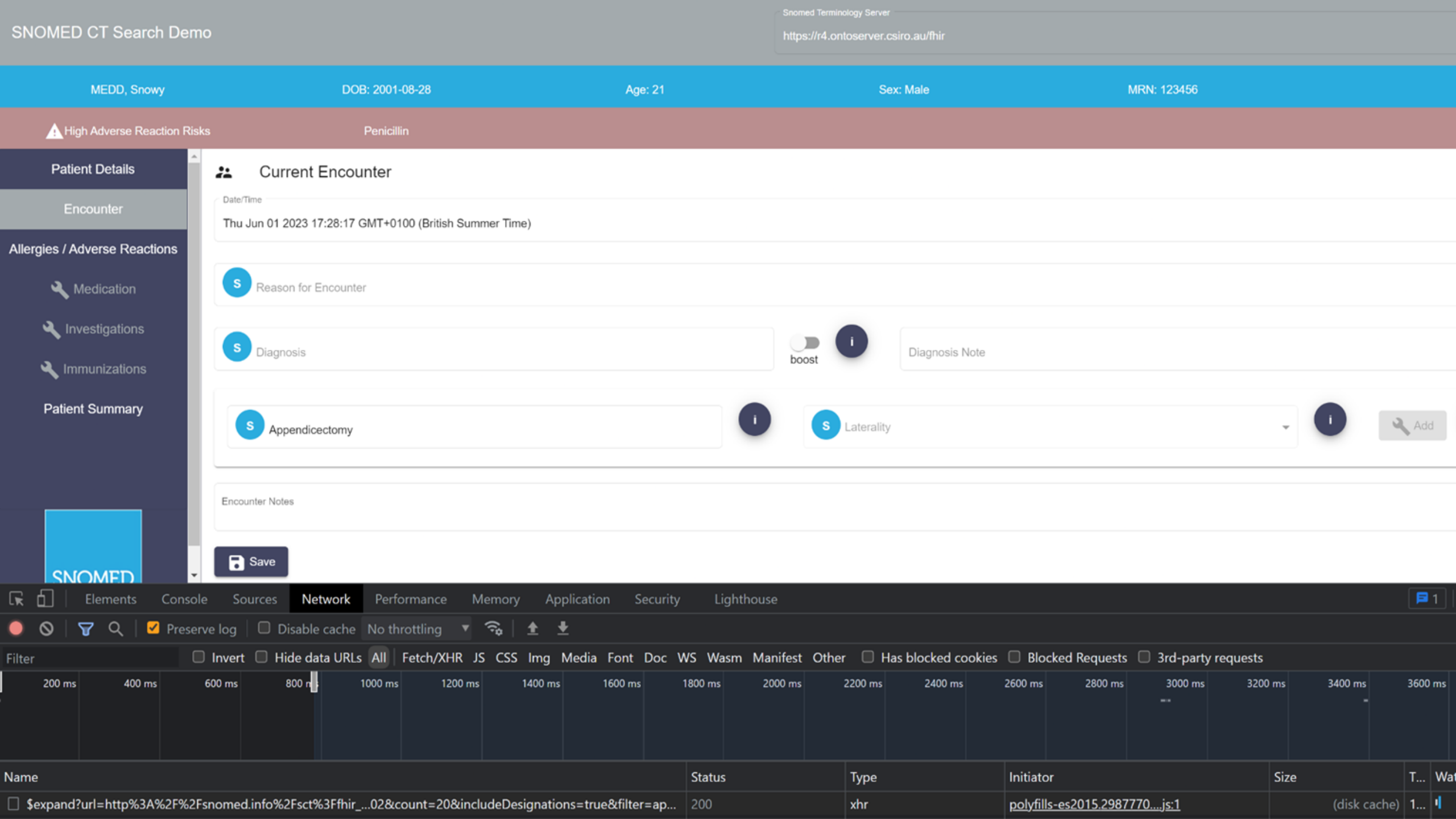
<< 362958002 |Procedure by site (procedure)| :
<< 363704007 |Procedure site (attribute)| = << 80891009 |Heart structure (body structure)|

.../ValueSet/$expand?url=http://snomed.info/sct?fhir_vs=ecl/<<362958002:<<363704007=<<80891009

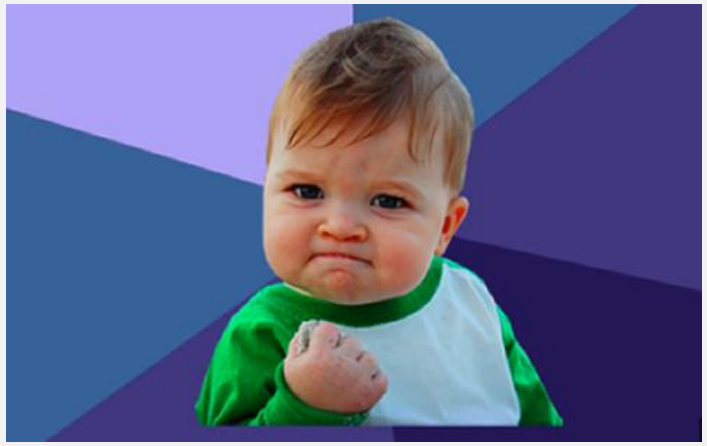
.../ValueSet/$expand?url=http://snomed.info/sct?fhir_vs=ecl/<<362958002:<<363704007=<<80891009&filter=MRI

Using ECL with Term Filtering in an Application

http://snomed.org/ui


SNOMED CT Search Demo
Snomed Terminology Server
https://r4.ontoserver.csiro.au/fhir
MEDD, Snowy
DOB: 2001-08-28
Age: 21
Sex: Male
MRN: 123456
High Adverse Reaction Risks
Penicillin
Patient Details
Encounter
Allergies / Adverse Reactions
Medication
Investigations
Immunizations
Patient Summary
Current Encounter
Date/Time
Thu Jun 01 2023 17:28:17 GMT+0100 (British Summer Time)
Reason for Encounter
Diagnosis
boost
Diagnosis Note
Appendicectomy
Laterality
Add
Encounter Notes
Save
Elements
Console
Sources
Network
Performance
Memory
Application
Security
Lighthouse
Preserve log
Disable cache
No throttling
Filter
Invert
Hide data URLs
All
Fetch/XHR
JS
CSS
Img
Media
Font
Doc
WS
Wasm
Manifest
Other
Has blocked cookies
Blocked Requests
3rd-party requests
200 ms
400 ms
600 ms
800 ms
1000 ms
1200 ms
1400 ms
1600 ms
1800 ms
2000 ms
2200 ms
2400 ms
2600 ms
2800 ms
3000 ms
3200 ms
3400 ms
3600 ms
Name
Status
Type
Initiator
Size
$expand?url=http%3A%2F%2Fsnomed.info%2Fsct%3Ffhir_...02&count=20&includeDesignations=true&filter=ap...
200
xhr
polyfills-es2015.2987770....js:1
(disk cache)

Learning Objectives



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Hot off the press!

LOINC® from Regenstrief

- Modelling LOINC Terms as a SNOMED Extension
- Initial pilot of 100 terms completed
- Next phase looking to pick up 26K concepts

Arbitrary concentration of thyrotrophin in serum or plasma at point in time (observable entity)

SCTID: 30191010000107 LOINC code ID: 3016-3

30191010000107 | Arbitrary concentration of thyrotrophin in serum or plasma at point in time (observable entity) |

en Arbitrary concentration of thyrotrophin in serum or plasma at point in time (observable entity)

en Arbitrary concentration of thyrotrophin in serum or plasma at point in time

en Thyrotropin [Units/volume] in Serum or Plasma

en Thyrotropin:ACnc:Pt:Ser/Plas:Qn

Component	→ Thyrotrophin
Property	→ Arbitrary concentration (property)
Scale type	→ Quantitative
Time aspect	→ Single point in time
Direct site	→ Acellular blood (serum or plasma) specimen

SNOMED on FHIR Workgroup

- Created Wellington, NZ Oct 2016
  - At request of members
  - Intended to support FHIR implementation specifically using SCT
- Every other Tuesday 20:00 UTC
- Every fourth Wednesday 10:00 UTC
- HL7 and SI on equal footing - Rob Hausam co-chair
- Two streams of work
  - Terminology Services
    - Michael Lawley (CSIRO), Peter Jordan (HL7 NZ)
  - Terminology Binding
    - Jeremy Rogers (NHS Digital), Daniel Karlsson (Sweden)

https://snomed.org/fhir

Q&A

Contact

- pwi@snomed.org
- During DevDays, you can find / reach me here:
  - Via Whova App – Speaker's Gallery

FIN

SNOMED International

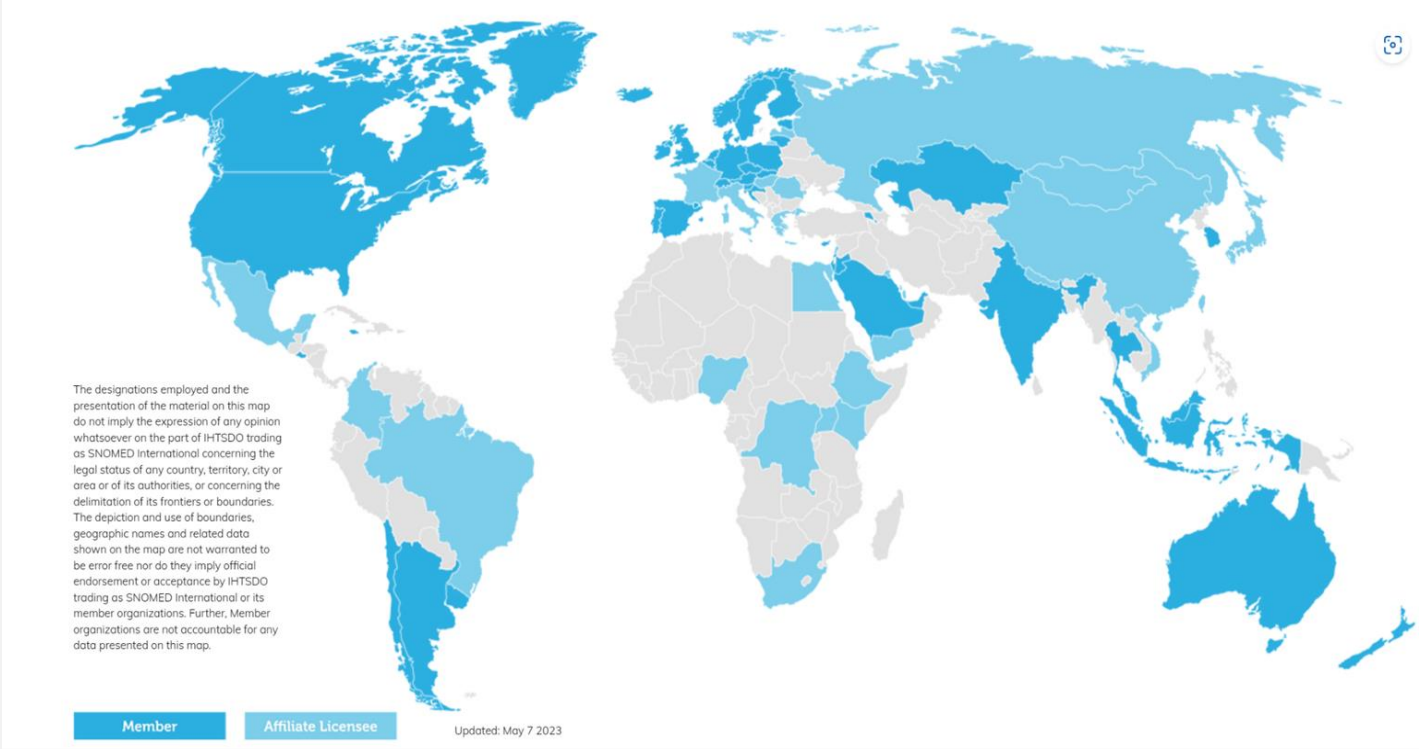
Leading healthcare terminology, worldwide

ORGANIZED BY

firely | HL7 International

SNOMED International

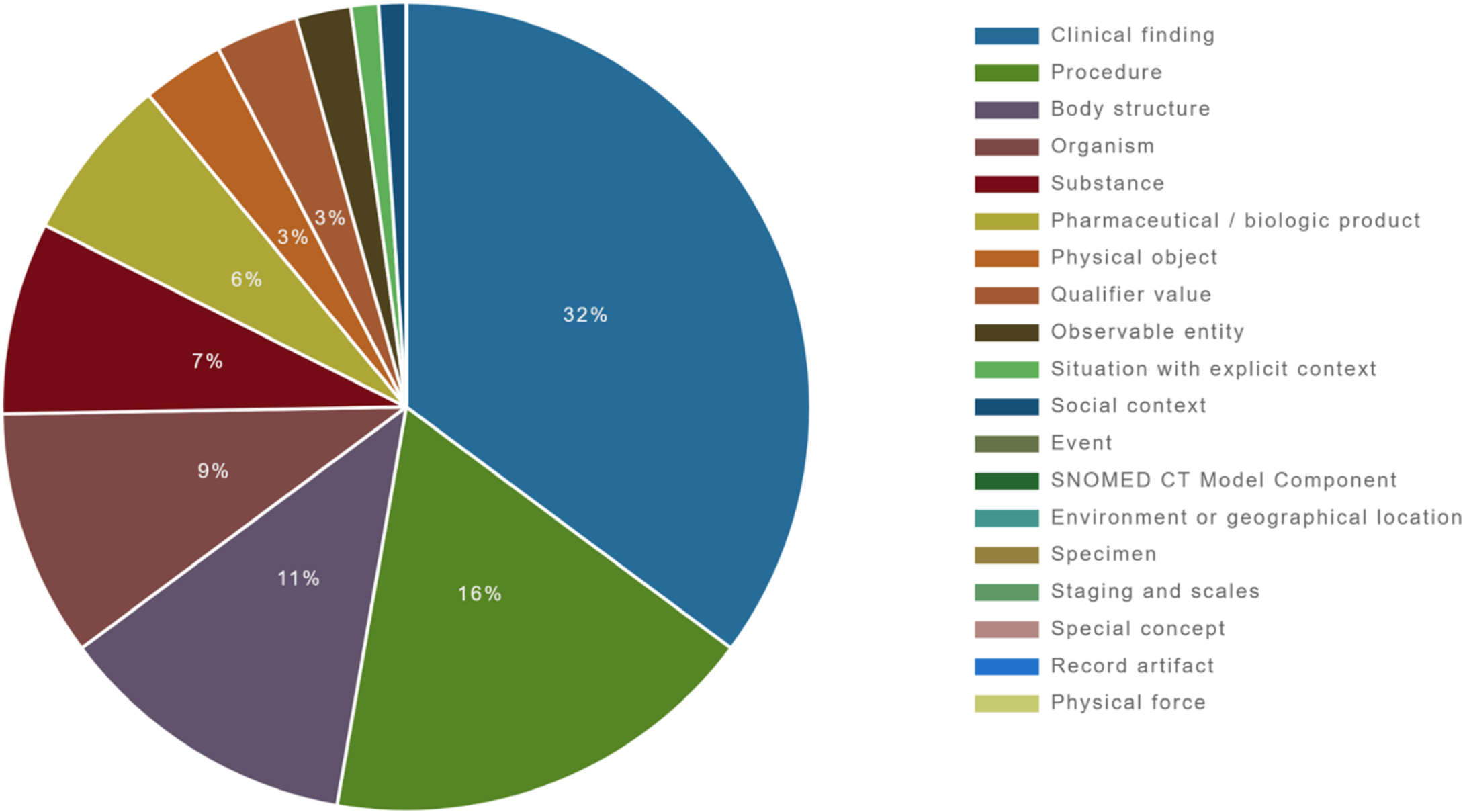
- Not for Profit Organization
- Formed in 2007 with 7 countries
- Now 48 countries. New Members:
  - Americas: El Salvador & Jamaica
  - Europe: Poland & Andorra
  - France scheduled for Membership by September
  - Croatia and Hungary to finalise membership (both have EU funding)
  - Asia: Indonesia
- Software is open source
  - https://github.com/IHTSDO



SNOMED Collaboration Agreements & Deliverables

- **AAP/EFP -** American Association of Periodontology & European Federation of Periodontology
- **ACS (AJCC) -** American College of Surgeons (American Joint Committee on Cancer
- **ADA -** American Dental Association
- **AMA** - American Medical Association
- **AND (NCPT) -** Academy of Nutrition and Dietetics
- **CDISC -** Clinical Data Interchange Standards Consortium
- **CEN -** European Committee for Standardization
- **DICOM -** Digital Imaging and Communications in Medicine Standards Committee
- **EDQM -** European Directorate for the Quality of Medicines & HealthCare
- **ERA-EDTA -** European Renal Association – European Dialysis and Transplant Association
- **GA4GH -** Global Alliance for Genomics and Health
- **GDHP -** Global Digital Health Partnership
- **GMDNA -** Global Medical Device Nomenclature Agency
- **GS1 -** GS1
- **HL7 International** - Health Level 7 International
- **HPO** - Human Phenotype Ontology
- **ICH (MedDRA) -** International Council for Harmonization of Technical Requirements for Pharmaceuticals for Human Use
- **ICN (ICNP) -** International Council of Nurses (International Classification for Nursing Practice)
- **IDDSI -** International Dysphagia Diet Standardisation Initiative
- **IHE -** Integrating the Healthcare Enterprise
- **ILAE -** International League Against Epilepsy
- **IPS** - International Patient Summary
- **ISO -** International Organization for Standardization
- **JIC -** Joint Initiatives Council
- **NANDA -** NANDA-I
- **NPU -** Nomenclature for Properties and Units
- **OBO -** Open Biological and Biomedical Ontologies Foundry
- **OHDSI -** Observational Health Data Sciences and Informatics
- **PAHO -** Pan American Health Organization
- **UCUM -** Unified Code for Units of Measure
- **UNICOM (project)**
- **WHO -** World Health Organization
- **WONCA** - World Organization of Family Doctors

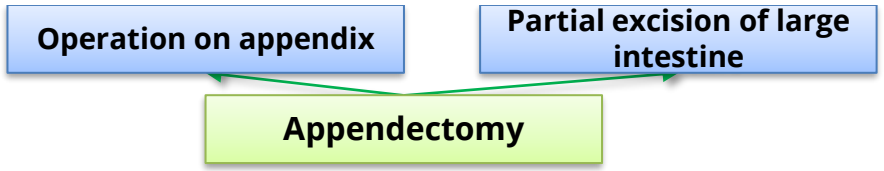
Active Concepts in SNOMED CT among all first level hierarchies



Release Summary

Release Date	Concept			Description			Text Definition			Language Refset			Axiom		
	Concepts added	Modified per release	Total unique	Added for new concepts	Updated for existing concepts	Total unique	Added for new concepts	Updated for existing concepts	Total unique	Added for new concepts	Updated for existing concepts	Total unique	Added for new concepts	Updated for existing concepts	Total unique
2023/04/30	853	501	503,177	2,238	453	1,595,980	49	11	10,352	4,275	1,050	3,117,192	853	1,496	384,860
2023/03/31	827	661	502,324	2,090	1,764	1,593,488	5	176	10,296	4,020	4,271	3,112,415	827	2,085	384,001
2023/02/28	1,141	697	501,497	2,927	1,579	1,590,279	43	46	10,242	5,780	3,923	3,106,221	1,141	2,912	383,151
2023/01/31	762	1,367	500,356	2,376	240	1,586,355	83	11	10,160	4,661	504	3,098,436	764	2,288	381,994
2022/12/31	1,236	575	499,594	3,090	2,688	1,583,863	25	15	10,069	6,011	6,438	3,093,538	1,242	2,749	381,224
2022/11/30	829	273	461,645	2,291	624	1,459,691	22	56	9,931	4,316	1,501	2,855,814	829	4,095	375,327
2022/10/31	961	511	460,934	2,714	670	1,457,479	91	25	9,881	5,366	1,516	2,851,597	967	2,547	374,617
2022/09/30	463	378	496,568	1,284	1,076	1,573,381	81	9	9,867	2,566	2,191	3,073,195	463	1,519	378,124
2022/08/31	468	242	496,105	1,335	314	1,571,567	14	4	9,779	2,596	692	3,069,562	470	1,542	377,652
2022/07/31	802	1,424	495,637	2,753	3,350	1,570,040	414	7	9,762	6,223	8,867	3,066,582	807	2,222	377,176
2022/06/30	908	440	494,835	2,642	2,103	1,565,205	112	39	9,342	5,234	5,047	3,056,285	908	1,927	376,363

IS A - Polyhierarchy



Search

Options

Search: Prefix any order

Status: Active concepts only

Description type: All

Language Refsets

Group by concept

Filter results by Language

english	51

Filter results by Semantic Tag

disorder	5
finding	22
organism	1
physical object	13
procedure	6
qualifier value	2
regime/therapy	1
situation	1

Filter results by Module

Type at least 3 characters ✔ Example: *shou fra*

Enhanced

51 matches found in 0.596 seconds.

CO2 enhanced bacteria	Capnophilic bacteria (organism)
Gadolinium-enhanced MRI	Magnetic resonance imaging using gadolinium contrast (procedure)
Ready for enhanced hope	Ready for enhanced hope (finding)
Ready for enhanced power	Ready for enhanced power (finding)
Enhanced S-cone syndrome	Goldmann-Favre syndrome (disorder)
Ready for enhanced comfort	Ready for enhanced comfort (finding)
Readiness for enhanced sleep	Ready for enhanced sleep pattern (finding)
Ready for enhanced knowledge	Ready for enhanced knowledge (finding)
Ready for enhanced self-care	Ready for enhanced self-care (finding)
Ready for enhanced parenting	Ready for enhanced parenting (finding)
Ready for enhanced nutrition	Ready for enhanced nutrition (finding)
Enhanced physiological tremor	Enhanced physiological tremor (finding)

Concept Details

Summary | Details | Diagram | Expression | Refsets | Members | History | References

Stated | Inferred

Parents

- General well-being finding (finding)
- Readiness finding (finding)

Ready for enhanced comfort (finding)

SCTID: 425818007

425818007 | Ready for enhanced comfort (finding) |

en Ready for enhanced comfort (finding)
en Ready for enhanced comfort
en Readiness for enhanced comfort

Interprets → Comfort level

Interprets → Readiness

Children (0)

No children

SNOMED Family of Languages

SNOMED Compositional Grammar

SNOMED Template Language

Expression Constraint Language

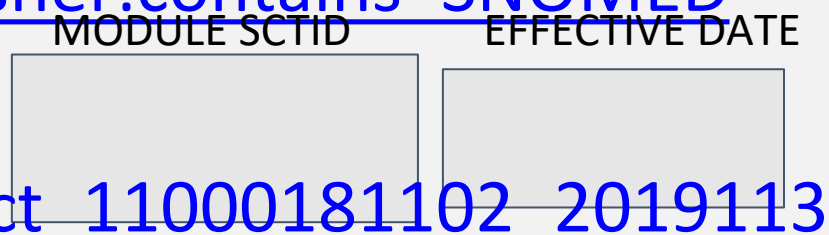
CodeSystem - instances & searching

https://browser.ihtsdotools.org/fhir/CodeSystem

.../CodeSystem?version:contains=20230430

.../CodeSystem?publisher:contains=SNOMED

Example:



.../fhir/CodeSystem/sct_11000181102_20191130

CodeSystem - $validate-code

https://browser.ihtsdotools.org/fhir/CodeSystem/$validate-code?coding=http://snomed.info/sct|711541005

.../CodeSystem/$validate-code?coding=http://snomed.info/sct|32553006&display=nausea

ValueSet- instances & searching

https://browser.ihtsdotools.org/fhir/ValueSet

https://browser.ihtsdotools.org/fhir/ValueSet?title:contains=condition

ValueSet - $validate-code

Is this code part of my ValueSet **and** is the correct display term used?

.../ValueSet/$validate-code?
url=http://snomed.info/sct/900000000000207008/version/20200309?fhir_vs=ecl/<<34014006|Viral+disease|&
coding=http://snomed.info/sct|840539006

ConceptMap - $translate NB R4

.../ConceptMap/$translate?code=254153009&
system=http://snomed.info/sct&
targetsystem=http://hl7.org/fhir/sid/icd-10

ICD-10 Map target for 254153009 |Familial expansile osteolysis (disorder)|

.../ConceptMap/$translate?code=1348110 01&
system=http://snomed.info/sct&
targetsystem=http://snomed.info/sct?fhir_vs&
url=http://snomed.info/sct?fhir_cm=900000000000527005

Historical Association find the "SAME AS" target for inactivated concept

CodeSystem - $subsumes

Is *399144008 |Bronze diabetes (disorder)|*

a type of *73211009 |Diabetes mellitus (disorder)|* ?

.../CodeSystem/$subsumes?system=http://snomed.info/sct&codeA=399144008&codeB=73211009

What did you learn today?

- What is SNOMED CT and why is it great?
- SNOMED CT's Logical Structure
- Hot Off The Press
- SNOMED Family of Languages
- Snowstorm - free to use Terminology Server
- How to best use SNOMED CT with FHIR
- SNOMED on FHIR Working Group