

# SNOMED

Courtesy: Health & Social Care Information Center, UK

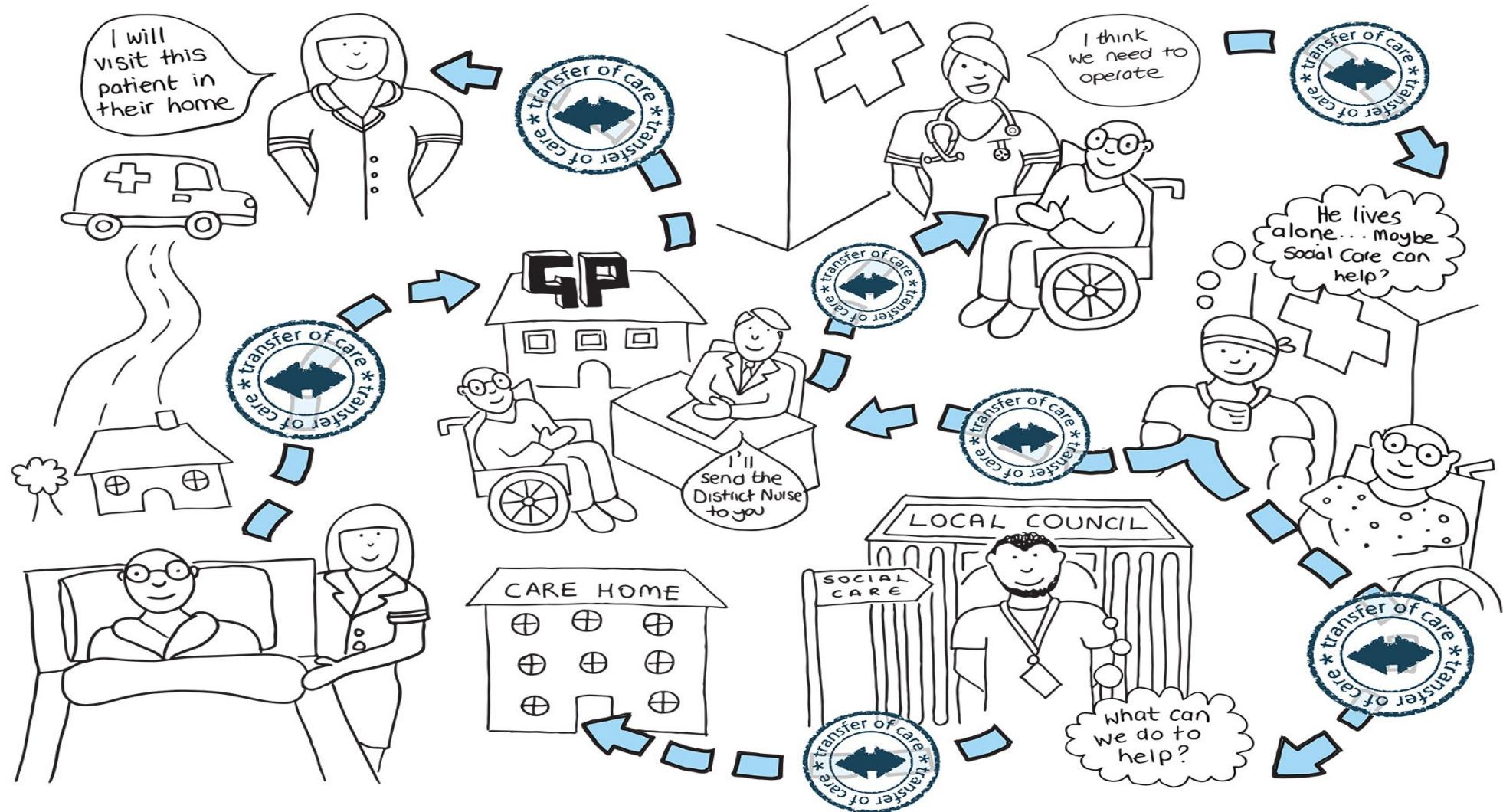
# Key Messages

- We are seeing the biggest change in healthcare that we've seen in years
  - Care model is going to change
  - Electronic records are driving improvements in care
- Shared care
  - Wherever the patient goes, the person treating them should have access to key information about this patient
- Analysis of patient data throughout healthcare will be used to improve patient care
- IT needed to support the growing knowledge that helps personalised patient care

# Strategy

- Aim: Patient centred – patients can view own records
- Actions:
  - Interoperability – move data around electronically
  - Record once, use many times
- All require a common standardised vocabulary

# Transfer of Care Initiative



# Data Representation: Machine and Human

- Effective communication for human and machine is essential for quality care
- What can we develop to capture the semantics of data in medical practices and also can be shared easily with different physicians.
- What data representation can we develop that can facilitate the communication among physicians, patients, and machines.

# SNOMED Clinical Terms (



- Systematized Nomenclature Of Medicine – Clinical Terms
- It is a standardized, multilingual vocabulary of clinical terminology that is used by physicians and other health care providers for the electronic exchange of clinical health information.
- It is the collection of medical terms providing codes, terms, synonyms and definitions used in clinical documentation and reporting.
- It is the most comprehensive, multilingual clinical healthcare terminology in the world.
- The primary goal is to encode the meanings in healthcare and support the effective clinical recording of data to improve patient care.
- It provides the core general terminology for EMR

# SNOMED CT

- It can be mapped to other coding systems, such as ICD-9 and ICD-10
- It benefits individual patients and clinicians, as well as populations, and it supports evidence based care.
- In EMR, SNOMED CT can represent relevant clinical information consistently and comprehensively as an essential part of producing EMR systems
- In USA, regulations have designated that SNOMED CT be the national standard for additional categories of information in EHRs and for additional health information exchange transactions.

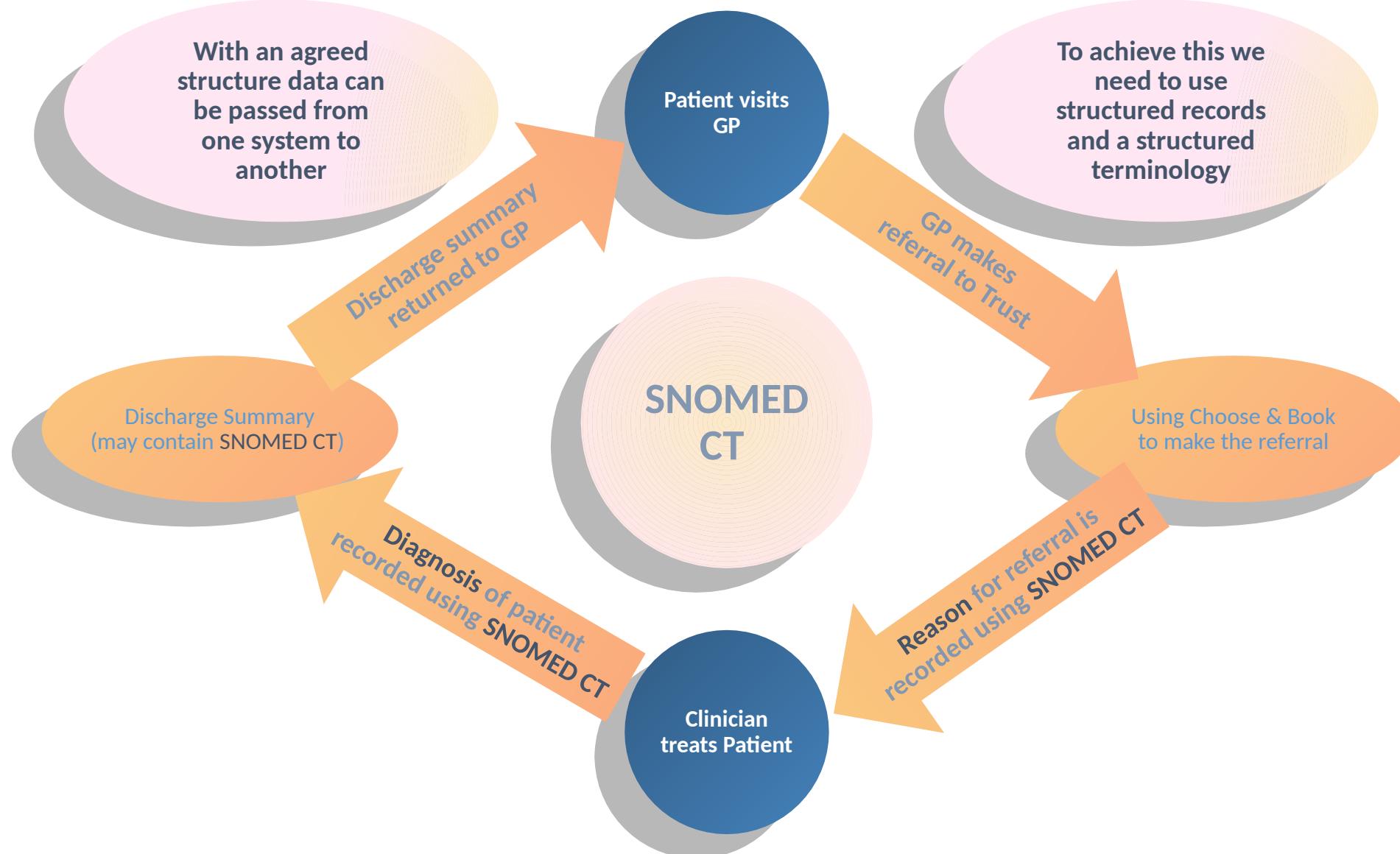
# Benefits

- There are many benefits of using SNOMED CT in Electronic Health Records including:
  - Health information can be shared consistently within and across healthcare settings.
  - Data can be organized, queried, and analyzed for the benefit of the individual and institution.
  - The risk of different interpretations of the record between different healthcare settings can be reduced.
  - Can remove language barriers as it enables multilingual use.
  - Updated twice a year to help users keep pace with the advances of healthcare terminology and add to the scope of coverage

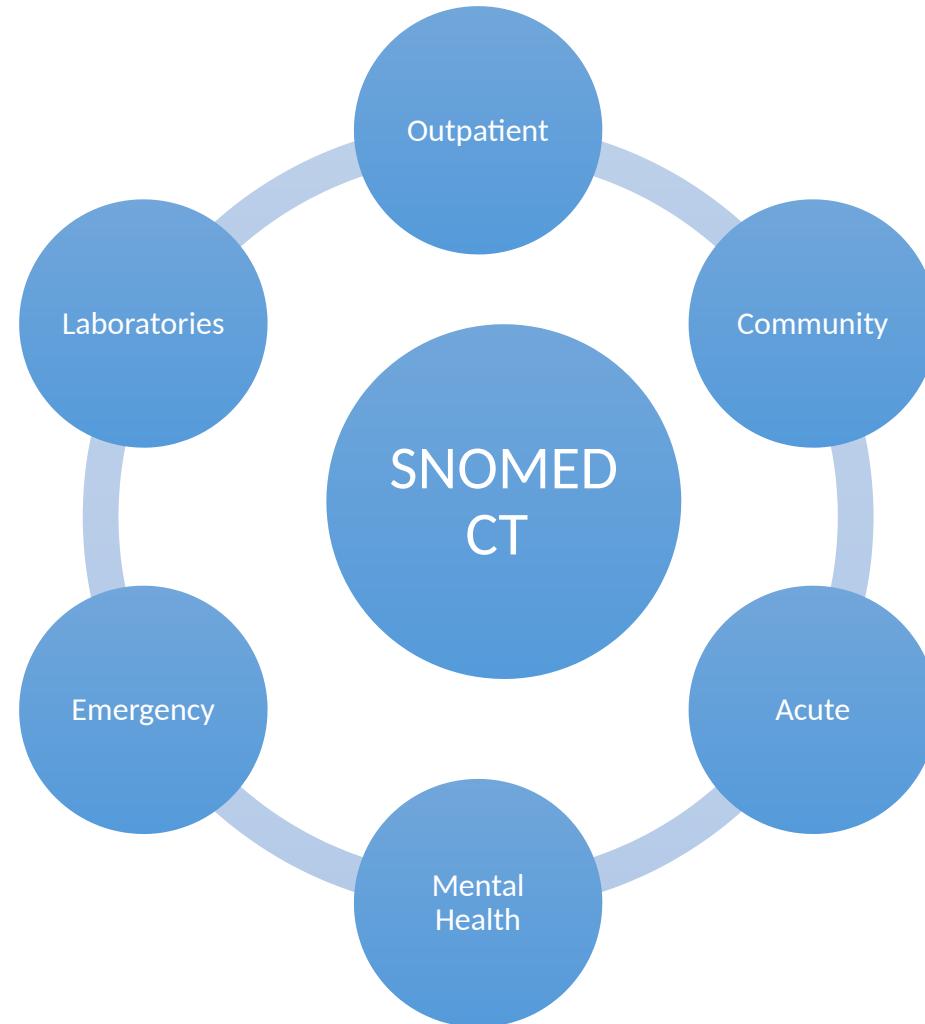
# Why SNOMED CT?

- SNOMED CT has been selected and approved as the terminology to be adopted by the majority of countries. It is the most comprehensive international terminology currently available and can be used across all care settings and all clinical domains.
- Terminologies are designed to be used by clinicians in their recording of data in a patient record. Classifications are intended for population statistics and analysis.

# Interoperability



# SNOMED CT



Use of  
Synonyms  
helps cater for  
different  
expressions  
with the same  
meaning

# SNOMED CT – What is it?

- SNOMED CT is a clinical terminology

Systematized Nomenclature of Medicine (Clinical Terms)

- Collection of names and words
- Relevant to the field of medicine
- Organised in a structured and logically consistent manner

# SNOMED CT Content

## Clinical Findings

- Disease and deformity – scar
- Symptoms – difficulty breathing
- Social – finding of walking aid use
- Examination findings – tachycardia

## Causes of Disease

- Forces – pressure change
- Events – road traffic accident
- Organisms – Coronavirus

## Procedures

- Laboratory
- Therapy
- Clinical Investigation
- Surgical procedure



View all

**Tachycardia** is a condition that makes your heart beat more than 100 times per minute. There are three types of it: Supraventricular. This happens when the electrical signals in the organ's upper chambers misfire and cause the heart rate to speed up. It beats so fast that it can't fill with blood before it contracts. Dec 4, 2019

# SNOMED CT Content

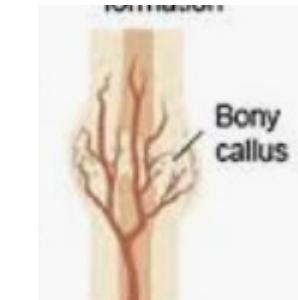
## Anatomy

- Normal - knee joint
- Abnormal - ganglion cyst
- Lesions - bony callus



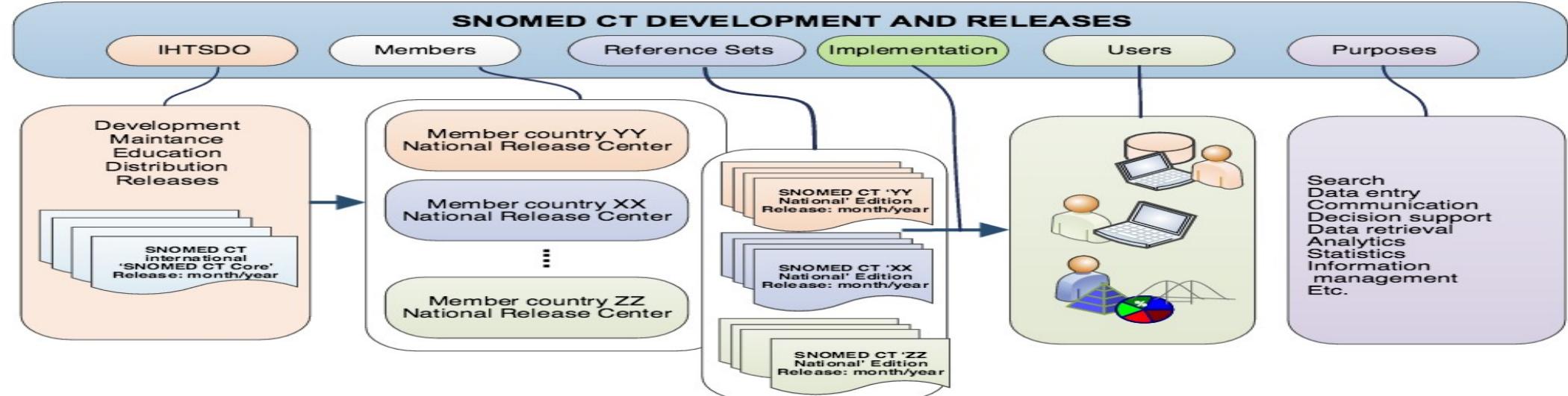
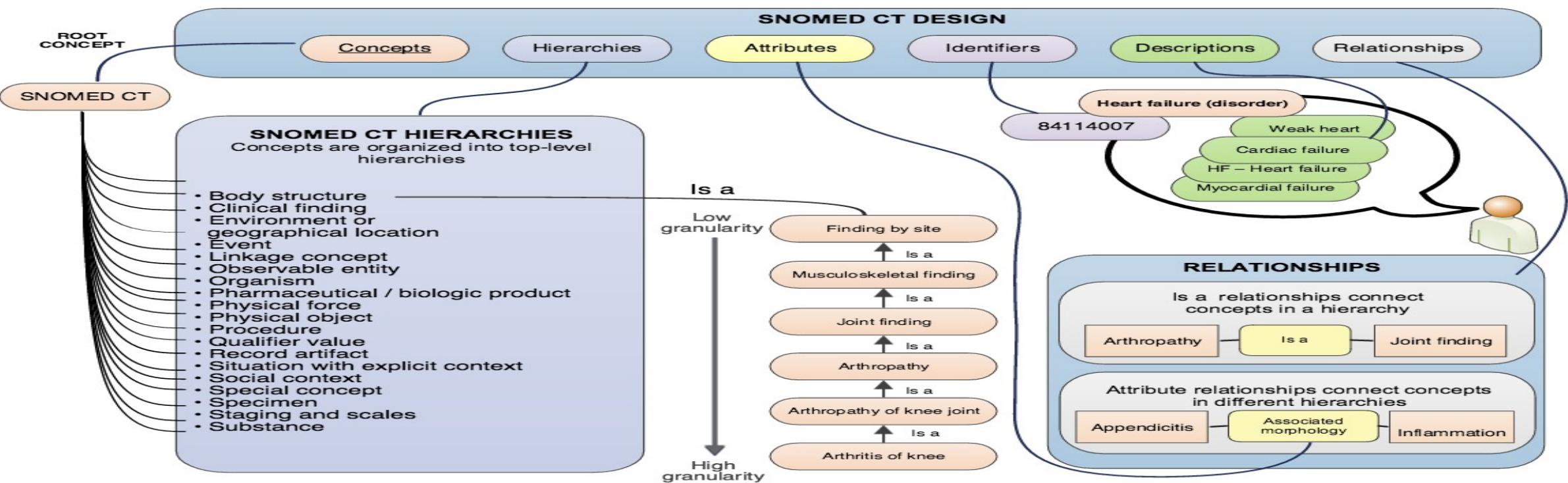
## Observations

- Vital signs - blood pressure
- Body product observable - colour of urine
- Values - present

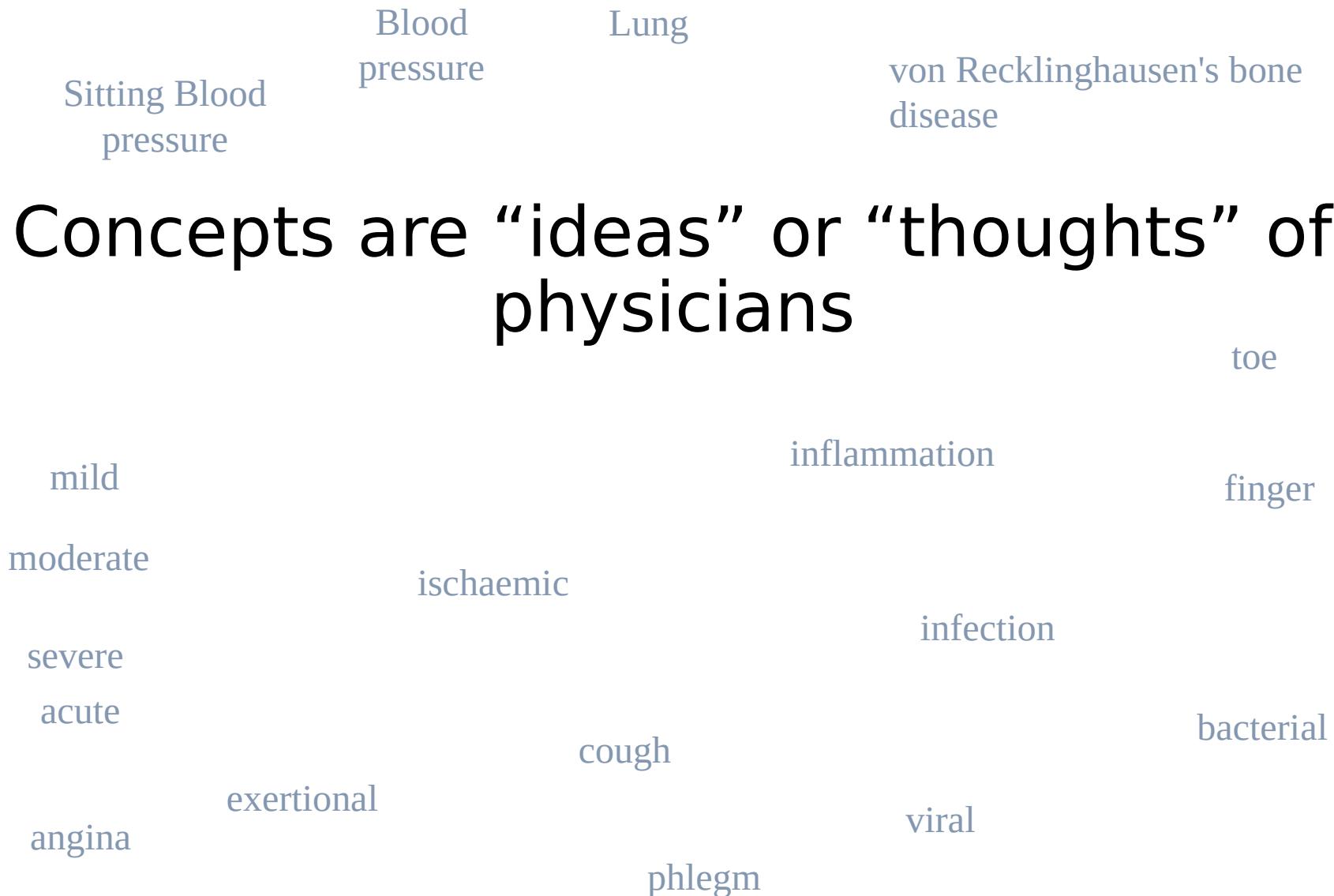


## Products

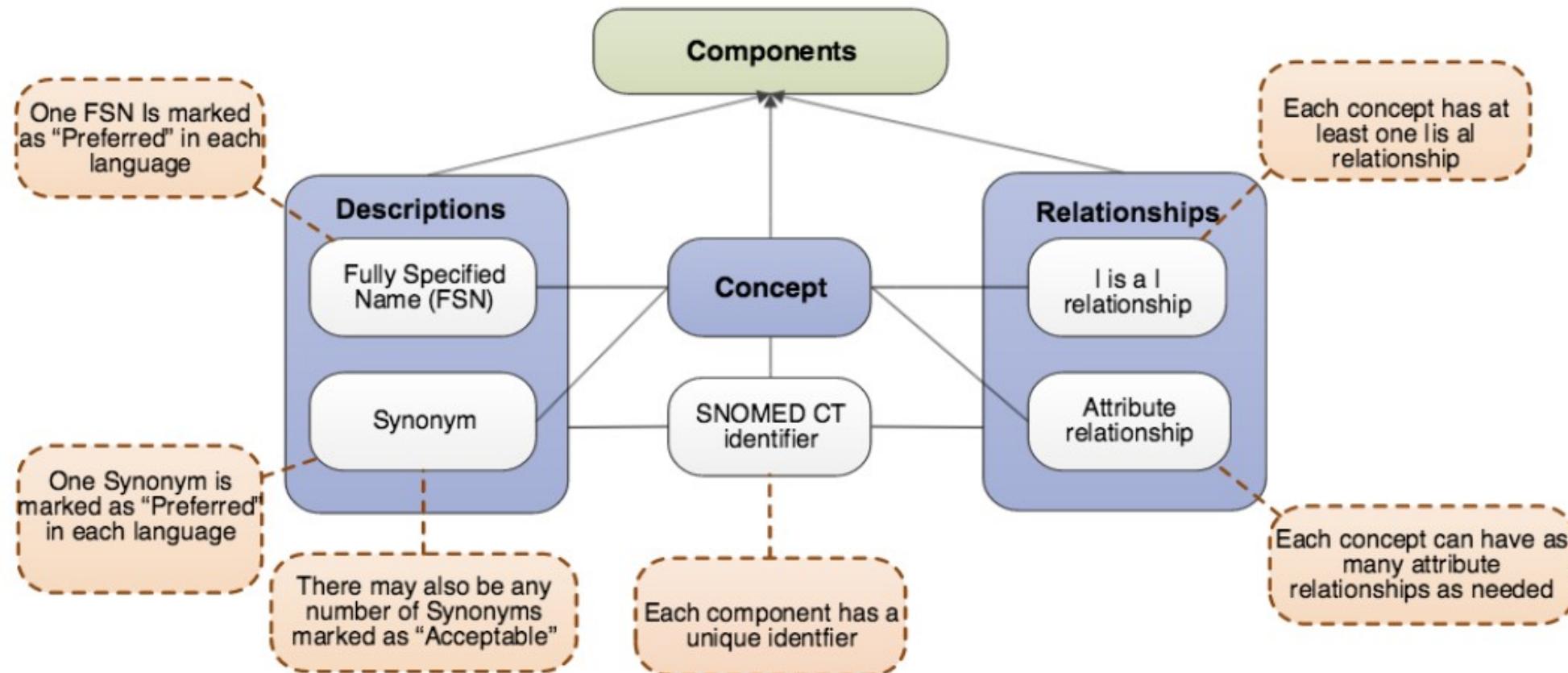
- Drugs - paracetamol
- Substances - latex
- Devices - bedpan



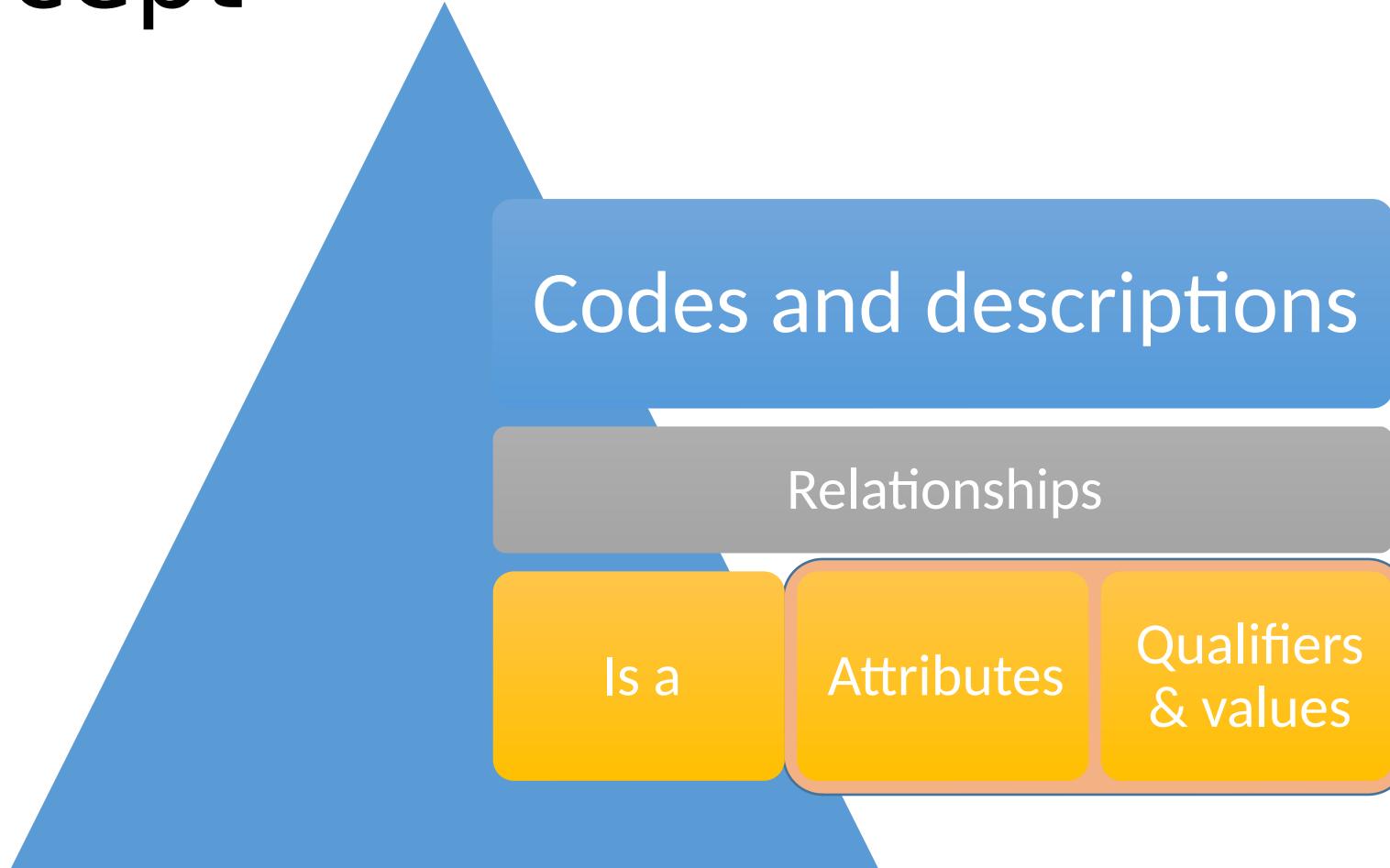
# Concepts: the building block of SNOMED



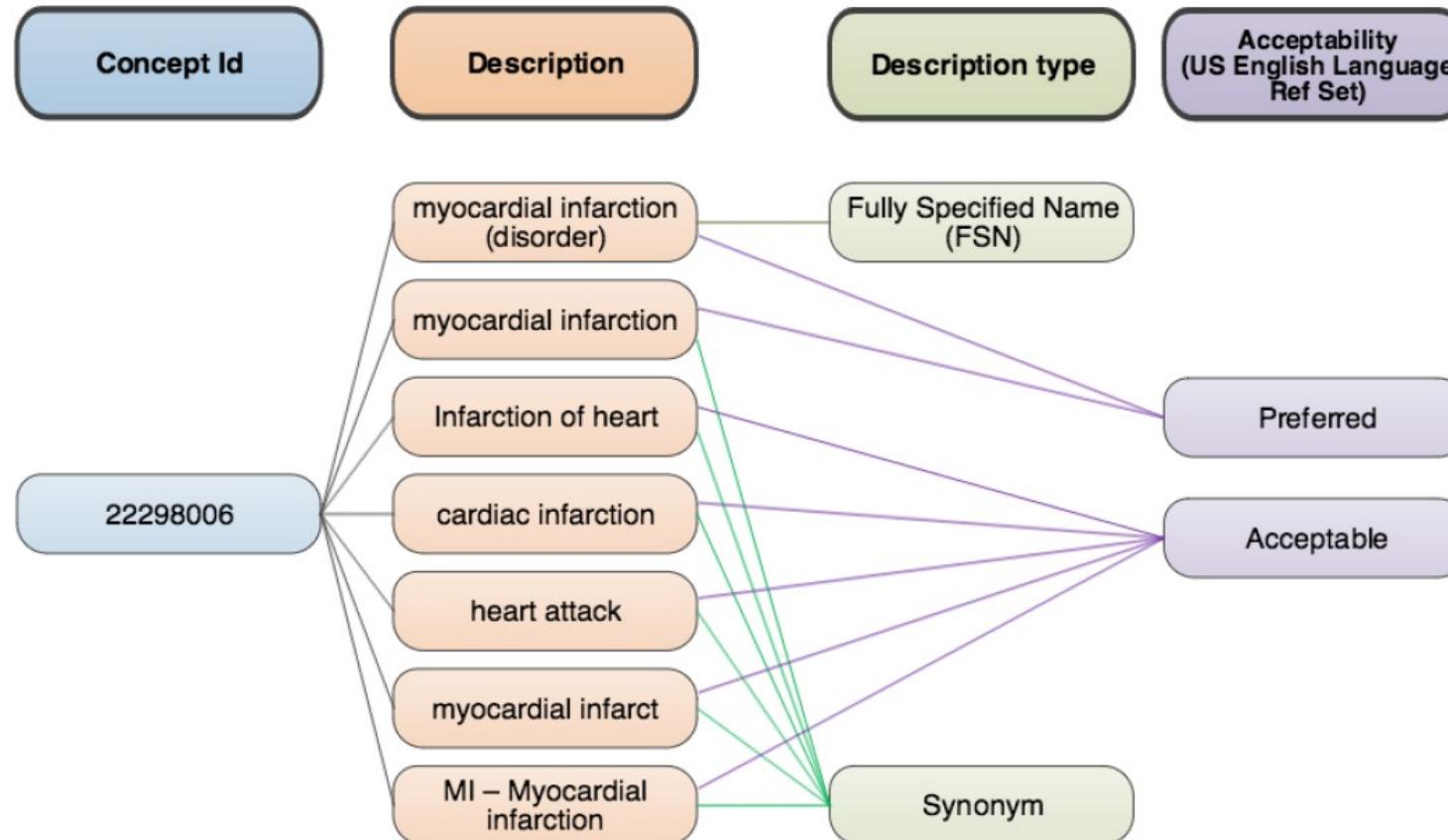
# SNOMED CT Logical Model



# A Concept



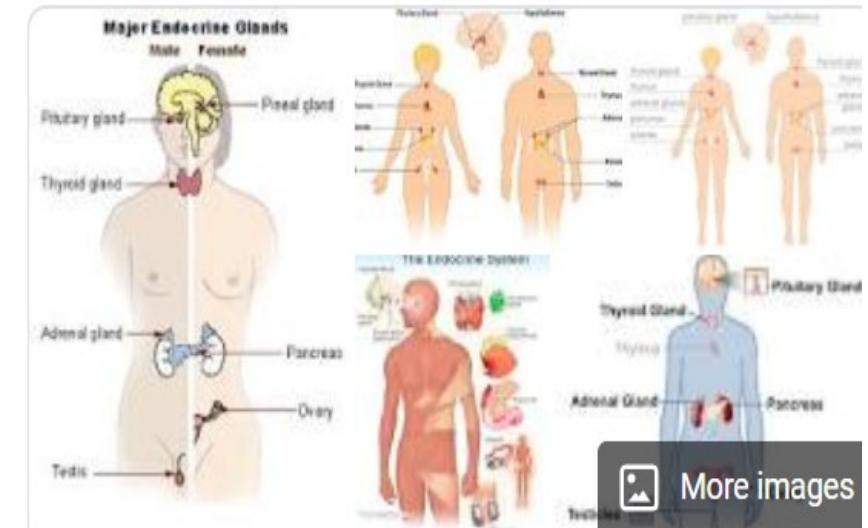
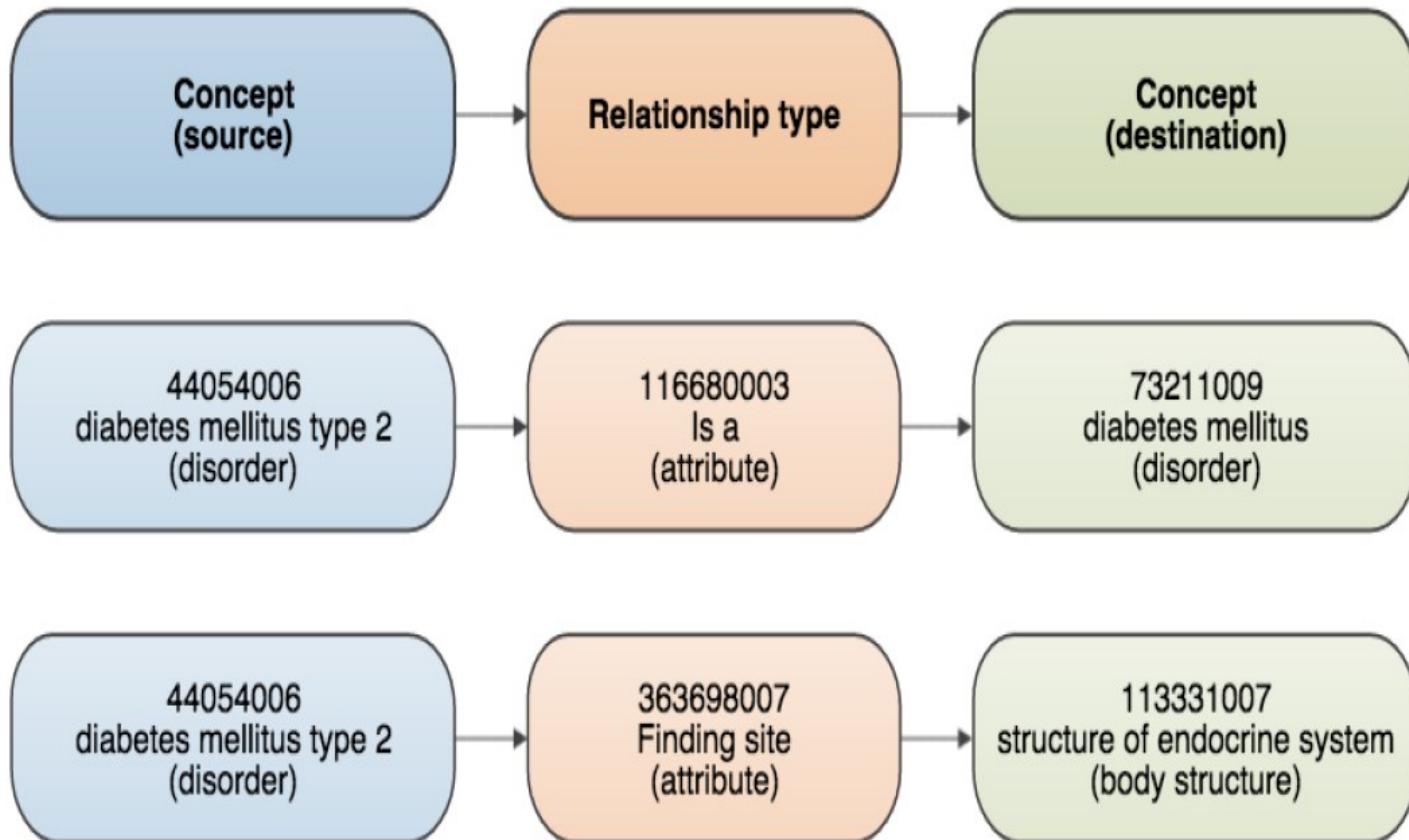
# Concept



SNOMED Browser:

<https://browser.ihtsdotools.org/?perspective=full&conceptId1=404684003&edition=MAIN/2020-07-31&release=&languages=en>

# Relationship

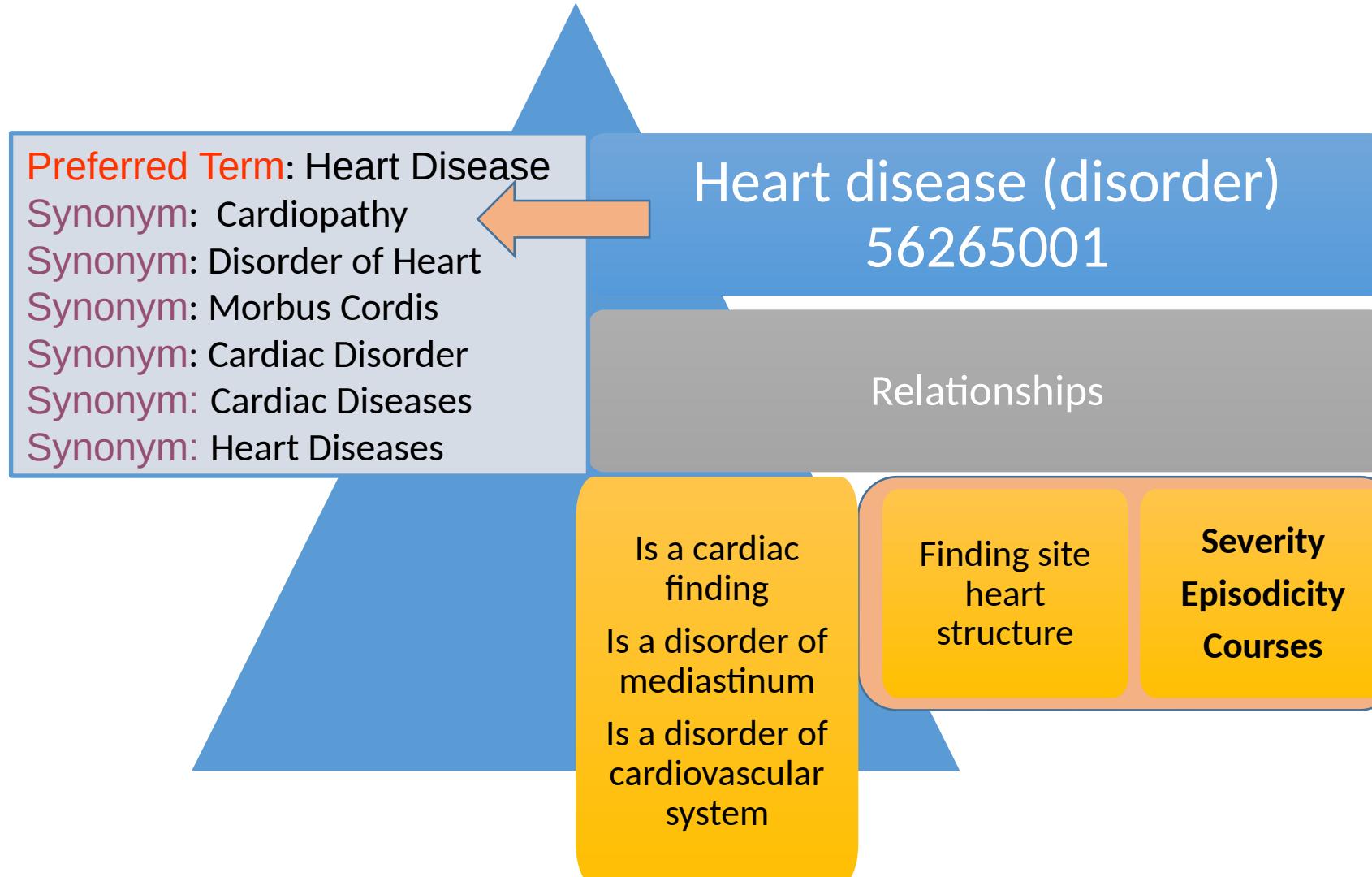


## Endocrine system



The endocrine system is a chemical messenger system comprising feedback loops of the hormones released by internal glands of an organism directly into the circulatory system, regulating distant target organs. In humans, the major endocrine glands are the thyroid gland and the adrenal glands. [Wikipedia](#)

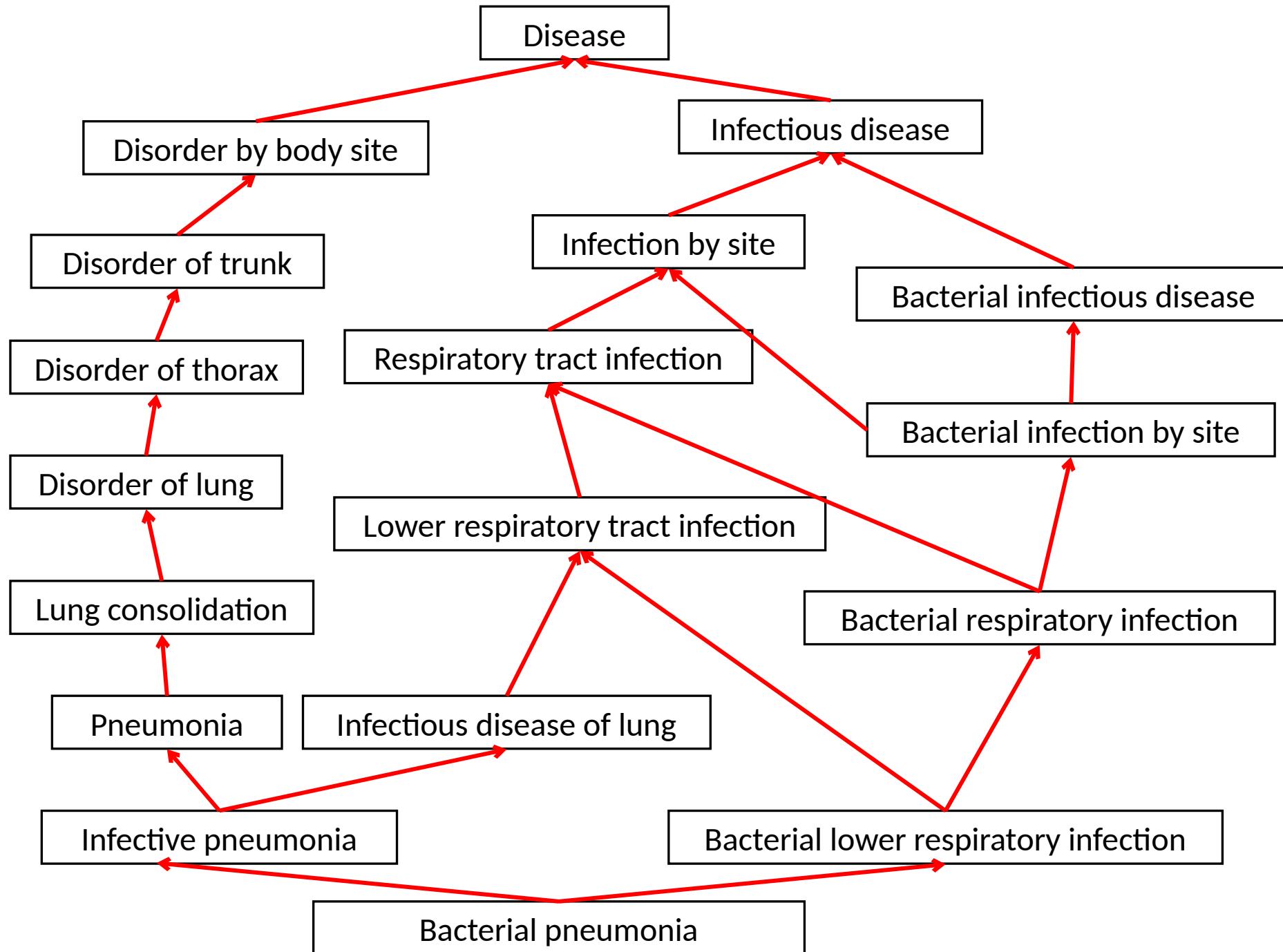
# A Concept in SNOMED CT



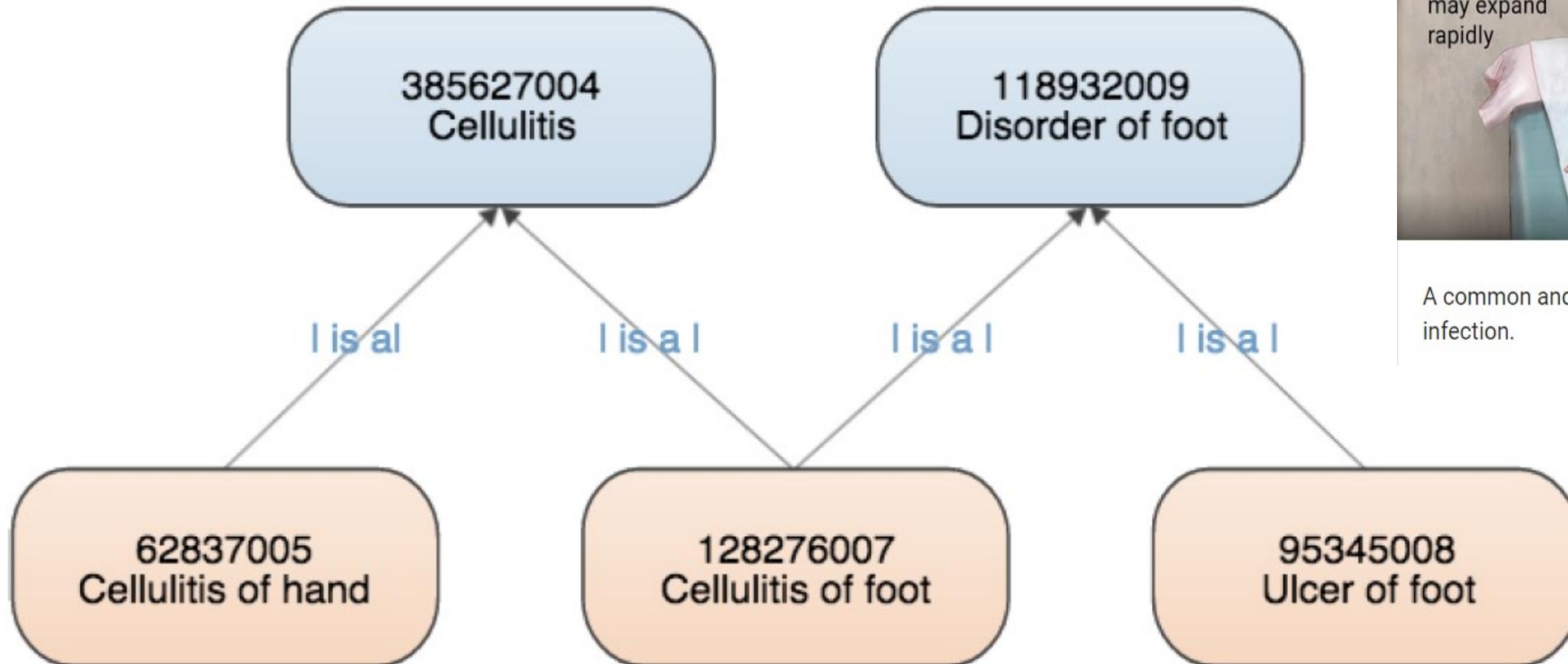
**Example:** It might be possible to qualify a disorder such as [53084003 |bacterial pneumonia|](#) according to its clinical course ([53737009 |acute|](#) or [90734009 |chronic|](#)) or severity ("mild," "moderate" or [24484000 |severe|](#)).

**Name:** Episodicities (qualifier value) [See more](#)  
**Concept ID:** 288526004  
**Read Codes:** Xa48Q Xa9Sn  
**ICD-10 Codes:** Not in scope.

- [First episode \(qualifier value\)](#)
- [New episode \(qualifier value\)](#)
- [Old episode](#)
- [Ongoing episode](#)
- [Undefined episodicity \(qualifier value\)](#)



# Is-a relationship



## Cellulitis

ABOUT

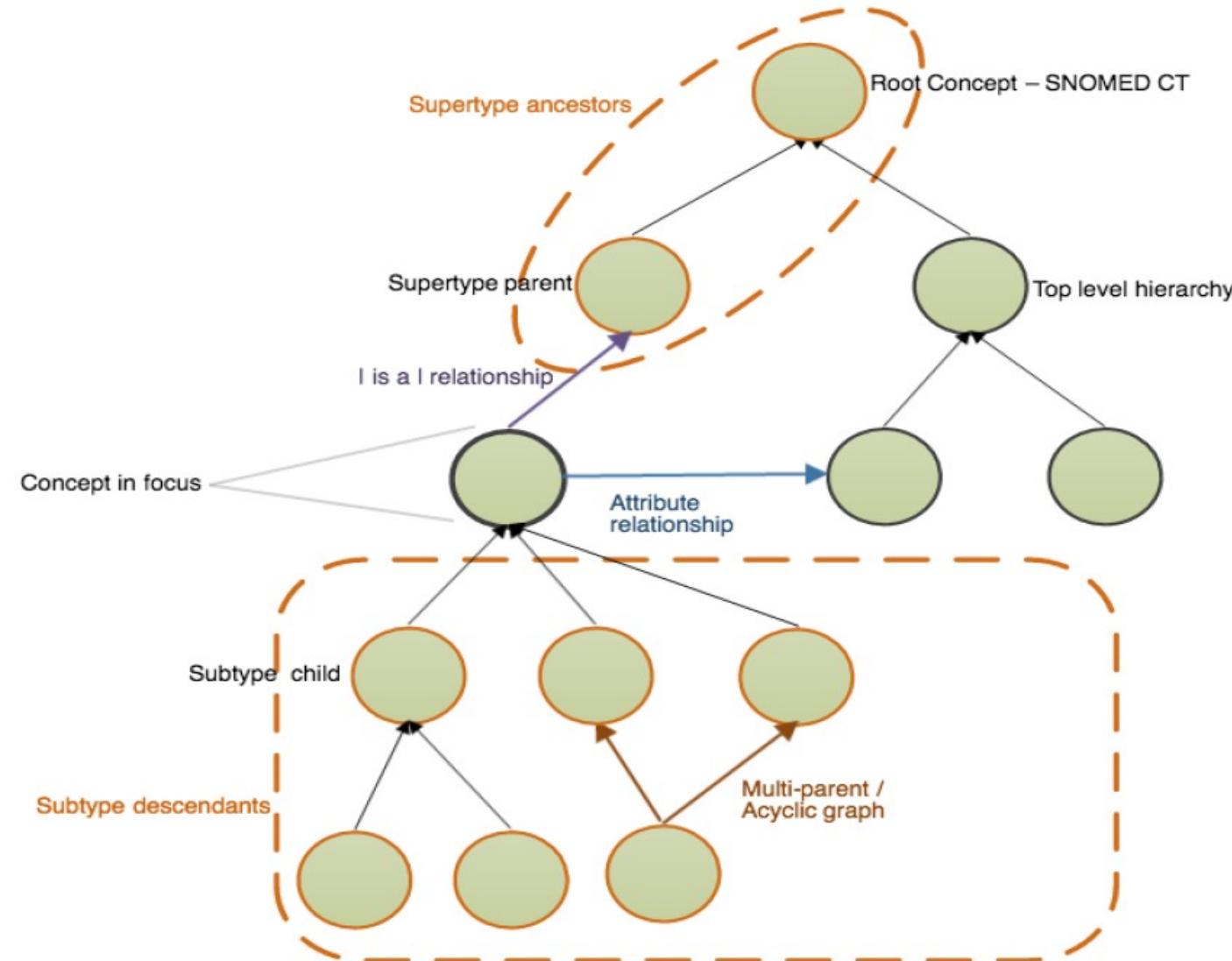
SYMPTOMS

TREATMENTS

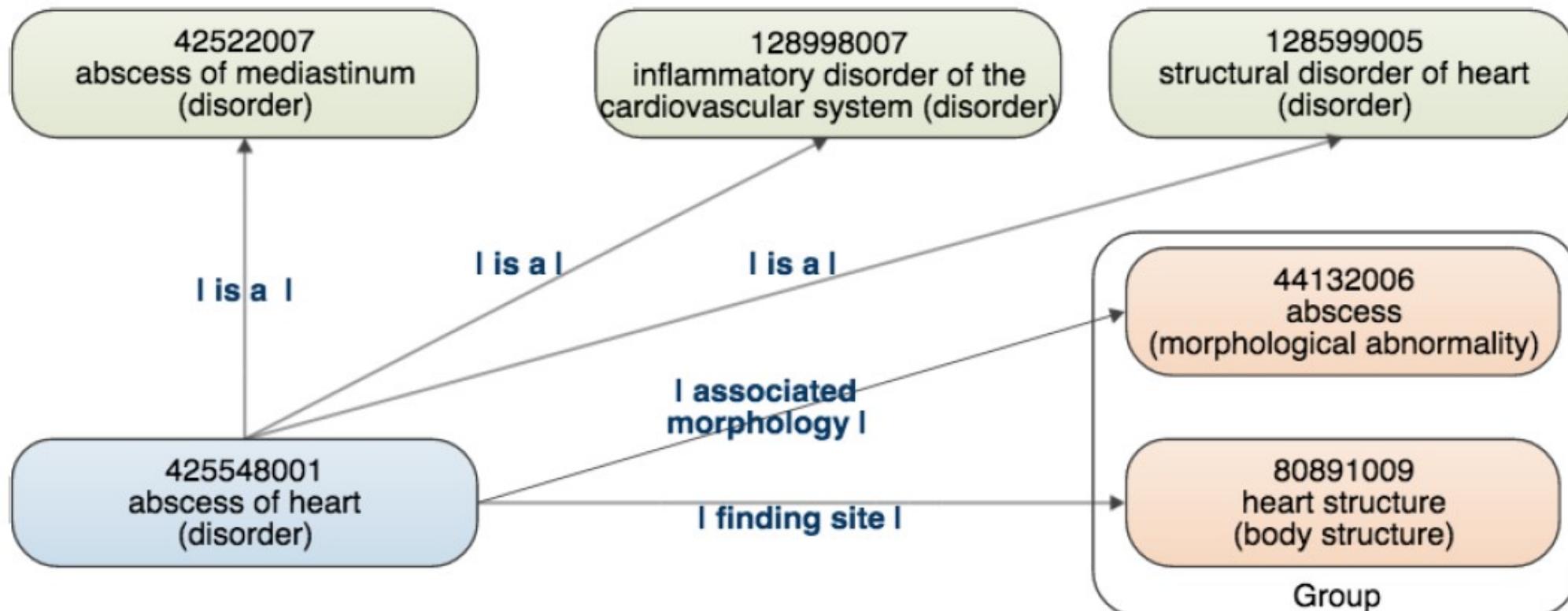
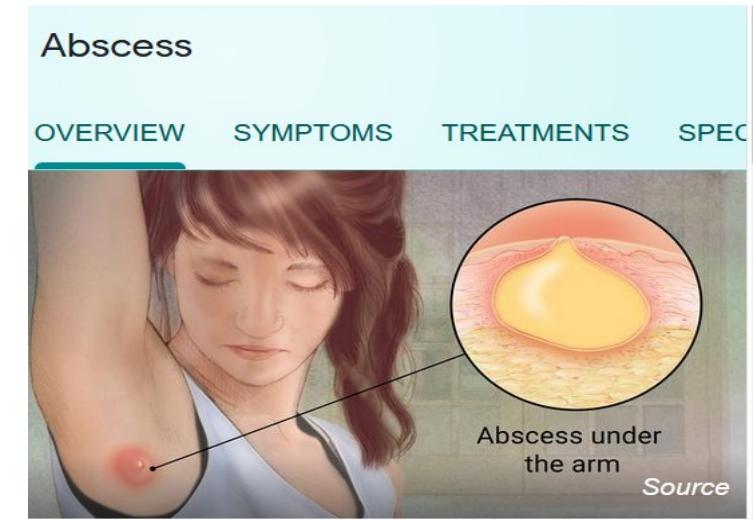


A common and potentially serious bacterial skin infection.

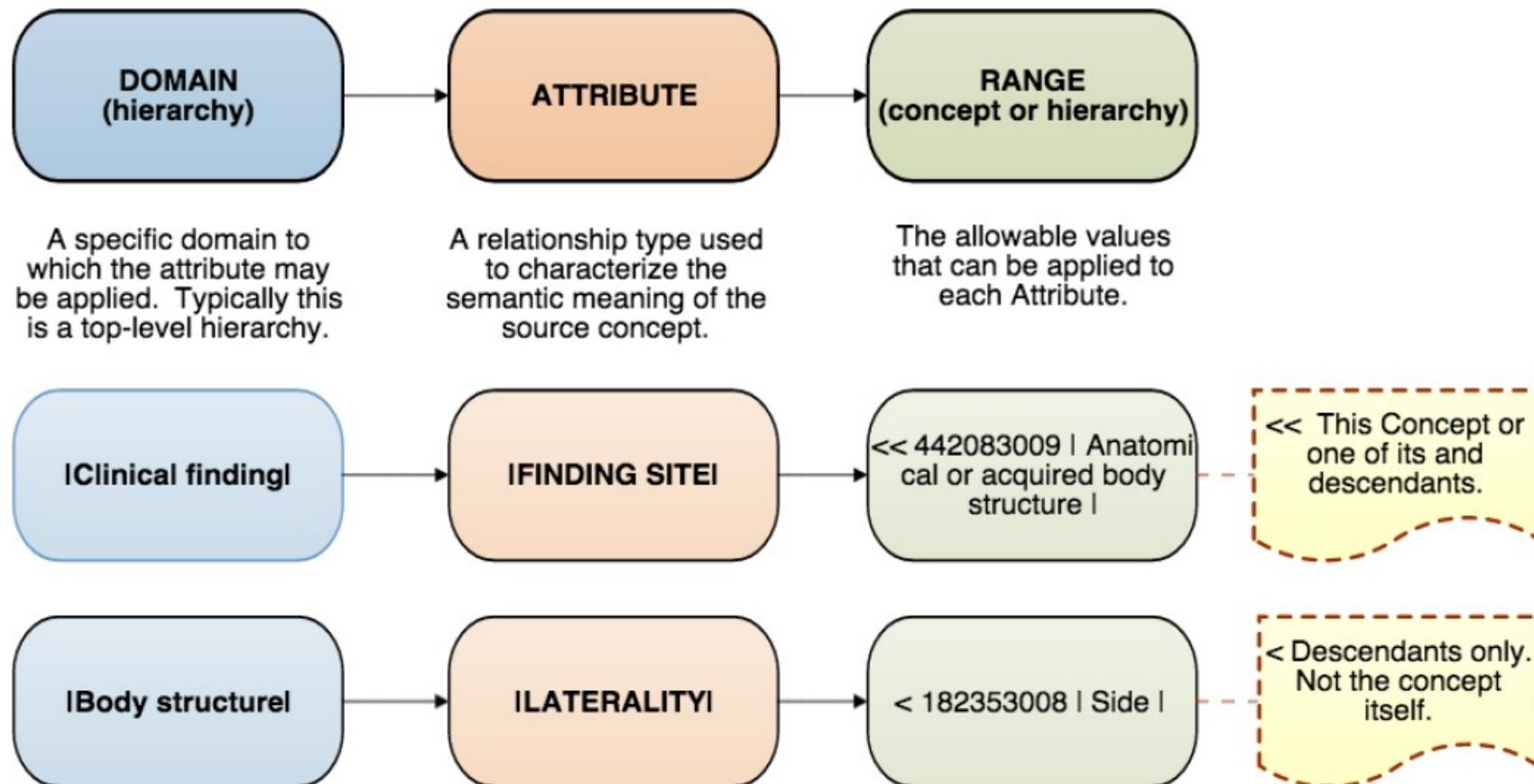
# Subtype hierarchy



# Attribute relationship



# Domain and Range



# SNOMED Browser

- <https://browser.ihtsdotools.org/>
- Use singular: leg, not legs
- No need to use fully spell-out words: diab would return both diabetic and diabetes
- Avoid words like: and, or, the

Taxonomy

Search

Favorites

Refset

Search

Options

Search Mode: Partial matching  
search mode ▾

Status: Active concepts only ▾

Description type: All ▾

Language Refsets ▾

Group by concept

Filter results by Language

english

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

viral pneumonia

9 matches found in 0.206 seconds.

Viral pneumonia	Viral pneumonia (disorder)
Congenital viral pneumonia	Congenital viral pneumonia (disorder)
Viral pneumonia (disorder)	Viral pneumonia (disorder)
Viral pneumonia associated with AIDS	Viral pneumonia associated with acquired immunodeficiency syndrome (disorder)
Congenital viral pneumonia (disorder)	Congenital viral pneumonia (disorder)
Viral pneumonia associated with acquired immunodeficiency syndrome	Viral pneumonia associated with acquired immunodeficiency syndrome (disorder)
Viral pneumonia associated with acquired immunodeficiency	Viral pneumonia associated with acquired immunodeficiency

Concept Details

Expression Constraint Queries

Concept Details

Summary

Details

Diagram

Expression

Refssets

Members

References

Stated

Inferred

## Parents

- Infective pneumonia (disorder)
- Viral lower respiratory infection (disorder)

 Viral pneumonia   
(disorder)

SCTID: 75570004

75570004 | Viral pneumonia (disorder) |

en Viral pneumonia  
en Viral pneumonia (disorder)Pathological process → Infectious process  
Associated morphology → Inflammation and consolidation  
Finding site → Lung structure  
Causative agent → Virus

## Children (15)

- Adenoviral pneumonia (disorder)
- Chickenpox pneumonia (disorder)

[Taxonomy](#) [Search](#) [Favorites](#) [Refset](#)

## Search

### Options

Search Mode: Partial matching  
search mode ▾

Status: Active concepts only ▾

Group by concept

### Filter results by Language

english 133

### Filter results by Semantic Tag

disorder 40

product 1

role 1

physical object 2

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

migraine

133 matches found in 0.338 seconds.

Migraine	Migraine (disorder)
FH: Migraine	Family history: Migraine (situation)
H/O: migraine	History of migraine (situation)
Common migraine	Migraine without aura (disorder)
Ocular migraine	Ophthalmic migraine (disorder)
Complex migraine	Complicated migraine (disorder)
Basilar migraine	Basilar migraine (disorder)
Retinal migraine	Retinal migraine (disorder)
Chronic migraine	Transformed migraine (disorder)
Allergic migraine	Allergic migraine (disorder)

[Concept Details](#)[Expression Constraint Queries](#)

### Concept Details

[Summary](#)[Details](#)[Diagram](#)[Expression](#)[Refssets](#)[Members](#)

### Parents

► Vascular headache (disorder)

Migraine (disorder)



SCTID: 37796009

37796009 | Migraine (disorder) |

en Migraine (disorder)

en Migraine

Finding site → Vascular structure of head

### Children (17)

- Acute confusional migraine (disorder)
- Allergic migraine (disorder)
- Chronic mixed headache syndrome (disorder)
- Complicated migraine (disorder)

Taxonomy Search Favorites Refset

## Search

Options

Search Mode: Partial matching  
search mode ▾

Status: Active concepts only ▾

 Group by concept

## Filter results by Language

english 133

## Filter results by Semantic Tag

disorder 40

product 1

role 1

physical object 2

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

migraine

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Migraine	Migraine (disorder)
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Complex migraine	Complicated migraine (disorder)
Basilar migraine	Basilar migraine (disorder)
Retinal migraine	Retinal migraine (disorder)
Chronic migraine	Transformed migraine (disorder)
Allergic migraine	Allergic migraine (disorder)

Concept Details

Expression Constraint Queries

## Concept Details

Summary Details Diagram Expression Refsets Members Refs State

## Parents

- Acute disease of cardiovascular system (disorder)
- Acute nervous system disorder (disorder)
- Migraine (disorder)

Acute confusional migraine (disorder)

SCTID: 95653008

95653008 | Acute confusional migraine (disorder) |

en Acute confusional migraine (disorder)

en Acute confusional migraine

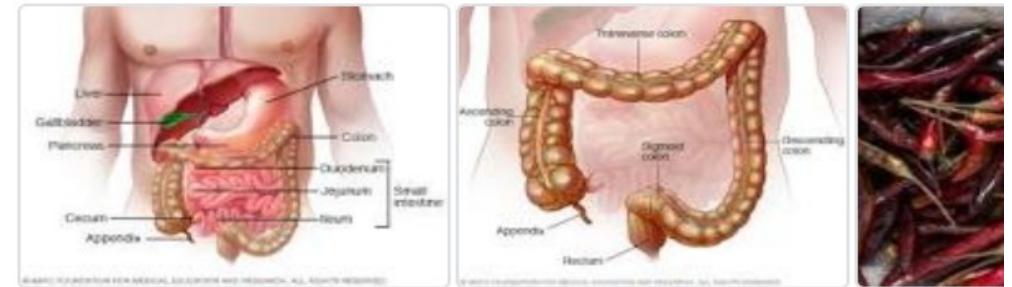
Finding site → Vascular structure of head
Finding site → Structure of nervous system
Clinical course → Sudden onset AND/OR short duration

## Children (0)

No children

# Example: EMR using SNOMED CT

- Diagnoses – e.g. Crohn's Disease
- Procedures – e.g. colonoscopy with biopsy
- Allergies – e.g. metronidazole
- Symptoms – e.g. abdominal pain
- Drugs – e.g. prednisolone

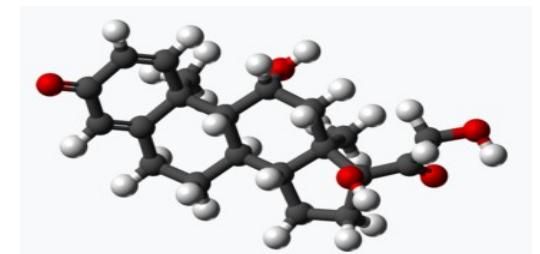


**Crohn's disease** is an inflammatory bowel **disease** (IBD).

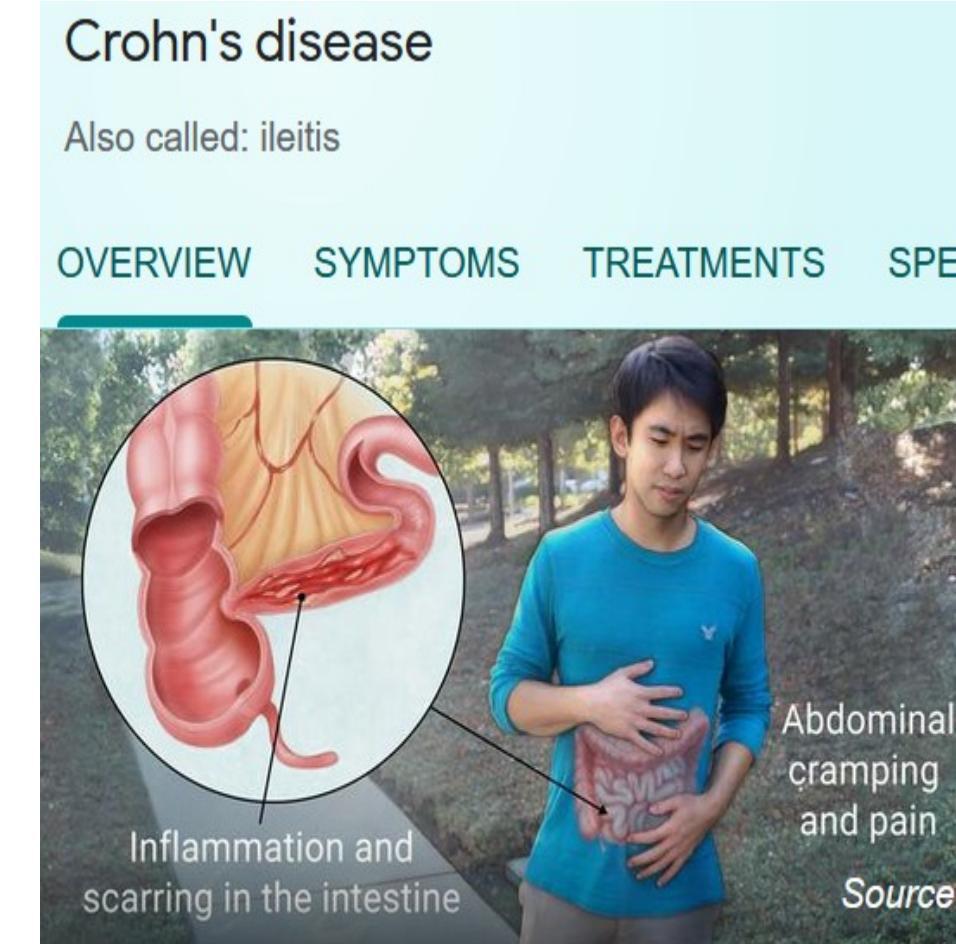
**Metronidazole Oral : Uses, Side Effects**

Metronidazole is an antibiotic that is used to treat a wide range of infections by stopping the growth of certain bacteria and parasites.

**Prednisolone** is a **steroid medication** used to treat certain types of **allergies**, **inflammatory conditions**, **autoimmune disorders**, and **cancers**.<sup>[1][2]</sup> Some of these conditions include **adrenocortical insufficiency**, **high blood calcium**, **rheumatoid arthritis**, **dermatitis**, **eye inflammation**, **asthma**, and **multiple sclerosis**.<sup>[2]</sup> It is used by mouth, injection into a **vein**, as a **skin cream**, and as **eye drops**.<sup>[3]</sup>



# What the Clinician Sees



A chronic inflammatory bowel disease that affects the lining of the digestive tract.

# Why use SNOMED CT

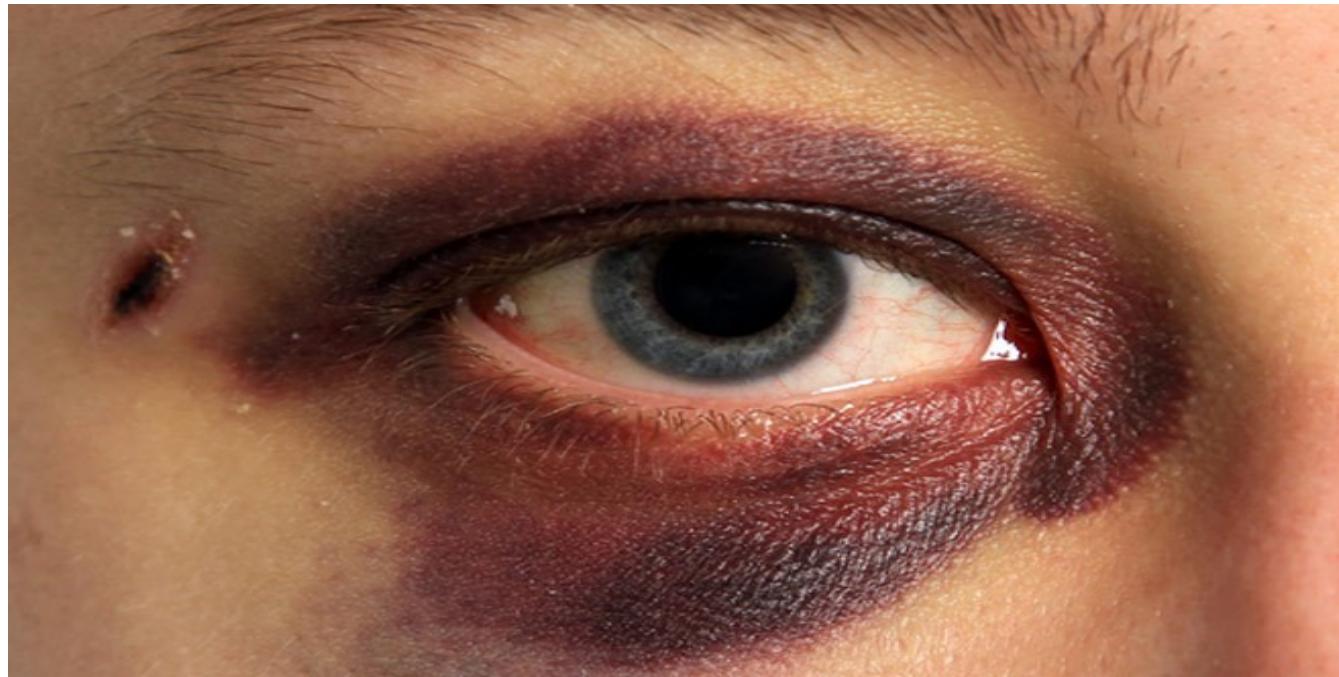
- If it is decided to admit a patient in Emergency, a structured form is completed with details of the speciality referred to and treatment required. When these are recorded in SNOMED CT they can be sent electronically to the GP so they are kept informed of key information about their patients.
- The recording of Allergies and Adverse Reactions can be critical for the effective care of a patient. Ensuring these are clearly recorded for use by other clinicians is an ideal use of SNOMED CT.
- Once the intervention has been completed a discharge summary is returned to the GP and may contain SNOMED CT terms that could be taken straight into the GP system

# Benefit: Across Professions

- Synonyms – same concept said in different ways to support cross discipline working

Patient –  
black eye

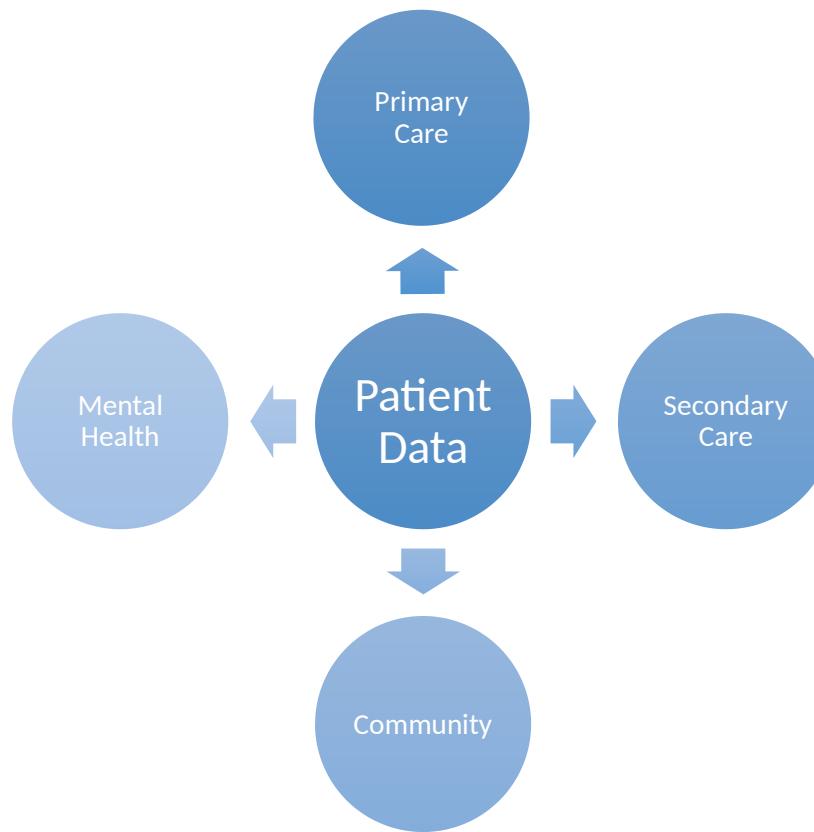
Nurse – bruise  
of eye



Doctor –  
contusion of  
eye

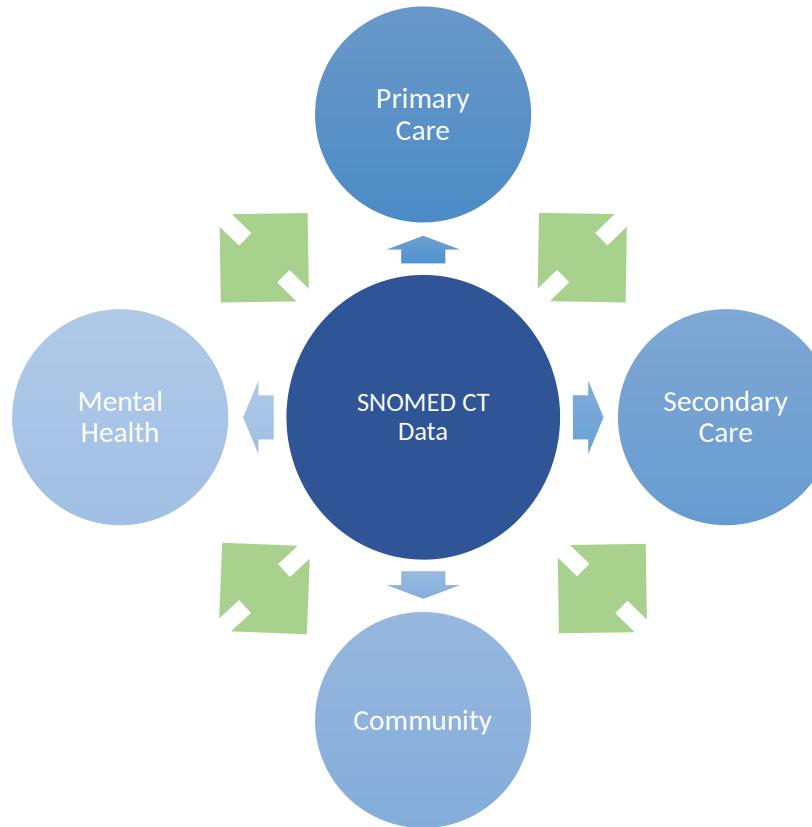
# Benefit: Across Professions

- Across primary, secondary, community, social care, mental health



# Benefit: Communication – “Connect all”

- Seamless transfer - coded information to be electronically communicated - without mapping

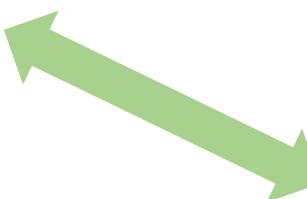


# Benefit: Communication – “Connect all”

- Translated into different languages: Spanish, French, Swedish, Danish ... Work starting in Lithuanian, Polish



morphine allergy



morfín allergi



# More Benefits

- Across different specialisms: orthopaedics, cardiology, renal, microbiology, histopathology ...
- Across primary, secondary, community, social care, mental health
- Synonyms – same concept said in different ways to support cross discipline working
- Seamless transfer - coded information to be electronically communicated - without mapping
- Translated into different languages: Spanish, French, Swedish, Danish ... Work starting in Lithuanian, Polish

# More Benefits

- Suppliers in different countries using the same terminology
- Potential for improved functionality of systems as supporting just one terminology
- Collaborative effort: more cost effective
- Links with other international standards – eg. World Health Organisation

# SNOMED Graph

Thrombin embedded bandage (ID 412025006) is tagged with both (PO, 6) and (PB, 3)

Input: SNOMED CT  
(Stated Relationships)

sourceId	destinationId	typeId
412025006	353983009	116680003
412025006	411972006	116680003
412025006	411973001	127489000
...		

## 1. Graph Transformation

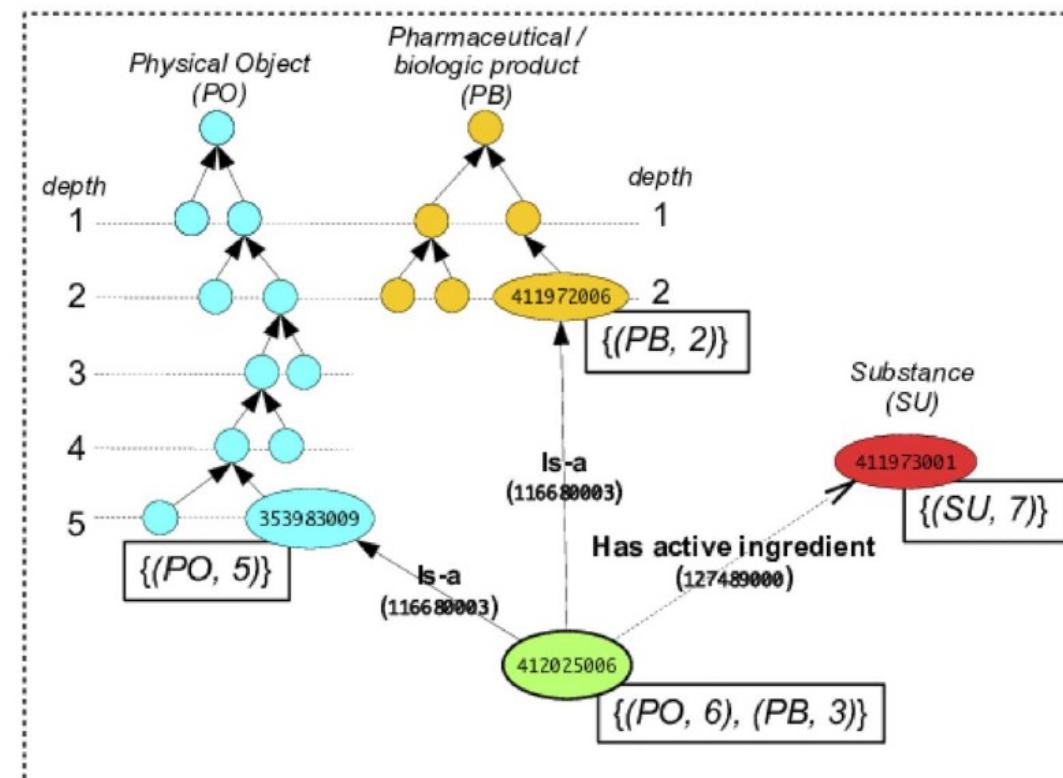
## 2. Sub-hierarchy and Depth Tagging

- 353983009  
Medicated dressing
- 411972006  
Antihaemorrhagic bandage
- 411973001  
Bovine thrombin

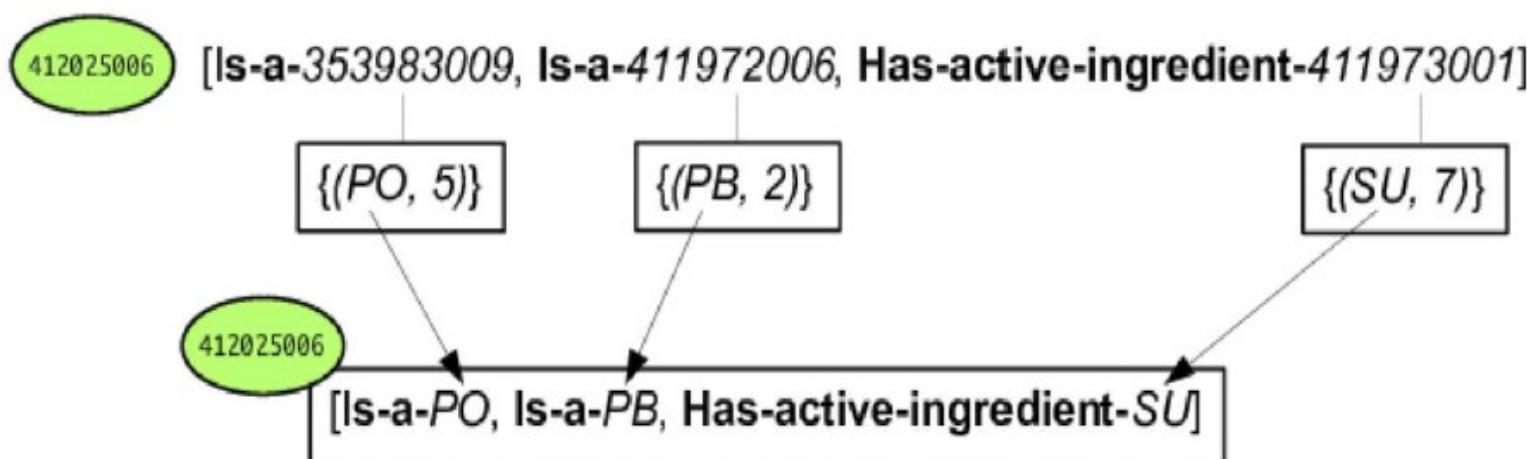
$\{(SH, d)\}$



SNOMEDCT\_GRAPH (after Step 2)



### 3. Structural Patterns Calculation



### 4. Output File Generation



Output: Structural Patterns File

ConceptId	SH	Depth	Pattern
412025006	PO	6	['116680003-PB', '116680003-PO', '127489000-SU']
412025006	PB	3	['116680003-PB', '116680003-PO', '127489000-SU']
...			

# Sub-hierarchies of SNOMED

1. Ten sub-hierarchies contained only one structural pattern: Environment or geographical location, Observable entity, Organism, Physical force, Qualifier value, Record artifact, Social context, Special Concept, Substance, and Staging and scales. The structural patterns found were inevitably taxonomic (*is-a* links are the minimum structural pattern), linking concepts to their own sub-hierarchy. According to the SNOMED CT concept model, no attribute relationships are foreseen for the content of these sub-hierarchies.

2. One sub-hierarchy, Body structure, contained two structural patterns:

• Body structure:	(1) [Is-a-Body structure]
	(2) [Is-a-Body structure, Is-a-Qualifier value]

Interestingly, no patterns with the **Part of** relationship were obtained using our method because **Part of** is not included in the stated relationships file of SNOMED CT. Partitive relationships between anatomy concepts are currently expressed using *is-a* relationships among Body structure concepts, following the SEP triplet modeling pattern [29].

3. The Physical object sub-hierarchy was the only one showing three patterns:

• Physical object:	(1) [Is-a-Physical object]
	(2) [Is-a-Physical object, Is-a-Pharmaceutical / biologic product]
	(3) [Is-a-Physical object, Is-a-Pharmaceutical / biologic product, Has active ingredient-Substance]

4. Procedure (PR, 587) and Clinical finding (CF, 195) alone accounted for 92% of the total patterns found. There were a small number of patterns among Specimen (SN, 28), Situation with explicit context (SI, 15), Event (EV, 8), and Pharmaceutical and biologic product (PB, 6).

## Parents

SNOMED CT Concept (SNOMED RT+CTV3)

Qualifier value  
(qualifier value)

SCTID: 362981000

362981000 | Qualifier value  
(qualifier value) |

en Qualifier value (qualifier value)  
en Qualifier value

No attributes

## Children (65)

- Action (qualifier value)
- Additional dosage instructions (qualifier value)
- Additional values (qualifier value)
- Alphanumeric entity (qualifier value)
- Anatomic reference point (qualifier value)
- Any hazardous entity (qualifier value)
- Basic dose form (basic dose form)
- Benefits, entitlements and rights (qualifier value)
- Classification system (qualifier value)
- Clinical specialty (qualifier value)
- Context values (qualifier value)

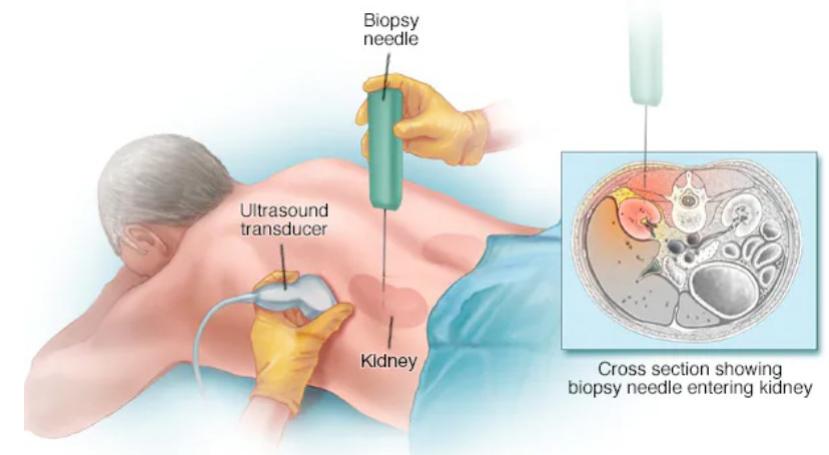
# SNOMED Hierarchies

Table 3. Distribution of structural patterns, attributes, and concepts among SNOMED CT's 18 top-level sub-hierarchies.

	SNOMED CT Top-level Sub-hierarchy	Structural Patterns	Attributes	Concepts
PR	Procedure	587	29	54 063
CF	Clinical finding	195	16	102 217
SN	Specimen	28	5	1 455
SI	Situation with explicit context	15	7	3 762
EV	Event	8	5	3 665
PB	Pharmaceutical / biologic product <sup>a</sup>	6	2	16 965
PO	Physical object <sup>a</sup>	3	2	14 288
BS	Body structure	2	2	30 774
EG	Environment or geographical location	1	0	1 814
OE	Observable entity	1	0	8 372
OR	Organism	1	0	32 912
PF	Physical force	1	0	170
QV	Qualifier value	1	0	9 363
RA	Record artifact	1	0	225
SO	Social context	1	0	4 710
SP	Special concept	1	0	648
ST	Staging and scales	1	0	1 325
SU	Substance	1	0	24 719
	<b>TOTAL<sup>a</sup></b>	<b>852</b>	<b>68</b>	<b>311 436</b>

Table 2. Stated relationships and structural pattern for the SNOMED CT concept “*Fine needle biopsy of kidney (procedure)*” in the stated version. See [Table 3](#) for sub-hierarchy abbreviations.

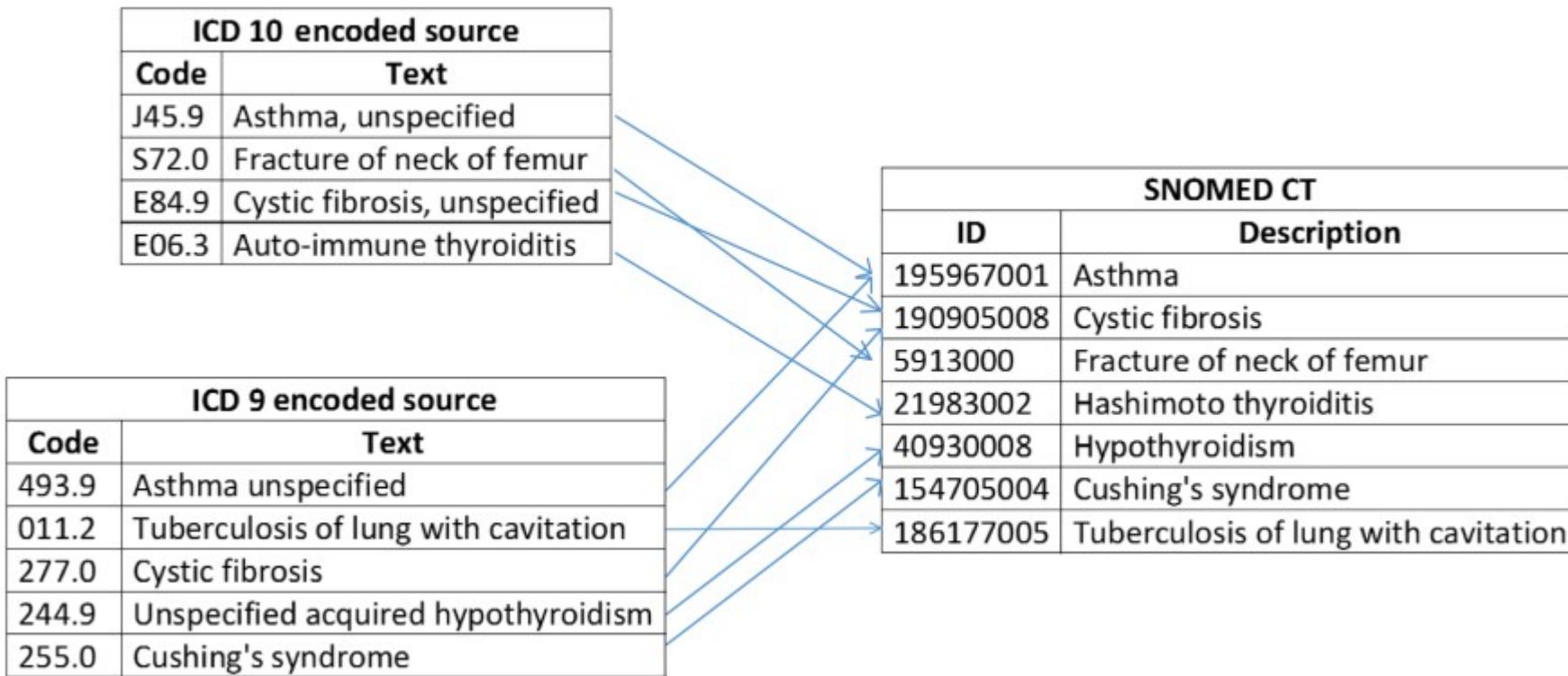
Stated Relationships	Structural Pattern
<b>Is-a</b> <i>Fine needle biopsy</i>	<b>Is-a</b> <i>Procedure</i>
<b>Is-a</b> <i>Kidney biopsy</i>	<b>Is-a</b> <i>Procedure (duplicate)</i> <b>Notation:</b> [Is-a-PR]
<b>Method</b> <i>Fine needle aspiration biopsy</i>	<b>Method</b> <i>Qualifier value</i>
<b>Procedure site</b> — <i>Direct Kidney structure</i>	<b>Procedure site</b> — <i>Direct Body structure</i>
<b>Using device</b> <i>Fine biopsy needle, device</i>	<b>Using device</b> <i>Physical object</i> <b>Notation:</b> [Method-QV, Procedure site—Direct-BS, Using device-PO]



# SNOMED issues

- Quality issues
  - 51% of SNOMED CT concepts did not exhibit any descriptive difference between parent and child.
  - 12% of SNOMED CT concepts contained redundant axioms in their descriptions, i.e., clauses that are stated in the formal description of a given concept but which can also be inferred from a parent.
  - 18 000 SNOMED CT concepts for which the wording suggested a connection to other concepts, but such connections were missing.

# Mapping between SNOMED and ICD



# ICD 10

- **Parent:** M71.34, Other Bursal Cyst, Hand
- **siblings:** M71.341, Other Bursal Cyst, Right, M71.342, Other Bursal Cyst, Left Hand
- **Diagnostic Category:** 08
- **Chronic Condition Indicator:** No
- **Billable:** Yes

<https://icd.who.int/browse10/2019/en> (WHO)

<https://icd10cmtool.cdc.gov/> (CDC)



# SNOMED CT



- **Has Parents:** 248519003 Lump on Extremities (Finding); 128597007 Disorder of Digit (Disorder); 445008009 Ganglion Cyst (Disorder)
- **Has an Associated Morphology:** 71307009 Ganglion Cyst (Morphologic Abnormality)
- **Has a Finding Site:** Digit Structure (Body Structure)
- **Is A:** 445008009 Ganglion Cyst (Disorder)
- **Is A:** 248519003 Lump on Extremities (Finding)
- **Is A:** 128597007 Disorder of Digit (Disorder)
- **Synonyms:** Digital Myxoid Cyst, Digital Synovial Cyst, Digital Mucous Cyst

# SNOMED in Diagnosis



## Radiology (e.g. Appropriate Imaging)

A clinician records notes into the appropriate fields of an EHR. For example, Clinical notes: "Pt is 75 yo. LBP (lower back pain) for the past 2 weeks. On exam normal SLR (straight leg raise)..." Using NLP, these notes are encoded as part of the record storage process. (For example, as **Low back pain** and **On examination - straight leg raising normal - left right**.) The clinician orders a series of imaging tests. The CDSS, based on specific quality metrics (e.g., appropriate use criteria or AUC), evaluates whether or not imaging guidelines are being followed by analyzing the patient's health record together with the proposed tests. If the guidelines were not followed, the CDSS will display an alert informing the clinician that they may want to consider alternative imaging or additional tests. For example, an alert may indicate: "The patient has **Low back pain** and **Numbness of lower limb**. A **MRI of lumbar spine without contrast** for this case has an appropriateness rating of 8 (scale of 10) and is recommended."

## Parents

- ▶ Backache (finding)
- ▶ Finding of abdominopelvic segment of trunk (finding)

### Low back pain

SCTID: 279039007

279039007 | Low back pain (finding) |

- en** Low back pain (finding)
- en** Low back pain
- en** LBP - Low back pain
- en** Low back syndrome
- en** Lumbago
- en** Lumalgia
- en** Lumbar pain
- en** Nonspecific pain in the lumbar region

Finding site → Structure of lumbar region of back

## Children (15)

- Acute low back pain (finding)
- Chronic low back pain (finding)
- Intractable low back pain (finding)
- Low back pain in pregnancy (finding)
- ▶ Lumbago with sciatica (disorder)



## Infectious Disease Reporting

A primary care physician logs on to their EHR with CDS and opens a patient chart to record a condition deemed communicable, such as [Mumps](#) or [Measles](#). The CDSS then triggers an alert to advise the provider that this condition is considered reportable to the jurisdictional public health office. The CDSS then provides a pre-populated smart form which facilitates quick, consistent, and accurate reporting of the condition to the local officer of medical health. The smart form is completed and submitted to the jurisdictional health office. The clinical findings in the report are terminology-encoded which promotes interoperability and facilitates population based health reporting.

### Parents

-  [Infection caused by Rubulavirus \(disorder\)](#)

 [Mumps \(disorder\)](#)  

SCTID: 36989005

[36989005 | Mumps \(disorder\) |](#)

[en Mumps \(disorder\)](#)  
[en Mumps](#)

Pathological process →  
Infectious process  
Causative agent → Mumps virus

### Children (19)

-  [Dacryoadenitis caused by mumps virus \(disorder\)](#)
-  [Mastitis of mumps \(disorder\)](#)
-  [Mumps acute sialadenitis \(disorder\)](#)
-  [Mumps arthritis \(disorder\)](#)
-  [Mumps encephalitis \(disorder\)](#)



## Acute Asthma Management



Staff in an Emergency Department (ED) use their EHR with CDS and clinical management pathways to provide a standardized evidence-based approach to patient assessment of **A** acute asthma in adults<sup>3</sup>. The guidelines help document indications and contraindications to determine eligibility. A triage nurse queries the EHR and learns that the patient is over 16 years of age, has a **Acute asthma**, and one or more episode of **Wheezing** which necessitated **Breathing treatment**. The CDSS then triggers an alert to follow the pathway's medical directives, which are carried out by a Respiratory Therapist (RT). The directives, in this case of **Mild asthma**, include **Heart rate monitoring**, establishing various baseline **Respiratory measurements**, and administration of a **Bronch dilator** and **Prednisone 50mg tablet**. The RT then notifies the attending physician who fills out and signs discharge instructions which a nurse then reviews with the patient. The desired clinical outcomes of this pathway include improved adherence to evidence-based management and improved patient outcomes such as reduced number of hospitalizations and lower ED return rates.

## Parents

- **Cardiac monitoring (regime/therapy)**



### Cardiotachometry (regime/therapy)

SCTID: 47101004

47101004 | Cardiotachometry (regime/therapy) |

**en** Cardiotachometry (regime/therapy)

**en** Cardiotachometry

**en** Heart rate monitoring

Method → Monitoring - action  
Procedure site → Structure of cardiovascular system

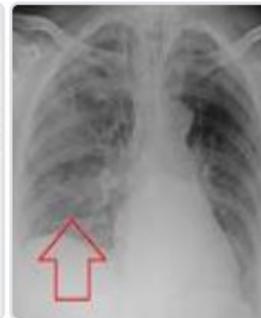
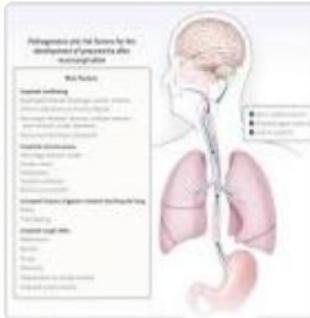
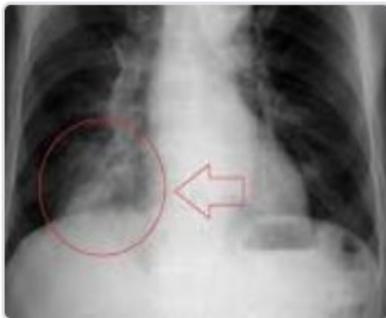
## Children (3)

- **Cardiotachometer monitoring (regime/therapy)**
- **Monitoring of pacemaker (regime/therapy)**
- **Monitoring of pulse (regime/therapy)**



## Nursing Interventions

Research has provided evidence to show that patients receiving **Mechanical ventilation** are at high risk for **Pneumonia** : due to = **Aspiration**.<sup>4</sup> Published guidelines recommend **Elevation of head of bed** from 30° to 45°, if not contraindicated, to reduce risk of **Pneumonia**. A nursing supervisor uses a dashboard-like tool in an ICU to monitor patients in her ward. Patients who meet the criteria for risk of **Aspiration pneumonia** are automatically flagged in the system using CDS logic so that the appropriate action may be initiated by nursing staff in the ward. Once the angle of the patient's bed is adjusted, the system is dynamically updated and the flag is removed.



**Aspiration pneumonia** is a lung infection that develops after you **aspirate** (inhale) food, liquid, or vomit into your lungs. You can also **aspirate** food or liquid from your stomach that backs up into your esophagus.

## Parents

► **Procedures relating to positioning and support (procedure)**

**Elevation of head of bed (procedure)**

SCTID: 423171007

423171007 | **Elevation of head of bed (procedure)** |

en **Elevation of head of bed (procedure)**

en **Elevation of head of bed**

en **Elevate head of bed**

No attributes

## Children (0)

No children



## Medication Management

A clinician uses an EHR with CDS to prescribe [Warfarin sodium 4mg tablet](#). The CDSS queries the EHR and discovers that the patient is [Pregnant](#). The CDSS determines that the proposed drug has [Warfarin](#) as an ingredient. As warfarin is contraindicated during pregnancy, the system triggers an alert to be displayed to the clinician. Relevant clinical guidelines are also displayed to the user. These guidelines suggest a safe alternate, such as [Dabigatran](#), which the clinician then safely prescribes to the patient.

### Parents

➤  Product containing only warfarin in oral dose form (medicinal product form)

 Product containing precisely warfarin sodium 4 milligram/1 each conventional release oral tablet (clinical drug)  
SCTID: 375374009

375374009 | Product containing precisely warfarin sodium 4 milligram/1 each conventional release oral tablet (clinical drug) |

*en* Product containing precisely warfarin sodium 4 milligram/1 each conventional release oral tablet (clinical drug)  
*en* Warfarin sodium 4 mg oral tablet

Has manufactured dose form → Conventional release oral tablet  
Has unit of presentation → Tablet  
Count of base of active ingredient → 1  
Plays role → Anticoagulant therapeutic role

Has precise active ingredient → Warfarin sodium  
Has basis of strength substance → Warfarin sodium  
Has presentation strength numerator value → 4  
Has presentation strength numerator unit → milligram  
Has presentation strength denominator value → 1  
Has presentation strength denominator unit → Tablet

Children (0)

## Parents

▶  Finding context value (qualifier value)

 Unknown (qualifier value)		<input type="checkbox"/>
SCTID: 261665006		
261665006   Unknown (qualifier value)		
en Unknown (qualifier value)		
en Unknown		

## Children (0)



### Diagnosis (e.g. Diabetes)

A clinician uses an EHR with CDS in a case analysis scenario to aid in diagnosis. The clinician records the patient's age and gender, then prepares to enter specific clinical findings, history, symptoms, etc. As the physician records symptoms of |Hunger|, |Fatigue|, and |Dry mouth|, a ranked list of common diseases, associated with these clinical findings, is dynamically presented to the clinician. At the top of this list is |Diabetes mellitus|. A scale is used to indicate the level of support for each disease. The CDSS then prompts the clinician for additional findings to help differentiate between diseases. Once a confirmed diagnosis is made, the differential diagnoses can be marked as |Absent|, |Present|, or |Unknown|. An additional finding of |Always thirsty| is recorded and the level of support for each disease in the list is adjusted accordingly. Support for |Diabetes mellitus| has now increased from minimal evidence to sufficient evidence. The clinician then selects |Type 2 diabetes mellitus| which opens an evidence screen displaying the recorded findings which either strongly support, support, or do not support the chosen disease. The clinician is then presented with a link that displays all the PubMed articles associated with |Type 2 diabetes mellitus|.



## Laboratory

(e.g. Critical Results) 

A patient presented at Emergency complaining of **Chest pain** and was subsequently admitted to the hospital. The attending physician ordered a series of lab tests including a **Serum potassium measurement**. Laboratory tests are completed and published to the laboratory information system (LIS). The CDSS then queries the LIS and learns that the **Potassium level** is **Low serum potassium level** and considered critical. The CDSS then queries the EHR to confirm the patient has been prescribed **Oral form digoxin**, which has **Digoxin** as an active ingredient. A knowledge base rule has been defined which stipulates, if the drug prescribed contains **Digoxin** and the laboratory test indicates a **Low serum potassium level**, then inform the user. An alert, in the form of an urgent pager message, is generated and sent to the attending physician.

A **low** level of **potassium** in the body can increase the risk of **digitalis** toxicity. **Digitalis** toxicity may also develop in people who take **digoxin** and have a **low** level of magnesium in their body. Apr 14, 2019

### Parents

-  Class IV antiarrhythmic agent (substance)
-  Digitalis glycoside (substance)

 **Digoxin (substance)** ★  

SCTID: 387461009

387461009 | Digoxin (substance) |

*en* Digoxin (substance)  
*en* Digoxin

Children (0)



Radiology  
(e.g. Contraindication)

An ordering physician has requested an upper [Gastrointestinal tract x-ray](#), which uses [Barium sulfate](#) materials. The patient presents at the imaging clinic on the day of their exam. During study protocoling, the imaging department uses the CDSS to query the patient record and determine the patient has a [History of hay fever](#). An alert is triggered to advise the imaging technician about the risk of an allergic reaction. The imaging department, in consultation with the GI radiologist, calls the ordering doctor to discuss the associated risks. Additional guidelines related to preparing for reactions and symptom management ([Hives](#), [Itching](#), [Swelling](#), etc.) are provided via the CDSS. An additional medication is administered prior to the contrast material to reduce the risk of an allergic reaction. The imaging department proceeds with the planned procedure.

Parents

➤ [Absence findings \(qualifier value\)](#)



[Not itching \(qualifier value\)](#)



[No attributes](#)

SCTID: 260416004

260416004 | [Not itching \(qualifier value\)](#) |

*en* [Not itching \(qualifier value\)](#)

*en* [Not itching](#)

Children (0)

# Clinical Note 2

- 23 F with h/o Lupus, ESRD not on HD (planned PD), labile hypertension, RUE VTE on anticoagulation, recent facial swelling who presents with hypertensive emergency. Patient developed severe frontal HA last evening, a/w nausea. BP was not [\*\*Location (un) 1131\*\*] on home BP cuff. In the AM her HA was severe [\*\*10-20\*\*] a/w nausea and vomiting yellow/green liquid and BP cuff again not able to obtain BP. Patient was last seen by VNA this past Friday with BP 130/70. Patient denies any CP, shortness of breath, abd pain. Her facial swelling is slightly worse today. She denies any weakness, dizziness, difficulty with speech, no numbness or tingling. She says that she is compliant with all of her medications. She denies any GU/GI complaints despite +UA in ED.

## Parents

-  General body state finding (finding)
-  General well-being finding (finding)

 Dizziness (finding)



SCTID: 404640003

404640003 | Dizziness (finding) |

en Dizziness (finding)

en Dizziness

en Dizzy

Interprets → General wellbeing

## Children (10)

-  Dissociative neurological symptom disorder co-occurrent with
-  Dizziness and giddiness (finding)
-  Dizziness due to drug (disorder)
-  Dizziness of unknown cause (finding)
-  Dizziness on standing up (finding)
-  Dizzy spells (finding)
-  Exertional dizziness (finding)
-  Oscillation of surroundings (finding)
-  Postural dizziness (finding)

# Data analysis using SNOMED

NLP  
extraction

The patient is a frail 88-year-old caucasian male was admitted to our hospital for complaints of **nausea** and **vomiting** and suspected **urinary tract infection**.

He has a past medical history of **hypertension**, **atrial fibrillation** and chronic right **hip pain** after total hip replacement in 2012.

The patient was started on antibiotics. **Urine culture** confirmed an **E. coli** urinary tract infection sensitive to trimethoprim.

During admission an episode of possible **coffee ground vomiting** coupled with his non-steroidal inflammatory drug use prompted an **upper GI endoscopy** at which no abnormality was detected. **Fecal occult blood was negative**.

The patient was also provided with **physiotherapy** and fully remobilised.

## Clinical Findings

Concept ID	Preferred term
16932000	Nausea and vomiting
68566005	Urinary tract infectious disease
38341003	Hypertensive disorder
49436004	Atrial fibrillation
49218002	Hip pain
301011002	Escherichia coli urinary tract infection
40835002	Coffee ground vomiting
167667006	Fecal occult blood: negative

## Procedures

Concept ID	Preferred term
52734007	Total replacement of hip
117010004	Urine culture
76009000	Esophagogastroduodenoscopy
91251008	Physical therapy procedure

# NLP extraction with context

The patient is a frail 88-year-old caucasian male was admitted to our hospital for complaints of **nausea** and **vomiting** and suspected **urinary tract infection**.

He has a past medical history of **hypertension**, **atrial fibrillation** and chronic right **hip pain** after **total hip replacement** in 2012.

The patient was started on antibiotics. **Urine culture** confirmed an **E. coli urinary tract infection** sensitive to trimethoprim.

During admission an episode of possible **coffee ground vomiting** coupled with his non-steroidal inflammatory drug use prompted an **upper GI endoscopy** at which no abnormality was detected. **Fecal occult blood was negative**.

The patient was also provided with **physiotherapy** and fully remobilised.

## Clinical Findings

Concept ID	Preferred term	Finding context	Temporal context	Subject relationship context
16932000	Nausea and vomiting	Known present	Current or specified time	Subject of record
68566005	Urinary tract infectious disease	Suspected	Current or specified time	Subject of record
38341003	Hypertensive disorder	Known present	Current or past	Subject of record
49436004	Atrial fibrillation	Known present	Current or past	Subject of record
49218002	Hip pain	Known present	Current or past	Subject of record
301011002	Escherichia coli urinary tract infection	Known present	Current or past	Subject of record
40835002	Coffee ground vomiting	Possible	Current or specified time	Subject of record
167667006	Fecal occult blood: negative	Known present	Current or specified time	Subject of record

## Procedures

Concept ID	Preferred term	Procedure context	Temporal context	Subject relationship context
52734007	Total replacement of hip	Done	Past	Subject of record
117010004	Urine culture	Done	Current or specified time	Subject of record
76009000	Esophagogastroduodenoscopy	Done	Current or specified time	Subject of record
91251008	Physical therapy procedure	Done	Current or specified time	Subject of record

# Clinical Note 3

- 62yo RH M h/o HTN, Afib on coumadin, CAD s/p PTCA x 2 in [\*\*2178\*\*] who was in USOH today when he began to have a mild right-sided headache around noon, a/w some photophobia and nausea. He was sitting at the computer half an hour later when he got up to go to [\*\*Company 7546\*\*] and noticed that his L foot was numb and "wobbly". The foot felt weak, "like it was asleep". He walked but was tripping and went to get a banana, thinking that he needed to eat something. He took his pulse which was regular and went to drive to [\*\*Company 7546\*\*]. While driving though, he felt confused and turned around. When he got home, he called his daughter and asked her if his speech was slurred, thinking he may be having a stroke. It was not and he had no difficulty speaking or comprehending what she was saying. She called 911 to get him checked out and he was brought to an OSH. There, the family noticed an increasing left facial droop. His ankle felt better. Head CT showed an ICH and INR was 2.89 and the patient was given 3U FFP, vit K 5mg IM, labetalol 10mg IV x 1 and dilantin 1g IV was started but d/c'd due to hypotension. The patient was then transferred here.

# Using ChatGPT to identify SNOMED CT Terms



I can help you identify some SNOMED CT terms from the medical note you provided.

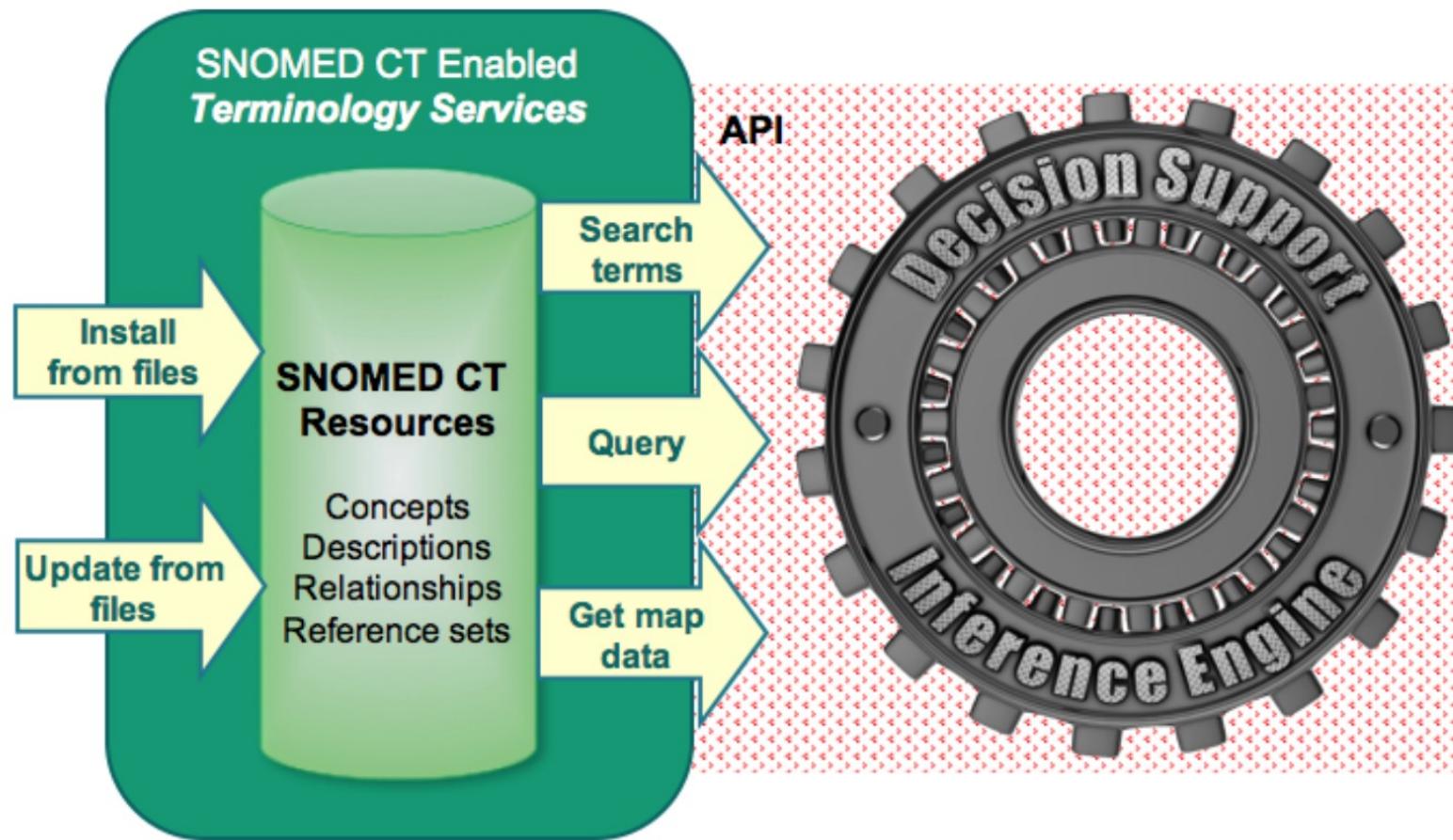
SNOMED CT (Systematized Nomenclature of Medicine - Clinical Terms) is a standardized medical terminology used for electronic health records and clinical documentation. Here are some SNOMED CT terms related to the medical note:

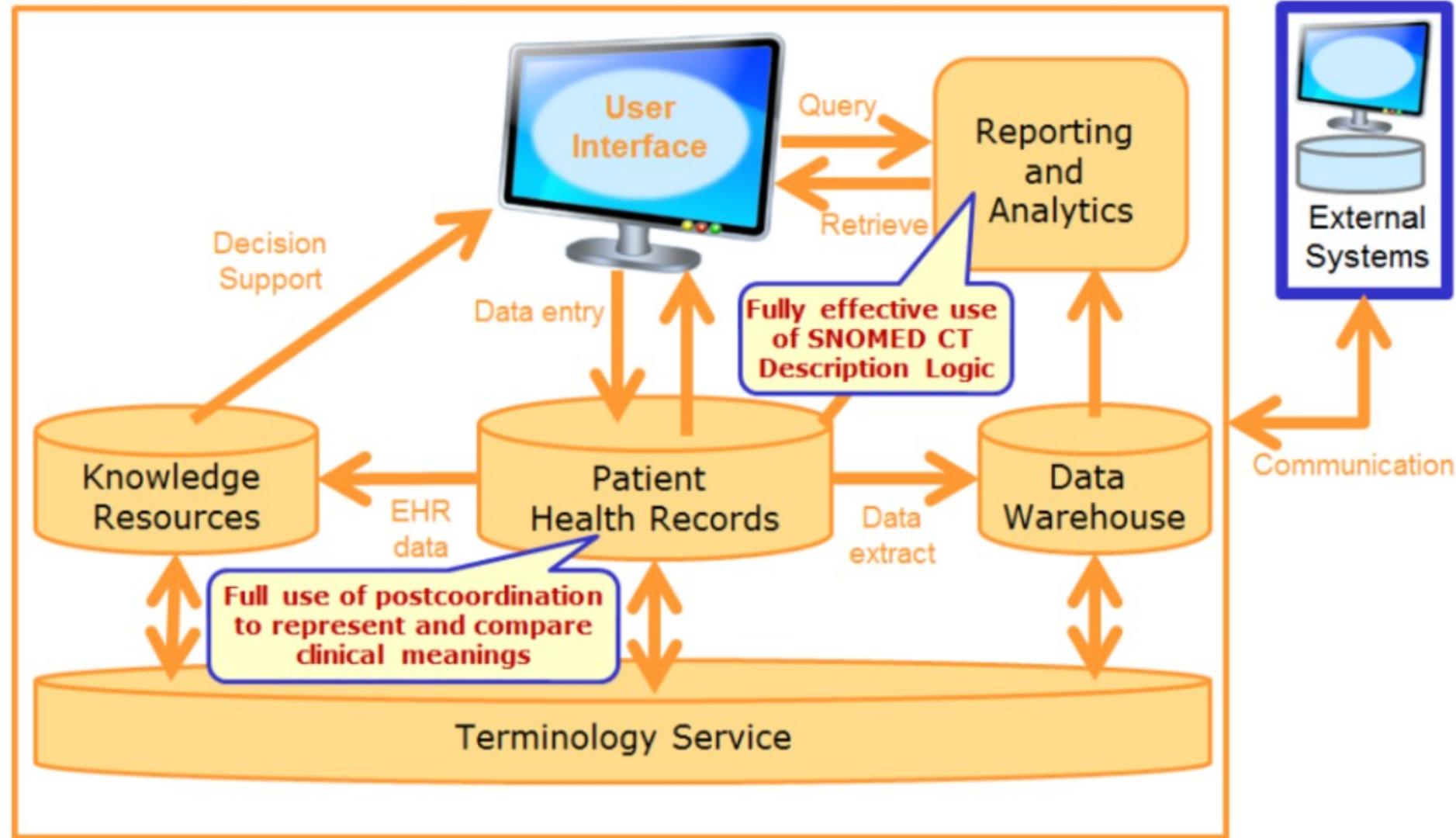
1. Hypertension (HTN) - SNOMED CT Code: 38341003
2. Atrial fibrillation (Afib) - SNOMED CT Code: 49436004
3. Coronary artery disease (CAD) - SNOMED CT Code: 53741008
4. Percutaneous transluminal coronary angioplasty (PTCA) - SNOMED CT Code: 29029007
5. Headache - SNOMED CT Code: 25064002
6. Photophobia - SNOMED CT Code: 246622003
7. Nausea - SNOMED CT Code: 422400008
8. Numbness in the left foot - SNOMED CT Code: 247592001
9. Weakness in the left foot - SNOMED CT Code: 262499000
10. Confusion - SNOMED CT Code: 404640003
11. Slurred speech - SNOMED CT Code: 28647000
12. Stroke - SNOMED CT Code: 230690007

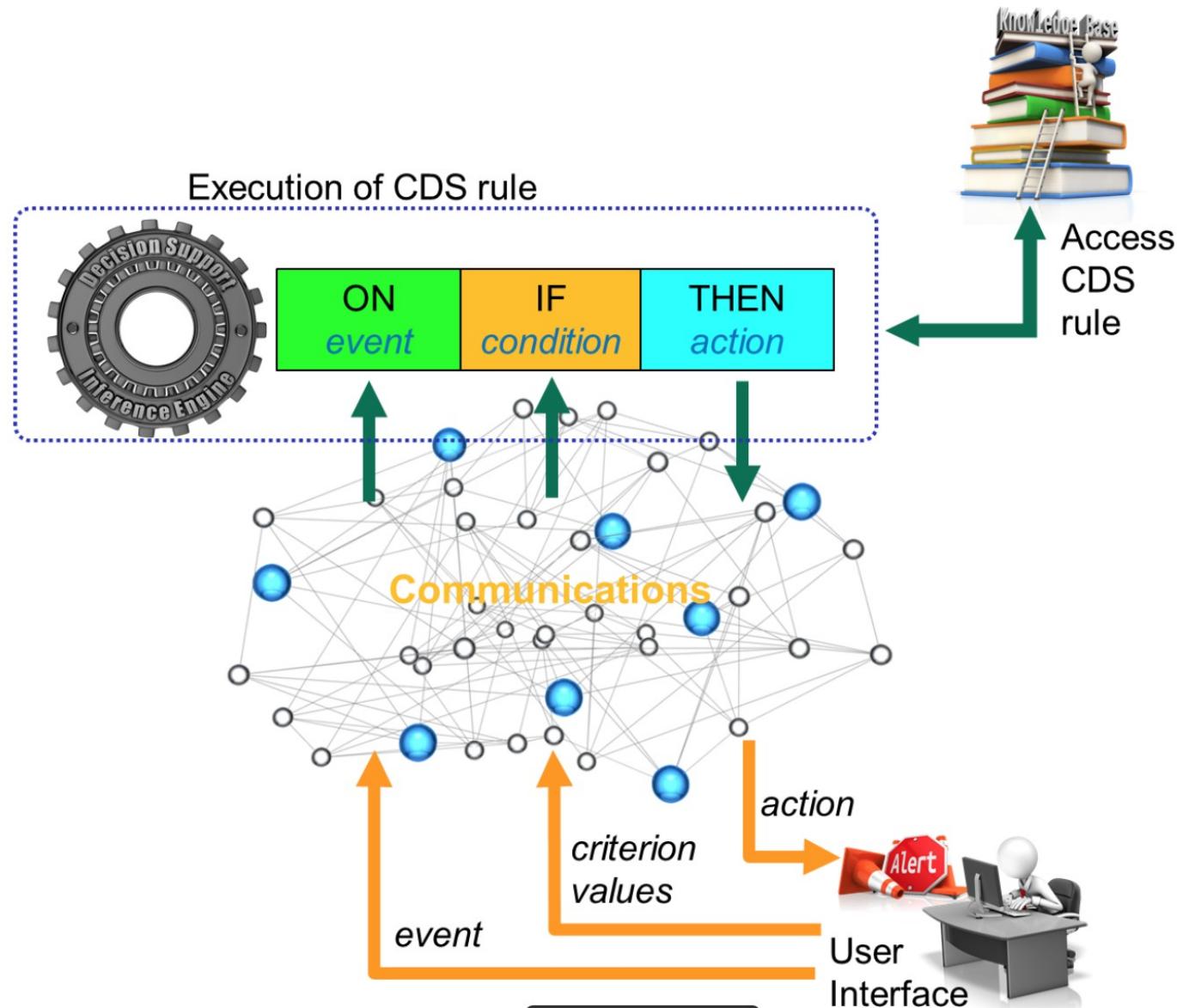
7. Nausea - SNOMED CT Code: 422400008
8. Numbness in the left foot - SNOMED CT Code: 247592001
9. Weakness in the left foot - SNOMED CT Code: 262499000
10. Confusion - SNOMED CT Code: 404640003
11. Slurred speech - SNOMED CT Code: 28647000
12. Stroke - SNOMED CT Code: 230690007
13. Facial droop - SNOMED CT Code: 424132000
14. Intracerebral hemorrhage (ICH) - SNOMED CT Code: 12816002
15. International Normalized Ratio (INR) - SNOMED CT Code: 86432003
16. Fresh frozen plasma (FFP) - SNOMED CT Code: 79944008
17. Vitamin K - SNOMED CT Code: 40801002
18. Labetalol - SNOMED CT Code: 11558411000119105
19. Dilantin - SNOMED CT Code: 11349011000119109
20. Hypotension - SNOMED CT Code: 89627008

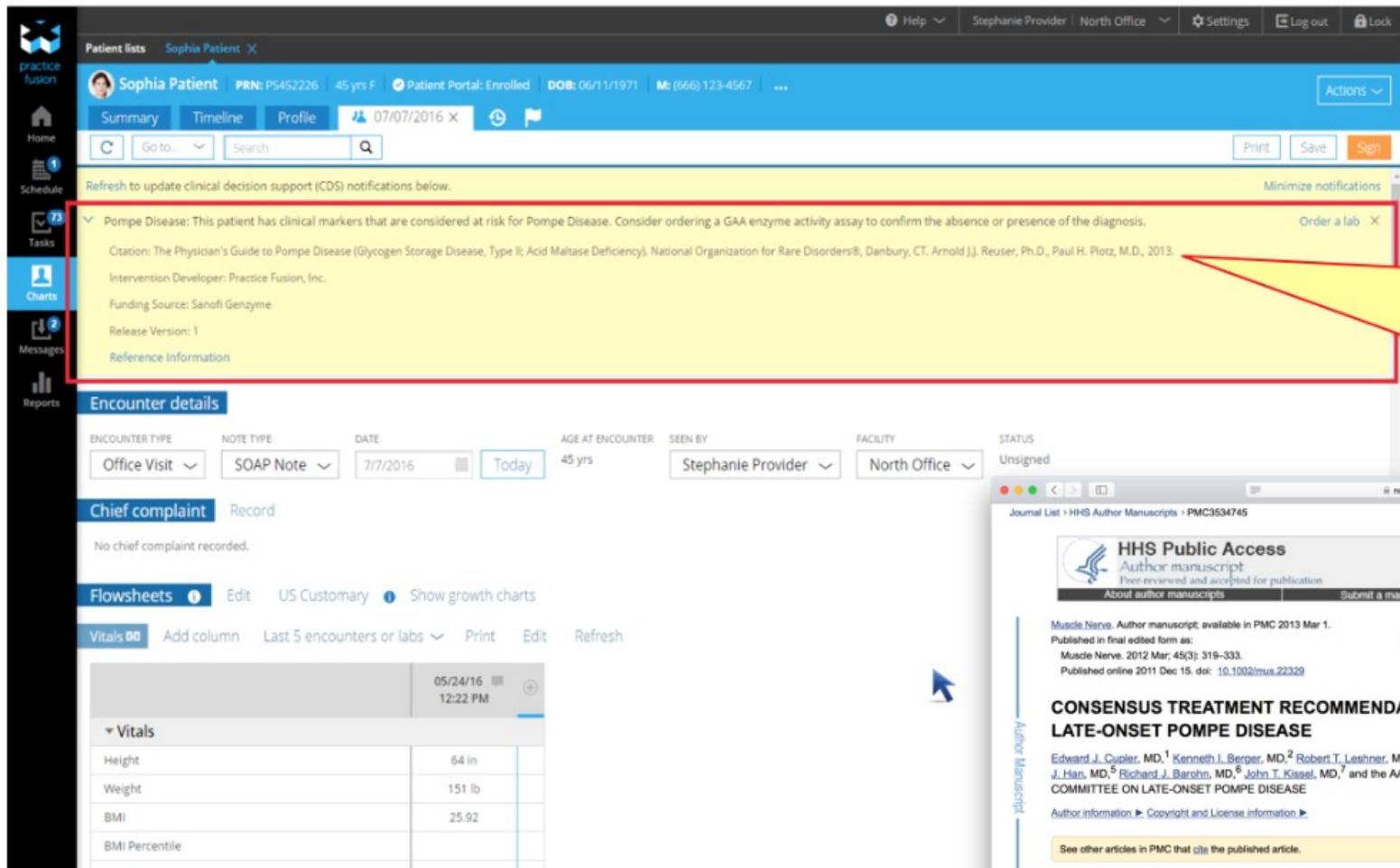
Please note that SNOMED CT codes may vary over time and are subject to updates. The codes provided here are based on information available up to my knowledge cutoff date in September 2021. Always consult the latest SNOMED CT resources for the most up-to-date codes and terminology.

# SNOMED in Clinical Decision Support System (CDSS)









Patient lists Sophia Patient X

**Sophia Patient** PRN: P545226 45 yrs F Patient Portal: Enrolled DOB: 06/11/1971 M: (666) 123-4567 ...

Summary Timeline Profile 07/07/2016 X Actions Print Save Sign

Refresh to update clinical decision support (CDS) notifications below.

**Pompe Disease:** This patient has clinical markers that are considered at risk for Pompe Disease. Consider ordering a GAA enzyme activity assay to confirm the absence or presence of the diagnosis.

Citation: The Physician's Guide to Pompe Disease (Glycogen Storage Disease, Type II; Acid Maltase Deficiency). National Organization for Rare Disorders®, Danbury, CT. Arnold JJ, Reuser, Ph.D., Paul H. Ploetz, M.D., 2013.

Intervention Developer: Practice Fusion, Inc.

Funding Source: Sanofi Genzyme

Release Version: 1

Reference Information

**Encounter details**

ENCOUNTER TYPE: Office Visit NOTE TYPE: SOAP Note DATE: 7/7/2016 AGE AT ENCOUNTER: 45 yrs SEEN BY: Stephanie Provider FACILITY: North Office STATUS: Unsigned

**Chief complaint:** Record

No chief complaint recorded.

**Flowsheets:** Edit US Customary Show growth charts

**Vitals:** Add column Last 5 encounters or labs Print Edit Refresh

	05/24/16 12:22 PM
Height	64 in
Weight	151 lb
BMI	25.92
BMI Percentile	

**CDS Notifications:**  
Patient has clinical markers that are considered a risk for Pompe Disease. Consider Ordering GAA enzyme activity assay to confirm absence or presence of diagnosis.

**Reference Information:**

[HHS Public Access](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3534745/)  
Author manuscript  
Published in final edited form as:  
Muscle Nerve. 2012 Mar; 45(3): 318–333.  
Published online 2011 Dec 15. doi: 10.1002/mus.22329

**CONSENSUS TREATMENT RECOMMENDATIONS FOR LATE-ONSET POMPE DISEASE**

Edward J. Cupler, MD,<sup>1</sup> Kenneth J. Berger, MD,<sup>2</sup> Robert T. Leshner, MD,<sup>3</sup> Gill J. Wolfe, MD,<sup>4</sup> Jay J. Han, MD,<sup>5</sup> Richard J. Barohn, MD,<sup>6</sup> John T. Kissel, MD,<sup>7</sup> and the AANEM CONSENSUS COMMITTEE ON LATE-ONSET POMPE DISEASE

Author information ► Copyright and License information ►

See other articles in PMC that cite the published article.

**Abstract**

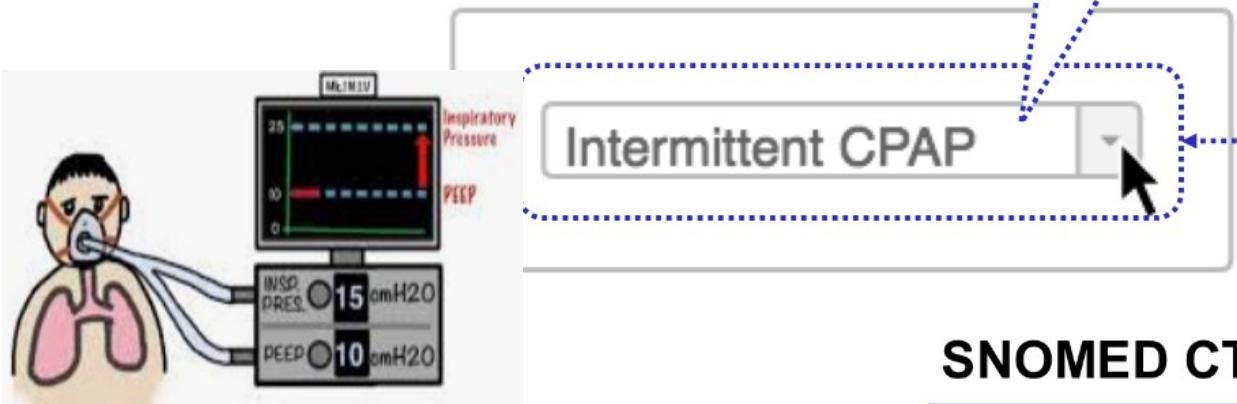
The new era of Pompe disease: advances in the detection, undiagnosis [Am J Med Genet C Semin Med Gen...]  
Pompe disease gene therapy. [Hum Mol Genet. 2011]

See reviews...  
See all...

**IF** *diagnosis* =  
^ 239999999106  
|Asthma conditions reference set|

**THEN** *display asthma  
management guidelines*

# Procedure:



- Match:
  - Yes
- Condition:
  - True
- Action:
  - Triggered

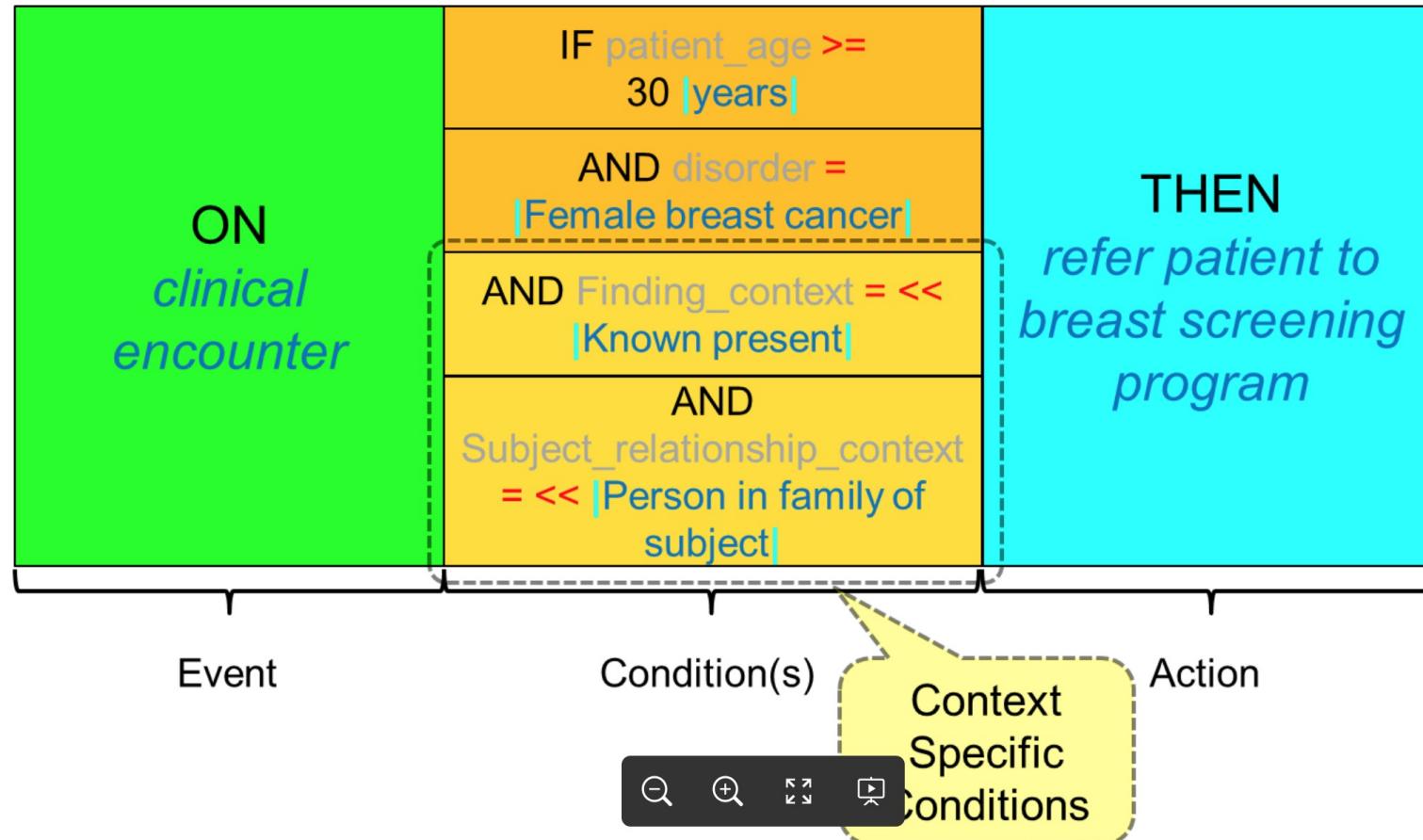
## SNOMED CT Relationships Table:

sourceld	destinationId	typeld
229308003	128258000	363702006
229308003	302803009	363702006
229308003	262202000	363703001
229308003	20139000	363704007
229308003	20139000	405813007
229308003	47545007	116680003
229308003	20139000	363704007

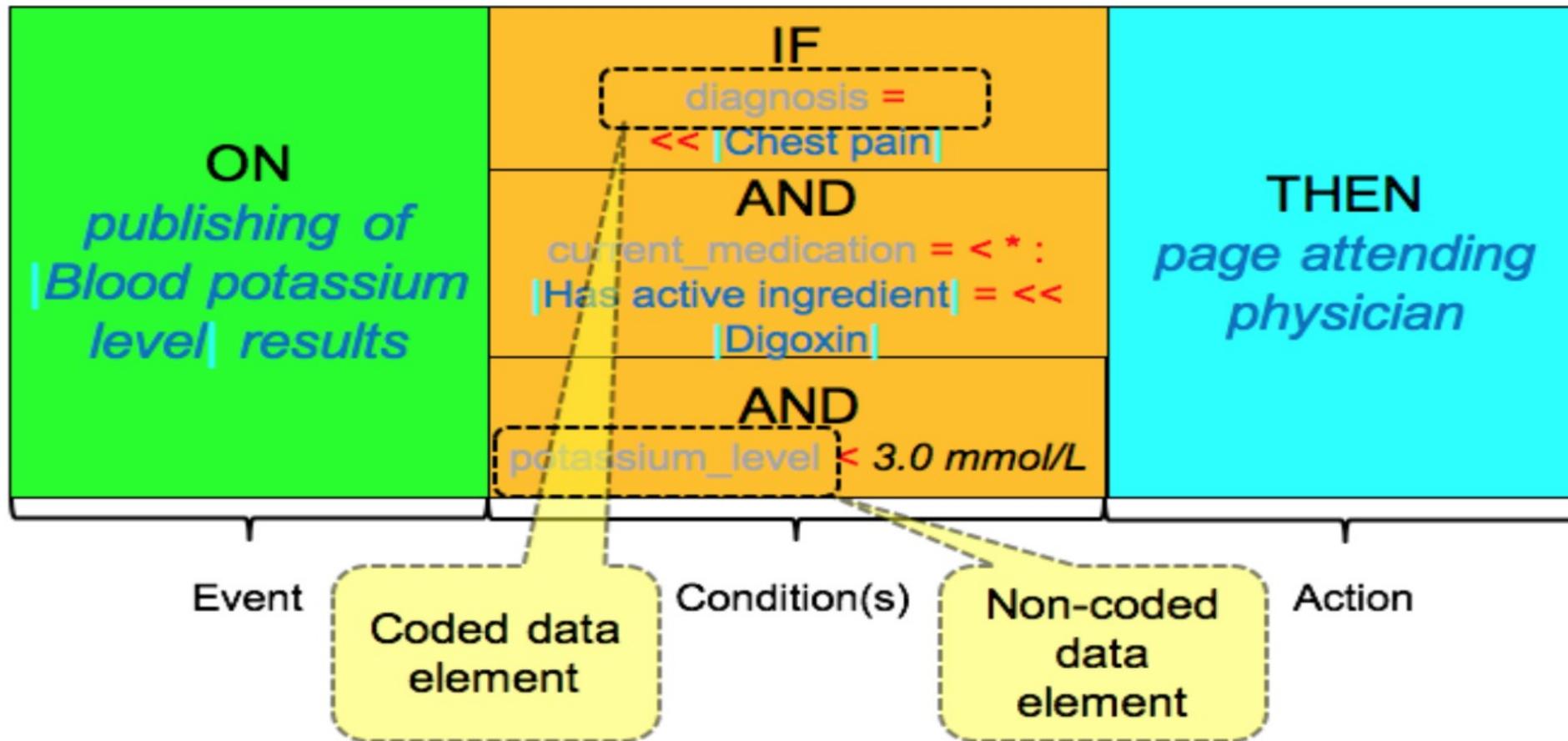
**Technique:**  
Examine Defining Relationships.

<< 71388002  
|Procedure| :  
363704007  
|Procedure site| <<  
20139000 |Structure  
of respiratory  
system|

# Clinical Decision Rules



The following example is a CDS rule designed to be used in an Emergency Department setting, when a patient has presented in the ER with chest pain. In this scenario, the attending physician may order a **|Blood potassium measurement|**. If the patient is currently taking a medication with an active ingredient of **|Digoxin|**, and the lab result is published indicating that the patient's potassium level is less than **3.0 mmol/L**, the attending physician will be paged.



## SNOMED CT Semantic Tagging:

195967001 |Asthma (disorder)|

406162001 |Asthma management (regime/therapy)|

445531003 |Asthma control questionnaire (assessment scale)|

### STEPWISE APPROACH FOR MANAGING ASTHMA LONG TERM

The stepwise approach tailors the selection of medication to the level of asthma severity (see page 5) or asthma control (see page 6). The stepwise approach is meant to help, not replace, the clinical decisionmaking needed to meet individual patient needs.

ASSESS  
CONTROL:

STEP UP IF NEEDED (first, check medication adherence, inhaler technique, environmental control, and comorbidities)

STEP DOWN IF POSSIBLE (and asthma is well controlled for at least 3 months)

At each step: Patient education, environmental control, and management of comorbidities							
0-4 years of age	Intermittent Asthma		Persistent Asthma: Daily Medication				
	Preferred Treatment <sup>1</sup>	SABA* as needed	low-dose ICS*	medium-dose ICS*	medium-dose ICS* + either LABA* or montelukast	high-dose ICS* + either LABA* or montelukast	high-dose ICS* + either LABA* or montelukast + oral corticosteroids
	Alternative Treatment <sup>1-4</sup>		cromolyn or montelukast				
	Quick-Relief Medication		<i>If clear benefit is not observed in 4-6 weeks, and medication technique and adherence are satisfactory, consider adjusting therapy or alternate diagnoses.</i>				
		<ul style="list-style-type: none"><li>SABA* as needed for symptoms; intensity of treatment depends on severity of symptoms.</li><li>With viral respiratory symptoms: SABA every 4-6 hours up to 24 hours (longer with physician consult). Consider short course of oral systemic corticosteroids if asthma exacerbation is severe or patient has history of severe exacerbations.</li><li>Caution: Frequent use of SABA may indicate the need to step up treatment.</li></ul>					

Document header  
(contains semantic tags as metadata)

Document body  
(contains clinical guideline)

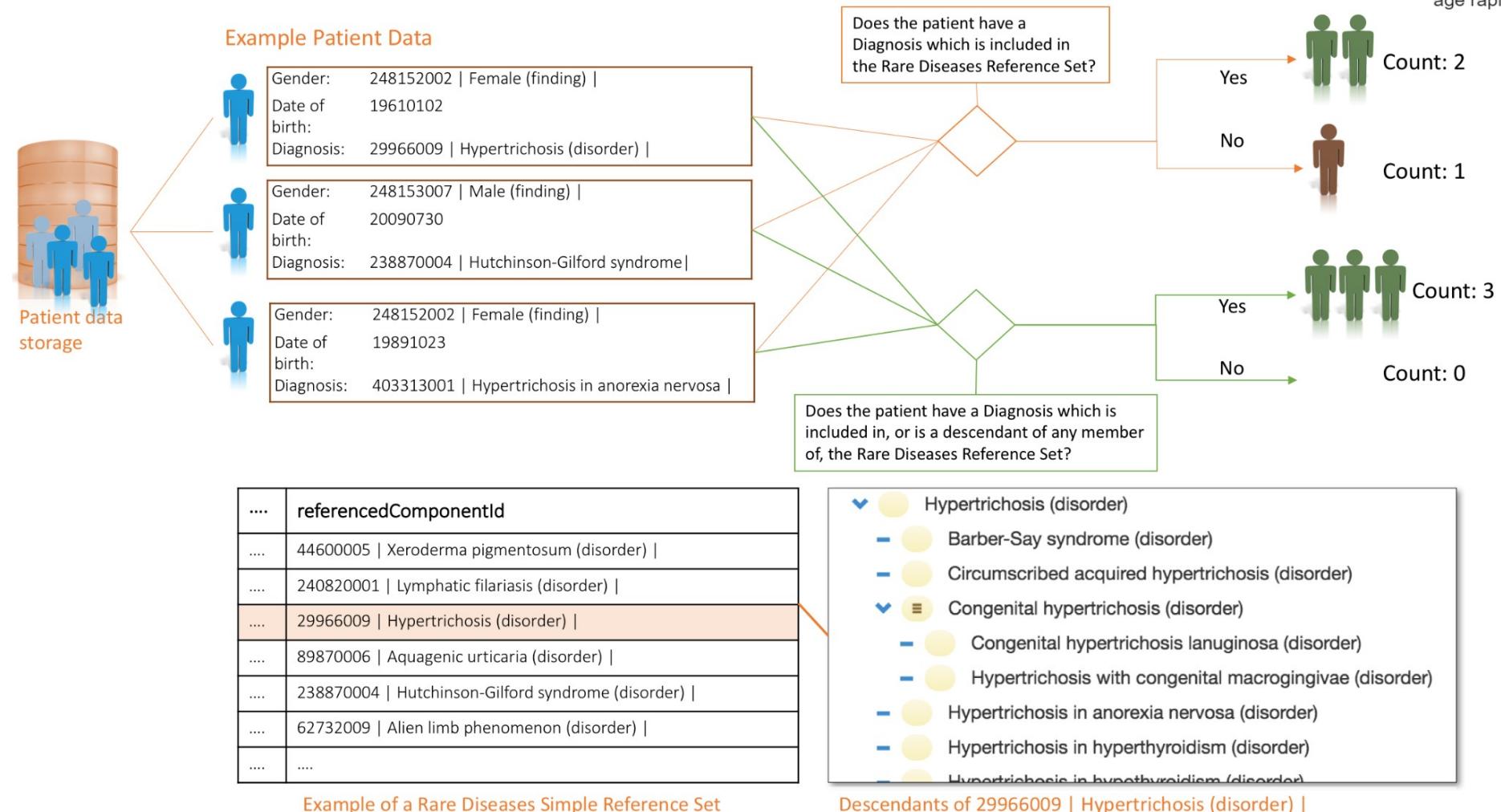
# Population Health

## Progeria

Also called: Hutchinson-Gilford progeria syndrome

OVERVIEW SYMPTOMS TREATMENTS SPE

A progressive genetic disorder that causes children to age rapidly.

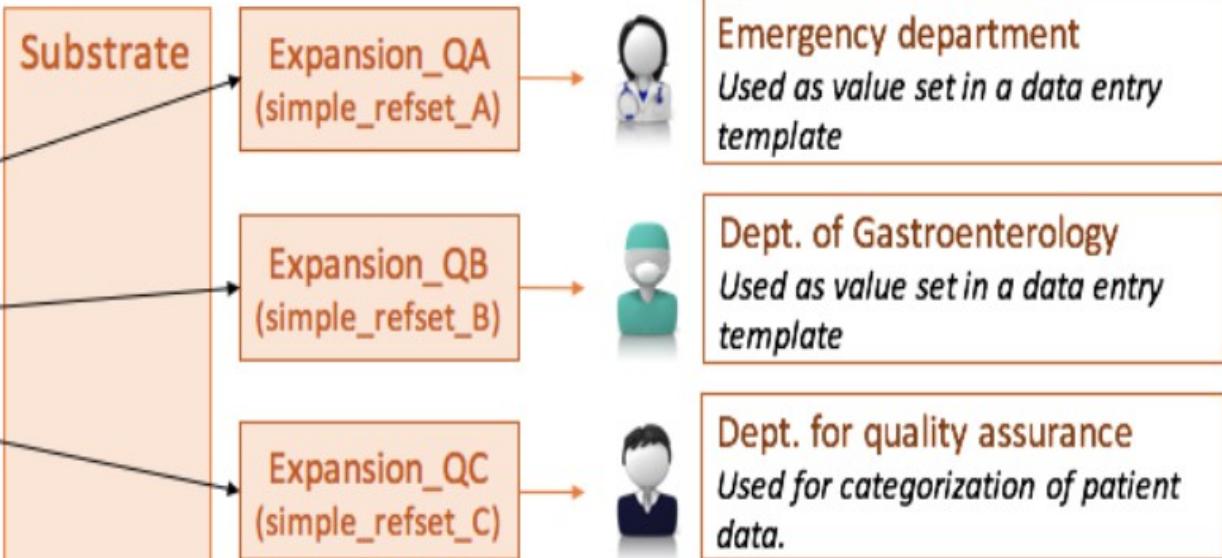


**Congenital Hypotrichosis** is a condition of no hair growth.

# Population Health

## Example query specification reference set

module	Referenced ComponentId	query
SNOMED CT Extension module	simple_refset_A	QA ^ 700043003   emergency department problem list concepts reference set
SNOMED CT Extension module	simple_refset_C	QC << 423827005   Endoscopy (procedure)
SNOMED CT Extension module	simple_refset_D	QD ^ 256734003   disease categories concepts reference set
...	...	...



The queries are run against a specific release of the international/national/affiliate Edition

Each expansion is represented as a Simple Reference Set

# References

- SNOMED Browser
  - <https://browser.ihtsdotools.org/?>
- SNOMED Starter Guide
  - <https://confluence.ihtsdotools.org/display/DOCSTART/SNOMED+CT+Starter+Guide>
- SNOMED Documents
  - <https://confluence.ihtsdotools.org/display/DOC/SNOMED+CT+Document+Library>
- <https://www.snomed.org/snomed-ct/snomed-in-action>
- <https://www.snomed.org>